GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum & Syllabus For

B.E. (ELECTRONICS AND COMMUNICATION ENGINEERING)

(Part Time)

2023

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

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GOVERNMENT COLLEGE OF TECHNOLOGY

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VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATIONENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

The vision of ECE department is to become pioneer in higher learning and research and to produce creative solution to societal needs.

MISSION

1. To provide excellence in education, research and public service.
2. To provide quality education and to make the students entrepreneur and employable.
3. Continuous upgradation of techniques for reaching heights of excellence in a global perspective.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E & ELECTRONICS AND COMMUNICATION ENGINEERING (Part Time)

FIRST SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL1Z1	Applied Mathematics I	40	60	100	3	0	0	3
2	23PTL1Z2	Environmental Science and Engineering	40	60	100	3	0	0	3
3	23PTL103	Electric Circuits and Electron Devices	40	60	100	3	0	0	3
4	23PTL104	C Programming	40	60	100	3	0	0	3
PRACTICAL									
5	23PTL105	C Programming Laboratory	60	40	100	0	0	3	1.5
TOTAL			**230**	**280**	**500**	**12**	**0**	**3**	**13.5**

SECOND SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL2Z1	APPLIED MATHEMATICS II	40	60	100	3	0	0	3
2	23PTL202	ELECTRONIC CIRCUITS	40	60	100	3	0	0	3
3	23PTL203	ANALOG INTEGRATED CIRCUITS	40	60	100	3	0	0	3
4	23PTL204	DIGITAL SYSTEM DESIGN	40	60	100	3	0	0	3
5	23PTL205	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	60	40	100	0	0	3	1.5
TOTAL					500	12	0	3	13.5

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E & ELECTRONICS AND COMMUNICATION ENGINEERING (Part Time)

THIRD SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL301	CONTINUOUS TIME SIGNALS AND SYSTEMS	40	60	100	3	0	0	3
2	23PTL302	DISCRETE TIME SIGNALS AND SYSTEMS	40	60	100	3	0	0	3
3	23PTL303	ANALOG COMMUNICATION	40	60	100	3	0	0	3
4	23PTL304	MICROPROCESSORS AND MICROCONTROLLERS	40	60	100	3	0	0	3
5	23PTL305	ELECTROMAGNETIC FIELDS	40	60	100	3	0	0	3
TOTAL			**200**	**300**	**500**	**15**	**0**	**0**	**15**

FOURTH SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL401	DIGITAL SIGNAL PROCESSING	40	60	100	3	0	0	3
2	23PTL402	DIGITAL COMMUNICATION	40	60	100	3	0	0	3
3	23PTL403	NETWORKS AND TRANSMISSION LINES	40	60	100	3	0	0	3
4	23PTL404	COMPUTER COMMUNICATION	40	60	100	3	0	0	3
PRACTICAL									
5	23PTL405	COMMUNICATION SYSTEMS LABORATORY	60	40	100	0	0	3	1.5
TOTAL			**220**	**280**	**500**	**12**	**0**	**3**	**13.5**

FIFTH SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL501	COMPUTER ARCHITECTURE ANDORGANIZATION	40	60	100	3	0	0	3
2	23PTL502	EMBEDDED SYSTEMS	40	60	100	3	0	0	3
3	23PTL503	CONTROL SYSTEMS	40	60	100	3	0	0	3
4	23PTL504	ANTENNAS AND WAVE PROPAGATION	40	60	100	3	0	0	3
5	23PTL5XX	ELECTIVE – I	40	60	100	3	0	0	3
TOTAL			**200**	**300**	**500**	**15**	**0**	**0**	**15**

SIXTH SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL601	VLSI DESIGN	40	60	100	3	0	0	3
2	23PTL602	MICROWAVE ENGINEERING	40	60	100	3	0	0	3
3	23PTL603	WIRELESS COMMUNICATION	40	60	100	3	0	0	3
4	23PTL6XX	ELECTIVE – II	40	60	100	3	0	0	3
PRACTICAL									
5	23PTL604	EMBEDDED AND VLSI LABORATORY	60	40	100	0	0	3	1.5
TOTAL			**220**	**280**	**500**	**12**	**0**	**3**	**13.5**

SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL7Z1	HUMAN VALUES AND ETHICS	40	60	100	3	0	0	3
2	23PTL702	FIBER OPTIC COMMUNICATION	40	60	100	3	0	0	3
3	23PTL703	INTERNET OF THINGS	40	60	100	3	0	0	3
4	23PTL7Z2	MANAGEMENT THEORY AND PRACTICE	40	60	100	3	0	0	3
5	23PTL7XX	ELECTIVE – III	40	60	100	3	0	0	3
TOTAL			**200**	**300**	**500**	**15**	**0**	**0**	**15**

EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	23PTL8XX	ELECTIVE – IV	40	60	100	3	0	0	3
2	23PTL8XX	ELECTIVE – V	40	60	100	3	0	0	3
PRACTICAL									
3	23PTL801	PROJECT WORK	60	40	100	0	0	12	6
TOTAL			**140**	**160**	**300**	**6**	**0**	**12**	**12**

Credits per Semester								Total no of credits
I	II	III	IV	V	VI	VII	VIII	
13.5	13.5	15	13.5	15	13.5	15	12	111

LIST OF ELECTIVE

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
ELECTIVE I									
1	23PTL5E1	SATELLITE COMMUNICATION	40	60	100	3	0	0	3
2	23PTL5E2	INFORMATION THEORY AND CODING	40	60	100	3	0	0	3
3	23PTL5E3	NEURAL NETWORKS	40	60	100	3	0	0	3
4	23PTL5E4	AUTOMOTIVE ELECTRONICS	40	60	100	3	0	0	3
5	23PTL5E5	DIGITAL IMAGE PROCESSING	40	60	100	3	0	0	3
ELECTIVE II									
1	23PTL6E1	MEASUREMENT AND INSTRUMENTATION	40	60	100	3	0	0	3
2	23PTL6E2	DEEP LEARNING	40	60	100	3	0	0	3
3	23PTL6E3	LOW POWER VLSI	40	60	100	3	0	0	3
4	23PTL6E4	ERROR CONTROL CODING	40	60	100	3	0	0	3
5	23PTL6E5	MICROWAVE INTEGRATED CIRCUITS	40	60	100	3	0	0	3
ELECTIVE III									
1	23PTL7E1	SOFT COMPUTING	40	60	100	3	0	0	3
2	23PTL7E2	DSP ARCHITECTURE AND PROGRAMMING	40	60	100	3	0	0	3
3	23PTL7E3	HIGH SPEED NETWORKS	40	60	100	3	0	0	3
4	23PTL7E4	MEMS	40	60	100	3	0	0	3
5	23PTL7E5	POWER ELECTRONICS	40	60	100	3	0	0	3
ELECTIVE IV									
1	23PTL8E1	BIO-MEDICAL ELECTRONICS	40	60	100	3	0	0	3
2	23PTL8E2	MACHINE LEARNING	40	60	100	3	0	0	3
3	23PTL8E3	SOFTWARE DEFINED RADIO	40	60	100	3	0	0	3
4	23PTL8E4	COMPUTER VISION	40	60	100	3	0	0	3
5	23PTL8E5	CRYPTOGRAPHY AND NETWORK SECURITY	40	60	100	3	0	0	3
ELECTIVE V									
1	23PTL8E6	MULTIMEDIA COMPRESSION TECHNIQUES	40	60	100	3	0	0	3
2	23PTL8E7	DISPLAY SYSTEMS	40	60	100	3	0	0	3
3	23PTL8E8	SMART SENSORS	40	60	100	3	0	0	3
4	23PTL8E9	INDUSTRIAL IOT AND INDUSTRIAL 4.0	40	60	100	3	0	0	3
5	23PTL8E10	ADHOC AND WIRELESS SENSOR NETWORKS	40	60	100	3	0	0	3

23PTL1Z1	APPLIED MATHEMATICS -I *(Common to Civil, Mech ,EEE & ECE)*	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	This course mainly deals with topics such as linear algebra, single variable calculus and numerical methods and plays an important role in the understanding of engineering science.	
UNIT – I	**LINEAR ALGEBRA**	**9 Periods**
Consistency of System of Linear Equations, Eigenvalues and eigenvectors, Diagonalization of matrices by orthogonal transformation, Cayley-Hamilton Theorem, Quadratic form to canonical forms.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9 Periods**
Radius of curvature, Centre of curvature, Circle of curvature , Evolutes of a curve, Envelopes		
UNIT – III	**INTEGRAL CALCULUS**	**9 Periods**
Evaluation of definite and improper integrals, Applications: surface area and volume of revolution (Cartesian coordinates only).		
UNIT – IV	**NUMERICAL SOLUTION OF EQUATIONS**	**9 Periods**
Algebraic and Transcendental equation: Fixed point iteration method, Bisection method, Newton-Raphson method, Simultaneous equation: Gauss elimination method, Gauss-Jordan method, Gauss Seidal method.		
UNIT – V	**NUMERICAL INTERPOLATION**	**9 Periods**
Equal interval: Newton's forward and Backward difference interpolation formulae, Gauss forward and Backward difference interpolation formulae, Unequal interval: Lagrange's interpolation, Newton's divided difference interpolation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK

1	*VeerarajanT., "**Engineering Mathematics I"**, Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi,2015.*
2	*P. Kandasamy, K. Thilagavathy, K. Gunavathi, "**Numerical Methods"**, S. Chand & Company, 3nd Edition, Reprint 2013.*

REFERENCE BOOK

1	*B.S.Grewal, " **Higher Engineering Mathematics"**, Khanna Publishers, 44th Edition, 2017.*
2	*David C.Lay, **"Linear Algebra and Its Application"**, PearsonPublishers, 6th Edition,2021.*
3	*Howard Anton, **"Elementry Linear Algebra"**,11th Edition,WileyPublication, 2013.*
4	*Narayanan.S and Manicavachagom Pillai. T.K. – **CalculasVol I and Vol II,**S.chand& Co, Sixth Edition, 2014.*
5	*S.S. Sastry, "**Introductory methods of numerical analysis"**, PHI, New Delhi, 5th Edition, 2015. Ward Cheney, David Kincaid, **"Numerical Methods and Computin"g,** Cengage Learning**,** Delhi, 7th Edition 2013.*
6	*Jain R.K. and Iyengar S.R.K., - **Advanced Engineering Mathematics**, NarosaPublicaitons, Eighth Edition, 2012.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use the essential tool of matrices and linear algebra in a comprehensive manner.	K3
CO2	Explain the fallouts of circle of curvature, evolute and envelops that is fundamental to application of analysis to Engineering problems.	K3
CO3	Interpret the integral calculus to notions of definite and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.	K3
CO4	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to polynomial and transcendental equations.	K3
CO5	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations.	K3

23PTL1Z2	ENVIRONMENTAL SCIENCE AND ENGINEEREING *(Common to Civil, Mech, , EEE, ECE)*	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	The course is aimed at creating awareness among the students and also inseminates the critical ideas of preserving environment.	
UNIT – I	**ENVIRONMENTAL ENERGY RESOURCES**	**9 Periods**
Food-effects of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications-Energy resources: renewable resources - Hydro Energy, Solar & Wind. Non-renewable resources – Coal and Petroleum - harnessing methods.		
UNIT – II	**ECO SYSTEM AND BIODIVERSITY**	**9 Periods**
Eco system and its components - biotic and abiotic components. Biodiversity: types and values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity: In situ and ex situ conservation. Threats to biodiversity-destruction of habitat, habit fragmentation, hunting, over exploitation and man-wildlife conflicts. The IUCN red list categories.		
UNIT – III	**ENVIRONMENTAL POLLUTION**	**9 Periods**
Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates. Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollution. Noise pollution - decibel scale, sources, effects and control.		
UNIT – IV	**ENVIRONMENTAL THREATS**	**9 Periods**
Global warming-measure to check global warming - impacts of enhanced Greenhouse effect, Acid rain-effects and control of acid rain, ozone layer depletion- effects of ozone depletion, disaster management - flood, drought, earthquake and tsunami.		
UNIT – V	**SOCIAL ISSUES AND ENVIRONMENT**	**9 Periods**
Water conservation, rain water harvesting, e-waste management, Pollution Control Act, Wild life Protection Act. Population growth- exponential and logistic growth, variation in population among nations, population policy. Women and Child welfare programs. Role of information technology in human and health, COVID-19 - effects and preventive measures.		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods**		

TEXT BOOK:

1	*Sharma J.P., **"Environmental Studies"**, 4th Edition, University Science Press, New Delhi 2016.*
2	*AnubhaKaushik and C.P.Kaushik**, "Environmental Science and Engineering"**, 7th Edition, New age International Publishers, New Delhi, 2021.*

REFERENCES:

1	*A k de,* ***"Environmental Chemistry"****, eight edition, new age international publishers, 2017.*
2	*G. Tyler miller and scott e. Spoolman,* ***"Environmental Science"****, cengage learning indiapvt, ltd, delhi, 2014.*
3	*ErachBharucha,* ***"Textbook of Environmental Studies"****, Universities Press(I) Pvt, Ltd, Hydrabad, 2015.*
4	*Gilbert M.Masters,* ***"Introduction to Environmental Engineering and Science"****, 3rd Edition, Pearson Education, 2015.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recognize and understand about the various environmental energy resources and the effective utility of modern agriculture.	K2
CO2	Acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.	K2
CO3	Be aware of the sources of various types of pollution, their ill effects and preventive methods.	K2
CO4	Identify and take the preventive measures to control the environmental threats and effects of Global warming, Ozone depletion, Acid rain, and natural disasters.	K2
CO5	Demonstrate an idea to save water and other issues like COVID -19.	K2

23PTL103	ELECTRIC CIRCUITS AND ELECTRON DEVICES	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	1. To learn the basic of circuit analysis and transient resonance in RLC circuits. 2. To learn functions and features of semiconductor devices.	
UNIT – I	**CIRCUIT ANALYSIS TECHNIQUES**	**9 Periods**
Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.		
UNIT – II	**TRANSIENT RESONANCE IN RLC CIRCUITS**	**9 Periods**
Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.		
UNIT –III	**SEMICONDUCTOR DIODES**	**9 Periods**
Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.		
UNIT –IV	**TRANSISTORS**	**9 Periods**
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.		
UNIT – V	**SPECIAL SEMICONDUCTOR DEVICES**	**9 Periods**
Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.		
Contact Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Joseph A. Edminister, Mahmood, Nahri, "**Electric Circuits**" – Shaum series,Tata McGraw Hill, (2001).*
2	*S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "**Electronic Devices and Circuits**",Tata McGraw Hill, 2 Edition, (2008)*
3	*David A. Bell, "**Electronic Devices and Circuits**", Oxford University Press, 5 Edition, (2008).*

REFERENCE BOOK :

1	*Robert T. Paynter, "**Introducing Electronics Devices and Circuits**", Pearson Education, (2006).*
2	*William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "**Engineering Circuit Analysis**",Tata McGraw Hill, 6 Edition, 2002.*
3	*J. Millman & Halkins, Satyebranta Jit, "**Electronic Devices & Circuits**",Tata McGraw Hill, 2 Edition, 2008.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand laws, theorems of circuit analysis	K1
CO2	Explain transient resonance in RLC circuits	K2
CO3	Learn Semiconductor diode characteristics	K2
CO4	Learn JFET and MOSFET transistor characteristics	K2
CO5	Understand special semiconductor devices Characteristics	K1

23PTL104	C PROGRAMMING	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	The students will be able to acquire knowledge about the basic concepts of Computer and programming fundamentals, Data types in C and Flow control statements, Functions, Arrays, Pointers and Strings, Bitwise Operators, Preprocessor Directives, Structures and Unions, List Processing, Input and Output.	
UNIT – I	**COMPUTER AND PROGRAMMING FUNDAMENTALS**	**9 Periods**
Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software Development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.		
UNIT – II	**DATA TYPES AND FLOW OF CONTROL**	**9 Periods**
An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control.		
UNIT – III	**FUNCTIONS, ARRAYS, POINTERS AND STRINGS**	**9 Periods**
Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic Memory allocation – Strings – String handing functions – Multidimensional Arrays.		
UNIT – IV	**ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES**	**9 Periods**
Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.		
UNIT – V	**STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS**	**9 Periods**
Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Pradip Dey, Manas Ghosh, "**Computer Fundamentals and Programming in C**", Second Edition, Oxford University Press, 2013.*
2	*Al Kelley, Ira Pohl, "**A Book on C-Programming in C**", Fourth Edition, Addison Wesley, 2001.*

REFERENCE BOOK :

1	*Yashavant P. Kanetkar, "**Let Us C**", 14th edition, BPB Publications, 2016.*
2	*Herbert Schildt., "**C: The Complete Reference**", Fourth Edition. McGraw Hill Education, 2017.*
3	*Brian W. Kernighan and Dennis Ritchie, "**The C Programming Language**", Second Edition, Prentice Hall Software Series, 1988.*
4	*E. Balagurusamy, "**Programming in Ansi C**", 6th Edition Tata McGraw-Hill Education, 2012*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental of computers programming and Design algorithm for solving the given problem statement.	K3
CO2	Reproduce and explain the operation of various data types and flow control statements	K2
CO3	Design and Compute programs using functions, arrays, pointers and strings	K3
CO4	Illustrate the different right storage classes, preprocessor directives, bitwise operators in programs	K2
CO5	Describe the concept of structures, unions and files in C programming.	K2

23PTL105	C PROGRAMMING LABORATORY	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	0	0	3	1.5

Course Objectives	The students will be able to write program and compile C programming using, Data types and Flow control statements, Functions, Arrays, Pointers and Strings, Dynamic memory allocation and command line arguments, Files, Structures and Unions.

LIST OF EXPERIMENTS:

1	Operators , Expressions and IO formatting
2	Decision Making and Looping
3	Arrays and Strings
4	Functions and Recursion
5	Pointers
6	Dynamic Memory Allocation
7	Structures
8	Unions
9	Files
10	Command line arguments
11	Mini Project

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

REFERENCES :

1	*Yashavant P. Kanetkar, "**Let Us C**", 14th edition, BPB Publications, 2016.*
2	*Herbert Schildt., "**C: The Complete Reference**", Fourth Edition. McGraw Hill Education, 2017.*
3	*Brian W. Kernighan and Dennis Ritchie, "**The C Programming Language**", Second Edition, Prentice Hall Software Series, 1988.*
4	*E. Balagurusamy, **"Programming in Ansi C",** 6th Edition Tata McGraw-Hill Education, 2012*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Reproduce and explain the operation of various data types and flow control statements using simple programming.	K2
CO2	Write programs using functions, arrays, pointers and strings.	K3
CO3	Write programs using dynamic memory allocation	K3
CO4	Implement programs using command line arguments, structures, unions, and files	K4
CO5	Develop applications using C.	K5

23PTL2Z1	APPLIED MATHEMATICS II *(Common to Mech, EEE & ECE)*	SEMESTER II

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	To focus on differential equations and Numerical Techniques which is important for comprehending engineering science.	
UNIT – I	**ORDINARY DIFFERENTIAL EQUATIONS**	**9 Periods**
Higher order linear differential equations with constant coefficients -variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation-Method of variation of parameters.		
UNIT – II	**PARTIAL DIFFERENTIAL EQUATIONS**	**9 Periods**
Formation of partial differential equations – First order partial differential equations – Standard types and Lagrange's linear equation – Homogeneous linear partial differential equations of second and higher order with constant coefficients.		
UNIT – III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9 Periods**
Numerical Differentiation (using Newton's interpolation formula) – Numerical integration: Trapezoidal rule and Simpson's rules (Both single and double integrals.		
UNIT – IV	**NUMERICAL SOLUTION OF FIRST ORDINARY DIFFERENTIAL EQUATIONS**	**9 Periods**
Single Step Methods : Taylor's series method-Euler's and modified Euler's methods-Runge- Kutta method of fourth order Multi Step methods - Milne's and Adam's predicator-corrector methods		
UNIT – V	**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS**	**9 Periods**
Finite difference solution of two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for one dimensional wave equation.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

1	*Veerarajan.T,* ***"Engineering Mathematics"****, Tata McGraw Hill Education (India) Private Limited, New Delhi, 2018.*
2	*P. Kandasamy, K. Thilagavathy, K. Gunavathi,* ***"Numerical Methods"****, S. Chand & Company, 3nd Edition, Reprint 2013.*

REFERENCES

1	*B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, New Delhi, 44th Edition, 2018.*
2	*SrimantaPal,* ***"Numerical Methods Principles, Analyses and Algorithms"****, Oxford University Press, New Delhi, I st Edition 2009.*
3	*Raisinghania.M..D,* ***"Ordinary And Partial Differential Equations"****, 20th Edition, S. ChandPublishing,2020*
4	*S.S. Sastry,* ***"Introductory methods of numerical analysis"****, PHI, New Delhi, 5th Edition, 2015.*
5	*S.Larsson and V.Thomee,* ***"Partial Differential Equations with Numerical Methods"****, Springer, 2003.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Obtain the knowledge for solving higher order linear differential equation with constant and variable coefficient techniques and simultaneous differential equation.	K3
CO2	Understand the knowledge of partial differential equations (PDEs), modeling; demonstrate accurate and efficient use of Lagrange's techniques.	K3
CO3	Demonstrate and understanding of common numerical methods and how they are used to obtain approximate solutions to polynomial and transcendental equations.	K3
CO4	Construct one-step and linear multistep methods for the numerical solution of initial-value problems for ordinary differential equations.	K3
CO5	Acquire the knowledge of principles for designing numerical schemes for PDEs in particular finite difference schemes.	K3

23PTL202	ELECTRONIC CIRCUITS	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To understand the functions and response of Basic Electronic circuits	
UNIT – I	**BJT AND FET AMPLIFIER**	**9 Periods**
Small Signal Hybrid π equivalent circuit of BJT – Early effect -CE, CC and CB amplifiers. - AC Load Line Analysis- Darlington Amplifier - Bootstrap technique - Cascade, Cascode configurations - FET AMPLIFIERS.CS, CD and CG amplifiers- BiCMOS circuits.		
UNIT – II	**FREQUENCY RESPONSE OF BJT AND FET AMPLIFIERS**	**9 Periods**
General Frequency Considerations- Low and High Frequency response of BJT and FET amplifiers – short circuit current gain - cut off frequency – fα, fβ and unity gain bandwidth – Miller Effect Capacitance-Multistage Frequency Effects.		
UNIT – III	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9 Periods**
Feedback Concepts– effect of feedback on gain stability, distortion, bandwidth, input and output impedances; Types of feedback amplifiers-stability-Gain and Phase margins-Frequency compensation. OSCILLATORS: Barkhausen criterion for oscillation - Hartley &Colpitt's oscillators – crystal oscillators.		
UNIT – IV	**TUNED AMPLIFIERS AND WAVE SHAPING CIRCUITS**	**9 Periods**
Small signal tuned amplifiers – 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. WAVE SHAPING CIRCUITS: Pulse circuits –RC integrator and differentiator circuits – diode clampers and clippers.		
UNIT – V	**POWER SUPPLIES AND POWER AMPLIFIERS**	**9 Periods**
Linear mode power supply – HW & FW Rectifiers – Filters- Voltage regulators- Over voltage protection - Switched mode power supply (SMPS) - Regulated DC Power Supply.Power amplifiers-Class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Donald. A. Neamen*, ***Electronic Circuits Analysis and Design***, *3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010.*
2	*Robert L. Boylestad and Louis Nasheresky, "**Electronic Devices and Circuit Theory**", 11th Edition, Pearson Education, 2013.*

REFERENCES

1	*Millman J, Halkias.C.andSathyabradaJit, **Electronic Devices and Circuits**, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.*
2	*Salivahanan and N. Suresh Kumar, **Electronic Devices and Circuits**, 4th Edition, , Mc Graw Hill Education (India) Private Ltd., 2017.*
3	*Floyd, **Electronic Devices**, Ninth Edition, Pearson Education, 2012.*
4	*David A. Bell, **Electronic Devices & Circuits**, 5th Edition, Oxford University Press, 2008.*
5	*Anwar A. Khan and Kanchan K. Dey, **A First Course on Electronics**, PHI, 2006.*
6	*Rashid M, **Microelectronics Circuits**, Thomson Learning, 2007.*

23PTL203	ANALOG INTEGRATED CIRCUITS	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
ELECTRON DEVICES AND CIRCUITS	PC	3	0	0	3

Course Objective	Upon completion of this course, the students will be familiar with: • To understand the characteristics and applications of Operational amplifiers, data converters and operation and applications of special function ICs.	
UNIT – I	**BASICS OF OPERATIONAL AMPLIFIERS**	**9 Periods**
Differential amplifier-Differential mode gain, common mode gain and CMRR -current mirror-Widlar current mirror - Building blocks of 741 operational amplifier-I/O stages, gain stage and level translator stage of 741op-amp -Characteristics of an Ideal and practical - Operational Amplifier-Op-amp parameters, DC & AC performance characteristics- frequency response – frequency compensation.		
UNIT – II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS**	**9 Periods**
Linear applications: voltage follower - inverting, non-inverting amplifiers-summing, scaling, averaging amplifiers-instrumentation amplifiers-difference amplifier **Nonlinear applications**: Integrator-differentiator-precision half wave & full wave rectifiers- peak detector-sample & hold circuit-log & anti-log amplifiers. **Open loop applications**: Comparator-zero crossing detector-Window detector-Schmitt trigger.		
UNIT – III	**OSCILLATORS AND MULTIVIBRATORS**	**9 Periods**
Barkhausen criterion- loop gain -Design of Oscillators: RC phase shift oscillator- Wien bridge oscillator-– Square wave generator - Triangular wave generator-Saw tooth wave generator - IC 555 timer: Functional block diagram and description of Astable & Mono-stable multi-vibrators using IC555 –Applications: Missing pulse detector, PWM, FSK generator, Schmitt trigger.		
UNIT – IV	**ACTIVE FILTERS AND DATA CONVERTERS**	**9 Periods**
Active filters - Sallen-Key filter structure- Design of I order and II order Butterworth filters: Low pass, High pass, Band pass filters- Switched capacitor filter- Data Converters: D/A converter – specifications - weighted resistor type, Voltage Mode and Current-Mode R 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits- A/D Converters – specifications - Flash type – Counter type - Successive Approximation type - Dual Slope type A/D converters.		
UNIT – V	**PLL AND SPECIAL FUNCTION ICS**	**9 Periods**
Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK demodulation and Frequency synthesizing -IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Voltage to Frequency converter- Audio Power amplifier IC.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*D.RoyChoudhry and Shail Jain, **"Linear Integrated Circuits",** New Age International Pvt. Ltd.,4th Edition 2010*
2	*Ramakant A. Gayakwad, **"OP-AMPs and Linear Integrated Circuits",** 4th Edition, Prentice Hall / Pearson Education, 2015.*

REFERENCES:

1	*Sergio Franco,* ***"Design with Operational Amplifiers and Analog Integrated Circuits****", 4th Edition, Tata McGraw-Hill, 2014*
2	*Gray and Meyer,* ***"Analysis and Design of Analog Integrated Circuits",*** *Wiley International, 2009.*
3	*S.Salivahanan and V.S. Kanchana Bhaaskaran,* ***"Linear Integrated Circuits",*** *Tata McGraw Hill Publishing company Ltd, 1st Edition, 2009.*
4	*Somanathan Nair,* ***"Linear Integrated Circuits, Analysis, Design and Applications",*** *Wiley India Publishers, 1st Edition, 2009*

23PTL204	DIGITAL SYSTEM DESIGN	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To understand the theoretical and design aspects of digital circuits for designing digital system	
UNIT - I	**DIGITAL FUNDAMENTALS**	**9 Periods**
Number Systems - Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes - Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Min terms and Max terms, Karnaugh map Minimization and Quine-McCluskey method of minimization. Introduction to Verilog HDL.		
UNIT - II	**COMBINATIONAL CIRCUIT DESIGN**	**9 Periods**
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder - Carry look ahead Adder, BCD Adder, Binary Multiplier, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.		
UNIT - III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 Periods**
Flip flops - SR, JK, T, D, Master/Slave. FF operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, circuit implementation. Design of Counters- Ripple Counters: Binary, BCD, Modulo n, Up/Down counters-Counter for Random Sequence - Shift registers: -Universal Shift Register-Synchronous counters-Ring counter-Johnson counter.		
UNIT - IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 Periods**
Analysis and Design of Asynchronous Sequential Circuits-Reduction of Flow Tables- Stable and Unstable states, state reduction, output specifications, cycles and races, race free assignments, Hazards: Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits- Clock skews.		
UNIT - V	**MEMORY AND PROGRAMMABLE LOGIC DEVICES**	**9 Periods**
Basic memory structure: ROM –PROM, EPROM, EEPROM, EAPROM, RAM: Static and dynamic RAM - Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL,CPLD's. TTL and CMOS Logic families.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*M.Morris R.Mano and Michael D.Ciletti,"**Digital Design",** 4th Edition, Pearson Education,2011.*
2	*M.Morris R.Mano and Michael D.Ciletti, "**Digital Design: With an Introduction to the Verilog HDL"**, 5th Edition, Pearson Education, 2013.*

REFERENCES :

1	*Charles H.Roth., "**Fundamentals of Logic Design"**, 6thEdition,Thomson Learning, 2013*
2	*Thomas L. Floyd, "**Digital Fundamentals**",10thEdition, Pearson Education Inc,2011*
3	*S.Salivahanan and S.Arivazhagan, "**Digital Electronics**', Ist Edition, Vikas Publishing House pvt Ltd,2012.*
4	*Anil K.Maini, "**Digital Electronics"**, Wiley, 2014.8*
5	*Soumitra Kumar Mandal, "**Digital Electronics"**, McGraw Hill Education Private Limited, 2016.*

23PTL205	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
ANALOG CIRCUITS AND DIGITAL CIRCUTS DESIGN	PC	0	0	3	1.5

Course Objective	To Design and construct analog circuits using ICs 741 and 555 , Digital Circuits using Logic gates, Flip Flops and MSI devices.
PRACTICALS	**LIST OF EXPERIMENTS** **ANALOG IC EXPERIMENTS** 1. DC and AC Characteristics of OP-AMP. 2. Simple Applications of OP-AMP – Inverting and non-inverting Amplifier, Voltage Follower, Adder, Integrator and Differentiator. 3. Design and testing of Oscillators, Comparator and Schmitt Trigger Circuit. 4. Design and Testing of Astable and mono-stable Multivibrator using 555 Timer IC. **DIGITAL IC EXPERIMENTS** 5. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters. 6. Design and implementation of Half/Full Adder and Subtractor using Logic Gates. 7. Design and implementation of combinational circuits using MSI devices: (i) 4 – bit binary adder / subtractor (ii) Parity generator / checker (iii) Magnitude Comparator (iv) Application using multiplexers 8. Verification of Flip-Flops. 9. Design and Testing of Shift register, synchronous and asynchronous Counters.
Contact Periods: **Lecture: 0 Periods** **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**	

REFERENCES

1.	*D. Roy Choudhry and Shail Jain,* ***"Linear Integrated Circuits",*** *New Age International Pvt. Ltd.,4th Edition 2010.*
2.	*Ramakant A. Gayakwad,* ***"OP-AMPs and Linear Integrated Circuits",*** *4th Edition, Prentice Hall / Pearson Education, 2015.*
3.	*Morris Mano,* ***"Digital Design****",4th Edition, Pearson Education, 2011.*
4.	*A.Anand Kumar,* ***"Fundamentals of Digital Circuits",*** *2nd Edition, PHI Learning Pvt. Ltd, NewDelhi,2011.*

23PTL301	CONTINUOUS TIME SIGNALS AND SYSTEMS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To analyse the Continuous Time signals and systems using Continuous Time Fourier Series, Fourier Transform and Laplace Transform.	
UNIT – I	**INTRODUCTION TO CONTINUOUS TIME SIGNALS AND SYSTEMS**	**9 Periods**
Introduction to Continuous Time (CT) signals - step, ramp, impulse, exponential, sinusoidal signals, Representation of CT signals by Standard signals - signal operations classification of CT signals - periodic and aperiodic signals, random signals, energy and power signals, even and odd signals- linear time invariant CT systems - basic system properties: linear time invariant, causality, BIBO stability		
UNIT – II	**ANALYSIS OF CONTINUOUS TIME SIGNALS USING CONTINUOUS TIME FOURIER SERIES**	**9 Periods**
Fourier series representation of Continuous Time Periodic signals - Convergence of the Fourier series - Properties of continuous time Fourier series - Fourier series and LTI systems.		
UNIT – III	**ANALYSIS OF CONTINUOUS TIME SIGNALS USING CONTINUOUS TIME FOURIER TRANSFORM**	**9 Periods**
Fourier transform representation of continuous time aperiodic signals - Convergence of Fourier transform - Fourier transform for periodic signals - Properties of continuous time Fourier transform - convolution integrals - Analysis and Characterization of LTI systems using Fourier Transform.		
UNIT – IV	**ANALYSIS OF CONTINUOUS TIME SIGNALS USING LAPLACE TRANSFORM**	**9 Periods**
Laplace Transform - Region of Convergence of Laplace Transform - Inverse Laplace Transform - Properties of Laplace Transform - Relation between Laplace transform and Fourier transform - Analysis and Characterization of LTI systems using Laplace transform.		
UNIT – V	**SYSTEM FUNCTION ALGEBRA AND BLOCK DIAGRAM REPRESENTATIONS**	**9 Periods**
Unilateral Laplace transform and its properties - Inverse Unilateral Laplace transform - Solving Differential equations using Unilateral Laplace transform - System functions for Interconnections of continuous time LTI systems - Block diagrams representations for causal LTI systems described by differential equations and Rational system functions.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Oppenheim, Willsky and Hamid, **"Signals and Systems"**, 2nd Edition, Pearson Education, New Delhi, 2015.*
2	*Simon Haykin and Barry Van Veen, **"Signals and Systems"**, Second Edition, Wiley, New Delhi, 2002.*

REFERENCES:

1	*B. P. Lathi, **"Principles of Linear Systems and Signals"**, 2nd Edition, Oxford, 2009.*
2	*M. J. Roberts, **"Signals and Systems Analysis using Transform methods and MATLAB"**, McGraw-Hill Education, 2018.*
3	*John Alan Stuller, **"An Introduction to Signals and Systems"**, Thomson, 2007.*
4	*Hwei Hsu, **"Schaum's Outline Series Signals and systems"**, Second Edition, TMH, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify Continuous time signals and systems based on various Characteristics and decomposition for easier analysis.	**K3**
CO2	Determine frequency components of Continuous time periodic signals and obtain the frequency response of the Continuous time LTI systems	**K3**
CO3	Determine frequency components of Continuous time Aperiodic signals and obtain the frequency response of the Continuous time LTI systems	**K3**
CO4	Determine and analyze the causality and stability of Continuous time LTI systems from their impulse responses.	**K3**
CO5	Analyze Continuous time LTI systems and realize with various structures	**K4**

23PTL302	DISCRETE TIME SIGNALS AND SYSTEMS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To analyse the Discrete Time signals and systems using Discrete Time Fourier Series, Discrete Time Fourier Transform and Z Transform.	
UNIT – I	**INTRODUCTION TO DISCRETE TIME SIGNALS AND SYSTEMS**	**9 Periods**
Introduction to Discrete Time (DT) signals - step, ramp, impulse, exponential, sinusoidal signals, Representation of DT signals by Standard signals - signal operations - classification of DT signals - periodic and aperiodic signals, random signals, energy and power signals, even and odd signals - linear time invariant DT systems - basic system properties: linear time invariant, causality, BIBO stability.		
UNIT – II	**ANALYSIS OF DISCRETE TIME SIGNALS USING DISCRETE TIME FOURIER SERIES**	**9 Periods**
Fourier series representation of Discrete Time Periodic signals - Convergence of the Fourier series - Properties of discrete time Fourier series – Discrete Time Fourier series and LTI systems.		
UNIT – III	**ANALYSIS OF DISCRETE TIME SIGNALS USING DISCRETE TIME FOURIER TRANSFORM**	**9 Periods**
Fourier transform representation of discrete time aperiodic signals -Discrete Time Fourier transform for periodic signals - Properties of Discrete Time Fourier Transform - convolution sum - Multiplication Property - Duality - Systems characterized by Linear constant coefficient difference equations.		
UNIT – IV	**ANALYSIS OF DISCRETE TIME SIGNALS**	**9 Periods**
Baseband Sampling of CT signals- Aliasing, Reconstruction of CT signal from DT signal - Z Transforms - Properties of Z Transform - Region of Convergence of Z Transform - Inverse Z Transform - Relation between Laplace transform and Z transform - Analysis and Characterization of LTI systems using Z transform.		
UNIT – V	**UNILATERAL Z TRANSFORM, SYSTEM FUNCTION ALGEBRA AND BLOCK DIAGRAM REPRESENTATIONS**	**9 Periods**
Unilateral Z transform and its properties - Inverse Unilateral Z transform - Solving Difference equations using Unilateral Z transform - System functions for Interconnections of Discrete time LTI systems - Block diagrams representations for causal LTI systems described by difference equations and Rational system functions.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Oppenheim, Willsky and Hamid, **"Signals and Systems"**, 2nd Edition, Pearson Education, New Delhi, 2015.*
2	*Simon Haykin and Barry Van Veen, **"Signals and Systems"**, Second Edition, Wiley, New Delhi, 2002.*

REFERENCES:

1	*B. P. Lathi, **"Principles of Linear Systems and Signals"**, 2nd Edition, Oxford, 2009.*
2	*M. J. Roberts, **"Signals and Systems Analysis using Transform methods and MATLAB"**, McGraw- Hill Education, 2018.*
3	*John Alan Stuller, **"An Introduction to Signals and Systems"**, Thomson, 2007.*
4	*Hwei Hsu, **"Schaum's Outline Series Signals and systems"**, Second Edition, TMH, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify Discrete time signals and systems based on various Characteristics and decomposition for easier analysis. metal semiconductor devices	**K3**
CO2	Determine frequency components of Discrete time periodic signals and obtain the frequency response of the Continuous time LTI systems	**K3**
CO3	Determine frequency components of Discrete time Aperiodic signals and obtain the frequency response of the Continuous time LTI systems	**K3**
CO4	Determine and analyze the causality and stability of Discrete time LTI systems from their impulse responses.	**K3**
CO5	Analyze Discrete time LTI systems and realize with various structures	**K4**

23PTL303	ANALOG COMMUNICATION	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
CONTINUOUS TIME SIGNALS AND SYSTEMS DISCRETE TIME SIGNALS AND SYSTEMS	PC	3	0	0	3

Course Objective	To understand the concepts of Analog modulation schemes and to impart knowledge about baseband signal processing techniques.	
UNIT – I	**AMPLITUDE MODULATION SYSTEMS**	**9 Periods**
Need for modulation - Amplitude Modulation –DSBFC, DSBSC, SSB, VSB – Modulation index, Spectra, Power relations and Bandwidth Requirements – AM Generation and detection- DSBSC Generation and detection - SSB Generation and detection - VSB Generation –Hilbert transform, Comparison of AM systems. Block diagram of AM broadcasting transmitters- Low Level and High Level transmitters.		
UNIT – II	**ANGLE MODULATION SYSTEMS**	**9 Periods**
Phase and Frequency Modulation - Single tone, Narrow Band and Wideband FM - Modulation index, Spectra, Power relations and Transmission Bandwidth - FM Generation: Direct method and Indirect method of FM Generation - Demodulation of FM Signal Balanced Slope detector - FM Discriminator - PLL as FM Demodulator - Stereo FM- FM Transmitter.		
UNIT – III	**NOISE THEORY**	**9 Periods**
Gaussian Process - Central limit theorem - Noise sources and types - Noise Figure- Noise temperature - Noise in cascaded systems - Representation of Narrow band noise - In-phase and Quadrature components - Envelope and Phase components - Properties of Narrow band noise.		
UNIT – IV	**PERFORMANCE OF CW MODULATION SYSTEMS**	**9 Periods**
Super heterodyne Radio receiver and its characteristic; SNR; Noise in DSBSC systems using coherent detection; Noise in AM system using envelope detection - Noise in FM system1Capture effect - FM threshold effect; Pre-emphasis and De-emphasis in FM; Comparison of performances, FDM.		
UNIT – V	**SAMPLING & WAVEFORM CODING**	**9 Periods**
Low pass sampling theorem - Aliasing - Signal Reconstruction-Quantization - Uniform & Non uniform quantization - quantization noise - Pulse Modulation-PAM, PPM, PDM, PCM - Prediction filtering and DPCM - Delta Modulation - Delta Sigma Modulation - ADPCM & ADM principles - Linear Predictive Coding - TDM - Digital Multiplexers.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Simon Haykin, **"Communication Systems"**,John Wiley & sons, NY, 4th Edition, 2001.*
2	*Kennedy G, **"Electronic Communication systems"**, Tata McGraw Hill, New Delhi, 2009.*

REFERENCES:

1	*B.P.Lathi, **"Modern Digital and Analog Communication Systems"**,3rd Edition, Oxford University Press, 2007.*
2	*Dennis Roddy & John Coolen,**"Electronic Communication" ,** (IV Ed.), Prentice Hall of India, 2014.*
3	*H P Hsu, Schaum Outline Series - **"Analog and Digital Communications"** TMH 2006.*
4	*Herbert Taub& Donald L Schilling – **"Principles of Communication Systems"** (3rd Edition) – Tata McGraw Hill, 2008.*
5	*J.G.Proakis, M.Salehi, **"Fundamentals of Communication Systems"**, Pearson Education 2006*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply transforms for signal modulation techniques.	**K3**
CO2	Develop the architecture of communication system for analog modulation techniques	**K3**
CO3	Explore the different types of noise sources	**K2**
CO4	Apply the concepts of random process in the analysis of performance of AM and FM systems	**K4**
CO5	Discuss the process of sampling, quantization and coding that are fundamentals to the digital transmission of analog signals	**K2**

23PTL304	MICROPROCESSORS AND MICROCONTROLLERS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
DIGITAL SYSTEM DESIGN	PC	3	0	0	3

Course Objectives	To conceptualize the Architecture of 8086 microprocessor, design aspects of I/O and Memory Interfacing circuit, Architecture of 8051 microcontroller and design.	
UNIT – I	**8086 MICROPROCESSORS**	**9 Periods**
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 Periods**
8086 signals - Basic configurations - System bus timing - System design using 8086 - IO programming - Introduction to Multiprogramming - System Bus Structure - Multiprocessor configurations - Co-processor, closely coupled and loosely Coupled configurations - Introduction to advanced processors.		
UNIT – III	**I/O INTERFACING**	**9 Periods**
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, LCD display, Keyboard display interface.		
UNIT – IV	**MICROCONTROLLER**	**9 Periods**
Architecture of 8051 - Special Function Registers(SFRs) - I/O Pins Ports and respective Circuits - Instruction set - Addressing modes - Types of Addressing Modes - Assembly language programming using 8051.		
UNIT – V	**INTERFACING MICROCONTROLLER**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

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.*

REFERENCES:

1	*Doughlas V.Hall****,-"Microprocessors and Interfacing, Programming and Hardware"****, TMH, 2012.*
2	*A.K.Ray, K.M.Bhurchandi,* ***"Advanced Microprocessors and Peripherals",*** *3rd edition, Tata McGraw-Hill, 2012*
3	*Krishna Kanth,* ***"Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051"****, Prentice Hall of India, 2011.*
4	*Kenneth J.Ayala,* ***"The 8051 Microcontroller"****, 3rdedition, Thompson Delmar Learning, 2007, New Delhi.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the basic concepts of 8086 processor .	**K2**
CO2	Explain the 8086 Bus structure.	**K2**
CO3	Illustrate the I/O Interfacing.	**K3**
CO4	Discuss the 8051 Microcontroller architecture.	**K2**
CO5	Illustrate the Microcontroller interfacing.	**K3**

23PTL305	ELECTROMAGNETIC FIELDS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To apply Maxwell's equations of electrostatic field and magnetostatic field to determine the field strength at various charge distributions and examine the behavior of time-varying electromagnetic field in different media and find the average power transmission.	
UNIT – I	**COORDINATE SYSTEMS**	**9 Periods**
Vector Algebra - Coordinate Systems: Cartesian - Cylindrical - Spherical coordinate systems - Types of charge distributions - Electric field intensity due to various charge distributions - Electric field due to infinite charge - Electric filed due to charged circular ring - Electric field due to infinite sheet of charge - Electric Field - Coulomb's Law - Electric flux density and dielectric constant - Gauss's law- Application of Gauss's law.		
UNIT – II	**ELECTROSTATIC FIELDS**	**9 Periods**
Maxwell's first equation - Divergence theorem - Electric potential due to point, line, surface and volume charges - Conductors in static electric field, Dielectrics in static electric field - Relationship between E and V - Energy density - Boundary conditions in electrostatic fields - Capacitance of parallel plates - Capacitance of coaxial cable - Laplace and Poisson's equations.		
UNIT – III	**MAGNETOSTATIC FILEDS**	**9 Periods**
Magnetic Fields and its properties-Biot Savart's Law- Ampere's Circuital Law-Applications of Ampere's circuital law-Magnetic flux density and Maxwell's Equations-Magnetic Vector Potential-Magnetic Boundary Conditions-inductance and Mutual Inductance-Energy Stored in magnetic field		
UNIT – IV	**MAXWELL'S EQUATION FOR TIME VARYING FIELDS**	**9 Periods**
Faraday's law - Equation of continuity - Inconsistency of Ampere's law - Modified Ampere's circuital law for time varying fields - Displacement current and displacement current density - Maxwell's equation of time varying field - Boundary conditions for time varying fields.		
UNIT – V	**ELECTROMAGNETIC WAVES**	**9 Periods**
Uniform plane waves - Wave equation for conducting medium - Uniform plane wave in dielectric medium - Reflection of uniform plane wave - Normal incidence - Polarization of uniform plane waves - Poynting vector and Poynting theorem.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Mathew.N.O.Sadiku, **"Elements of Electromagnetics"**, 7th Edition, Oxford University press, 2021.*
2	*William H.Hayt**,"Engineering Electromagnetics"**, 8th Edition, Tata McGraw-Hill, 2012.*

REFERENCES:

1	*Edward.C.Jordan & Keith.G.Balmain**,"Electromagnetic Waves and Radiating Systems"**, 2nd Edition, Prentice Hall of India,2009.*
2	*David K.Cheng, **"Field and Wave Electromagnetics"** ,2nd Edition, Pearson Education, 2013*
3	*U.A.Bakshi & A.V. Bakshi , **"Electromagnetic Waves and Transmission Lines"**, Technical Publications, Pune, 2009.*
4	*Rajeev Bansal**,"Fundamentals of Engineering Electromagnetics"**, Taylor & Francis, 2018*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the knowledge of co-ordinate systems to Electric fields	**K3**
CO2	Explain the concepts of Electrostatic fields.	**K2**
CO3	Explain the concepts of Magnetostatic fields.	**K2**
CO4	Apply the Maxwell's equation solution to Time varying fields.	**K3**
CO5	Discuss the characteristics of Electromagnetic wave propagation in Uniform plane.	**K2**

23PTL401	DIGITAL SIGNAL PROCESSING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
CONTINUOUS TIME SIGNALS AND SYSTEMS DISCRETE TIME SIGNALS AND SYSTEMS	PC	3	0	0	3

Course Objective	To study DFT, digital filter design algorithms, finite word length effects, multi rate signal processing and architecture of Digital signal processor.	
UNIT – I	**DISCRETE FOURIER TRANSFORM**	**9 Periods**
Review of discrete-time signals and systems - DFT and its properties, FFT algorithm1Decimation in Time Algorithm - Decimation in Frequency - Computation of Inverse DFT using FFT and its application to convolution. Sectioned convolution - Overlap add and overlap save methods.		
UNIT – II	**INFINITE IMPULSE RESPONSE DIGITAL FILTERS**	**9 Periods**
Design of analog Butterworth and Chebyshev Filters - Frequency transformation in analog domain - Design of IIR digital filters - Impulse invariance technique, Bilinear transformation -Realization of IIR filters - Direct, cascade and parallel forms.		
UNIT – III	**FINITE IMPULSE RESPONSE DIGITAL FILTERS**	**9 Periods**
Symmetric and Anti-symmetric FIR filters - Linear phase FIR filters - FIR Design using Fourier series method - window method - rectangular, Hamming and Hanning windows - Frequency sampling method - Realization of FIR filters - Linear phase, Traversal structures - comparison of FIR and IIR filters.		
UNIT – IV	**FINITE WORD LENGTH EFFECTS AND MULTI-RATE SIGNAL PROCESSING**	**9 Periods**
Fixed point and floating-point number representations - Comparison - Quantization Error - Quantization Noise Power - Finite word length effects - Signal scaling - Introduction to Multi -rate signal processing Decimation - Interpolation - multistage implementation - Application.		
UNIT – V	**DIGITAL SIGNAL PROCESSOR**	**9 Periods**
Harvard and modified Harvard architectures - architecture of C6X processors - Features of C67X processor - Internal architecture - CPU - General Purpose register files - Functional Units and operation - data paths - Control registers - Functional Units and instructions - Parallel and pipeline operations - Interrupts.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*John G Proakis and Manolakis,* ***"Digital Signal Processing Principles, Algorithms and Applications"****, Pearson, Fourth Edition, 2007.*
2	*B. Venkataramani, M. Bhaskar, "****Digital Signal Processor Architecture, Programming and Applications****", Second Edition, 2011.*

REFERENCES:

1	*Johny R. Johnson,* ***"Introduction to Digital Signal Processing"****, PHI, 2008*
2	*E.C. Ifeachor and B.W. Jervis,* ***"Digital signal processing – A Practical approach"****, Prentice Hall, 2011*
3	*S.K. Mitra,* ***"Digital Signal Processing, A Computer Based approach"****, Tata McGrawHill, 2011 fourth international edition*
4	*Monson H. Hayes,* ***"Statistical Digital Signal Processing and Modeling"****, John Wiley and Sons Inc., New York, 2006.*
5	*Rulph Chassaing,* ***"Digital Signal Processing and Applications with the C6713 and C6416DSK"****,*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve problems using DFT & FFT algorithms	**K3**
CO2	Design and realize digital IIR filters	**K3**
CO3	Design and realize digital FIR filters	**K3**
CO4	Understand finite word length effects and have an exposure to Multirate signal processing and its applications.	**K2**
CO5	Explain Digital signal Processor families and architecture	**K2**

23PTL402	DIGITAL COMMUNICATION	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
CONTINUOUS TIME SIGNALS AND SYSTEMS DISCRETE TIME SIGNALS AND SYSTEMS	PC	3	0	0	3

Course Objective	To understand the various source coding theorems, Channel coding theorem using information theory, impart knowledge in the basics of error control coding, spread spectrum techniques, baseband and pass band digital transmission.	
UNIT – I	**INFORMATION THEORY**	**9 Periods**
Measure of information - Entropy - Source coding theorem - Discrete memoryless channels - Lossless, deterministic, noiseless channel - BEC, BSC - Mutual information - Channel capacity - Shannon Hartley law - Arithmetic coding - Shannon-Fano coding, Huffman Coding, Run length coding, LZW algorithm.		
UNIT – II	**ERROR CONTROL CODING TECHNIQUES**	**9 Periods**
Channel coding theorem - Linear block codes - Hamming codes - Cyclic codes - Convolutional Codes - Viterbi decoding.		
UNIT – III	**BASEBAND TRANSMISSION**	**9 Periods**
Line codes - Properties - Power Spectral Density of Unipolar / Polar RZ & NRZ - Bipolar NRZ - Manchester - ISI - Nyquist criterion for distortionless transmission - Pulse shaping - Correlative coding - Eye pattern - Equalization.		
UNIT – IV	**BANDPASS SIGNALING**	**9 Periods**
Introduction to Band Pass Sampling theorem - Geometric representation of signals - ML detection - Correlator and matched filter detection - Generation and detection, BER and Power spectral Density of BPSK, BFSK,QPSK,MSK - Structure of non-coherent receivers generation and detection of BFSK, DPSK – Comparison - M-ary PSK, M-ary FSK - Principles of QAM.		
UNIT – V	**SYNCHRONISATION AND SPREAD SPECTRUM TECHNIQUES**	**9 Periods**
Carrier, frame and symbol/Chip synchronization techniques, Spread Spectrum - PN Sequences, Direct Sequence and Frequency Hopping Spread Spectrum Systems, BER Analysis, Processing gain and Jamming Margin.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*S. Haykin, "**Digital Communications**", John Wiley, 2015*
2	*B.P.Lathi, **"Modern Digital and Analog Communication Systems"** ,Third edition, Oxford University Press 2007.*

REFERENCES:

1	*S.P.Eugene Xavier, **"Statistical theory of Communication"**, New Age International Private Limited, 2008.*
2	*H P Hsu, Schaum Outline Series, **"Analog and Digital Communications"**, TMH 2006.*
3	*J.G Proakis, **"Digital Communication"**, Fifth edition, Tata Mc Graw Hill Company, 2008.*
4	*Herbert Taub & Donald L Schilling – **"Principles of Communication Systems"** Third Edition Tata McGraw Hill, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Relate the notion of Entropy and mutual information to source coding theorem and channel capacity	**K3**
CO2	Apply error control coding techniques to find the error detection and correction capability of codes	**K3**
CO3	Summarize the various baseband processing techniques	**K2**
CO4	Explain the spectral characteristics of band pass signaling schemes and their noise performance	**K2**
CO5	Describe the concept of synchronization, spread spectrum systems	**K2**

23PTL403	NETWORKS AND TRANSMISSION LINES	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
ELECTRIC CIRCUITS AND ELECTRON DEVICES	PC	3	0	0	3

Course Objectives	To understand the basic concepts of two port networks, synthesis network and familiarize the concepts of transmission lines.	
UNIT – I	**TWO PORT NETWORKS**	**9 Periods**
Two Port Network Parameters: Z, Y, ABCD and Hybrid Parameters - Interconnection of networks: Cascade, Series, Parallel - Symmetrical networks: T and PI equivalent of two port network - characteristic impedance and propagation constant - Asymmetrical networks: Image and Iterative impedances - Image transfer constant and iterative transfer constant.		
UNIT – II	**PASSIVE NETWORKS**	**9 Periods**
Constant K filters - m derived filters - Composite filters - Design procedures - Series and shunt equalizer - Symmetrical and asymmetrical attenuators - T and PI sections.		
UNIT – III	**PASSIVE NETWORK SYNTHESIS**	**9 Periods**
Hurwitz polynomials - positive real functions - Driving point function synthesis - LC immittance functions - RC impedance/admittance functions - RL admittance/impedance functions - Foster and Cauer forms of RC,RL and LC networks.		
UNIT – IV	**TRANSMISSION LINE THEORY**	**9 Periods**
Line parameters and transmission constants - Transmission line equation-Physical significance of the equation - Infinite line - Input and transfer impedance - Waveform distortion - Distortion less line Loading - Reflection phenomena-Reflection loss and insertion loss - Skin and proximity effect-T and PI equivalent of transmission lines.		
UNIT – V	**LINE AT RADIO FREQUENCIES**	**9 Periods**
Parameters of open wire line and co-axial line at high frequencies – Standing Waves-Standing wave ratio- Input impedance of open and short circuited lines- Relation between VSWR and reflection coefficient-Quarter wave transformer- Single and double stub matching- Smith chart and its applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sudhahar.A, ShyammohanS.P,* ***"Circuits and Networks: Analysis and Synthesis"****, Tata McGraw Hill, New Delhi, Fourth Edition, 2010.*
2	*John D. Ryder,* ***"Networks, Lines and Fields"****, PHI, 2nd edition, 2009..*

REFERENCES:

1	*Umesh Sinha,* ***"Transmission Lines and Network"****, Satya Prakashan Publishing Company, New Delhi,2012.*
2	*S.P. Ghosh and A.K. Chakraborty,* "***Network Analysis and Synthesis***"*, McGraw Hill, 1stedition 2010.*
3	*Roy, Choudhury D.,* **"*Networks and Systems,*"** *New Age International Publishers, 2ndedition reprint , 2014.*
4	*M.E. VanValkenburg,* ***"Network Analysis, INDIA PEARSON,"****3rd edition, 2015.*
5	*G.S.N. Raju* **"*Electromagnetic Field theory and Transmission lines*", ***Pearson Education,First Edition 2005***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Compute the network parameters and recollect the symmetrical and asymmetrical networks.	**K2**
CO2	Design the various passive networks.	**K3**
CO3	Synthesize an electric network using driving point functions.	**K3**
CO4	Derive the transmission line equation and loading effect.	**K2**
CO5	Illustrate the line behaviour at radio frequencies and stub matching techniques.	**K3**

23PTL404	COMPUTER COMMUNICATION	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To gain knowledge about the network layers and familiarize with the functions and protocols of each layer of TCP/IP protocol suite.	
UNIT – I	**APPLICATION LAYER**	**9 Periods**
Evolution of Computer Networking - Layered Architecture - ISO/OSI Model - Internet Architecture (TCP/IP) - Application Layer Protocols - HTTP - FTP - Telnet - Email - DNS - Socket programming		
UNIT – II	**TRANSPORT LAYER**	**9 Periods**
End to End Protocols - Connectionless Transport Protocols - User Datagram Protocol (UDP) - Reliable Data Transfer - Connection Oriented Transport Protocols - Transmission Control Protocol (TCP) - Flow Control - Congestion Control - Transport Layer Alternatives (RPC) - Real Time Transport protocol.		
UNIT – III	**NETWORK LAYER**	**9 Periods**
Internet Protocol - IPV4 Packet Format - IP Addressing - Subnetting - Variable Length Subnet Mask(VLSM) - Classless Inter Domain Routing (CIDR) - Private Addressing - Network Address Translation - BOOTP/DHCP - ICMP - Router - Routing Principles - Distance Vector Routing - (RIP) - Link State Routing - (OSPF) - Path Vector Routing (BGP) - IPV6 - Quality of Service (QoS).		
UNIT – IV	**DATA LINK LAYER**	**9 Periods**
Link Layer - Framing - Addressing - Error Detection and Correction - Multiple Access Protocols Address Resolution Protocol (ARP) - Ethernet Basics - CSMA/CD - Frame Format - Switching - Types (datagram, virtual) - Hubs, Bridges, Switches - Virtual LAN (VLAN) - Wireless LAN (IEEE 802.11) - WAN Technologies - ATM - Frame Relay - MPLS.		
UNIT – V	**DATA COMMUNICATIONS**	**9 Periods**
Transmission - Impairments - Bandwidth Limitations - Modulation - Frequency Spectrum - Multiplexing - Encoding Techniques - Transmission Media - Copper - Fiber - Optical - Radio (wireless) - Cable Pinouts - Crossover - Straight Through - Rollover.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Behrouz A. Forouzan and Firouz Mosharraf,* ***"Computer Networks a Top Down Approach"****, Tata McGraw-Hill, 1st Edition, 2011.*
2	*James F. Kurose, Keith W. Ross,* ***"Computer Networking, A Top-Down Approach Featuring the Internet"****, 6th Edition, Pearson Education, 2012.*

REFERENCES:

1	*Larry L. Peterson, Bruce S. Davie,* ***"Computer Networks: A Systems Approach"****, 5th Edition, Morgan Kaufmann Publishers Inc., 2011.*
2	*William Stallings,* ***"Data and Computer Communications"****, 10th Edition, Pearson Education, 2014.*
3	*Nader F. Mir,* ***"Computer and Communication Networks"****, 2nd Edition, Prentice Hall, 2015*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Gain Knowledge about application layer Protocols.	**K1**
CO2	Discuss the protocols and Congestion control algorithms in Transport layer protocols.	**K2**
CO3	Gain knowledge about various internet protocols and apply the networking algorithms.	**K3**
CO4	Describe protocol in data link layer and error detection and correction methods.	**K3**
CO5	Explain the concepts of data communications in computer network.	**K2**

23PTL405	COMMUNICATION SYSTEMS LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objective	To understand the role of each module present in the communication link that includes various Analog modulation and Digital modulation techniques, Source coding theorems, Line coding schemes, Error control coding techniques, Spread spectrum techniques and Equalizer
PRACTICALS	**Simulation using MATLAB/SIMULINK/ SDR equivalent (OR) Hardware** **LIST of EXPERIMENTS:** 1. Amplitude Modulation and Demodulation 2. Frequency Modulation and Demodulation 3. ASK, FSK, PSK and DPSK schemes 4. Natural sampling and Flat top sampling 5. Time Division Multiplexing 6. Pulse Code Modulation and Demodulation 7. Delta Modulation and Demodulation 8. Line coding schemes. 9. Error control coding using Linear Block Codes and Convolutional codes 10.Shannon Fano coding and Huffmann coding 11. Code Division Multiplexing 12. Equalization – Zero Forcing & LMS algorithms
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

REFERENCES:

1	*John G.Proakis, **"Contemporary Communication Systems Using MATLAB",** 3rd Edition, Cengage learning, 2013.*
2	*Wayne Tomasi, **"Laboratory Manual to Electronic Communications Systems"**Pearson, 2000.*
3	*https://forums.ni.com/t5/Curriculum-and-Labs-for/Analog-Digital-Communications-Systems-with-LabVIEW-Experiments/ta-p/3513761*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Ability to experimentally analyze the performance of various kinds of Analog modulation techniquesand Digital modulation techniquesused incommunication systems	**K4**
CO2	Ability to experimentally analyze the performance of sampling, Time Division Multiplexing and line coding formatsin Digitalcommunication systems	**K4**
CO3	Ability to experimentally analyze the performance of various kinds of error control coding schemes used inDigital communication systems	**K4**
CO4	Ability to understand the code division multiplexing and equalizer performance by applying various equalization algorithms	**K4**
CO5	Ability to experimentally analyze the performance of various kinds of source coding techniques used in Digital communication systems	**K4**

23PTL501	COMPUTER ARCHITECTURE AND ORGANIZATION	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To compute the basic arithmetic structure, pipelined execution, parallelism and multi-core processors along with the memory hierarchies, cache memories and virtual memories and different ways of communication with I/O devices.	
UNIT – I	**BASIC STRUCTURE OF A COMPUTER**	**9 Periods**
Functional units - Basic operational concepts of a Computer - Performance Issues - Execution of Instructions in the Computer - Operations - Operands - Instruction and instruction sequencing - Logical operations - Decision making - Addressing modes .		
UNIT – II	**ARITHMETIC FOR COMPUTERS**	**9 Periods**
Arithmetic and Logic Unit (ALU) - Addition and Subtraction - Signed and unsigned Multiplication - Division - Floating Point Representation - Floating Point addition and subtraction - Sub word Parallelism.		
UNIT – III	**PROCESSOR AND CONTROL UNIT**	**9 Periods**
A Basic MIPS implementation - Building a Data path - Control Implementation Scheme - Pipelining - Pipelined data path and control - Handling Data Hazards & Control Hazards - Exceptions.		
UNIT – IV	**PARALLELISM**	**9 Periods**
Parallel processing challenges - Flynn's classification - SISD, MIMD, SIMD, SPMD and Vector Architectures - Hardware multithreading - Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message - Passing Multiprocessors.		
UNIT – V	**MEMORY & I/O SYSTEMS**	**9 Periods**
Memory Hierarchy - memory technologies - cache memory - measuring and improving cache performance - virtual memory, TLBs - Accessing I/O Devices - Interrupts - Direct Memory Access - Bus structure - Bus operation - Arbitration - Interface circuits - USB.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*William Stallings,* ***"Computer Organization and Architecture – Designing for Performance"****, Eighth Edition, Pearson Education, 2019.*
2	*Carl Hamacher, ZvonkoVranesic, SafwatZaky,* ***"Computer Organization"****, McGraw-Hill, Fifth Edition, Reprint 2016*

REFERENCES:

1	*John P. Hayes,* ***"Computer Architecture and Organization"****, Third Edition, Tata McGraw Hill, 2012*
2	*John L. Hennessey and David A. Patterson,* ***"Computer Architecture – A Quantitative Approach"****, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2017*
3	*BehroozParahami,* ***"Computer Architecture"****, Oxford University Press, Eighth Impression, 2011*
4	*David A. Patterson and John L. Hennessy,* ***"Computer Architecture-A Quantitative Approach"****, Elsevier, a division of reed India Private Limited, Fifth edition, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basics structure of computers, operations and instructions.	**K2**
CO2	Design arithmetic and logic unit in a computer.	**K3**
CO3	Describe the concepts of Data path and Control Path.	**K2**
CO4	Discuss the pipelined execution and parallel processing architectures.	**K2**
CO5	Illustrate the various memory systems and I/O communication	**K2**

23PTL502	EMBEDDED SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To learn the basic concepts of embedded systems, program design and networks and exploit the architecture and applications of ARM CORTEX.	
UNIT – I	**INTRODUCTION TO EMBEDDED SYSTEM DESIGN**	**9 Periods**
Complex systems and microprocessors - Characteristics and challenges of embedded computing system - Embedded system design process - Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, - Formalism for system Design - Structural Description, Behavioral Description, Design example: Model train controller, Alarm Controller.		
UNIT – II	**ARM CORTEX M4**	**9 Periods**
Introduction to cortex M4 – Features - ARM Architecture - Block diagram - operation modes and states – Registers - Memory system - Exception and Interrupts - Instruction Set - Low Power Characteristics		
UNIT – III	**EMBEDDED PROGRAMMING**	**9 Periods**
Components for embedded programs - Models of programs - Assembly, linking and loading - Compilation techniques - Program level performance analysis - Software performance optimization - Program level energy and power analysis and optimization - Analysis and optimization of program size - Program validation and testing.		
UNIT – IV	**INTERFACING WITH ARM CORTEX**	**9 Periods**
ARM Cortex STM32F controller - Configuring GPIO Ports - Switches and LEDs - LCD Display -ADC - DAC - Pulse width Modulation - DMA - Serial Communication USART.		
UNIT – V	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9 Periods**
Operating System Basics - Types of Operating Systems - Tasks, Process and Threads - Multiprocessing and Multitasking - Task Scheduling - Inter process Communication mechanisms - Evaluating Operating system Performance - Power Optimization Strategies for Process.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Marilyn Wolf,* ***"Computers as Components - Principles of Embedded Computing System Design"****,Third Edition "Morgan Kaufmann Publisher,2012.*
2	*https://www.st.com/resource/en/reference_manual/dm00031020-stm32f405-415-stm32f407-advanced -arm-based-32-bitmcus-stmicroelectronics.pdf.*

REFERENCES:

1	*Shibu K.V,* ***"Introduction to Embedded Systems"****, McGraw Hill.2014.*
2	*Dr. Mark Fisher,* ***ARM Cortex M4 Cook Book****, Packt Publishing, 2016.*
3	*Raj Kamal,* ***"Embedded Systems-Architecture, Programming and Design"****, 3 editions, TMH.2015*
4	*Lyla,* ***"Embedded Systems"****, Pearson, 2013. 5. David E. Simon, "An Embedded Software Primer", Pearson Education, 2000.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the concepts of embedded systems.	**K2**
CO2	Interpret the Architecture and features of ARM CORTEX controller	**K2**
CO3	Explain the interfacing of ARM Cortex	**K2**
CO4	Illustrate the code for constructing a system	**K3**
CO5	Demonstrate the concepts of Real Time operating system	**K2**

23PTL503	CONTROL SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To acquire knowledge in the modeling of the system, analyze time and frequency response, stability and state variables of the system.	
UNIT – I	**MODELING OF CONTROL SYSTEMS**	9 Periods
Basic Elements of Control System - Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electrical systems - Block diagram reduction Techniques - Signal flow graph - Mason's gain formula.		
UNIT – II	**TIME RESPONSE ANALYSIS**	9 Periods
Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors - P, PI, PD and PID Controllers.		
UNIT – III	**FREQUENCY RESPONSE ANALYSIS**	9 Periods
Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Series, Parallel, series - parallel Compensators - Design of Lead and Lag Compensators.		
UNIT – IV	**STABILITY ANALYSIS**	9 Periods
Stability - Routh - Hurwitz Criterion, Root Locus Technique - Construction of Root Locus - Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability.		
UNIT – V	**STATE SPACE ANALYSIS**	9 Periods
Concepts of State variable and State space model - State space representation of Continuous Time systems - Transfer function from State model - State transition matrix - Kalman's test of Controllability and Observability.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*J.Nagrath and M.Gopal,* ***"Control Systems Engineering"****, New Age International Publishers, 7th Edition, 2021.*
2	*A.Nagoor Kani,* ***"Control Systems"****, RBA Publications, 3rd Edition, 2015.*

REFERENCES:

1	*A.Nagoor Kani,* ***"Advanced Control Theory"****, CBS Publishers and Distributors, 3rd Edition, 2020.*
2	*M.Gopal,* ***"Control System – Principles and Design"****, Tata McGraw Hill, 4th Edition, 2012*
3	*Ogata K,* ***"Modern Control Engineering"****, PHI Publishers, 5th Edition, 2010.*
4	*Richard C. Dorf & Robert H. Bishop,* ***"Modern Control Systems"****, Prentice Hall, 12th edition, 2010.*
5	*B. C. Kuo,* ***"Digital Control Systems"****, Oxford University Press, 2/e, Indian Edition, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the differential equation and transfer function of the system	**K2**
CO2	Analyze time response specifications	**K3**
CO3	Analyze the frequency domain response	**K3**
CO4	Examine the stability of the system	**K3**
CO5	Develop state space model of the system	**K2**

23PTL504	ANTENNAS AND WAVE PROPAGATION	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
ELECTROMAGNETIC FIELDS	PC	3	0	0	3

Course Objective	To design and analyze various types of antennas and arrays, learn measurements of antenna parameters and understand characteristics of a wave propagation in free space.	
UNIT – I	**FUNDAMENTALS OF RADIATION**	**9 Periods**
Antenna Parameters: Radiation mechanism - current distribution on a thin wire antenna - Radiation Pattern, Beam solid angle, Radiation intensity, Radiation Power density, Directivity, Gain, Effective aperture, Effective height, Polarization, Bandwidth, Beam width, antenna impedance, Duality of Antennas. Radiation: Retarded potentials - Radiation fields of oscillating dipole, Power radiated by a current element, short antennas, Radiation from Half wave Dipole.		
UNIT – II	**ANTENNA ARRAYS**	**9 Periods**
Two element array - N-element Linear arrays, Pattern multiplication, Effect of earth on Vertical Patterns, Broad side array, End fire array, Evaluation of null directions and maxima, amplitude distributions - Binomial arrays, - Log periodic dipole array - Phased array - Yagi-Uda array - Folded Dipole - Impedance matching		
UNIT – III	**APERTURE AND SLOT ANTENNAS**	**9 Periods**
Induction and Equivalence Theorems - Field of a secondary source - Radiation from open end of a co-axial line - Radiation through an Aperture - Fraunhofer and Fresnel Diffraction - Radiation from Electromagnetic Horns - Rectangular Horn Antennas - Conical Horn Antenna - Slot antennas - Patterns of Slot Antennas in Flat Sheets - Edge Diffraction - Babinets Principle -Impedance of Complementary Sheets - Impedance of Slot Antennas .		
UNIT – IV	**SPECIAL ANTENNAS**	**9 Periods**
Helical Antennas - Design of Monofilar Axial mode and normal mode Helical antenna - loop antennas- Power radiated, Radiation Resistance and directivity Reflector Antennas - flat sheets and corner reflector - Paraboloidal reflector - Feed methods - Micro-stripe Antennas - Cell tower Trees - Base station Antennas - Mobile station Antennas.		
UNIT – V	**WAVE PROPAGATION AND ANTENNA MEASUREMENTS**	**9 Periods**
Modes of propagation - Structure of atmosphere - Characteristics of different ionized regions - Sky wave propagation - Effects of the earth's magnetic field on ionospheric radio wave propagation - Virtual height - Maximum usable frequency - Critical angle - Skip distance - Space wave propagation - Duct propagation. Measurement of Radiation Pattern - Beam Width - Gain - Directivity - Polarization- Input impedance - SWR method - Reflection coefficient-VSWR - Antenna Test Ranges: Elevated ranges - Ground reflection ranges - Anechoic chambers & absorbing materials - Compact Antenna Test Ranges.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Edward C. Jordon , Keith G. Balmain ,* ***"Electromagnetic Waves and Radiating Systems"*** *,Pearson 2nd Edition,2015*
2	*Prasad.K.D,* ***"Antennas and Wave Propagation"****, Sathya Prakashan, 3rd Edition, 2009*

REFERENCES:

1	*Constantine A. Balanis,* ***"Antenna Theory-Analysis and Design"****, 3rdedition, Wiley-India, 2010*
2	*R.E.Collin,* ***"Antennas and Radio wave Propagation",*** *McGraw Hill,2002*
3	*Jhon D Kraus,****"Antennas"****,2nd Edition McGraw Hill, 1988*
4	*H.Sizun ,* ***"Radio Wave Propagation for Telecommunication Applications"****, First Indian Reprint, Springer Publications, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain and analyze the radiation characteristics of dipole.	**K2**
CO2	Discuss the design and radiation pattern of antenna arrays.	**K3**
CO3	Describe and analyze Aperture and Slot antennas	**K3**
CO4	Describe the radiation characteristics and design of special antennas.	**K2**
CO5	Explain the various modes of radio wave propagations and measurement procedure of antenna parameters.	**K2**

23PTL601	VLSI DESIGN	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To introduce various aspects of CMOS logic and CMOS logic networks to realize the VLSI system components.	
UNIT – I	CMOS LOGIC DESIGN	9 Periods
VLSI Design Flow - MOSFET Switches - Basic Logic Gates in CMOS - Complex Logic Gates in CMOS - Transmission Gate Circuits - Stick Diagram and Layout Design Rules - Layout of Basic Structures - Physical structure of MOSFETs - CMOS Layers – FinFET – VI Charateristics of FinFET.		
UNIT – II	CHARACTERISTICS AND ANALYSIS OF CMOS LOGIC	9 Periods
MOS Threshold Voltage Equation - nFET Current-Voltage Equations - The FET RC Model -DC Characteristics of the CMOS Inverter - Switching Characteristics - Power Dissipation -Transient Response - Analysis of Complex Logic Gates.		
UNIT – III	DESIGNING HIGH-SPEED CMOS LOGIC NETWORKS	9 Periods
Gate delays - driving large capacitive loads - Logical effort – Advanced Logic Circuits: Pseudo-NMOS - Tri-state - clocked CMOS- dynamic and dual rail logic – Domino logic - CPL – DCVSPG – DPL. Timing Issues : Timing Classification Of Digital System, Synchronous Design.		
UNIT – IV	VLSI CLOCKING AND TESTING	9 Periods
VLSI clocking: CMOS clocking styles - Pipelined systems - Clock generation and distribution. VLSI testing -need for testing - manufacturing test principles - design strategies for test - chip level and system level test techniques.		
UNIT – V	SYSTEM DESIGN AND ADVANCED TECHNOLOGIES	9 Periods
Verilog structures - Multiplexers - Binary Decoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM - DRAM and Flash Memories. Advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*
2	*N. Weste et. al., "**CMOS VLSI Design**", Third Edition, Pearson Education,2013.*

REFERENCES:

1	*Jan M. Rabaey, "**Digital Integrated Circuits: A Design Perspective**", PHI, Second Edition, 2012.*
2	*R. Jacob Baker, "**CMOS: Circuit Design, Layout, and Simulation**", Wiley-IEEE, Revised Second Edition, 2008.*
3	*Pucknell, "**Basic VLSI Design**", Prentice Hall, 2006.*
4	*Sung-Mo Kang & Yusuf Leblebici, "**CMOS Digital Integrated Circuits Analysis And Design**", Mcgraw-Hill, 2022.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Construct the complex logic circuits with MOSFETs	**K2**
CO2	Explain the characteristics and analyze the characteristics of CMOS logic	**K3**
CO3	Design the high-speed CMOS Logic Networks	**K2**
CO4	Use clocking styles to design basic VLSI system and illustrate the testing principles for the device under test.	**K2**
CO5	Design the basic digital blocks and understand the advanced technologies.	**K3**

23PTL602	MICROWAVE ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
ELECTROMAGNETIC FIELDS NETWORKS AND TRANSMISSION LINES	PC	3	0	0	3

Course Objective	To analyze the microwave networks behavior, understand the function of microwave active and passive devices and acquire knowledge on matching networks.	
UNIT – I	MICROWAVE SOURCES AND AMPLIFICATION	9 Periods
Microwave frequencies (IEEE Standards) - High frequency limitations of conventional tubes - Microwave Vacuum Tubes: Reflex Klystron Oscillator - Two cavity Klystron amplifier - TWT amplifier - Active RF Devices: Gunn effect diode - Gunn Oscillator - Tunnel diode		
UNIT – II	MICROWAVE NETWORK ANALYSIS AND PASSIVE DEVICES	9 Periods
S-Parameters - Formulation of Scattering (S) matrix - Properties of S parameters - Testing of reciprocal and lossless networks - Properties of ferromagnetic materials, principle of faraday's rotation, isolator, circulator and phase Shifter.		
UNIT – III	MICROWAVE POWER DIVIDERS	9 Periods
S-matrix analysis of E-Plane Tee, H-Plane Tee, Magic Tee, Two-hole directional coupler. T junction and resistive power divider, Rat Race Coupler. Microstrip transmission Lines: effective dielectric constant-characteristic impedance-losses-Quality factor.		
UNIT – IV	IMPEDANCE MATCHING TECHNIQUES	9 Periods
Smith chart - Concept of impedance matching - Quarter-wave transformer - Smith Chart solutions to matching with lumped elements (L networks), Micro strip Line Matching Networks.		
UNIT – V	MICROWAVE MEASUREMENTS	9 Periods
Microwave measurements: Guide wavelength, unknown frequency, unknown impedance reflection coefficient and low and high VSWR. Case Study: Microwave Oven		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*David M. Pozar, "**Microwave Engineering**", Wiley India (P) Ltd, New Delhi, 4th edition, 2012.*
2	*Annapurna Das and Sisir K Das, "**Microwave Engineering**", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2017.*

REFERENCES:

1	*Samuel Y. Liao, "**Microwave Devices and Circuits**", Prentice Hall of International Ltd, 4th edition, 2009.*
2	*Reinhold Ludwig and Gene Bogdanov, "**RF Circuit Design: Theory and Applications**", Pearson Education Inc., 2nd edition, 2011.*
3	*S. Rao, "**Microwave Engineering**", Prentice Hall of India, 2nd edition, 2015.*
4	*Thomas H Lee, "**Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits**", Cambridge University Press, 2004.*
5	*Robert E Colin, "**Foundations for Microwave Engineering**", John Wiley & Sons, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the various sources of microwave generation and amplification procedures.	**K2**
CO2	Formulate S matrix of microwave components and test for its various properties	**K3**
CO3	Discuss the function and role of microwave power divider networks	**K2**
CO4	Design impedance matching networks using Smith chart	**K3**
CO5	Describe the operation of RF amplifiers and discuss the procedure of Microwave measurements.	**K2**

23PTL603	WIRELESS COMMUNICATION	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
ANALOG COMMUNICATION DIGITAL COMMUNICATION	PC	3	0	0	3

Course Objective	To understand the Cellular Architecture, concept behind mobile propagation, various multipath mitigation techniques, multi antenna and Wireless systems.	
UNIT – I	**CELLULAR ARCHITECTURE**	**9 Periods**
Introduction to 2G Cellular Networks and 3G Wireless Networks – Cellular Concept: Introduction – Frequency Reuse – Channel Assignment Strategies –Handoff Strategies – Interference and System Capacity –Trunking and Grade of Service –Improving Coverage and Capacity in Cellular Systems. Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA.		
UNIT – II	**MOBILE RADIO PROPAGATION**	**9 Periods**
Free Space Propagation Model –Reflection – Ground Reflection Model – Diffraction – Scattering – Practical Link Budget Design –Small Scale Multipath Propagation – Time dispersion Parameters – Coherence Bandwidth – Doppler Spread and Coherence Time – Fading Effects due to Multipath Time Delay Spread and Doppler Spread.		
UNIT – III	**MULTIPATH MITIGATION TECHNIQUES**	**9 Periods**
Equalization – Adaptive Equalizer – Linear and Nonlinear Equalization – Zero Forcing Algorithm – LMS Algorithm – Recursive Least Square Algorithm –Diversity: Micro and Macro Diversity – Combination of Signals - Error Probability in Fading Channels with Diversity Reception –RAKE Receiver.		
UNIT – IV	**MULTIANTENNA SYSTEMS**	**9 Periods**
Smart Antennas - Multiple Input Multiple Output Systems - System Model - Channel State Information - Capacity - Impact of the Channel - Layered Space–Time Structure - Diversity - Tradeoffs between Diversity, Beamforming Gain, and Spatial Multiplexing - Multiuser MIMO - Performance Limits - Scheduling - Linear Precoding – Uplink and Downlink - Closed-Loop Systems and Quantized Feedback - Base Station Cooperation. NOMO in Single input single output and Multi input and Multi Output Systems.		
UNIT – V	**WIRELESS SYSTEMS**	**9 Periods**
Global System for Mobile Communications -System Overview -The Air Interface - Logical and Physical Channel – Synchronization – Coding -Establishing a Connection and Handover - WiMAX/IEEE 802.16 - System Overview - Modulation and Coding - Logical and Physical Channels - Multiple-Antenna Techniques - Link Control - Wireless Local Area Network – Introduction to 4G and 5G communication systems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Rappaport,T.S., "***Wireless communications***", Second Edition, Pearson Education, 2010.*
2	*Andreas.F. Molisch, "***Wireless Communications***", Second Edition, John Wiley – India, 2011.*

REFERENCES:

1	*Simon Haykin , Michael Moher, David Koilpillai, **"Modern Wireless Communications",** First Edition, Pearson Education 2013.*
2	*David Tse and Pramod Viswanath, **"Fundamentals of Wireless Communication",** Cambridge University Press, 2005.*
3	*Jochen Schiller, **"Mobile Communications"**, Second Edition, Pearson Education 2012.*
4	*Upena Dalal, **"Wireless Communication"**, Oxford University Press, 2009.*
5	*Vincent W. S. Wong, Robert Schober, Derrick Wing Kwan Ng, Li-Chun Wang**, "Key Technologies***

	for 5G Wireless Systems", *Cambridge University Press, 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Characterize wireless channels and understand the concept of cellular system	**K2**
CO2	Describe the mobile radio propagation.	**K2**
CO3	Compare multipath mitigation techniques and interpret their performance	**K2**
CO4	Design and implement systems with transmit/receive diversity and MIMO systems and analyze their performance	**K3**
CO5	Conversant with the latest trends in Wireless Systems.	**K2**

23PTL604	EMBEDDED AND VLSI LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
DIGITAL SYSTEM DESIGN EMBEDDED SYSTEMS	PC	0	0	3	1.5

Course Objective	To design, simulate and analyze digital IC design using VLSI and embedded applications using ARM processor.
PRACTICALS	**LIST of EXPERIMENTS:** **PART 1: EMBEDDED DESIGN** 1. Interfacing 8 Bit LED and Switch. 2. Implementation of Buzzer Interface using IDE environment. 3. Display a message in a 2 line x 16 Characters LCD display. 4. Simple interrupt handler and setting up a timer. 5. Interfacing ADC, DAC and Matrix Keypad. 6. Generation of PWM. **PART 2: DIGITAL SUB-SYSTEM AND IC DESIGN** 1. Study of basic combinational circuits, code converters, adders, multipliers and ALUs. 2. Study of sequential circuits, flipflops, memories, shift registers and counters. 3. Design and simulation of basic gates and Flip-Flops using CMOS. 4. Layout & Circuit Simulation of CMOS Inverter and Universal logic gates and perform the transient analysis.
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

REFERENCES:

1	*J Bhasker,* ***"A verilog HDL Primer"****, BS Publication, 2017*
2	*Charles H.Roth,* ***"Fundamentals of Logic Design"****, Cengage, 2019*
3	*N. Weste et. al.,* ***"CMOS VLSI Design"****, Third Edition, Pearson Education,2013.*
4	*R. Jacob Baker,* ***"CMOS: Circuit Design, Layout, and Simulation"****, Wiley-IEEE, Revised Second Edition, 2008.*
5	*Andrew N.Sloss Dominic Symes Chris Wright,* ***"ARM System Developer's Guide Designing and Optimizing System Software"****, Elsevier Inc 2010.*
6	*JosephYiu ,* ***"The Definitive Guide to the ARM Cortex-M"*** *, Elsevier- Newness, 2014*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Develop an ARM CORTEX M4 based Assembly Language Programs	**K4**
CO2	Develop embedded C programs to implement the functions of On-chip peripherals of ARM CORTEX M4 processor.	**K4**
CO3	Demonstrate C programs to interface ADC and DAC	**K4**
CO4	Develop embedded C programs to handle interrupts and timer in ARM processor.	**K4**
CO5	Demonstrate real time clock and serial data transfer.	**K4**

23PTL7Z1	HUMAN VALUES AND ETHICS	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objective	To understand the need and importance of physical, emotional health and social health in profession, society and polity.	
UNIT – I	**BEING GOOD AND RESPONSIBLE**	**9 Periods**
Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self - Confidence - Character.		
UNIT – II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9 Periods**
Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Models of Professional Roles. Engineering as Experimentation - Engineers as responsible Experimenters - Research Ethics - Codes of Ethics - Industrial Standards - A Balanced Outlook on Law - Case studies: Chernobyl disaster and Titanic disaster.		
UNIT – III	**ADDICTION AND HEALTH**	**9 Periods**
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases. Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention		
UNIT – IV	**PROFESSIONAL ETHICS**	**9 Periods**
Abuse of Technologies: Hacking and other cybercrimes, Addiction to mobile phone usage, Video games and Social networking websites.		
UNIT – V	**GLOBAL ISSUES**	**9 Periods**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct - Corporate Social Responsibility		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Mike W Martin and Roland Schinzinger, **"Ethics in Engineering"**, McGraw-Hill, New York, 4 th Edition, 2017.*
2	*Govindarajan M, Natarajan S and Senthil Kumar VS, **"Engineering Ethics"**, Prentice Hall of India, New Delhi, 2013.*

REFERENCES:

1	*Dhaliwal, K.K, "**Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts**", Writers Choice, New Delhi, India,2016.*
2	*Jayshree suresh, B.S.Raghavan,"**Human values and professional ethics**" S.Chand&;company Ltd, New Delhi, 2ndEdition, 2007.*
3	*L.A. and Pagliaro, A.M, "**Handbook of Child and Adolescent Drug and Substance Abuse:***
4	*Pandey, P. K(2012), "**Sexual Harassment and Law in India**", Lambert Publishers, Germany 2012.*
5	*Kiran D.R, "**Professional ethics and Human values**," Tata McGraw Hill, New Delhi, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand and appreciate the ethical issues faced by an individual in profession, society and polity.	**K2**
CO2	Learn about Engineering Ethics and case studies	**K2**
CO3	Understand the negative health impacts of certain unhealthy behaviors	**K2**
CO4	Appreciate the need and importance of physical, emotional health and social health.	**K2**
CO5	Get familiar with the global issues.	**K2**

23PTL702	FIBER OPTIC COMMUNICATION	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To gain knowledge in the optical communication systems and optical fibers, to study about optical transmitter, receiver and basic elements used in the construction of optical systems and to gain knowledge in advanced technologies.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Evolution of fiber optical system - Elements of Optical Fiber Systems - EM Spectrum, Total Internal Reflection - Choice of operating wavelength - Mode theory - Single Mode Fiber, Multi-mode Fiber - Step index fiber, Graded Index Fiber - Numerical Aperture - Signal degradation in fibers - Dispersion, Attenuation, Bending loss and propagation loss - Advantages and applications of fiber optic transmission systems.		
UNIT – II	**OPTICAL SOURCES**	**9 Periods**
Spontaneous and Stimulated emission - Optical sources - Light Emitting Diode (LED) - V-I characteristics of LED - Laser Diode - V-I and P-I characteristics of Laser Diode - Ruby laser - He-Ne laser - Splicing technique - Optical fiber connectors and couplers.		
UNIT – III	**OPTICAL DETECTORS**	**9 Periods**
Photo detectors - Photodiode and V-I characteristics of Photodiode, Avalanche photomultiplier tubes - Photo detector noise - Signal to Noise ratio - BER calculation - Power budget and Rise time budget.		
UNIT – IV	**SYSTEM CONFIGURATIONS**	**9 Periods**
Optical amplifiers - Erbium Doped Fiber Amplifier (EDFA), Raman Amplifier- Multiplexing strategies - Wavelength Division Multiplexing (WDM) - Dense Wavelength Division Multiplexing (DWDM).		
UNIT – V	**ADVANCES IN OPTICAL FIBER SYSTEMS**	**9 Periods**
Synchronous Optical Network / Synchronous Digital Hierarchy (SONET/SDH) - Wavelength Routing Networks - Optical switches - Optical fiber LAN link - Optical CDMA.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Keiser G, **"Optical Fiber Communications"**, McGraw Hill, New Delhi, Fifth edition, 2014.*
2	*John M. Senior, **"Optical Fiber Communications Principles and Practice"**, PHI, New Delhi, Third edition, 2009.*

REFERENCES:

1	*G.P. Agrawal, "**Fiber optic Communication Systems**", John Wiley and sons, Fourth Edition, 2011.*
2	*Franz J.H. Jain V.K, "**Optical Communication, Components and systems**", Narosa publications, New Delhi, 2000.*
3	*Gower, J "**Optical Communication Systems**", PHI, New Delhi, Second edition, Fifth reprint, 2001.*
4	*K. Mynbaev and Lowell L Scheiner, "**Fiber Optic Communication Technology**", Prentice Hall 2001.*
5	*V.S.Bagad, "**Optical Fiber Communication**", Technical Publications, Pune, Fifth edition, 2023.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recognize the structures, types of optical fibers and applications of optical Communication systems.	**K2**
CO2	Explain the principles of optical sources and can able to design optical transmitter.	**K2**
CO3	Apply the ideologies of optical detectors and analyze the functioning of optical receivers.	**K3**
CO4	Acquire knowledge about the losses in the fiber and to analyze the functioning of optical components.	**K2**
CO5	Illustrate the advances in optical fiber system.	**K2**

23PTL703	INTERNET OF THINGS	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To learn about the fundamentals of Internet of Things and apply the concept of Internet of Things in real world scenario.	
UNIT – I	**FUNDAMENTALS OF IOT**	**9 Periods**
Introduction - Characteristics - Physical design - Protocols-Logical design - Enabling technologies - IoT levels - Domain specific IoTs - IoT vs M2M.		
UNIT – II	**IOT DESIGN METHODOLOGY**	**9 Periods**
IoT System Management with NETCONF - YANG, SNMP, NETOPEER - IoT design methodology - Specifications - Integration and Application Development.		
UNIT – III	**IOT COMPONENTS**	**9 Periods**
Sensors and Actuators: Definition, Types of Sensors, Types of Actuators - Examples and Working - Communication modules - Zigbee - Wi-Fi - RFID Principles and Components.		
UNIT – IV	**BUILDING IOT WITH HARDWARE PLATFORMS**	**9 Periods**
Platform - Arduino Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.		
UNIT – V	**CASE STUDIES AND ADVANCED TOPICS**	**9 Periods**
Various Real time applications of IoT- Home Automation - Smart Cities - Environment - Agriculture - Connecting IoT to cloud -Cloud storage for IoT - Designing a RESTful web API - Amazon Web services for IoT - Data Analytics for IoT - Software & Management Tools for IoT		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*ArshdeepBahga, Vijay Madisetti, "**Internet of Things-A hands-on approach**", Universities Press,2015*
2	*Olivier Hersent, David Boswarthick, and Omar Elloumi, — "**The Internet of Things: Key Applications and Protocols**", Wiley Publications-2011*

REFERENCES:

1	*Marco Schwartz, **"Internet of Things with the Arduino",** Yun, Packt Publishing.*
2	*Hakima Chaouchi **"The Internet of Things: connecting objects to the web"** John Wiley & Sons, 2013*
3	*Massimo Banzi- **Getting Started with Arduino** · O'Reilly Media Publishing, 3rd Edition, 2015*
4	*Matt Richardson and Shawn Wallace - **Getting Started with Raspberry Pi**- O'Reilly Media Publishing, 3rd Edition, 2016*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the main concepts, key technologies, strength and limitations of IoT.	**K2**
CO2	Design and analyze various IOT applications	**K3**
CO3	Familiarize the IoT Components	**K2**
CO4	Design a portable IoT using Arduino/Equivalent boards and relevant protocols	**K3**
CO5	Apply data analytics and use cloud offerings related to real time scenario.	**K3**

23PTL7Z2	MANAGEMENT THEORY AND PRACTICE	SEMESTER VIII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objective	To develop an understanding of the relationship aspect of management and to cultivate the skills needed to face the difficulties in management of people and other resources. .	
UNIT – I	BASICS OF MANAGEMENT THOUGHT	9 Periods
Evolution of Management - Definition - Levels - Principles - Differences with administration - Roles of Managers - Social Responsibility of Business - External environment of business - Management Ethics.		
UNIT – II	PLANNING	9 Periods
Nature - Importance - Types - Steps - Management by Objectives - Strategic planning process - Decision making - Types of decisions - Steps in rational decision making - Decision making under uncertainty.		
UNIT – III	ORGANIZING	9 Periods
Formal and Informal organization - Span of Management - Departmentalisation - Line and Staff authority, Decentralization and Delegation of authority - Effective organization and organization culture.		
UNIT – IV	STAFFING AND LEADING	9 Periods
Importance and need for staffing - Manpower Planning - Recruitment - Sources, internal and external sources of recruitment, Leadership theories and its characteristics, Functions of a Leader, Communication - Importance, Purpose, Process, Barriers, Principles of effective communication.		
UNIT – V	CONTROLLING	9 Periods
Steps in a Control Process, Need for control system, Benefits of Control, Feedback loop of Management control - Types of Control techniques - Overall and Preventive control.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Harold Koontz, Weihrich, "**Essential of Management**", 11th Edition, Tata McGraw Hill New Delhi 2020.*
2	*Tripathy P.C and Reddy P.N "**Principles of Management**", 7th Edition, McGraw Hill 2021.*

REFERENCES:

1	*Joseph Massie, "**Essentials of Management**", Prentice Hall of India, New Delhi 2010.*
2	*Prasad, L.M., "**Principles and Practice of Management**", Sultan Chand and Sons, New Delhi 2010.*
3	*Stoner, Freeman and Gilbert, "**Management**", 6th Edition, Pearson Education, New Delhi, 2018*
4	*R.K. Chopra and Puneet Mohan, "**Principles & Practice of Management**", Sun India Publications, 2020.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain basic terminology and concepts for Management theory.	**K2**
CO2	Handle planning and decision making under uncertainity.	**K2**
CO3	Demonstrate the ability to apply selected Management frameworks to real world business situations for problem-solving purposes.	**K3**
CO4	Illustrate the leadership theories and effective communication.	**K2**
CO5	Demonstrate business caliber online communications and proficient participation in group discussion forums.	**K3**

23PTL5E1	SATELLITE COMMUNICATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To identify the different orbital parameters and the subsystems involved in designing space segment and explain the different multiplexing techniques used in satellite systems for various applications.	
UNIT – I	**SATELLITE ORBITS AND TRAJECTORIES**	**9 Periods**
Kepler's Laws, orbital parameters, orbit perturbations, geo stationary and non Geo-stationary orbits - Look Angle Determination - Limits of visibility - Earth eclipse satellite - Sun transit outage - Launching orbits - Satellite Launch Vehicle.		
UNIT – II	**SPACE SEGMENT**	**9 Periods**
Spacecraft Technology - Structure, Primary power, Attitude and Orbit control, Station keeping, Thermal control and Propulsion, communication subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.		
UNIT – III	**LINK DESIGN**	**9 Periods**
Basic transmission theory - System Noise temperature and G/T ratio - Noise figure and noise temperature - G/T ration for Earth Station Link budgets - Uplink and Downlink budget calculations , Design for a specified C/N ratio with GEO and LEO examples - Atmospheric and Rain effects on link performance.		
UNIT – IV	**MULTIPLE ACCESS AND CODING TECHNIQUES**	**9 Periods**
Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digital video Broadcast, Multiple access : Frequency division Multiple access (FDMA) - Time division Multiple access (TDMA) - Onboard Processing systems - Demand access Multiple access (DAMA) and Permanently assigned Multiple access (PAMA) - Code division Multiple access (CDMA) – compression - encryption		
UNIT – V	**APPLICATIONS**	**9 Periods**
Remote sensing - Navigation - Scientific and military application - VSAT: Network architecture, Access Control protocols and techniques, VSAT Earth stations - Satellite Mobile Telephony - Global star - DBS/DTH Television - GPS - Weather satellites - Maritime satellites.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Dennis Roddy, "**Satellite Communications**", 4th Edition, Mc Graw Hill, 2017.*
2	*Pratt T, Bostian C and Allnutt J, "**Satellite Communications**", John Wiley and Sons, 3rd Edition, 2021.*

REFERENCES :

1	*Pritchard W L, Suyderhoud H G and Nelson R A, "**Satellite Communication System Engineering**", 2nd Edition, Prentice Hall, 2013.*
2	*Anil K. Mani, Varsha Agrawal, "**Satellite technology: Principles and Applications**", 2nd Edition, Wiley India Pvt.Ltd., 2015.*
3	*Tri. T. Ha, "**Digital Satellite Communications**", 2nd Edition, McGraw Hill, 2017.*
4	*Madhavendra Richharia, Leslie David Westbrook, "**Satellite systems for Personal Applications**", John Wiley, 2010.*
5	*Manojit Mithra , "**Satellite Communication**", Prentice Hall,2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the different orbital parameters and summarize the types of satellite orbits and determine the orbital parameters.	**K3**
CO2	Classify the different subsystems used in satellite communication to build a space segment.	**K2**
CO3	Determine the link design for the signal-to-noise ratio.	**K3**
CO4	Explain the different multiplexing techniques used in satellite systems for various applications.	**K2**
CO5	Apply the link design for signal-to-noise ratio and multiplexing techniques for various satellite applications.	**K2**

23PTL5E2	INFORMATION THEORY AND CODING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To study the several source coding techniques, entropy in the context of data compression and Network information theory.	
UNIT – I	**QUANTITATIVE STUDY OF INFORMATION**	**9 Periods**
Basic inequalities, Entropy, Kullback - Leibler distance, Mutual information, Bounds on entropy, Fisher information, Cramer Rao inequality, Second law of thermodynamics, Sufficient statistic, Entropy rates of a Stochastic process.		
UNIT – II	**SOURCE CODING: TEXT, AUDIO AND SPEECH**	**9 Periods**
Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm - Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding.		
UNIT – III	**COMPRESSION TECHNIQUES**	**9 Periods**
Principles - Text compression - Static Huffman Coding - Dynamic Huffman coding - Arithmetic coding - Image Compression - Graphics Interchange format - Tagged Image File Format - Digitized documents - Introduction to JPEG standards		
UNIT – IV	**AUDIO AND VIDEO CODING**	**9 Periods**
Linear Predictive coding - code excited LPC - Perceptual coding, MPEG audio coders - Dolby audio coders - Video compression - Principles - Introduction to H.261 & MPEG Video standards.		
UNIT – V	**NETWORK INFORMATION THEORY**	**9 Periods**
Gaussian multiple user channels, Multiple access channel, Encoding of correlated sources, Broadcast channel, Relay channel, Source coding and rate distortion with side information, General multi-terminal networks.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*R Bose, "**Information Theory, Coding and Cryptography**", TMH 2007.*
2	*Fred Hassall, "**Multimedia Communications: Applications, Networks, Protocols and Standards**", Pearson Education Asia, 2002*

REFERENCES :

1	*K Sayood, "**Introduction to Data Compression**" Third Edition, Elsevier 2006.*
2	*S Gravano, "**Introduction to Error Control Codes**", Oxford University Press 2007*
3	*Amitabha Bhattacharya, "**Digital Communication**", TMH 2006*
4	*Thomas Cover, Joy Thomas, **"Elements of Information Theory",** Wiley, 2006.*
5	*David Mackay**,"Information Theory, Interference &Learning Algorithms**", Cambridge University,Press, Ist Edition, 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the basic information theoretic concepts	**K2**
CO2	Apply the fundamentals of information theory to source coding	**K3**
CO3	Summarize the principle of compression techniques	**K2**
CO4	Explain the concepts of audio and video coder	**K2**
CO5	Describe the fundamentals of Network information theory	**K2**

23PTL5E3	NEURAL NETWORKS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks.	
UNIT – I	**BASICS OF NEURAL NETWORKS**	**9 Periods**
Basic Neural Network: Perceptron; Multi-layer Perceptron; Back propagation; Stochastic gradient descent; Universal approximation theorem; Applications in imaging such as for denoising.		
UNIT – II	**AUTO ENCODERS**	**9 Periods**
Auto-encoders: Auto-encoder; Denoising auto-encoder; Sparse auto-encoder; Variational auto-encoder; Applications in imaging such as segnet and image generation		
UNIT – III	**CONVOLUTIONAL NEURAL NETWORKS (CNN)**	**9 Periods**
CNN Architectures **-** Convolution **-** Pooling Layers **-** Transfer Learning **-** Image Classification using Transfer Learning **-** Recurrent and Recursive Nets **-** Recurrent Neural Networks **-** Deep Recurrent Networks **-** Recursive Neural Networks **-** LeNet, Alex Net **-** Applications.		
UNIT – IV	**DEEP GENERATIVE MODELS AND ADVERSARIAL NETWORK**	**9 Periods**
Deep Generative Models: Restricted Boltzmann machine; Deep Boltzmann machine; Recurrent Image Density Estimators (RIDE); PixelRNN and PixelCNN; Plug – and - Play generative networks. Generative Adversarial Network (GAN): GAN; Deep Convolutional GAN; Conditional GAN; Applications.		
UNIT – V	**APPLICATIONS OF DEEP LEARNING**	**9 Periods**
Images segmentation - Object Detection - Automatic Image Captioning - Image generation with Generative adversarial networks - Video to Text with LSTM models - Attention models for Computer Vision - Case Study: Named Entity Recognition - Opinion Mining using Recurrent Neural Networks - Parsing and Sentiment Analysis using Recursive Neural Networks - Sentence Classification using Convolutional Neural Networks - Dialogue Generation with LSTMs.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Ian J. Goodfellow, YoshuaBengio, Aaron Courville, **"Deep Learning"**, MIT Press, 2017.*
2	*Navin Kumar Manaswi, **"Deep Learning with Applications Using Python"**, Apress, 2018.*

REFERENCES :

1	*Phil Kim, **"Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"**, Apress, 2017.*
2	*RagavVenkatesan, Baoxin Li, **"Convolutional Neural Networks in Visual Computing",** CRC Press, 2018.*
3	*Francois Chollet, **"Deep Learning with Python"**, Manning Publications, 2018.*
4	*Stanford CS231n,**"Convolutional Neural Networks for Visual Recognition"**, http://cs231n.stanford.edu/*
5	*Michael Nielsen, **"Neural Networks and Deep Learning"**,http://neuralnetworksanddeeplearning.com/*
6	*Hugo Larochelle,**"Online course on Neural Network",** http://info.usherbrooke.ca/hlarochelle/neural_networks/content.html*
7	*Joshua F. Wiley, **"R Deep Learning Essentials"**, Packt Publications, 2016.*
8	*Phil Kim, **"Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"**, Apress, 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basics of neural network	**K2**
CO2	Explain the auto decoders and CNN	**K2**
CO3	Gain knowledge on Deep Generative Models and Adversarial Network	**K3**
CO4	Apply the knowledge of deep learning to application	**K3**
CO5	Explain real world applications such as object recognition and Computer Vision, image and video processing, text analytic and other types of classifiers.	**K3**

23PTL5E4	AUTOMOTIVE ELECTRONICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire in-depth knowledge of an embedded system in automotive electronics and to learn the various vehicle communication protocols.	
UNIT – I	**ELECTRONICS IN AUTOMOTIVE SYSTEMS**	**9 Periods**
Overview of Automotive Mechanical systems- Need for Automotive Electronics System – Overview of vehicle electronic systems - Basic electrical components and their operation in an automobile- Power train subsystem: Starting systems, Charging systems, Ignition systems, Electronic fuel control - Chassis subsystem: ABS, TCS and ESP - Comfort and safety subsystems: Night vision, airbags, Seatbelt Tensioners, Cruise Control- Lane-departure-warning, Parking.		
UNIT – II	**HARDWARE AND SOFTWARE MODULES**	**9 Periods**
Hardware module - Introduction to an embedded board -components - Software Module: IDE - Getting started: Creating new project, creating new files, adding files to project, compile, build, debug and simulation of a project.		
UNIT – III	**EMBEDDED SYSTEM PROGRAMMING AND DEBUGGING**	**9 Periods**
Embedded System Programming - Up-loaders- ISP - ROM Emulators - In-Circuit Emulators - Debug Interfaces: BDM and JTAG.		
UNIT – IV	**EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS**	**9 Periods**
Engine management systems - Gasoline/ Diesel systems, various sensors used in system - Electronic transmission control - Vehicle safety system - Electronic control of braking and traction- Body electronics - Infotainment systems - Navigation systems - System level tests - Software calibration using engine and vehicle dynamometers - Environmental tests for Electronic Control Unit.		
UNIT – V	**EMBEDDED SYSTEM COMMUNICATION PROTOCOLS**	**9 Periods**
Introduction to control networking - Communication protocols in embedded systems - SPI, I 2C, USB - Vehicle communication protocols - Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Denton.T, "**Automobile Electrical and Electronic Systems**", Edward Arnold Publishers, 4th Edition 2012.*
2	*Nicholas Navit, "**Automotive Embedded System Handbook**", CRC press, 2009.*

REFERENCES :

1	*Robert Bosch GmbH, "**Automotive Handbook**", John Wiley & Sons, 6th Edition, 2004.*
2	*Knowles.D, "**Automotive Electronic and Computer Controlled Ignition Systems**", Prentice Hall,1998.*
3	*William B. Ribbens, "**Learning Automotive Electronics**", Newnes Publishing, 6th Edition 2003*
4	*Joerg Schaeuffele, Thomas Zurawka - "**Automotive Software Engineering- Principles, Processes, Methods and Tools**", SAE Publications,2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize the electrical and electronic components used in an automotive systems.	**K2**
CO2	Design and implement projects using Embedded hardware and software.	**K3**
CO3	Explore programming and debugging skills.	**K2**
CO4	Apply knowledge of an embedded system in automotive electronics.	**K3**
CO5	Explain embedded system and vehicle communication protocols.	**K2**

23PTL5E5	DIGITAL IMAGE PROCESSING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To conceptualize the image processing fundamentals and algorithms for real time applications, Image Restoration and Reconstruction.	
UNIT – I	**IMAGE FORMATION AND ENHANCEMENT**	**9 Periods**
Human visual system - Sampling and Quantization - Color fundamentals - Spatial domain processing - Simple image operations - Point wise intensity transformations - Histogram processing - Linear and non-linear noise smoothening - Sharpening - Derivatives - Laplacian - Combining spatial enhancement methods..		
UNIT – II	**FREQUENCY TRANSFORMS AND APPLICATIONS**	**9 Periods**
Frequency domain processing - 2-D transforms: DFT, DCT, and DWT - Properties - Frequency domain filtering techniques - sub band coding of image compression - Coding techniques: Huffman, Run length and Block transform - JPEG - Performance metrics.		
UNIT – III	**IMAGE RESTORATION AND RECONSTRUCTION**	**9 Periods**
Image degradation - Noise models - Image observation models- Spatial filtering: mean filters, order statistics filters, adaptive filters - Inverse filtering - Wiener filtering - Constrained least squares filtering. Image Reconstruction from projections - Radon transform and its Application		
UNIT – IV	**SEGMENTATION AND FEATURE EXTRACTION**	**9 Periods**
Edge detection: Gradient operators - edge linking and boundary detection: Global processing via Hough transforms, Graph theoretic techniques - Thresholding techniques - K-means Clustering - Feature extraction: Boundary feature descriptors - Region feature descriptors - Principal components - SIFT. Object Recognition applications		
UNIT – V	**IMAGE COMPRESSION**	**9 Periods**
Image compression - Redundancy - interpixel and psycho visual - Lossless Compression - predictive and entropy - Lossy Compression - Predictive and transform coding - Discrete Cosine Transform - Compression standards - JPEG and JPEG 2000. Discrete Wavelet transform and its properties.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Gonzalez R.C., Woods R.E.*, "**Digital Image Processing**", Fourth Edition, Pearson, 2017.
2	*Jayaraman S., Esakkirajan S., Veerakumar T.,* "**Digital Image Processing**", Tata McGraw Hill, 2011.

REFERENCES :

1	*J.C. Russ," **The Image Processing Handbook**", (5/e), CRC, 2006.*
2	*A.K.Jain," **Fundamentals of Digital Image Processing**", PHI,2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the Digital Image fundamentals.	**K2**
CO2	Apply Image Transforms to image processing applications.	**K3**
CO3	Explain efficient Image enhancement and Restoration algorithms.	**K2**
CO4	Illustrate on Image segmentation and representation schemes.	**K2**
CO5	Describe basic image coding schemes and image compression standards.	**K2**

23PTL6E1	MEASUREMENT AND INSTRUMENTATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire knowledge in the measurements, transducer, display and recording systems.	
UNIT – I	**BASICS OF MEASUREMENT**	**9 Periods**
Measurement Systems - Instrumentation - Significance of measurements - Static and Dynamic Characteristics of Instruments - Errors in Measurements - Calibration and Standards-Principle and types of Analog Voltmeters and Ammeters- D'Arsonval galvanometer.		
UNIT – II	**TRANSDUCERS**	**9 Periods**
Classification of Transducers - Resistive transducers - Strain gauges, Thermistor, RTD - Inductive transducers - LVDT, RVDT - Capacitive Transducers – Hall Effect - Piezoelectric transducers - Thermocouple - IC sensors.		
UNIT – III	**SIGNAL CONDITIONING AND SIGNAL ANALYZERS**	**9 Periods**
DC bridge - Wheatstone, Kelvin - AC bridge - Maxwell, Hay and Schering. Spectrum Analyzers - Wave analyzers - Resonant wave analyzer, Heterodyne wave analyzer - Harmonic distortion analyzers - Logic Analyzer.		
UNIT – IV	**DIGITAL INSTRUMENTS**	**9 Periods**
Digital instruments-Classification of Digital instruments - Digital frequency meter – Period measurement, Time interval measurement - Digital Voltmeter (DVM) - Accuracy and Resolution in DVM - Frequency counter - DMM.		
UNIT – V	**DATA DISPLAY AND RECORDING SYSTEMS**	**9 Periods**
Dual trace oscilloscope - Digital Storage, Analog Storage and Mixed Signal Oscilloscope. Analog and Digital Recorders - Virtual Instrumentation - Block diagram and Architecture - Applications in various fields.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Albert D.Helfrick and William D. Cooper, "**Modern Electronic Instrumentation and Measurement Techniques**", Prentice Hall of India, 2007.*
2	*A.K Sawhney, "**Course In Electrical And Electronic Measurement And Instrumentation**", Dhanpat Rai Publisher, 2000.*

REFERENCES :

1	*John P. Bentley, "**Principles of Measurement Systems**", 4th edition, pearson Education Limited, 2005.*
2	*A.K.Jain," **Fundamentals of Digital Image Processing**", PHI,2016.*
3	*Ernest.O. Doebelin and Dhanesh. N. manik, "**Measurement systems**" ,5th edition, McGraw-Hill, 2007.*
4	*Bouwens,A.J, "**Digital Instrumentation**", Tata Mc-Graw Hill, 1986.*
5	*David A.Bell, "**Electronic Instrumentation and Measurements**", 2nd edition, PHI, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the standards, characteristics and errors of measurements	**K2**
CO2	Summarize the principle and working of different transducers	**K2**
CO3	Construct DC and AC bridges and analyze the signals using Waveform analyzers	**K3**
CO4	Identify instruments for the measurement of different quantities.	**K2**
CO5	Discuss the recent advancements in the displays device technology.	**K2**

23PTL6E2	DEEP LEARNING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To cover the fundamentals and advanced topics in Deep Learning.	
UNIT – I	**PROBLEM SOLVING**	**9 Periods**
Introduction to AI - AI Applications - Problem solving agents - search algorithms - uninformed search strategies - Heuristic search strategies - Local search and optimization problems - adversarial search - constraint satisfaction problems (CSP).		
UNIT – II	**PROBABILISTIC REASONING**	**9 Periods**
Acting under uncertainty - Bayesian inference - naïve bayes models. Probabilistic reasoning - Bayesian networks - exact inference in BN - approximate inference in BN - causal networks.		
UNIT – III	**SUPERVISED LEARNING**	**9 Periods**
Introduction to machine learning - Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function - Probabilistic discriminative model - Logistic regression, Probabilistic generative model - Naive Bayes, Maximum margin classifier - Support vector machine, Decision Tree, Random forests.		
UNIT – IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	**9 Periods**
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.		
UNIT – V	**NEURAL NETWORKS**	**9 Periods**
Perceptron - Multilayer perceptron, activation functions, network training - gradient descent optimization - stochastic gradient descent, error backpropagation, from shallow networks to deep networks - Unit saturation (aka the vanishing gradient problem) - ReLU, hyperparameter tuning, batch normalization, regularization, dropout.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Stuart Russell and Peter Norvig, **"Artificial Intelligence – A Modern Approach"**, Fourth Edition, Pearson Education, 2021.*
2	*EthemAlpaydin, **"Introduction to Machine Learning"**, MIT Press, Fourth Edition, 2020.*

REFERENCES :

1	*Dan W. Patterson, **"Introduction to Artificial Intelligence and Expert Systems"**, Pearson Education,2007*
2	*Kevin Night, Elaine Rich, and Nair B., **"Artificial Intelligence"**, McGraw Hill, 2008*
3	*Christopher M. Bishop, **"Pattern Recognition and Machine Learning"**, Springer, 2006.*
4	*Tom Mitchell, **"Machine Learning"**, McGraw Hill, 3rd Edition,1997.*
5	*Charu C. Aggarwal, **"Data Classification Algorithms and Applications"**, CRC Press, 2014*
6	*Ian Goodfellow, YoshuaBengio, Aaron Courville, **"Deep Learning"**, MIT Press, 2016*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basics of neural network	**K2**
CO2	Explain the auto decoders and CNN	**K2**
CO3	Gain knowledge on Deep Generative Models and Adversarial Network	**K2**
CO4	Apply the knowledge of deep learning to application	**K3**
CO5	Explain real world applications such as object recognition and Computer Vision, image and video processing, text analytic and other types of classifiers.	**K2**

23PTL6E3	LOW POWER VLSI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To understand the low power design at architecture, algorithm and system level design.	
UNIT – I	**INTRODUCTION & SIMULATION POWER ANALYSIS**	**9 Periods**
Need for low power VLSI chips, sources of power dissipation Device & technology impact on low power, impact of technology scaling, technology & device innovation, Power estimation, SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static power, gate level capacitance estimation, architecture level analysis, Monte-Carlo simulation		
UNIT – II	**PROBABILISTIC POWER ANALYSIS & CIRCUIT LEVEL, LOGIC LEVEL DESIGN**	**9 Periods**
Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy, low power design, Power consumption in circuits, Flip-Flops & Latches design, high capacitance nodes, low power digital cells library, Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.		
UNIT – III	**LOW POWER ARCHITECTURE & SYSTEMS**	**9 Periods**
Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design, Low-Power ROM and RAM Technologies.		
UNIT – IV	**LOW POWER CLOCK DISTRIBUTION**	**9 Periods**
Power dissipation in clock distribution, single driver vs distributed buffers, zero skew vs tolerable skew, chip & package co-design technique of clock network.		
UNIT – V	**ALGORITHM & ARCHITECTURAL LEVEL METHODOLOGIES**	**9 Periods**
Introduction, design flow, algorithmic level analysis & optimization, architectural level estimation & synthesis		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Kaushik Roy and Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**", Wiley, 2000*
2	*Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002*

REFERENCES :

1	*Rabaey, Pedram, "**Low power design methodologies**", Kluwer Academic, 1997*
2	*A.P.Chandrakasan, R.W.Broadersen, "**Low Power Digital CMOS Design**", Kluwer, Springer US, 2012.*
3	*Sung-Mo Kang, Yusuf Leblebici, "**CMOS Digital Integrated Circuits – Analysis and Design**", TMH, 2011.*
4	*G. Narendra and A. Chandrakasan, "**Leakage in Nanometer CMOS Technologies"**, Springer, 2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the need of low power and simulation power analysis	**K2**
CO2	Analyze the probabilistic power analysis and circuit, logic level design	**K3**
CO3	Infer low power architecture & systems	**K2**
CO4	Illustrate the low power clock distribution	**K2**
CO5	Explain algorithm and architectural level methodologies for low power	**K2**

23PTL6E4	ERROR CONTROL CODING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To provide a comprehensive introduction to error correction coding, including both classical block- and trellis-based codes and the recent developments in Space time codes, iteratively decoded codes such as turbo codes and low-density parity-check codes.	
UNIT – I	**LINEAR BLOCK CODES AND CONVOLUTIONAL CODES**	**9 Periods**
Review of modern algebra - Galois fields - Linear block codes - encoding and decoding - Cyclic codes - Nonbinary codes. Convolutional codes - Generator sequences - Structural properties - ML decoding - Viterbi decoding- Sequential decoding.		
UNIT – II	**LDPC CODES**	**9 Periods**
LDPC Codes: Construction and Notation - Tanner Graph - Decoding of LDPC Codes - EXIT Chart for LDPC codes - Irregular LDPC codes - LDPC codes in 5G.		
UNIT – III	**TRELLIS CODES**	**9 Periods**
Modulation codes - Trellis coded modulation - Lattice type Trellis codes - Geometrically uniform trellis codes - Decoding of modulation codes.		
UNIT – IV	**TURBO CODES**	**9 Periods**
Turbo codes - Turbo decoder – Interleaver - MAP and log MAP decoders – Iterative turbo decoding - Optimum decoding of turbo codes.		
UNIT – V	**SPACE TIME CODES**	**9 Periods**
Space-time codes - MIMO systems - Space-time block codes (STBC) – decoding of STBC-Space-time trellis codes-Decoding of Space-time Trellis codes.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*S.Lin&D.J.Costello, "**Error Control Coding (2/e)**", Pearson, 2005.*
2	*Tood.K.Moon "**Error Correcting Codes**" A John Wiley &Sons, INC, Publication*

REFERENCES :

1	*B.Vucetic&J.Yuan, "**Turbo codes**", Kluwer, 2000.*
2	*C.B.Schlegel&L.C.Perez, "**Trellis and Turbo Coding**", Wiley,2004.*
3	*B.Vucetic&J.yuan, "**Space-Time Coding**", Wiley, 2003.*
4	*H. Jafarkhani, **"Space-time coding: Theory & Practice"**, Cambridge University Press, 2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Examine the arithmetic of Galois fields as well as linear block, cyclic, and convolutional codes	**K3**
CO2	Discuss the construction of LDPC codes	**K2**
CO3	Explain the encoding and decoding of Trellis coded modulation	**K2**
CO4	Apply the encoding and decoding methods of Turbo codes	**K3**
CO5	Apply the encoding and decoding methods of Space time codes	**K3**

23PTL6E5	MICROWAVE INTEGRATED CIRCUITS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To have a depth knowledge on building blocks of microwave integrated circuits.	
UNIT – I	PLANAR TRANSMISSION LINES AND COMPONENTS	9 Periods
Review of Transmission line theory – S parameters-Transmission line equations – reflection coefficient – VSWR – Microstrip lines: Structure, waves in microstrip, Quasi-TEM approximation, Coupled lines: Even mode and odd mode analysis – Strip line – Slot line – Coplanar waveguide		
UNIT – II	IMPEDANCE MATCHING NETWORKS	9 Periods
Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements.		
UNIT – III	MICROWAVE FILTERS	9 Periods
Basic RLC Series and Parallel resonators – RF Filter design using Insertion Loss method: Butterworth, Chebyshev and Linear Phase: LPF, HPF, BPF and BSF – Design of filters		
UNIT – IV	MICROWAVE AMPLIFIERS	9 Periods
Characteristics of microwave transistors – Two Port Power Gains - Stability considerations – Input and Output Stability circles – Unconditional Stability – Design for Maximum Gain and Specified Gain		
UNIT – V	MICROWAVE OSCILLATORS	9 Periods
Oscillators: Oscillation conditions – Basic oscillator model – Feedback oscillator design –High frequency oscillator configurations – Voltage controlled oscillator – Gunn element oscillator – Design and stability considerations of Microwave Transistor Oscillators.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Thomas H Lee, "**Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits**", Cambridge University Press, 2004.*
2	*Reinhold Ludwig and Gene Bogdanov, "**RF Circuit Design: Theory and Applications**",PearsonEducation Inc., 2nd edition, 2011.*

REFERENCES :

1	*Jia Sheng Hong, M. J. Lancaster, "**Microstrip Filters for RF/Microwave Applications**", John Wiley & Sons, 2011*
2	*David M. Pozar, "**Microwave Engineering**", Wiley India (P) Ltd, New Delhi, 4th edition, 2012.*
3	*Annapurna Das and Sisir K Das, "**Microwave Engineering**", Tata McGraw Hill PublishingCompany Ltd, New Delhi, 2017.*
4	*Samuel Y. Liao, "**Microwave Devices and Circuits**", Prentice Hall of International Ltd, 4th edition, 2009.*
5	*Robert E Colin, "**Foundations for Microwave Engineering**", John Wiley & Sons, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain design constraints of planar transmission lines	**K2**
CO2	Design impedance matching networks for MICs	**K3**
CO3	Design microwave filters for given specifications	**K3**
CO4	Design microwave amplifiers to meet out the requirements	**K2**
CO5	Design oscillator circuit and monolithic MICs	**K2**

23PTL7E1	SOFT COMPUTING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To learn various soft computing techniques like neural networks, genetic algorithms, and fuzzy systems, and apply these techniques in real-time problem solving.	
UNIT – I	**INTRODUCTION TO SOFT COMPUTING**	**9 Periods**
Introduction - Artificial Intelligence - Artificial Neural Networks - Fuzzy Systems - Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems - Classification of ANNs - McCulloch and Pitts Neuron Model - Learning Rules: Hebbian and Delta - Perceptron Network - Adaline Network - Madaline Network.		
UNIT – II	**NEURAL NETWORKS**	**9 Periods**
Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network - Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks - Support Vector Machines - Spike Neuron Models.		
UNIT – III	**FUZZY SYSTEM**	**9 Periods**
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions – De-fuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.		
UNIT – IV	**GENETIC ALGORITHM**	**9 Periods**
Genetic algorithm and search space - general genetic algorithm - operators - Generational cycle - stopping condition - constraints - classification - genetic programming - multilevel optimization - real life problem - advances in GA.		
UNIT – V	**HYBRID TECHNIQUES**	**9 Periods**
Hybrid Systems - Neural Networks, Fuzzy Logic and Genetic - GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP - Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*S.Rajasekaran, G.A.Vijayalakshmi Pai,* ***"Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications"****, PHI Learning Pvt.Ltd., 2017.*
2	*S.N.Sivanandam and S.N.Deepa, "****Principles of Soft Computing****", Wiley India Pvt Ltd, 2011.*

REFERENCES :

1	*Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "****Neuro-Fuzzy and Soft Computing****", Prentice-Hall of India, 2002.*
2	*George J. Klir, Ute St. Clair, Bo Yuan, "****Fuzzy Set Theory: Foundations and Applications",*** *Prentice Hall, 1997.*
3	*David E. Goldberg, "****Genetic Algorithm in Search Optimization and Machine Learning****" Pearson Education India, 2013.*
4	*JamesA.Freeman, David M. Skapura, "****Neural Networks Algorithms, Applications, and Programming Techniques",*** *Pearson Education India, 1991.*
5	*Kwang H.Lee, "****First course on Fuzzy Theory and Applications****", Springer, 2005*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamentals of various soft computing techniques.	**K3**
CO2	Acquire In-depth knowledge about neural networks.	**K3**
CO3	Discuss the basic concept of fuzzy system.	**K2**
CO4	Describe the process involved in genetic algorithms.	**K2**
CO5	Summarize the different hybrid soft computing techniques	**K2**

23PTL7E2	DSP ARCHITECTURE AND PROGRAMMING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To Understand the Fundamental blocks of TMS32007xArchitecture and to implement various DSP Algorithms.	
UNIT – I	**FUNDAMENTALS OF PROGRAMMABLE DSPs**	**9 Periods**
VonNeumann, Harvard Architecture, Modified Harvard and VLIW Architecture - Modified Bus Structures and Memory access in P-DSPs - Multiple access memory, Multi - ported memory, Pipelining - Special Addressing modes in P- DSPs - Onchip Peripherals - Computational accuracy in DSP processor - MAC.		
UNIT – II	**TMS320C67x DSP ARCHITECTURE**	**9 Periods**
TMS320 DSP Family Overview - TMS320C6000 DSP Family Overview - TMS320C67x DSP Features - TMS320C67x DSP Architecture - Central Processing Unit (CPU),Internal Memory Memory and Peripheral.		
UNIT – III	**TMS320C67x CPU DATAPATHS AND CONTROL**	**9 Periods**
General - Purpose Register Files - Functional Units - Register File Cross - Memory, Load, and Store Paths - Data Address Paths - Control Register File - Instruction Operation and Execution - Parallel Operations - Conditional Operations - Resource Constraints - Addressing Modes - Instruction Compatibility.		
UNIT – IV	**TMS320C67x PIPELINE AND INTERRUPTS**	**9 Periods**
Pipeline Operation - Pipeline Execution of Instruction Types - Functional Unit Constraints - Performance Considerations - Interrupts - Overview - Globally Enabling and Disabling Interrupts - Individual Interrupt Control - Interrupt Detection and Processing - Performance Considerations - Programming Considerations		
UNIT – V	**IMPLEMENTATION OF BASIC DSP ALGORITHMS**	**9 Periods**
Study of time complexity of DFT and FFT algorithm ,Use of FFT for filtering long data sequence, IIR and FIR Filters, Interpolation, Decimation, Wavelet filter		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*DigitalSignalProcessors,"**Architecture,ProgrammingandApplications**"– B.VenkataRamaniandM.Bhaskar,TMH,2004.*

REFERENCES:

1	***"DigitalSignalProcessing"**–JonathamStein,JohnWiley,2005*
2	*AvtarSingh and S. Srinivasan" **Digital Signal Processing – Implementations using DSP Microprocessors**",cengageLearningIndiaPrivateLimited,Delhi2012*
3	*AvtarSinghandS.Srinivasan"**DigitalSignalProcessing**",ThomsonPublications,2004.*
4	*Lapsleyetal.S.Chand&Co"**DSPProcessorFundamentals,Architectures&Features**",2000.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the Fundamentals of Programmable DSPs	**K2**
CO2	Understand various components of DSP Architecture	**K2**
CO3	In depth knowledge on CPU Data Paths and Control	**K2**
CO4	Understand various concepts Pipeline and Interrupts	**K2**
CO5	Implement various DSP Algorithms	**K3**

23PTL7E3	HIGH SPEED NETWORKS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To highlight the features of different technologies involved in High Speed networking and their performance.	
UNIT – I	**HIGH SPEED NETWORKS**	**9 Periods**
Frame Relay Networks - Asynchronous transfer mode - ATM Protocol Architecture, ATM logical Connection, ATM Cell - ATM Service Categories - AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel - Wireless LANs: applications, requirements - Architecture of 802.11.		
UNIT – II	**CONGESTION AND TRAFFIC MANAGEMENT**	**9 Periods**
Queuing Analysis - Queuing Models - Single Server Queues - Effects of Congestion - Congestion Control - Traffic Management - Congestion Control in Packet Switching Networks - Frame Relay Congestion.		
UNIT – III	**TCP AND ATM CONGESTION CONTROL**	**9 Periods**
TCP Flow control - TCP Congestion Control - Retransmission - Timer Management - Exponential RTO backoff - KARN's Algorithm - Window management - Performance of TCP over ATM. Traffic and Congestion control in ATM - Requirements - Attributes - Traffic Management Frame work, Traffic Control - ABR traffic Management - ABR rate control, RM cell formats, ABR Capacity allocations - GFR traffic management.		
UNIT – IV	**INTEGRATED AND DIFFERENTIATED SERVICES**	**9 Periods**
Integrated Services Architecture - Approach, Components, Services - Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ - Random Early Detection, Differentiated Services.		
UNIT – V	**PROTOCOLS FOR QoS SUPPORT**	**9 Periods**
RSVP - Goals and Characteristics, Data Flow, RSVP operations, Protocol Mechanisms - Multiprotocol Label Switching - Operations, Label Stacking, Protocol details - RTP - Protocol Architecture, Data Transfer Protocol, RTCP.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*William Stallings,* ***"HIGH SPEED NETWORKS AND INTERNETS****", Second Edition, Pearson Education, 2002.*
2	*IrvanPepelnjk, Jim Guichard, Jeff Apcar,* ***"MPLS and VPN architecture",*** *Cisco Press, Volume 1 and 2, 2003.*

REFERENCES:

1	*Jean warland and Pravin Wadaja,* ***"High Performance Communication Networks"****, 2nd Edition, Jean Harcourt Asia Pvt. Ltd.,2001.*
2	*Andrew S. Tanenbaum, "Computer networks", PHI Private limited, New Delhi.*
3	*Abhijit S. Pandya, Ercan Sea,* ***"ATM Technology for Broad Band Telecommunication Networks",*** *CRC Press, New York, 2004.*
4	*Tere Parnell,* ***"Guide to Building High-speed Networks",*** *Osborne/McGraw-Hill, 1998, 0072119578, 9780072119572.*
5	*Sumit Kasera, Pankaj Sethi,* ***" ATM Networks",*** *Tata Mc Graw- Hill, New Delhi , 2000*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize about ATM and Frame relay	**K2**
CO2	Discuss the effects of congestion and identify the different Queueing models	**K3**
CO3	Identify techniques to support real-time traffic and congestion control	**K2**
CO4	Describe the integrated and differentiated services	**K2**
CO5	Interpret protocols for different levels of quality of service (QoS)	**K2**

23PTL7E4	MEMS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To learn the fabrication process in MEMS and acquire knowledge on various sensors and actuators.	
UNIT – I	**INTRODUCTION**	**9 Periods**
History of Micro Electro Mechanical Systems (MEMS) - MEMS Materials: Silicon and other materials - Intrinsic Characteristics of MEMS - Transducers - Silicon based MEMS processes - New Materials - Stress and strain analysis - Flexural beam bending.		
UNIT – II	**MEMS FABRICATION**	**9 Periods**
MEMS fabrication processes: Review of IC fabrication process. Micromachining: Bulk Micromachining - Dry and Wet etching - Surface micromachining - Deposition, Evaporation, Sputtering, Epitaxial growth - Deep Reaction ion etching - LIGA process.		
UNIT – III	**ELECTROSTATIC SENSORS**	**9 Periods**
Electrostatic sensors - Parallel plate capacitors - Applications - Interdigitated Finger capacitor - Comb drive devices - Micro Grippers - Micro Motors - Thermal Sensing and Actuation: Thermal expansion - Thermal couples - Thermal resistors - Thermal Bimorph.		
UNIT – IV	**MAGNETOSTATIC SENSORS**	**9 Periods**
Piezoresistive sensors - Piezoresistive sensor materials - Applications to Inertia, Pressure, Tactile and Flow sensors - Piezoelectric sensors and actuators - piezoelectric effects - piezoelectric materials - Applications to Inertia , Acoustic, Tactile and Flow sensors.		
UNIT – V	**APPLICATION CASE STUDIES**	**9 Periods**
Application case studies: MEMS Scanners, Grating Light Valve (GLV), Optical switching, Capacitive Micromachined Ultrasonic Transducers (CMUT), Air bag system, Micromotors, Scanning Probe Microscopy.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*ChangLiu,**"Foundations of MEMS"**, Pearson Education Inc.,2nd edition 2006.*
2	*Stephen D Senturia, **"Microsystem Design",** Springer Publication,1st edition 2007.*

REFERENCES:

1	*JulianW.Gardner,VijayK.Varadan,OsamaO.AwadelKarim,"**Microsensors MEMS and Smart Devices**", JohnWiby & sons Ltd., 5th edition 2014.*
2	*Rai-Choudhury P."**MEMS and MOEMS Technology and Applications**",PHI Learning Private Limited,1st edition2009.*
3	*MarcFMadou,"**Fundamentals ofMicroFabrication**",CRCPress,2nd Edition,2002.*
4	*Tai Ran Hsu, "**MEMS & Micro systems Design and Manufacture**" 2nd edition Tata McGrawHill, New Delhi, 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic concepts of MEMS.	**K2**
CO2	Describe the process involved in MEMS fabrication.	**K2**
CO3	Summarize the different electrostatic sensors	**K2**
CO4	Analyse the various magnetostatic sensors.	**K3**
CO5	Illustrate the case studies of MEMS.	**K2**

23PTL7E5	POWER ELECTRONICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire knowledge about the power converters for various loads, to implement the power converters for the drives and to study the series & parallel connections and protection circuits.	
UNIT – I	**SEMICONDUCTOR POWER DEVICES**	**9 Periods**
SCR characteristics - Two transistor analogy - Methods of turning on and turning off - Other members of SCR family - Series and parallel connection of SCRs - Thyristor protection. Other semiconductor devices: Power MOSFETs, GTOs, IGBT.		
UNIT – II	**CONTROLLED RECTIFIERS AND AC VOLTAGE CONTROLLERS**	**9 Periods**
Single Phase Controlled rectifiers - Half wave controlled rectifier with R load and Full wave controlled rectifier with R load - AC Voltage controllers, Single phase cyclo converter.		
UNIT – III	**DC CHOPPER AND AC CHOPPER**	**9 Periods**
DC Chopper : Elementary chopper with an active switch and diode, Duty ratio and Average voltage - Step - up, step down & step up - down chopper, chopper configuration - AC Chopper,		
UNIT – IV	**SINGLE PHASE INVERTER**	**9 Periods**
Power circuit of single - phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, Series inverter, Parallel inverter and Bridge inverter - Current source inverter.		
UNIT – V	**APPLICATIONS**	**9 Periods**
DC motor drives-Induction and Synchronous motor drives - Switched reluctance and brushless motor drives - Solid state relays - Microelectronic relays.		
Contact Periods: **Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*P.C. Sen**, "PowerElectronics" ,**TataMcGraw-Hill, 2017.*
2	*Muhammad H.Rashid**, "Power Electronics – Circuits , Devices and Applications",**3rd Edition, Prentice Hall of India, 2004.*

REFERENCES:

1	*S.N. Singh, **Text Book of Power Electronics**, DhanpathRai & Co., New Delhi, 2000.*
2	*M.D.Singh,K.B.Khanchandani,"**PowerElectronics**",TataMcGraw-Hill,1998.*
3	*B.K.Bose,"**ModernPowerElectronics**",JaicoPublishingHouse,1999.*
4	*Ned Mohan, Tore M.Undeland, William P.Robbins, "**Power Electronics, Converters, Applications and Design**",John Wiley & Sons, 1994.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the details of switching devices	**K2**
CO2	Explain the use of thyristors in different types of rectifier circuits and Controllers	**K2**
CO3	Interpret the operation of DC-DC up – down choppers	**K2**
CO4	Discuss the different modulation techniques to the operation of single-phase voltage source inverters	**K2**
CO5	Discuss the operation of thyristors to various applications	**K2**

23PTL8E1	BIO - MEDICAL ELECTRONICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To gain knowledge about the various physiological parameters both electrical and nonelectrical and the methods of recording and also the method of transmitting these parameters.	
UNIT – I	**PHYSIOLOGY AND TRANSDUCERS**	**9 Periods**
Cell and its structure - Resting and Action potential - Nervous system: Structure of nervous system, neurons - synapse - transmitters and neural communication - Cardiovascular system - Basic components of a biomedical system. Transducers - selection criteria - Piezo electric, ultrasonic transducers, Temperature measurements, Fibre optic temperature sensors.		
UNIT – II	**ELECTRO-PHYSIOLOGICAL MEASUERMENTS**	**9 Periods**
Electrodes - Limb and surface electrodes - Amplifiers; Preamplifiers - differential amplifiers - chopper amplifiers - Isolation amplifier. Physiological measurements - ECG, EEG, EMG, ERG - Lead systems and recording methods - Typical waveforms. Electrical safety in medical environment: shock hazards - leakage current..		
UNIT – III	**NON-ELECTRICAL PARAMETER MEASUREMENTS**	**9 Periods**
Measurement of blood pressure - cardiac output - heart rate - heart sounds - pulmonary function measurements - spirometer - blood gas analysers - pH of blood - measurement of blood pCO2, pO2, fingertip oxymeter.		
UNIT – IV	**MEDICAL IMAGING AND BIOTELEMETRY**	**9 Periods**
Computer Tomography - Magnetic Resonance Imaging - Real time Ultrasound Scanner - M mode - Different types of biotelemetry systems and patient monitoring - Wireless telemetry, single channel, multi-channel, multi patient and implantable telemetry systems		
UNIT – V	**ASSISTING AND THERAPEUTIC EQUIPMENTS**	**9 Periods**
Pacemakers - External and Internal pacemakers - Defibrillators - DC defibrillator, Implantable defibrillators - Ventillators - Surgical diathermy, safety aspects in Electro surgical units - Lithotripsy.		
Contact Periods: 45 **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Khandpur R.S., "**Handbook of Bio-medical Instrumentation**" Tata McGraw Hill, New Delhi, 2nd edition 2015.*
2	*Leslie Cromwell, Fred J. Weibell, Erich A.Pfeiffer, "**Bio-medical Instrumentation and Measurements**", 2nd edition, Pearson Education, 2012.*

REFERENCES :

1	*M. Arumugam, "**Bio-medical instrumentation**", Anuradha Agencies, 2012..*
2	*L.A. Geddes and L.E. Baker, "**Principles of Applied Bio-medical instrumentation**", John Wiley & Sons, 2017*
3	*J. Webster "**Medical Instrumentation**", 3rd Edition, Wiley India Edition, 2017..*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the electrode behavior and circuit models.	**K2**
CO2	Discuss the fundamentals of Bio potential recording.	**K2**
CO3	Design various bio amplifiers.	**K3**
CO4	Interpret the various nonelectrical physiological parameters.	**K2**
CO5	Interpret the various biochemical parameters.	**K2**

23PTL8E2	MACHINE LEARNING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To Learn the basic concepts of Problem solving, Probabilistic reasoning, Supervised Learning, Reinforcement learning and advanced Machine learning concepts.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction- Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning: Classification and Regression Trees, Support vector machines - Model Selection and feature selection – Decision trees Ensemble methods : Bagging - Boosting - Real-world applications.		
UNIT – II	**UNSUPERVISED LEARNING**	**9 Periods**
Unsupervised learning : Clustering, Instance-based learning- K-nearest Neighbor, Locally weighted regression, Radial Basis Function - EM- Mixtures of Gaussians-The Curse of Dimensionality Dimensionality Reduction -Factor analysis -Principal Component Analysis - Probabilistic PCA Independent components analysis.		
UNIT – III	**PROBABILISTIC GRAPHICAL MODELS**	**9 Periods**
Graphical Models -Undirected graphical models-Markov Random Fields -Directed Graphical Models - Bayesian Networks -Conditional independence properties -Inference –Learning-Generalization -Hidden Markov Models – Machine learning tools – R, Scikit Learn, Octave, BigML , WEKA.		
UNIT – IV	**REINFORCEMENT LEARNING**	**9 Periods**
Reinforcement Learning – Introduction -Elements of Reinforcement Learning – Learning Task – Qlearning – k-armed Bandit Elements – Model-Based learning – Value Iteration – Policy iteration – Temporal Difference Learning - Exploration Strategies – non-deterministic rewards and actions		
UNIT – V	**ADVANCED MACHINE LEARNING**	**9 Periods**
Introduction to learning theory - Modeling structured outputs: multi-label classification, introduction to Conditional Random Fields (CRFs) - Spectral clustering- Semi-supervised learning - Recommendation systems - Active Learning - Learning from streaming data, online-learning - Deep learning.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Tom Mitchell, **"Machine Learning"**, McGraw-Hill, 1997.*
2	*Richard Sutton and Andrew Barto, **"Reinforcement Learning: An Introduction"**, MIT Press, 1998.*

REFERENCES:

1	*Christopher Bishop, **"Pattern Recognition and Machine Learning"**, Springer, 2006*
2	*Kevin P. Murphy, **"Machine Learning: A Probabilistic Perspective"**, MIT Press, 2012*
3	*Trevor Hastie, Robert Tibshirani, Jerome Friedman, **"The Elements of Statistical Learning"**, Second Edition, Springer, 2011.*
4	*Ethem Alpaydin, **"Introduction to Machine Learning"**, Third Edition, MIT Press, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	The knowledge about basic concepts, fundamental issues and challenges of machine learning algorithms	**K2**
CO2	Discuss the paradigms of supervised learning and un-supervised machine learning	**K3**
CO3	Describe the Probabilistic graphical Models	**K2**
CO4	Design the architecture of reinforcement learning algorithms and machine learning algorithms.	**K3**
CO5	Explain advanced Machine learning concepts	**K2**

23PTL8E3	SOFTWARE DEFINED RADIO

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To provide a comprehensive introduction to Software Defined Radio and Cognitive Radio concepts.	
UNIT – I	**INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO**	**9 Periods**
Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.		
UNIT – II	**SDR ARCHITECTURE**	**9 Periods**
Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules		
UNIT – III	**INTRODUCTION TO COGNITIVE RADIOS**	**9 Periods**
Marking radio self-aware, cognitive techniques – position awareness, environment awareness in Cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.		
UNIT – IV	**COGNITIVE RADIO ARCHITECTURE**	**9 Periods**
Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture		
UNIT – V	**NEXT GENERATION WIRELESS NETWORK**	**9 Periods**
The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*JosephMitolaIII,"**Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering**", John Wiley & Sons Ltd. 2000.*
2	*Bruce A. Fette, "**Cognitive Radio Technology**", Elsevier, 2009.*

REFERENCES:

1	*SimonHaykin, "**Cognitive Radio: Brain –Empowered Wireless Communications**", IEEE Journal on selected areas in communications, Feb 2005.*
2	*ThomasW.Rondeau, Charles W. Bostain, "**Artificial Intelligence in Wireless Communication**", ARTECH HOUSE .2009.*
3	*Markus Dillinger, KambizMadani, Nancy Alonistioti, "**Software Defined Radio**", John Wiley, 2003.*
4	*HuseyinArslan, "**Cognitive Radio, SDR and Adaptive System**", Springer, 2007.*
5	*Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "**Cognitive Radio Communication and Networks**", Elsevier, 2010.*
6	*Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, "**Next generation dynamic spectrum access / cognitive radio wireless networks: A Survey**" Elsevier Computer Networks, May 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize requirements, benefits for Software Defined Radio and Cognitive Radio	**K2**
CO2	Describe the architecture of SDR	**K2**
CO3	Explain the basics of Cognitive radio	**K2**
CO4	Discuss the architecture of Cognitive radio	**K2**
CO5	Explain the wireless networks based on Cognitive radios	**K2**

23PTL8E4	COMPUTER VISION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To gain knowledge in the recent advances in algorithmic techniques, of Image processing, Geometric techniques and Machine learning .	
UNIT – I	**IMAGE REPRESENTATION**	**9 Periods**
Computer Vision- Image representation and image analysis tasks – Image representations - digitization – properties – color images – Data structures for Image Analysis – Levels of image data representation – Traditional and Hierarchical image data structures.		
UNIT – II	**FEATURE DETECTION, MATCHING AND SEGMENTATION**	**9 Periods**
Points and patches – Edges – Lines – Segmentation – Active contours – Split and merge – Mean shift and mode finding – Normalized cuts – Graph cuts and energy-based methods.		
UNIT – III	**IMAGE FORMATION AND PROCESSING**	**9 Periods**
Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear filtering – More neighborhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations – Global optimization.		
UNIT – IV	**3D RECONSTRUCTION**	**9 Periods**
Shape from X – Active range finding – Surface representations – Point-based representations- Volumetric representations – Model-based reconstruction – Recovering texture maps and albedos.		
UNIT – V	**IMAGE BASED RENDERING AND RECOGNITION**	**9 Periods**
View interpolation Layered depth images – Light fields and Lumigraphs – Environment mattes - Video-based rendering-Object detection – Face recognition – Instance recognition – Category recognition – Context and scene understanding- Recognition databases and test sets.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Richard Szeliski, "**Computer Vision: Algorithms and Applications**", Springer- Texts in Computer Science, Second Edition, 2022.*
2	*D. A. Forsyth, J. Ponce,"**Computer Vision: A Modern Approach**", Pearson Education, Second Edition, 2015.*

REFERENCES:

1	*Richard Hartley and Andrew Zisserman, "**Multiple View Geometry in Computer Vision**", Second Edition, Cambridge University Press, March 2004.*
2	*Christopher M. Bishop,"**Pattern Recognition and Machine Learning**", Springer, 2016.*
3	*E. R. Davies, "**Computer and Machine Vision**", Fourth Edition, Academic Press, 2012*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Translate the geometric techniques in computer vision..	**K2**
CO2	Discuss the concepts of image classification, detection, and segmentation.	**K3**
CO3	Discuss the tenchinques of image formation and processing	**K2**
CO4	Explain the concepts of 3D-Reconstruction.	**K2**
CO5	Explain the concepts of image based rendering and recongination	**K2**

23PTL8E5	CRYPTOGRAPHY AND NETWORK SECURITY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To understand Cryptography theories, algorithms and to build protection mechanisms in order to secure computer networks.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Significance of network and data security in today's communication scenario – Overall Classification - Model of network security – Security attacks, services and mechanisms –Modular Arithmetic – Linear congruence - Substitution ciphers – Transposition ciphers		
UNIT – II	**MODERN SYMMETRIC KEY CIPHERS**	**9 Periods**
Algebraic structures – GF(2^n) fields- Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers and stream cipher		
UNIT – III	**ASYMMETRIC KEY ENCIPHERMENT**	**9 Periods**
Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve Cryptography		
UNIT – IV	**INTEGRITY AUTHENTICATION AND KEY MANAGEMENT**	**9 Periods**
Message integrity – message authentication – SHA-512 -Digital signature Standard– Kerberos – symmetric key management – public key distribution – steganography, Diffie Hellman key exchange.		
UNIT – V	**NETWORK SECURITY**	**9 Periods**
Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSL and TLS – Security at the network layer: IPsec, System Security: Intruders – viruses – Firewalls.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*William Stallings,"**Cryptography and Network security: Principles and practice**", , Pearson Education, 7th Edition ,2017*
2	*Behrouz A. Ferouzan, "**Cryptography & Network Security",** , Tata McGraw- Hill Education, 5th Edition, 2011*

REFERENCES :

1	*James.F.Kurose and Keith.W.Ross,"**Computer Networking-A Top-Down-Approach**,Sixth Edition.*
2	*Doughlas.E.Comer,**Computer Networks and Internets with Internet Applications**,Fourth Edition.*
3	*Charlie Kaufman, Radia Perlman, and Mike Speciner, **Network Security: private Communication in a public world**, Prentice Hall, ISBN 0-13-046019-2*
4	*C K Shyamala, N Harini and Dr. T R Padmanabhan: **Cryptography and Network Security**, Wiley India Pvt.Ltd*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the issues, scope and significance of various security mechanisms and services applicable to communication networks.	**K2**
CO2	Interpret modern symmetric key ciphers to various cryptographic applications.	**K2**
CO3	Outline the various cryptographic techniques used in asymmetric key encipherment	**K2**
CO4	Apply various authentication, key management schemes to enhance security and inspect the system security	**K3**
CO5	Examine the applications of cryptography in application, transport and network layers.	**K3**

23PTL8E6	MULTIMEDIA COMPRESSION TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To summarize the various multimedia components, text and image compression techniques and describe the various audio and video compression standards.	
UNIT – I	**MULTIMEDIA COMPONENTS**	**9 Periods**
Multimedia components and their characteristics – Multimedia software, editing and authoring tools-File formats: GIF, PNG, JPEG, TIFF, Windows BMP, PS and PDF, Applications of Multimedia.		
UNIT – II	**TEXT AND IMAGE COMPRESSION**	**9 Periods**
Compression principles-Source encoders and destination encoders-Lossless and lossy compression-Entropy encoding -Source encoding- Text compression -Static Huffman coding, Dynamic Huffman coding - Arithmetic coding - Lempel Ziv-Welsh Compression–Lossy Image Compression standard: JPEG.		
UNIT – III	**AUDIO AND VIDEO COMPRESSION**	**9 Periods**
Audio compression: ADPCM, Vocoders –Channel vocoder, Linear Predictive Coding, Code Excited LPC- Perceptual coding. Video compression: H.261, H.263, MPEG 1, 2, 4 and 7.		
UNIT – IV	**MULTIMEDIA COMMUNICATION AND NETWORKING**	**9 Periods**
Protocol Layers of Computer Communication Networks - Network Layer: IP – Transport Layer: TCP and UDP - Protocols for multimedia transmission and interaction: HTTP, RTP, RTCP, RTSP-Internet telephony: H.323, SIP-QoS and QoE for multimedia communication- Integrated and differentiated services.		
UNIT – V	**CLOUD COMPUTING AND AUGMENTED REALITY FOR MULTIMEDIA**	**9 Periods**
Cloud computing Overview: Representative Storage Service Amazon S3, Representative Computation Service: Amazon EC2 - Multimedia content sharing over cloud: Case study Netflix. Augmented Reality technology and applications in Augmented Reality-Workflow of Augmented reality: Sensory data collection, Localization and alignment, world generation and emission – Enabling Hardware and infrastructure – Limitations and Challenges.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Li, Ze-Nian, Drew, Mark S, and Liu, Jiangchuan, "**Fundamentals of Multimedia**", 3rd edition, Springer International Publishing, 2022.*
2	*Fred Halshall,"**Multimedia Communication – Applications, Networks, Protocols and Standards**", Pearson Education, 2013.*

REFERENCES:

1	*Kurose and W. Ross, "**Computer networking? A Top down Approach**", 7th Edition, Pearson education, 2017.*
2	*Tay Vaughan, "**Multimedia: Making It Work**", 9th edition, Tata McGraw Hill, 2014.*
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**", 1st Edition, Pearson Education, 1995.*
5	*Ranjan Parekh, "**Principles of Multimedia**", 2nd Edition, Tata McGraw Hill, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the various the multimedia components.	**K2**
CO2	Discuss the principles of image and text compression.	**K2**
CO3	Discuss the audio and video compression techniques.	**K2**
CO4	Interpret the multimedia networking protocols.	**K2**
CO5	Describe the cloud computing and AR techniques in multimedia.	**K2**

23PTL8E7	DISPLAY SYSTEMS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To understand the basics of the display systems and to illustrate the current design practices of the display systems.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Properties of Light - Vision and Perception - Light detection and sensitivity of eyes - Light sources-standard and advanced measurement procedures - Units and definition-wide viewing angle - Etching of thin films - Patterning - Photo lithography - Pixels, Pixel geometry, Array of Pixel - Size, resolution, Aspect ratios, color depth, standard definition.		
UNIT – II	**DISPLAY TECHNOLOGIES**	**9 Periods**
Passive and Active matrix driving technology - Direct driving-Transistor switch addressing - Field emission Displays - Plasma display - Application ,Display technology dependant issues.		
UNIT – III	**LCD DISPLAYS**	**9 Periods**
Generation of Display devices - Energy aspects of displays - Touch screen - Fundamentals of liquid crystals - Liquid crystal molecules and geometries - Twisted nematic Structures - LCD Structures - Backlight and transrefelective types - LCD Panel - Panel interfacing - micro to Gigantic displays.		
UNIT – IV	**ELECTRO LUMINESCENT DISPLAYS**	**9 Periods**
Electroluminscence from inorganic PN Junction diode - Display panel structures - Driving pixels - TFT switching - panel interfacing - Electroluminescence from organic semiconductor - Organic display devices - Green technologies in displays - Low power consumption - Applications.		
UNIT – V	**ADVANCED DISPLAY DEVICES**	**9 Periods**
Next generation of Flexible Displays - 3D Displays, MEMS Based Displays - Autosteroscopic 3D cinema technology - Quantum dot - based displays - Hybrid displays - Cost effective display marketing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*L.W. Mackonald & A.C. Lowe, "**Display Systems, Design and Applications**", Wiley, 2003.*
2	*Janglin Chen,Wayne Cranton,Mark Fihn,"**Handbook of Visual Display Technology**",Springer Publication*

REFERENCES:

1	*Peter A. Keller, "**Electronic Display Measurement: Concepts, Techniques, and Instrumentation",** Wiley-Inter science, 1997.*
2	*Peter J.Collings and Michael Hird,"**Introduction to Liquid crystals**",Taylor and Francis.*
3	*E.H. Stupp &M. S. Brennesholtz, "**Projection Display**s", Wiley,1999*
4	*Recent literature in Display Systems*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the technical requirement of different types of display systems	**K2**
CO2	Explain the various Technology used in display systems	**K2**
CO3	Summarize the operation of TFTs and LCD displays.	**K3**
CO4	Explain the various kinds of Electroluminescent display	**K2**
CO5	Discuss the advancements in the display device technology.	**K2**

23PTL8E8	SMART SENSORS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To learn the different types of sensors, smart sensors, interfacing sensors with MCU and their applications.	
UNIT – I	**DISPLACEMENT, FORCE AND PRESSURE SENSORS**	**9 Periods**
Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.		
UNIT – II	**TEMPERATURE, POSITION, FLOW AND LEVEL SENSORS**	**9 Periods**
Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.		
UNIT – III	**SMART SENSORS**	**9 Periods**
General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.		
UNIT – IV	**INTERFACING SENSOR INFORMATION AND MCU**	**9 Periods**
Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital conversion, MCU Control MCUs for Sensor Interface, Techniques and System Consideration, Sensor Integration.		
UNIT – V	**COMMUNICATION FOR SMART SENSORS**	**9 Periods**
Automotive Protocols - Industrial Networks - Home Automation - MCU Protocols - Wireless Data Communications- RF Sensing, Telemetry. Standards: IEEE 1451, STIM, Smart Plug-and-Play.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*D.Patranabis, -**Sensors and Transducers,** Second Edition, Prentice Hall of India, 2005.*
2	*Randy Frank, -**Understanding Smart Sensors**, Third Edition, Artech House Publishers, 2013.*

REFERENCES:

1	*Jacob Fraden, **"Hand Book of Modern Sensors: physics, Designs and Applications"**, 2015, 3rd edition, Springer, New York.*
2	*Jon. S. Wilson, **"Sensor Technology Hand Book"**, 2011, 1st edition, Elsevier, Netherland.*
3	*SabrieSolomon,"**SensorsHandbook**,"2ndeditionMcGrawHill,1998.*
4	*Y.L. Lin, **"Smart Sensors and Systems",** Springer, 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the applications of various sensors and transducers available for physiological and cellular measurements.	**K2**
CO2	Discuss and design the different types of sensors, electrodes, signal conditioning circuits for acquiring and recording various physiological parameters.	**K3**
CO3	Gain knowledge about the working of Chemical Biosensors.	**K2**
CO4	Narrate the operation of optical sensors and radiation detectors.	**K2**
CO5	Depict the principles of working of various Biological Sensors.	**K2**

23PTL8E9	INDUSTRIAL IOT AND INDUSTRIAL 4.0

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To study the fundamentals of Industry 4.0, Industrial internet of things and apply the concept of industrial internet of things in real world scenario.	
UNIT – I	**INTRODUCTION TO INDUSTRIAL 4.0**	**9 Periods**
Overview of Internet of Things and IIOT- Introduction to Industry 4.0 –Evolution - Design requirements, Drivers, Impacts and applications - Sustainability assessment of industries - Cybersecurity - Industrial Internet Systems - Cyber Physical Systems - Characteristics - Industrial Processes - Functional and Operational Viewpoint.		
UNIT – II	**INDUSTRIAL INTERNET OF THINGS**	**9 Periods**
IIOT Architecture – IIOT Requirements - IIoT Business Model: Categorization- Business opportunities - Reference Architecture of IIoT - Key technologies: Augmented Reality - Virtual Reality - Artificial Intelligence - Introduction to Sensors- Characteristics- Categories- Smart Sensor-Actuators.		
UNIT – III	**INDUSTRIAL DATA TRANSMISSION**	**9 Periods**
Introduction to Industrial Data Transmission - Fieldbus, Profibus, Interbus, Bitbus, Modbus, Digital STROM - Communication protocols - Types: 802.15.4, Zigbee, 6LoWPAN, HART, Z wave, Wi-Fi, RFID, NFC- Industrial Data Acquisition - PLC- SCADA.		
UNIT – IV	**IoT ANALYTICS**	**9 Periods**
Introduction to IIoT -IoT Analytics - Big Data Analytics - Software Defined Networks- Machine Learning and Data Science in Industries - Cloud and FOG Computing- Industrial IoT: Security.		
UNIT – V	**IIoT APPLICATION**	**9 Periods**
Industrial IoT- Application Domains: Healthcare Applications in Industries - Inventory Management and Quality Control -Plant Safety and Security - Smart factories and Smart Cities.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee,* ***"Introduction to Industrial Internet of Tings and Industry 4.0****", CRC Press, 1st edition, 2021*
2	*Alasdair Gilchrist,* ***"Industry 4.0: The Industrial Internet of Things",*** *Apress, 2017.*

REFERENCES:

1	*ArshdeepBahga, Vijay Madisetti, "****Internet of Things-A hands-on approach****", Universities Press,* *2015.*
2	*Marco Schwartz, —****Internet of Things with the Arduino Yun,*** *Packt Publishing.*
3	*Hakima Chaouchi "****The Internet of Things: connecting objects to the web****" John Wiley& Sons, 2013*
4	*Massimo Banzi****- Getting Started with Arduino*** *· O'Reilly Media Publishing, 3rd Edition, 2015*
5	*Matt Richardson and Shawn Wallace-* ***Getting Started with Raspberry Pi****- O'Reilly Media Publishing, 3rd Edition, 2016*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the IoT, IIoT differences and key technology enablers for IIoT	**K2**
CO2	Explain the architecture of IIoT	**K2**
CO3	Assimilate various protocols used for IIoT	**K2**
CO4	Comprehend the role of AI in IIoT based system	**K2**
CO5	Identify IoT use cases in various industries and recognize the IoT project implementation modalities	**K3**

23PTL8E10	ADHOC AND WIRELESS SENSOR NETWORKS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To learn the Adhoc and Sensor network fundamentals, different routing protocols, sensor network security issues and network simulator tool.	
UNIT – I	**NETWORKS – INTRODUCION AND ROUTING**	**9 Periods**
Elements of Wireless Networks, Issues in Ad hoc wireless networks, Issues in Designing a Routing Protocol for 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 Periods**
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 Periods**
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 Periods**
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 Periods**
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		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*C. Siva Ram Murthy and B. S. Manoj, "**Ad Hoc Wireless Networks Architectures and Protocols**", Prentice Hall, PTR, 2004.*
2	*Holger Karl , Andreas willig,"**Protocol and Architecture for Wireless Sensor Networks**", John wiley publication, Jan 2006.*

REFERENCES :

1	*Feng Zhao, Leonidas Guibas, "**Wireless Sensor Networks: an information processing approach**", Elsevier publication, 2004.*
2	*I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "**Wireless sensor networks: a Survey**", computer networks, Elsevier, 2002, 394 - 422*
3	*Charles E. Perkins, "**Ad Hoc Networking**", Addison Wesley, 2000.*
4	*Kazem Sohraby, Daniel Minoli and Taieb Znati, **Wireless Sensor Networks: Technology, Protocols and Applications,** Wiley Inter science A John Wiley & sons, Inc., Publication, 2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Summarize the challenges and issues in the wireless Ad Hoc network and its protocol.	**K2**
CO2	Interpret network architecture and its components	**K2**
CO3	Summarize the features of MAC & Routing protocols for WSN	**K3**
CO4	Describe the basic concept of network security.	**K2**
CO5	Explain the various WSN platforms and tool.	**K2**