GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore-641013

Curriculum & Syllabus For

B.E. DEGREE PROGRAMME FOR WORKING PROFESSIONALS

(ELECTRONICS AND COMMUNICATION ENGINEERING)

2025

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

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GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE–641013
B.E. DEGREE PROGRAMME FOR WORKING PROFESSIONALS

ELECTRONICS AND COMMUNICATION ENGINEERING

FIRST SEMESTER

S. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	25WPL1Z1	Applied Mathematics I (Common to Civil, Mech & EEE Branches)	40	60	100	3	0	0	3
2	25WPL1Z2	Environmental Science and Engineering (Common to Civil, Mech & EEE Branches)	40	60	100	3	0	0	3
3	25WPL103	Electric Circuits and Electron Devices	40	60	100	3	0	0	3
4	25WPL104	C Programming	40	60	100	3	0	0	3
PRACTICAL									
5	25WPL105	C Programming Laboratory	60	40	100	0	0	3	1.5
TOTAL			**220**	**280**	**500**	**12**	**0**	**3**	**13.5**

SECOND SEMESTER

S. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	25WPL2Z1	Applied Mathematics II (common to Mech & EEE Branches)	40	60	100	3	0	0	3
2	25WPL202	Electronic Circuits	40	60	100	3	0	0	3
3	25WPL203	Analog Integrated Circuits	40	60	100	3	0	0	3
4	25WPL204	Digital System Design	40	60	100	3	0	0	3
PRACTICAL									
5	25WPL205	Analog and Digital Integrated Circuits Laboratory	60	40	100	0	0	3	1.5
TOTAL			**220**	**280**	**500**	**12**	**0**	**3**	**13.5**

THIRD SEMESTER

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
THEORY									
1	25WPL301	Signals and Systems	40	60	100	3	0	0	3
2	25WPL302	Analog and Digital Communication	40	60	100	3	0	0	3
3	25WPL303	Microprocessors and Microcontrollers	40	60	100	3	0	0	3
4	25WPL304	Electromagnetic Fields	40	60	100	3	0	0	3
5	25WPL305	Computer Architecture and Organization	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	25WPL401	Digital Signal Processing	40	60	100	3	0	0	3
2	25WPL402	Artificial Intelligence and Machine Learning	40	60	100	3	0	0	3
3	25WPL403	Networks and Transmission Lines	40	60	100	3	0	0	3
4	25WPL404	Computer Communication	40	60	100	3	0	0	3
PRACTICAL									
5	25WPL405	Communication Systems and DSP 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	25WPL501	Microwave Engineering	40	60	100	3	0	0	3
2	25WPL502	Embedded Systems	40	60	100	3	0	0	3
3	25WPL503	Control Systems	40	60	100	3	0	0	3
4	25WPL504	Antennas and Wave Propagation	40	60	100	3	0	0	3
5	25WPL5XX	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	25WPL601	VLSI Design	40	60	100	3	0	0	3
2	25WPL602	Wireless Communication	40	60	100	3	0	0	3
3	25WPL6XX	Elective–II	40	60	100	3	0	0	3
4	25WPL6XX	Elective–III	40	60	100	3	0	0	3
PRACTICAL									
5	25WPL603	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	25WPL701	Fiber Optic Communication	40	60	100	3	0	0	3
2	25WPL7XX	Elective–IV	40	60	100	3	0	0	3
PRACTICAL									
3	25WPL702	Project Work	60	40	100	0	0	16	8
TOTAL			**140**	**160**	**300**	**6**	**0**	**16**	**14**

Credits per Semester							Total no of Credits
I	II	III	IV	V	VI	VII	
13.5	13.5	15	13.5	15	13.5	14	**98**

LIST OF ELECTIVES

Sl. No.	Course Code	Course Title	CA Marks	End Sem Marks	Total Marks	Hours/Week			
						L	T	P	C
ELECTIVE I									
1	25WPL5E1	Satellite Communication	40	60	100	3	0	0	3
2	25WPL5E2	Multimedia Compression Techniques	40	60	100	3	0	0	3
3	25WPL5E3	Neural Networks and Deep Learning	40	60	100	3	0	0	3
4	25WPL5E4	VLSI Technology	40	60	100	3	0	0	3
5	25WPL5E5	Smart Sensors	40	60	100	3	0	0	3
ELECTIVE II									
1	25WPL6E1	Bio-Medical Electronics	40	60	100	3	0	0	3
2	25WPL6E2	Advanced Embedded Processors	40	60	100	3	0	0	3
3	25WPL6E3	Low Power VLSI	40	60	100	3	0	0	3
4	25WPL6E4	Error control coding	40	60	100	3	0	0	3
5	25WPL6E5	Measurement and Instrumentation	40	60	100	3	0	0	3
ELECTIVE III									
1	25WPL7E1	Industrial IoT and Industry 4.0	40	60	100	3	0	0	3
2	25WPL7E2	Network Security	40	60	100	3	0	0	3
3	25WPL7E3	Wireless Sensor Networks	40	60	100	3	0	0	3
4	25WPL7E4	Nano Electronics	40	60	100	3	0	0	3
5	25WPL7E5	Digital Image Processing	40	60	100	3	0	0	3
ELECTIVE IV									
1	25WPL7E6	Computer Vision	40	60	100	3	0	0	3
2	25WPL7E7	Display Systems	40	60	100	3	0	0	3
3	25WPL7E8	Programming FPGA using HDLs	40	60	100	3	0	0	3
4	25WPL7E9	Software Defined Radio	40	60	100	3	0	0	3
5	25WPL7E10	Introduction to MEMS	40	60	100	3	0	0	3

25WPL1Z1	**APPLIED MATHEMATICS I** *(Common to CIVIL, MECH & EEE Branches)*	**SEMESTER I**

PREREQUISITES	**L**	**T**	**P**	**C**
NIL	**3**	**0**	**0**	**3**

Course Objective	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**	**9Periods**
Consistency of System of Linear Equations, Eigen values and eigen vectors, Diagonalization of matrices by orthogonal transformation, Cayley-Hamilton Theorem, Quadratic form to canonical forms.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9Periods**
Radius of curvature, Centre of curvature, Circle of curvature,Evolutes of a curve, Envelopes		
UNIT – III	**INTEGRAL CALCULUS**	**9Periods**
Evaluation of definite and improper integrals, Applications: surface area and volume of revolution (Cartesian coordinates only).		
UNIT – IV	**NUMERICAL SOLUTION OF EQUATIONS**	**9Periods**
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**	**9Periods**
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: 0Periods Total: 45 Periods**		

TEXT BOOK

1	*Veerarajan T.,"**Engineering Mathematics I"**, TataMcGraw-Hill Education(India)Pvt.Ltd, New Delhi, Ist Edition 2017.*
2	*P.Kandasamy, K. Thilagavathy, K.Gunavathi, "**Numerical Methods"**, S.Chand& Company,3rd Edition, Reprint 2013.*

REFERENCES

1	*B.S.Grewal," **Higher Engineering Mathematics"**, Khanna Publishers,4th Edition,2021.*
2	*DavidC.Lay,**"Linear Algebra and Its Application"**,PearsonPublishers,6th Edition,2021.*
3	*Howard Anton,**"Elementry Linear Algebra"**,11th Edition,Wiley Publication,2013.*
4	*Narayanan.S and ManicavachagomPillai. T.K.–**Calculas Vol Iand Vol II,** S.chand&Co, Sixth Edition,2016.*
5	*S.S.Sastry, "**Introductory methods of numerical analysis"**, PHI,New Delhi,5th Edition, 2015.*
6	*WardCheney, David Kincaid, **"Numerical Methods and Computing",** Cengage Learning, Delhi,7th Edition 2013.*
7	*JainR.K.and Iyengar S.R.K.,-**Advanced Engineering Mathematics**, Narosa Publications, Eighth Edition,2012.*

COURSE OUTCOMES: Upon 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

25WPL1Z2	**ENVIRONMENTAL SCIENCE AND ENGINEEREING** *(Common to CIVIL, MECH & EEE Branches)*	**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 BOOKS:

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

REFERENCES:

1	*A k de, **"Environmental Chemistry"**, 8th edition, New age international publishers, 2017.*
2	*G. Tyler miller and scott e. Spoolman, **"Environmental Science"**, cengage learning indiapvt. Ltd., delhi, 2014.*
3	*Erach Bharucha, **"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: Upon 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

25WPL103	ELECTRIC CIRCUITS AND ELECTRON DEVICES	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objectives	To learn the concepts of circuit analysis and various semiconductor devices.	
UNIT – I	**CIRCUIT ANALYSIS TECHNIQUES**	**9Periods**
Kirchoff's current and voltage laws – Voltage and Current division – Mesh and Nodal Analysis (dc analysis) – Network Theorems – Thevenin, Superposition, Norton and Maximum power transfer theorem (dc analysis) – Star-delta conversion.		
UNIT – II	**TRANSIENT AND RESONANCE CONCEPTS**	**9Periods**
Basic RL, RC and RLC circuits and their responses to pulse inputs – Series and Parallel resonance – Resonant frequency, Voltage and Current, Impedance, Bandwidth, Q factor – single tuned and double tuned circuits.		
UNIT – III	**SEMICONDUCTOR DIODES**	**9Periods**
Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitance – effect of temperature and breakdown mechanism – Zener diode and its characteristics.		
UNIT – IV	**TRANSISTORS**	**9Periods**
PNP and NPN transistors Operation – CE, CB and CC configuration and comparison of their characteristics – Breakdown in transistors – operation and characteristics of N-ChannelJFET – drain current equation – MOSFET – Enhancement and depletion mode – structure and operation – Comparison of BJT with FET- CMOS: Operation and Characteristics.		
UNIT – V	**SPECIAL SEMICONDUCTOR DEVICES**	**9Periods**
Tunnel diode – PIN diode – Varactor diode – SCR, UJT, Diac and Triac – Operation and Characteristics – Solar Cell, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD, Laser diode.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*A.Sudhakar and ShyammohanS.Palli, "**Circuits and Networks: Analysis and Synthesis**", Tata McGraw Hill, 3rd Edition (2008).*
2	*S. Salivahanan, N. Suresh kumar and A.Vallavanraj, **"Electronic Devices and Circuits",** TataMcGraw Hill, 2nd Edition, (2018).*

REFERENCES:

1	*Joseph A. Edminister, Mahmood, Nahri, "**Electric Circuits**" – Shaum series, TataMcGraw Hill, 6th Edition, (2013).*
2	*William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "**Engineering Circuit Analysis**", Tata McGraw Hill, 6thEdition, (2011).*
3	*David A. Bell, "**Electronic Devices and Circuits**", Oxford University Press, 5thEdition, (2017).*
4	*J. Millman & Halkias, Satyebranta Jit, "**Electronic Devices &Circuits**",Tata McGraw Hill, 2nd Edition, (2013).*
5	*Robert Boylestad and Louis Nashelsky, **"Electron Devices and Circuit Theory**" Pearson,Prentice Hall, 11th Edition, (2015).*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply network laws and theorems in circuit analysis	K3
CO2	Analyze resonance and transient response in RLC circuits	K3
CO3	Understand Semiconductor diode characteristics	K2
CO4	Understand BJT, JFET and MOSFET characteristics	K2
CO5	Understand special semiconductor devices Characteristics	K2

25WPL104	C PROGRAMMING	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objective	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 PROGRAMMINGFUNDAMENTALS**	**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- Object Oriented Programming Concepts – C Vs C++.		
UNIT – II	**DATA TYPES AND FLOW OF CONTROL**	**9 Periods**
An overview of C – Programming and Preparation-The use of #include, printf(), scanf() ,Program output. The fundamental data types and variables. Expressions, Operators, Flow of control and branching statements. Data Structures – Introduction, Examples of Linear and non linear data structures –applications in real life.		
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.*
3	Narasimha Karumanchi, *"**Data Structures and Algorithms Made Easy**", Fifth Edition, CareerMonk Publications, 2011*
4	*Ira Pohl, : "**Object Oriented Programming Using C++**", Second Edition, Pearson Publisher, 2012.*

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*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental of computers programming and algorithmic design and fundamentals of data structures.	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

25WPL105	C PROGRAMMING LABORATORY	SEMESTER I

PREREQUISITES	L	T	P	C
NIL	0	0	3	1.5

Course Objective	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*

COURSEOUTCOMES: Uponcompletion ofthe course,the studentswill beable 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

25WPL2Z1	APPLIED MATHEMATICS II *(Common to Mech & EEE Branches)*	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**		

TEXTBOOK

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, 3rd Edition, Reprint 2013.*

REFERENCES

1	*B.S.Grewal,* ***"Higher Engineering Mathematics"****, Khanna Publishers, New Delhi, 45th Edition, 2024.*
2	*SrimantaPal,* ***"Numerical Methods Principles, Analyses and Algorithms"****, Oxford University Press, New Delhi, I Edition 2012.*
3	*Raisinghania.M..D,* ***"Ordinary And Partial Differential Equations"****, 20th Edition,S. Chand Publishing, 2020.*
4	*S.Larsson and V.Thomee,* ***"Partial Differential Equations with Numerical Methods"****, Springer,* ***2003, 2nd printing 2008 Edition***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve higher order linear differential equation with constant and variable coefficients and simultaneous differential equation.	K3
CO2	Form partial differential equations and find solutions of first and higher order partial differential equations	K3
CO3	Obtain approximate solutions for transcendental equations and problems on interpolation, differentiation, integration.	K3
CO4	Find the numerical solutions of first order ordinary differential equations using single and multi-step techniques.	K3
CO5	Solve second order partial differential equations using explicit and implicit methods.	K3

25WPL202	ELECTRONIC CIRCUITS	SEMESTER II

PREREQUISITES	L	T	P	C
NIL	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-FETs AMPLIFIERS: CS, CD and CG amplifiers.		
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–f_α, f_β 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- Frequencycompensation. OSCILLATORS: Barkhausen criterion for oscillation - Hartley &Colpitt's oscillators –crystal oscillators.		
UNIT–IV	**TUNED AMPLIFIERS AND WAVE SHAPING CIRCUITS**	**9 Periods**
Single Tuned Amplifier: 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 – Half Wave and Full Wave 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.		
Contact Periods: **Lecture:45 Periods Tutorial:0 Periods Practical:0 Periods Total:45 Periods**		

TEXT BOOK

1	*Robert L. Boylestad and Louis Nasheresky, "**Electronic Devices and Circuit Theory**", 11th Edition, Pearson Education, 2013.*
2	*Salivahanan and N.Suresh Kumar, **Electronic Devices and Circuits**,4th Edition, Mc Graw Hill Education (India) Private Ltd.,2017.*

REFERENCES

1	*Millman J, Halkias.C. and SathyabradaJit, **Electronic Devices and Circuits**, 4th Edition, Mc Graw Hill Education (India) Private Ltd.,2015.*
2	*Donald.A.Neamen**, Electronic Circuits Analysis and Design**,3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010.*
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.*

COURSEOUTCOMES: Uponcompletionofthecourse,thestudentswillbeable to:		**Bloom'sTaxonomy Mapped**
CO1	Explain the Working principles, characteristics and applications of BJT and FET amplifiers.	K2
CO2	Explain the Frequency response characteristics of BJT and FET amplifiers	K2
CO3	Describe the performance of Feedback Amplifiers and Oscillators	K2
CO4	Analyze the operation of Tuned Amplifiers and Wave Shaping circuits	K4
CO5	Describe the working principles of Power supplies and Power Amplifiers.	K2

25WPL203	ANALOG INTEGRATED CIRCUITS	SEMESTER II

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

Course Objective	To understand the characteristics and applications of Operational amplifiers, data converters 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–frequencycompensation.		
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 IC 555 –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 - Data Converters: D/A converter – specifications- weighted resistor type,R2R Ladder types- switches for D/A converters - A/D Converters – specifications - Flash type - Successive Approximation type-Dual Slope type A/D converters.		
UNIT–V	**PLL AND SPECIAL FUNCTIONICS**	**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-IC723 General purpose regulator.		
Contact Periods: **Lecture:45 Periods Tutorial:0 Periods Practical:0 Periods Total:45 Periods**		

TEXT BOOKS:

1	*D.Roy Choudhry and Shai lJain,* ***"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 Mc Graw-Hill, 2014*
2	*Gray and Meyer,* ***"Analysis and Design of Analog Integrated Circuits",*** *Wiley International, 2009.*
3	*S.Salivahanan and V.S.KanchanaBhaaskaran,* ***"Linear Integrated Circuits",*** *Tata McGraw Hill Publishing company Ltd, 1st Edition, 2009.*
4	*Somanathan Nair,* ***"Linear Integrated Circuits, Analysis, Design and Applications",*** *WileyIndia Publishers,1st Edition,2009*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain DC & AC characteristics and Building blocks of OP AMP.	K2
CO2	Explain Linear, Nonlinear and open loop applications of OP AMP	K2
CO3	Design and construct oscillators and Multi-vibrators.	K3
CO4	Design and analyze active filters and data converters using OP AMP	K3
CO5	Describe the operation & applications of PLL and special function ICs	K2

25WPL204	DIGITAL SYSTEM DESIGN	SEMESTER II

PREREQUISITES	L	T	P	C
NIL	3	0	0	3

Course Objective	To understand the theoretical and design aspects of digital circuits for designing digital systems	
UNIT-I	**DIGITAL FUNDAMENTALS**	**9 Periods**
Codes: Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization. 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, and 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/Downcounters-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, cycles and races, race free assignments, Hazards: Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.		
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.MorrisR.Mano and Michael D.Ciletti,"**Digital Design",4th Edition, Pearson Education,2011.*
2	*Charles H.Roth.,"**Fundamentals of Logic Design",6th Edition, Thomson Learning,2013*

REFERENCES:

1	*Thomas L.Floyd,"**Digital Fundamentals",10th Edition, Pearson Education Inc,2011*
2	*S.Salivahanan and S.Arivazhagan,"**Digital Electronics', I Edition, Vikas Publishing House pvtLtd,2012.*
3	*Anil K.Maini,"**Digital Electronics",Wiley,2014.*
4	*Soumitra Kumar Mandal,"**Digital Electronics",Mc Graw Hill Education Private Limited,2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand number Systems and digital fundamentals.	K2
CO2	Design Combinational circuits used in digital systems.	K3
CO3	Design Synchronous sequential circuits in digital system.	K3
CO4	Analyze and design Explain Asynchronous sequential circuits in digital system.	K4
CO5	Describe memory device and implement the combinational circuits using Programmable logic devices.	K3

25WPL205	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	SEMESTER II

PREREQUISITES	L	T	P	C
ANALOG CIRCUITS AND DIGITAL CIRCUTS DESIGN	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 555Timer 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, New Delhi, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarization with characteristics and applications of Op-amp	K2
CO2	Ability to design circuits using IC723 and IC 555 Timer.	K3
CO3	Implement simplified combinational circuits using logic gates	K3
CO4	Design and Implement combinational and sequential circuits	K3
CO5	Implement combinational and sequential logic circuits using HDL	K3

25WPL301	SIGNALS AND SYSTEMS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To analyze the Continuous Time and Discrete time signals and systems using suitable transforms.	
UNIT – I	**INTRODUCTION TO CONTINUOUS TIME SIGNALS AND SYSTEMS**	**9 Periods**
Continuous Time (CT) signals and Discrete Time (DT) signals - step, ramp, impulse, exponential, sinusoidal signals, Representation of DT signals by impulses- signal operations- classification of CT and DT signals –periodic and aperiodic signals, random signals, energy and power signals, even and odd signals- linear time invariant CT systems and DT systems-basic system properties: linear time invariant, causality, BIBO stability.		
UNIT – II	**FOURIER AND LAPLACE TRANSFORM**	**9 Periods**
Fourier transform of continuous time aperiodic signals - properties of continuous time Fourier transform. Laplace Transform – Properties – Inverse Laplace Transform - Fourier and Laplace Transforms in signal Analysis.		
UNIT – III	**ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS**	**9 Periods**
Convolution integrals - Differential Equation- Block diagram representation- Impulse response, Frequency response of systems characterized by Differential Equations- Fourier and Laplace transforms in analysis of LTI systems.		
UNIT – IV	**DTFT AND Z TRANSFORM**	**9 Periods**
Baseband Sampling of CT signals- Aliasing, Reconstruction of CT signal from DT signal, Representation of DT aperiodic signals by Discrete Time Fourier Transform (DTFT) – Properties – Z Transform - Properties.		
UNIT – V	**ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS**	**9 Periods**
Difference Equations - Block diagram representation-Impulse Response- Frequency response - Convolution sum –DTFT and Z Transform analysis of Recursive & Non-Recursive systems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Alan V.Oppenheim, Alan S.Willsky and S.Hamid Nawab, "**Signals & Systems**", Prentice-Hall of India, Second Edition, 2011*
2	*Simon Haykin and Barry Van Veen, "**Signals and Systems**", Wiley India, New Delhi, 2010*

REFERENCES:

1	*P Hsu, Rakesh Ranjan, "**Signals and Systems**", Tata McGraw Hill, 7th Reprint, 2010.*
2	*Edward W. Kamen, Bonnie S. Heck, "**Fundamentals of Signals and Systems Using the Web and MATLAB**", Pearson Prentice Hall, 2007.*
3	*John Alan Stuller, "**An Introduction to Signals and Systems**", Thomson, 2008.*
4	*M.J.Roberts, "**Signals and Systems, Analysis Using Transform Methods and MATLAB**", Tata McGraw Hill (India), 2nd Edition, 2011.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply various operations on signals and understand the System properties.	K3
CO2	Analyze frequency components of CT signals and understand the Importance of frequency domain analysis.	K4
CO3	Apply convolution integral and differential equation in analyzing CT LTI systems	K3
CO4	Analyze the effect of sampling and frequency content of DT signals through DTFT and Z transform.	K4
CO5	Apply convolution Sum and difference equation in analyzing DT LTI Systems.	K3

25WPL302	ANALOG AND DIGITAL COMMUNICATION	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
SIGNALS AND SYSTEMS		3	0	0	3

Course Objectives	To provide a comprehensive understanding of analog and digital communication systems by exploring modulation techniques, noise analysis, sampling, error correction, and signal transmission principles.	
UNIT – I	**AMPLITUDE MODULATION**	**9 Periods**
Principles ofAmplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representationof FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filterand Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Superheterodyne Radio Receiver and its characteristic's.		
UNIT – II	**RANDOM PROCESS & SAMPLING**	**9 Periods**
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding.		
UNIT – III	**DIGITAL TECHNIQUES AND ERROR CORRECTING CODES**	**9 Periods**
Pulse modulation PAM, PPM, PWM, PCM, Noise considerations inPCM- Differential pulse code modulation. Delta modulation, ,TDM, FDM Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes – Cycliccodes - Convolutional codes - Viterbi Decoder		
UNIT – IV	**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 – V	**DIGITAL MODULATION AND DEMODULATION TECHNIQUES**	**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-coherentreceivers generation and detection of BFSK, DPSK – Comparison - M-ary PSK, M-ary FSK - Principles of QAM.		
Contact Periods: **Lecture: 45Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Simon Haykins,* ***"Communication Systems"****, Wiley, 5th Edition, 2009.*
2	*B.P.Lathi,* ***"Modern Digital and Analog Communication Systems"****, 4th Edition, Oxford University Press, 2011.*

REFERENCES:

1	*Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.*
2	*D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006*
3	*A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.*
4	*B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007*
5	*H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006*
6	*Couch.L., "Modern Communication Systems", Pearson, 2001*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the principles, generation methods, and spectral characteristics of amplitude and angle modulation systems, including the operation of superheterodyne receivers.	**K2**
CO2	Apply the concepts of probability and random processes to determine noise behavior in communication systems, and illustrate the processes of sampling and quantization.	**K3**
CO3	Summarize various digital pulse modulation techniques and apply linear block, cyclic, and convolutional error-correcting codes for reliable transmission.	**K3**
CO4	Discuss the power spectral density of different line codes and apply the Nyquist criterion and equalization techniques to mitigate Inter Symbol Interference (ISI).	**K3**
CO5	Explain the geometric representation of signals and the generation, detection, and performance characteristics of various band-pass digital modulation schemes	**K2**

25WPL303	MICROPROCESSORS AND MICROCONTROLLERS	SEMESTER III

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

Course Objective	This course enables students to understand the architecture, programming, interfacing, and applications of 8086 microprocessor and 8051 microcontrollers.	
UNIT – I	**8086 MICROPROCESSORS**	**9**
Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.		
UNIT – II	**8086 SYSTEM BUS STRUCTURE**	**9**
8086 signals – Basic configurations – System bus timing – System design using 8086 – 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**
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**
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**
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: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	**Apply** the knowledge of 8086 microprocessor and 8051 microcontrollers to write efficient assembly language programs.	**K2**
CO2	**Analyze** the operation of system bus timing, and multiprocessor to identify suitable configurations for real-time and embedded applications.	**K3**
CO3	**Apply** interfacing techniques to connect memory, I/O devices, and controllers.	**K2**
CO4	**Analyze**the embedded system applications by integrating microprocessors/microcontrollers with peripherals and appropriate interfacing techniques.	**K3**
CO5	**Analyze**the different microprocessor and microcontroller to choose appropriate hardware platforms for specific application requirements.	**K3**

25WPL304	ELECTROMAGNETIC FIELDS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL		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 findthe average power transmission.	
UNIT–I	**VECTOR ALGEBRA**	**9Periods**
Review of Vector Algebra - Coordinate Systems: Cartesian - Cylindrical - Spherical coordinate systems – Vector Calculus: Differential length, area and volume – Line, Surface and Volume integrals – Del, Gradient, Divergence, Curl and Laplacian operations – Classification of vector fields.		
UNIT–II	**ELECTROSTATIC FIELDS**	**9Periods**
Coulomb's law and field intensity – Electric fields due to continuous charge distributions – Electric flux density – Gauss's law – Applications of Gauss's law – Electric potential – Relationship between E and V – Electric dipole and flux lines – Energy density in Electrostatic fields – Boundary conditions in electrostatic fields – Capacitance of parallel plates – Capacitance of coaxial cable – Laplace and Poisson's equations.		
UNIT–III	**MAGNETOSTATIC FILEDS**	**9Periods**
Biot Savart's Law- Ampere's Circuital Law-Applications of Ampere's circuital law-Magnetic flux density - Maxwell's Equations for static EM fields - Magnetic Vector Potential- Magnetic Boundary Conditions-inductance and Mutual Inductance-Energy Stored in magnetic field		
UNIT–IV	**MAXWELL'S EQUATION FOR TIME VARYING FIELDS**	**9Periods**
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**	**9Periods**
Uniform plane waves – Wave propagation in lossy dielectrics – Plane waves propagation in lossless dielectrics, free space and good conductors – power and Poynting vector – Poynting theorem - Reflection of uniform plane wave at Normal incidence - Polarization of uniform plane waves. Case Study: Magnetic Levitation train		
ContactPeriods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXTBOOK:

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, 2016.*

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*

COURSEOUTCOMES: 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**

25WPL305	COMPUTER ARCHITECTURE AND ORGANIZATION	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To apply the concepts of architecture, arithmetic and logic operations, pipelining, memory hierarchy, and I/O organization in digital computer systems.	
UNIT–I	**COMPUTER DESIGN AND ORGANIZATON**	**9Periods**
Functional units, Operational concepts, Performance, Instructions and instruction sequencing, Hardware-Software Interface, Parallel and Scalable Architectures, Multi-Threated Architecture, Dataflow Architectures.		
UNIT–II	**ARITHMETIC UNIT**	**9Periods**
Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, Signed operand multiplication (Booth's algorithm), Fast multiplication, Integer division.		
UNIT–III	**PROCESSING UNIT**	**9Periods**
Fundamental concepts, Execution of a complete instruction, Multiple bus organization, Hardwired control, Microprogrammed control, Pipelining: Data hazards, Control hazards.		
UNIT–IV	**MEMORY AND I/O ORGANIZATION**	**9Periods**
Memory Hierarchy, RAM, ROM, SDRAM, DDR, Cache Memory, Virtual Memory - Performance considerations.InternalCommunication Methodologies, Serial Bus Architectures, Input and Output Devices		
UNIT–V	**ADVANCED COMPUTER ARCHITECTURE**	**9Periods**
Parallel Processing Architecture and Challenges, Multiprocessors, Muli-core and Share memory Multiprocessors, Software and Hardware Multi-Threating, SMT and CMP Architectures		
ContactPeriods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0PeriodsTotal:45Periods**		

TEXTBOOK:

1	*Carl Hamacher, ZvonkoVranesic, Safwat Zaky, "**Computer Organization**", 5th Edition, Tata McGraw Hill, 2011.*
2	*David A. Patterson and John L. Hennessy, "**Computer Organization and Design: The Hardware/Software Interface**", 5th Edition, Morgan Kaufmann, 2014.*
3	*Kai-Hwang, "**Advanced** **Computer Architecture**", Mc-Grawl International 2001.*

REFERENCES:

1	*M. Morris Mano, "**Computer System Architecture**", 3rd Edition, Pearson Education, 2007.*
2	*William Stallings, "**Computer Organization and Architecture: Designing for Performance**", 10th Edition, Pearson Education, 2016.*
3	*John P. Hayes, "**Computer Architecture and Organization**", 3rd Edition, McGraw Hill, 1998.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the performance of various computer architectures.	K4
CO2	Design and implement arithmetic algorithms for computer processors.	K5
CO3	Comprehend cache memory mapping and virtual memory management.	K2
CO4	Evaluate the performance of pipelined processors by identifying hazards.	K5
CO5	Apply knowledge of I/O organization to design efficient interfacing circuits.	K3

25WPL401	DIGITAL SIGNAL PROCESSING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
SIGNALS AND SYSTEMS		3	0	0	3

Course Objectives	To study DFT, digital filter design algorithms, finite word length effects and architecture of Digital signal processor.	
UNIT – I	**DISCRETE FOURIER TRANSFORM**	**9 Periods**
DFT and its properties, FFT algorithm - Decimation in Time Algorithm - Decimation in Frequency - Computation of Inverse DFT using FFT and its application to convolution. Sectioned convolution - Overlap add and overlap save method.		
UNIT – II	**INFINITE IMPULSE RESPONSE FILTERS**	**9 Periods**
Design of analog Butterworth 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 FILTERS**	**9 Periods**
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.		
UNIT – IV	**FINITE WORD LENGTH EFFECTS**	**9 Periods**
Fixed point and floating-point number representations - Comparison - Quantization Methods – Truncation and Rounding – Quantization Error – Input, Product and Coefficient Quantization error – Limit Cycle Oscillation - Deadband - Signal scaling.		
UNIT – V	**DIGITAL SIGNAL PROCESSOR**	**9 Periods**
Harvard and modified Harvard architectures - Architecture of C6X processor - Features - 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 andApplications"****, Pearson, Fourth Edition, 2007.*
2	*B. Venkataramani, M. Bhaskar, "****Digital Signal Processor Architecture, Programmingand 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, 2011fourth international edition.*
4	*Monson H. Hayes,* ***"Statistical Digital Signal Processing and Modeling"****, John Wiley and SonsInc., New York, 2006.*
5	*Rulph Chassaing,* ***"Digital Signal Processing and Applications with the C6713 and C6416DSK"****,A John Wiley & Sons, Inc., Publication, 2005.*

COURSE OUTCOMES: On 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	K2
CO5	Explain Digital signal Processor families and architecture	K2

25WPL402	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To Learn the basic concepts of Problem solving, Probabilistic reasoning, Supervised Learning, Ensemble Technique, Neural Networks.	
UNIT – I	**PROBLEM SOLVING**	**9 Periods**
Introduction to AI- AI Applications - Problemsolvingagents –search algorithms–uninformed searchstrategies– Heuristicsearchstrategies–Localsearchandoptimizationproblems–adversarialsearch–constraintsatisfaction 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 – Naïve 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 back propagation, from shallow networks to deep networks – Unit saturation (akathe vanishing gradient problem) – ReLU, hyper parameter 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	Ethem Alpaydin, "**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**", Mc GrawHill, 2008
3	Christopher M.Bishop, "**Pattern Recognition and Machine Learning**", Springer, 2006.
4	Tom Mitchell, "**Machine Learning**", Mc GrawHill, 3rd Edition, 1997.
5	Charu C.Aggarwal, "**Data Classification Algorithms and Applications**", CRC Press, 2014
6	Ian Good fellow, Yoshua Bengio, Aaron Courville, "**Deep Learning**", MIT Press, 2016

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use appropriate search algorithms for problem solving	K2
CO2	Apply reasoning under uncertainty	K3
CO3	Build supervised learning models	K2
CO4	Build ensembling and unsupervised models	K2
CO5	Build deep learning neural network models	K2

25WPL403	NETWORKS AND TRANSMISSION LINES	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
ELECTRIC CIRCUITS AND ELECTRON DEVICES		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: Impedance, Admittance, Transmission and Hybrid Parameters - Interconnection of two-port networks - Symmetrical networks: T and PI equivalent of two port network - characteristic impedance and propagation constant – Image parameters		
UNIT–II	**PASSIVE NETWORKS**	**9 Periods**
Primary constants of transmission line – Skin effect - Transmission line equation- Secondary constants- characteristic impedance – propagation constant – Infinite line – Input impedance of lossless line- Reflected and incident waves – Standing waves in open and shortcircuited lines – Input impedance of open and shortcircuited lines – Reflection coefficient – Reflection loss.		
UNIT–III	**TRANSMISSION LINE THEORY**	**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	**LINE AT RADIO FREQUENCIES**	**9 Periods**
Parameters of open wire line andco-axial line athigh frequencies –Standing wave ratio - Relation between VSWR and reflection coefficient – Location of voltage maxima and minima – Quarter wave transformer – Smith chart and its applications –Single and double stub impedance matching using Smith chart.		
UNIT–V	**WAVEGUIDES**	**9 Periods**
Rectangular waveguide – Transverse Magnetic (TM) mode - Transverse Electric (TE) mode – dominant mode – cut off frequency, propagation constant, intrinsic wave impedance calculations – Wave propagation in the rectangular waveguide – Power transmission and attenuation – Rectangular cavity resonator.		
ContactPeriods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXTBOOK:

1	*Sudhahar.A, Shyammohan S.P,* ***"Circuits and Networks : Analysis and Synthesis"****, Tata McGraw Hill, New Delhi, Fourth Edition, 2018.*
2	*Umesh Sinha****, "Transmission Lines and Network"****, SatyaPrakashan Publishing Company, New Delhi, 2016.*

REFERENCES:

1	*Mathew.N.O.Sadiku,* ***"Elements of Electromagnetics"****, 7th Edition, Oxford University press, 2021.*
2	*John D.Ryder,* ***"Networks, Lines and Fields"****, PHI, 2nd edition, 2009.*
3	*Roy, Choudhury D.,* **"*Networks and Systems*",** *NewAge International Publishers, 2nd edition 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	Derive the transmission line equation and loading effect.	**K3**
CO4	Illustrate the line behavior at radio frequencies and stub matching techniques.	**K2**
CO5	Describe the behavior of rectangular waveguide and cavity resonator for wave propagation	**K3**

25WPL404	COMPUTER COMMUNICATION	SEMESTERIV

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To understand the division of network functionalities into layers and learn the protocols used in different layers of the network.	
UNIT–I	**NETWORKING FUNDAMENTALS**	**9 Periods**
Data communications, Networks, Network types, Protocol layering, OSI model, TCP/IP protocol suite, Transmission media, Switching.		
UNIT–II	**DATA LINK LAYER**	**9 Periods**
Introduction, Link layer addressing, Error detection and correction, Data link control, Wired LANs: Ethernet, Wireless LANs, Connecting devices.		
UNIT–III	**NETWORK LAYER**	**9 Periods**
Network layer services, Packet switching, IPV4 addressing, Forwarding of IP packets, IPV6 protocol, Routing algorithms: Distance Vector, Link State, Path Vector.		
UNIT–IV	**TRANSPORT LAYER**	**9 Periods**
Introduction, Transport layer protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control, Quality of service.		
UNIT–V	**APPLICATION LAYER SECURITY**	**9 Periods**
Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain keys identified mail, wireless network security,Mobile device security, https end-end encryption protocol.		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXTBOOK:

1	*Behrouz A. Forouzan, **"Data Communications and Networking"**, 5th Edition, Tata McGraw Hill, 2013.*
2	*Andrew S. Tanenbaum, **"Computer Networks"**, 6th Edition, Pearson Education, 2021.*
3	*Network security: Private communications in a public world, M. Speciner, R. Pearlman, C.KaufmanPrentice hall 2002.*

REFERENCES:

1	*William Stallings, "**Data and Computer Communications**", 10th Edition, Pearson Education, 2014.*
2	*James F. Kurose, Keith W. Ross, "**Computer Networking: A Top-Down Approach**", 7th Edition, Pearson Education, 2017.*
3	*Larry L. Peterson, Bruce S. Davie, "**Computer Networks: A Systems Approach**", 5th Edition, Morgan Kaufmann, 2011.*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the functions of each layer in OSI and TCP/IP models.	**K2**
CO2	Analyze various routing algorithms and transport layer protocols.	**K4**
CO3	Evaluate the performance of different network protocols	**K5**
CO4	Design network configurations for given communication requirements.	**K6**
CO5	Apply error detection and correction techniques in data link layer.	**K3**

25WPL405	COMMUNICATION SYSTEMS AND DSP LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL		0	0	3	1.5

Course Objectives	To generate modulation, demodulation, sampling, and multiplexing techniques in communication systems and to develop DSP algorithms for signal processing applications using software tools.
PRACTICALS	**LIST OF EXPERIMENTS USING COMMUNICATION TRAINER KITS:** 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 **LIST OF EXPERIMENTS USING SOFTWARE:** 6. Generation of basic signals 7. Computation of FFT of a signal 8. Linear and Circular Convolution 9.Design of IIR filters – Butterworth using Impulse invariance and Bilinear Transform 10.Design of FIR filters –windowing technique
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

REFERENCES:

1.	*Wayne Tomasi,* ***"Laboratory Manual to Electronic Communications Systems"*** *Pearson, 2000.*
2.	*John G Proakis and Manolakis,* ***"Digital Signal Processing Principles, Algorithms and Applications"****, Pearson, Fourth Edition, 2007.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Demonstrate analog modulation and demodulation techniques such as AM and FM using communication trainer kits	**K3**
CO2	Apply digital modulation techniques including ASK, FSK, PSK, and DPSK for communication systems.	**K3**
CO3	Apply sampling and Time Division Multiplexing techniques in communication systems.	**K3**
CO4	Develop code to generate basic signals and spectral analysis.	**K3**
CO5	Write program to design IIR and FIR digital filters.	**K3**

25WPL501	MICROWAVE ENGINEERING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
ELECTROMAGNETIC FIELDS NETWORKS AND TRANSMISSION LINES		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**	**9Periods**
Microwave frequencies (IEEE Standards) - High frequency limitations of conventional tubes - Microwave Vacuum Tubes: Reflex Klystron Oscillator - Two cavityKlystron amplifier - TWT amplifier - Active RF Devices: Gunn effect diode - Gunn Oscillator - Tunnel diode Oscillator		
UNIT–II	**MICROWAVE NETWORK ANALYSIS AND PASSIVE DEVICES**	**9Periods**
S-Parameters- Formulation of Scattering(S)matrix – Properties of Sparameters –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**	**9Periods**
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**	**9Periods**
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**	**9Periods**
Microwave measurements: Guide wavelength, unknown frequency, unknown impedance reflection coefficient and low and high VSWR. CaseStudy: Microwave Oven		
ContactPeriods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total: 45Periods**		

TEXT BOOK:

1	*David M.Pozar,"**Microwave Engineering**",WileyIndia(P)Ltd, NewDelhi, 4th edition, 2016.*
2	*Annapurna Das and Sisir K Das, "**Microwave Engineering**",Tata McGrawHill 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 EducationInc., 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**", JohnWiley & Sons, 2010*

COURSEOUTCOMES: 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**

25WPL502	EMBEDDED SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
MICROPROCESSORS AND MICROCONTROLLERS		3	0	0	3

Course Objectives	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, AlarmController.		
UNIT – II	**ARM CORTEX M4**	**9 Periods**
Introduction to cortex M4 – Features - ARM Architecture - Block diagram - operation modes andstates – 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 ofprogram 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: On 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	Illustrate the programming concept for constructing the embedded system.	**K3**
CO4	Illustrate the interfacing concept and coding with ARM Cortex.	**K3**
CO5	Demonstrate the concepts of Real Time operating system.	**K2**

25WPL503	CONTROL SYSTEMS	SEMESTERV

PREREQUISITES	CATEGORY	L	T	P	C
NIL		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 AND STABILITY ANALYSIS**	**9 periods**
Frequency domain specifications - Bode Plot, Polar Plot - Stability - Routh - Hurwitz Criterion, Root Locus Technique - Construction of Root Locus - Application of Root Locus Diagram.		
UNIT – IV	**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.		
UNIT – V	**DIGITAL CONTROL SYSTEMS**	**9 periods**
Introduction- Comparison between analog and digital control-Importance, Structure and examples of digital control system- Difference equations - Transfer function of zero order hold – Autonomous control systems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	A. Nagoor Kani**, "Control Systems",** RBA Publications, 3rd Edition, 2015.
2	Norman Nise, "**Control Systems Engineering**", Wiley Publishers, 7th Edition, 2020.

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	M. Sam Fadalli, **"Digital Control Engineering Analysis and Design"**, Elsevier Publication, 1st Edition, 2012.
5	J.Nagrath and M.Gopal, **"Control Systems Engineering",** New Age International Publishers, 7th Edition, 2021.

COURSE OUTCOMES: On 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**

25WPL504	ANTENNAS AND WAVE PROPAGATION	SEMESTERV

PREREQUISITES	CATEGORY	L	T	P	C
ELECTROMAGNETIC FIELDS		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**	**9Periods**
Antenna Parameters: Radiation mechanism - current distribution on a thin wire antenna - Radiation Pattern, Beam width, Beam solid angle, Radiation intensity, Radiation Power density, Directivity, Gain, Effective aperture, Effective height, Polarization, Bandwidth, antenna impedance, Duality of Antennas. **Radiation:**Retarded potentials – Radiation fields of oscillating dipole, Power radiated by a current element, Radiation fields from Halfwave Dipole and its radiation resistance -		
UNIT–II	**ANTENNA ARRAYS**	**9Periods**
Advantages of antenna array - Folded Dipole array – Two element array: in phase and out of phase excitation - Broadside array, End fire array - N-element Linear arrays – Array factor –Evaluation of null directions and maxima, amplitude distributions- Pattern multiplication - Binomial arrays - Logperiodic dipole array- Phased array		
UNIT–III	**SPECIAL ANTENNAS**	**9Periods**
Helical antennas: Axial mode and normal mode – Rectangular Horn antennas – Pyramidal Horn antenna – Reflector antennas: Parabolic reflector principles – Feed antennas for reflectors – Microstrip antenna – Feeding methods – Base station Antennas – Mobile station Antennas - Introduction to Smart Antennas		
UNIT–IV	**ANTENNA MEASUREMENTS**	**9Periods**
Antenna Test Ranges: Slant range - Elevated ranges - Ground reflection ranges - Anechoic chambers & absorbingmaterials - Compact Antenna Test Ranges. Antenna Measurements: Measurement of Radiation Pattern - Beam Width - Gain measurement-Directivity – Polarization measurement - Input impedance measurement using SWR method.		
UNIT–V	**WAVE PROPAGATION**	**9Periods**
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 wavepropagation - Duct propagation.		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total: 45Periods**		

TEXT BOOK:

1	*Warren L.Stutzma, Gary A.Thiele,* ***"Antenna Theory and Design"****, John Wiley and Sons Inc., 3rd Edition,2016*
2	*Prasad.K.D,* ***"Antennas and Wave Propagation"****, SathyaPrakashan, 3rd Edition, 2016*

REFERENCES:

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

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

25WPL601	VLSI DESIGN	SEMSETER VI

PREREQUISITES	CATEGORY	L	T	P	C
DIGITAL SYSTEM DESIGN		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 –Dual gate MOS transistors-FinFET – VI Characteristics 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	**SUB 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, Shortchannel effects, High–k, Metal Gate Technology.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXTBOOK:

1	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley &Sons, 8th Reprint2009*
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: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Construct the complex logic circuits with MOSFETs	**K3**
CO2	Explain the characteristics and analyze the characteristics of CMOS logic	**K2**
CO3	Design the high-speed CMOS Logic Networks	**K3**
CO4	Use clocking styles to design basic VLSI system and illustrate the testing principles for the device under test	**K3**
CO5	Design the basic digital blocks and understand the advanced technologies	**K3**

25WPL602	WIRELESS COMMUNICATION	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
ANALOG COMMUNICATION DIGITAL COMMUNICATION		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**	**9Periods**
Frequency Spectrum – Cellular Concept: Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and System Capacity–Improving Coverage and Capacity in Cellular Systems. Multiple Access Techniques : FDMA, TDMA, CDMA, OFDMA.		
UNIT–II	**MOBILE RADIO PROPAGATION**	**9Periods**
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**	**9Periods**
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	**MIMO SYSTEMS**	**9Periods**
Smart Antennas - MIMO 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 - Uplink and Downlink - Closed-Loop Systems and Quantized Feedback - Base Station Cooperation. NOMA in Single input single output and Multi input and Multi Output Systems.		
UNIT–V	**WIRELESS SYSTEMS**	**9Periods**
GSM System Overview – GSM architecture–Network subsystem-base station subsystem -Air Interface - Logical and Physical Channel – GPRS and EDGE system overview – UMTS and HSPA system overview – WLAN System Overview –LTE and LTE Advanced systems overview -Introduction to 5G and 6G communication systems		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXT BOOK:

1	*RappaportT.S. "***Wireless communications***", Second Edition, Pearson Education, 2010.*
2	*Martin Sauter, "**From GSM to LTE-Advanced**" Wiley, Revised 2nd Edition, 2016.*

REFERENCES:

1	*Simon Haykin, Michael Moher, David Koilpillai,* ***"Modern Wireless Communications",*** *First Edition, Pearson Education 2013.*
2	*Andreas.F.Molisch,"***Wireless Communications***",Second Edition, JohnWiley–India,2011.*
3	*JochenSchiller,* ***"Mobile Communications"****, Second Edition, Pearson Education 2012.*
4	*David Tse and Pramod Viswanath ,* ***"Fundamentals of Wireless Communication",*** *Cambridge University Press, 2015.*
5	*Vincent W.S.Wong, Robert Schober, Derrick WingKwanNg, Li- ChunWang,* ***"Key Technologies for 5G Wireless Systems",*** *Cambridge University Press, 2017.*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom'sTaxonomy 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**

25WPL603	EMBEDDED AND VLSI LABORATORY	SEMESTER VI

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

Course Objectives	To design, simulate and analyze digital IC design using VLSI and embedded applications using ARM processor.
PRACTICALS	**LIST OF EXPERIMENTS:** **PART1: 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 x16 Characters LCD display. 4. Simple interrupt handler and setting up a timer. 5. Interfacing ADC, DAC and Matrix Keypad. 6. Generation of PWM. **PART2: DIGITAL SUB-SYSTEM AND IC DESIGN** 1. HDL based FPGA implementation of basic combinational circuits, code converters, adders, multipliers 2. HDL based FPGA implementation of sequential circuits, flipflops, memories, shift registers and counters. 3. HDL based FPGA implementation ALUs. 4. CMOS Realization of basic gates and Flip-Flops. 5. 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**	

REFERENCE:

1	*JBhasker,* ***"A Verilog HDL Primer"****, BS Publication, 2017*
2	*Charles H.Roth,* ***"Fundamentals of Logic Design"****, Cengage, 2019*
3	*N.Westeet.al.,* ***"CMOS VLSI Design"****, Third Edition, Pearson Education, 2013.*
4	*R.JacobBaker,* ***"CMOS:CircuitDesign, Layout, and Simulation"****, Wiley-IEEE, Revised Second Edition, 2008.*
5	*Andrew N.Sloss Dominic Symes ChrisWright,* ***"ARM System Developer's Guide Designing and Optimizing System Software"****, ElsevierInc2010.*
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 realtime clock and serial data transfer.	**K4**

25WPL701	FIBER OPTIC COMMUNICATION	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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). Optical CDMA		
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 -.Introduction to Optical networks -Gigabit passive optical network.		
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: On 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**

25WPL702	PROJECT WORK	SEMESTER VII

	CATEGORY	L	T	P	C
		0	0	16	8

Course Objectives	To create an opportunity for a small team environment in applying the knowledge learned throughout the program by undertaking problem identification, formulation and solution to a small industrial problem.

The students may be grouped into groups of about four members per group and work under a project supervisor. The device / system / component(s) to be fabricated / investigated / analyzed may be decided in consultation with the supervisor. A project report to be submitted by the group and the fabricated model / investigation / analysis to be reviewed and evaluated continuously by a committee constituted by the Head of the department.

Contact Periods:

Lecture: 0 Periods **Tutorial: 0Periods** **Practical: 240 Periods** **Total: 240 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Model or simulate solutions to small engineering problems considering environmental issues.	K4
CO2	Apply the principles of electronics and communication engineering to solve engineering problems.	K3
CO3	Perform feasibility study and manage activities to complete task in specified duration.	K4
CO4	Assign and undertake tasks in a team as per team discussion.	K4
CO5	Do presentation and write technical reports for effective communication within and outside the team.	K4

25WPL5E1	SATELLITE COMMUNICATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To identify the different orbital parameters and the subsystems involvedin designing space segment and explain the different multiplexing techniques used in satellite systems for various applications.	
UNIT–I	**SATELLITE ORBITS AND TRAJECTORIES**	**9Periods**
Kepler's Laws, orbital parameters, orbit perturbations, Geostationary and Non Geo-stationary orbits- Look Angle Determination – Limits of visibility – Earth eclipse satellite - Suntransit outage - Launching orbits - Satellite Launch Vehicle.		
UNIT–II	**SPACE SEGMENT**	**9Periods**
Spacecraft Technology - Structure, Primary power, Attitude and Orbit control, Station keeping, Thermal control and Propulsion, C ommunication sub systems, Telemetry, Tracking and command – Transponders Antenna Subsystem.		
UNIT–III	**LINK DESIGN**	**9Periods**
Basic transmission theory – System Noise temperature and G/T ratio – Noise figure and noise temperature - G/T ratio 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**	**9Periods**
Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digital video Broadcast, Multiple access: Frequency division Multiple access (FDMA) - Time division Multipleaccess (TDMA) – Onboard Processing systems – Demand access Multiple access (DAMA) and Permanently assigned Multiple access (PAMA) - Code division Multiple access(CDMA).		
UNIT–V	**APPLICATIONS**	**9Periods**
Applications of LEO Satellites –Remote sensing – Navigation – Scientific and military application- VSAT: Network architecture, Access Control protocols and techniques, VSAT Earthstations – Satellite Mobile Telephony- Global star - DBS/DTH Television - GPS - Weather satellites - Maritime satellites.		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXTBOOK:

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

REFERENCES:

1	*Pritchard WL, Suyderhoud HG and Nelson RA,"**Satellite Communication System Engineering**", 2nd Edition, Prentice Hall, 2013.*
2	*AnilK.Mani, Varsha Agrawal, "**Satellite technology: Principles and Applications**", 2nd Edition, Wiley India Pvt.Ltd., 2015.*
3	*Tri.T.Ha,"**Digital Satellite Communications**",2nd Edition, McGrawHill,2017.*
4	*MadhavendraRichharia, Leslie David Westbrook, "**Satellite systems for Personal Applications**", John Wiley, 2010.*
5	*Manojit Mithra, "**Satellite Communication**", Prentice Hall, 2005.*

COURSEOUTCOMES: 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	Describe the design and function of spacecraft subsystems.	**K2**
CO3	Calculate system noise temperature, G/T ratio, and uplink/downlink budgets for GEO and LEO scenarios accounting for atmospheric and rain losses.	**K3**
CO4	Compare and evaluate FDMA, TDMA, and CDMA schemes along with DAMA, PAMA strategies, digital modulation, compression, and encryption techniques.	**K4**
CO5	Identify and explain the architecture of VSAT, GPS, DBS/DTH, satellite mobile telephony, weather, and maritime satellite systems.	**K2**

25WPL5E2	MULTIMEDIA COMPRESSION TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To summarize the various multimedia components, text and image compression techniques and describe the various audio and video compression standards.	
UNIT – I	**MULTIMEDIA COMPONENTS**	**9Periods**
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**	**9Periods**
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**	**9Periods**
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**	**9Periods**
Protocol Layers of Computer Communication Networks - Network Layer: IP – Transport Layer: TCP and UDP - Protocols for multimedia transmission and interaction: HTTP, RTP, RTCP, RTSPInternet telephony: SIP-QoS and QoE for multimedia communication- Integrated and differentiated services.		
UNIT – V	**CLOUD COMPUTING AND AUGMENTED REALITY FOR MULTIMEDIA**	**9Periods**
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: On 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**

25WPL5E3	NEURAL NETWORKS AND DEEP LEARNING

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long shortterm memory cells and convolutional neural networks.	
UNIT – I	**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	**AUTOENCODERS**	**9 Periods**
Autoencoders: Autoencoder; Denoising auto-encoder; Sparse auto-encoder; Variational autoencoder; 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); Pixel RNN and Pixel CNN; 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, Yoshua Bengio, Aaron Courville,* ***"Deep Learning"****, MIT Press, 2017.*
2	*Navin Kumar Manaswi,* ***"Deep Learning with Applications Using Python"****, A press, 2018.*

REFERENCES:

1	*Phil Kim,* ***"Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"****, Apress, 2017.*
2	*Ragav Venkatesan, 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: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basics of neural network	**K3**
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 analytics and other types of classifiers.	**K3**

25WPL5E4	VLSI TECHNOLOGY

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To provide a comprehensive understanding of the VLSI fabrication lifecycle, encompassing semiconductor material properties and crystal growth techniques, the core processing steps of oxidation, doping, and metallization, and the physical operation of MOS transistors leading to CMOS integration and packaging.	
UNIT – I	**CRYSTAL GROWTH AND WAFER PREPARATION**	**9 Periods**
Overview of VLSI materials: Silicon (Si) and Gallium Arsenide (GaAs). Crystal growth techniques: Czochralski (CZ) and Float Zone (FZ) methods for bulk Silicon. Physics of doping during growth: Distribution coefficient and effective segregation. Wafer preparation: Slicing, polishing, and cleaning technology (RCA wet cleaning and dry-cleaning concepts).		
UNIT – II	**THERMAL OXIDATION AND INTERFACE**	**9 Periods**
Thermal oxidation of Silicon: The Deal-Grove model for oxide growth kinetics. Factors influencing oxidation: temperature, pressure, and crystal orientation. The Si-SiO_2 interface and its importance in MOS devices. Methods for characterizing oxide thickness and quality.		
UNIT – III	**DOPING AND JUNCTION FORMATION**	**9 Periods**
Dopant introduction techniques: Diffusion (Fick's laws, constant and limited source) and Ion Implantation (Range, Straggle, and Channeling). Thermal annealing and dopant activation. Formation of P-N junctions and their role in transistor fabrication.		
UNIT–IV	**METALLIZATION AND PACKAGING**	**9 Periods**
Metallization process: Deposition of Aluminum and Copper interconnects. Formation of Ohmic and Schottky contacts. Overview of semiconductor packaging: Die bonding, wire bonding, and encapsulation. Common package types: DIP, QFP, and BGA.		
UNIT – V	**MOS TRANSISTOR PHYSICS**	**9 Periods**
MOS structure and operation: Accumulation, Depletion, and Inversion modes. Threshold voltage (Vt) physics and I-V characteristics of NMOS and PMOS. Introduction to CMOS: N-well and P-well formation. Basics of the CMOS inverter as a logic building block.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	Gary S. May and S.M. Sze, "**Fundamentals of Semiconductor Fabrication"**, John Wiley & Sons, 2004.
2	S. M. Sze and Ming-Kwei Lee, "**Semiconductor Devices: Physics and Technology"**, 3rd Edition (Wiley India Edition), 2012

REFERENCES:

1	S.M. Sze, VLSI Technology, McGraw Hill, 2nd Edition, 1988.
2	Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, PHI, 3rd Edition, 1994.
3	Weste and Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson Education, 2015 (Reprint).
4	Kang, Leblebici, and Kim, CMOS Digital Integrated Circuits: Analysis and Design, 4th Edition, McGraw Hill, 2014.
5	Yuan Taur and Tak H. Ning, Fundamentals of Modern VLSI Devices, 3rd Edition, Cambridge University Press, 2021
6	Donald A. Neamen and Dhrubes Biswas, Semiconductor Physics and Devices, 4th Edition (Revised/Global Edition), McGraw Hill, 2021.
7	Stephen A. Campbell, Fabrication Engineering at the Micro and Nanoscale, 4th Edition, Oxford University Press, 2013
8	Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition (Pearson India Reprint), 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the process of Silicon crystal growth and wafer cleaning.	K2
CO2	Analyze the kinetics of thermal oxidation and the Si-SiO_2 interface.	K4
CO3	Compare diffusion and ion implantation techniques for junction formation.	K4
CO4	Describe metallization and the final stages of semiconductor packaging.	K2
CO5	Evaluate the operational parameters and threshold voltage of MOS devices	K5

25WPL5E5	SMART SENSORS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	This course enables the students 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	*Sabrie Solomon, "****Sensors Handbook****," 2nd edition McGrawHill,1998.*
4	*Y.L. Lin,* ***"Smart Sensors and Systems",*** *Springer, 2017.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recall the various displacement, force and pressure sensors.	**K2**
CO2	Exploit the temperature, position, flow and level sensors.	**K2**
CO3	Interpret the smart sensors and their applications.	**K2**
CO4	Interface sensor information and MCU.	**K3**
CO5	Summarize the communication protocols for smart sensors.	**K3**

25WPL6E1	BIO-MEDICAL ELECTRONICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To introduce the student to the various physiological systems of the human body and understand the instrumentation required for measurement of bio-potentials.	
UNIT – I	**PHYSIOLOGY AND TRANSDUCERS**	**9 periods**
Cell and its structure, Action and resting potential, Nervous system: CNS, PNS, Physiological transducers: Displacement, Pressure, Temperature, Optical.		
UNIT – II	**ELECTRO-PHYSIOLOGICAL MEASUREMENTS**	**9 periods**
ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms, Electrical safety in medical environment, Shock hazards, Isolation amplifier.		
UNIT – III	**NON-ELECTRICAL PARAMETER MEASUREMENTS**	**9 periods**
Measurement of blood pressure, Blood flow, Cardiac output, Plethysmography, Pulmonary function measurements, Oximetry.		
UNIT – IV	**MEDICAL IMAGING AND DIAGNOSTICS**	**9 periods**
X-ray machine, Radio graphic and fluoroscopic techniques, Computer Tomography, MRI, Ultrasonography, Endoscopy.		
UNIT – V	**ASSISTING AND THERAPEUTIC DEVICES**	**9 periods**
Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart-Lung machine, Audio meters, Dialyzers- Introduction to Telemedicine in Healthcare systems		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Leslie Cromwell, "**Biomedical Instrumentation and Measurement**", 2nd Edition, Pearson Education, 2015.*
2	*R.S. Khandpur, "**Handbook of Biomedical Instrumentation**", 3rd Edition, Tata McGraw Hill, 2014.*

REFERENCES:

1	*M. Arumugam, "**Bio-Medical Instrumentation**", 2nd Edition, Anuradha Agencies, 2010.*
2	*John G. Webster, "**Medical Instrumentation Application and Design**", 4th Edition, Wiley India, 2015.*
3	*Joseph J. Carr and John M. Brown, "**Introduction to Biomedical Equipment Technology**", 4th Edition, Pearson Education, 2001.*

COURSE OUTCOMES: On 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**

25WPL6E2	ADVANCED EMBEDDED PROCESSORS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To learn the basic concepts of PIC and MSP430 microcontroller and interfacing various peripherals with PIC and MSP430 microcontrollers.	
UNIT–I	**EMBEDDED SOFTWARE TOOLS**	**9 Periods**
Software development tools- editor, assembler, compiler, cross-compiler and simulator, Hardware development tools- development board, device programmer, in-circuit emulator and debuggers. Embedded C Programming, data types and variables, data type modifiers, storage Class modifiers, C statements, structures and operations, pointers, libraries, in-line assembly programming, optimizing and testing embedded C programs.		
UNIT–II	**PIC CONTROLLER**	**9 Periods**
PIC16F877-architecture, memory technologies, timing circuits, power-up and reset, parallel ports, ADC, interrupt, PWM, counters and timers, instruction set and assembly language programming.		
UNIT–III	**INTERFACING WITH PIC**	**9 Periods**
Human and physical interfaces – switches to keyboard, LED display, liquid crystal display, Actuators and sensors, PWM, serial communication protocols (UART, I2C, SPI), programming interrupt, timers and counter.		
UNIT–IV	**MSP430 CONTROLLER**	**9 Periods**
MSP430–Introduction to Architecture – Embedded C Programming in MSP430–GPIOPins & Configuration Timers, Capture, & PWM DAC- ADCs –Memory System-Flash Memory-DMA.		
UNIT–V	**INTERFACING WITH MSP430**	**9 Periods**
USCI Port –SPI mode - I2C Mode-UART Mode & RS232 Low Power Mode Operation- Interfacing-Input Devices- Output Devices-DC Motor-Stepper Motor- Alarm interface.		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXT BOOK:

1	*John B.Peatman,**"Design with PIC Microcontroller"**, 1st edition, Pearson Education, 2002.*
2	*John H.Davies,**"MSP430 Microcontrollers Basics"**, 1st edition, Elsevier Limited, 2008.*

REFERENCES:

1	Tim Wilmshurst, **"Designing Embedded Systems with PIC microcontrollers-Principles and Applications"**, 1st edition, Newnes Publications, 2007.
2	Martin Bates, **"Interfacing PIC microcontrollers-Embedded Design by Interactive Simulation",** Newnes Publication, 2st edition, 2006.
3	Steven Barrett, Daniel Pack, **"Microcontroller Programming and Interfacing TI MSP430, Part 1",** Morgan and Claypool, 2st edition, 2011.
4	Brock J. LaMeres, **"Embedded Systems Design Using the MSP430FR2355 LaunchPadTM"**,

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the various embedded software tools.	K2
CO2	Explain the fundamental blocks of PIC microcontroller.	K2
CO3	Interface Peripherals with PIC microcontroller.	K3
CO4	Exploit the fundamental blocks of MSP430 microcontroller.	K2
CO5	Interface Peripherals with MSP430 microcontroller.	K3

25WPL6E3	LOW POWER VLSI

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To understand the fundamentals of low power VLSI design, power dissipation mechanisms, power estimation and optimization techniques, and to analyze and design energy-efficient circuits and architectures at circuit, logic, and system levels.	
UNIT – I	**PRINCIPLES OF LOW POWER VLSI DESIGN**	**9 periods**
Need for Low power VLSI chips - Sources of Power Dissipation – Dynamic Power Dissipation - Charging and Discharging of Capacitance – Short Circuit Current in CMOS Circuits - CMOS Leakage current – Static Current - Basic Principles of Low Power VLSI Design		
UNIT – II	**POWER ANALYSIS**	**9 periods**
Simulation power Analysis - Gate-Level Analysis - Architecture level Analysis – Data Correlation Analysis – Monte Carlo Simulation - Probabilistic Power Analysis Techniques		
UNIT – III	**POWER REDUCTION AT THE CIRCUIT LEVEL**	**9 periods**
Transistor and Gate Sizing – Equivalent Pin Ordering – Network Restructuring and Reorganization – Special Latches and Flip Flops – Low Power Digital Cell Library – Adjustable Device Threshold Voltage		
UNIT – IV	**POWER REDUCTION AT THE LOGIC,ARCHITECTURE AND SYSTEM LEVEL**	**9 periods**
POWER REDUCTION AT THE LOGIC LEVEL: Gate Reorganization – Signal Gating – Logic Encoding – State Machine Encoding – Precomputation Logic. POWER REDUCTION AT THE ARCHITECTURE AND SYSTEM LEVEL: Power and Performance management – Switching Activity Reduction – Parallel Architecture with Voltage Reduction – Flow Graph Transformation		
UNIT – V	**ADVANCED TECHNIQUES**	**9 periods**
Adiabatic Computation - Pass Transistor Logic Synthesis - Power Reduction in Clock Networks - CMOS Floating Node - Low Power Bus-Software power estimation and optimization techniques		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*Gary K Yeap, "**Practical Low Power Digital VLSI Design**", Kluwer academic publishers, 2002.*
2	*Kaushik Roy, Sharat C. Prasad, "**Low Power CMOS VLSI circuit Design**", John Wiley & Sons, 2009.*

REFERENCES:

1	*Kuo J B, Lou J H, "**Low Voltage CMOS VLSI Circuits**", John Wiley & Sons, 2001.*
2	*AP Chandrakasan, RW Brodersen, "**Low Power Digital CMOS Design**", Kluwer Academic Publishers, 1995.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain low power VLSI design principles and CMOS power dissipation.	**K2**
CO2	Apply power estimation and analysis techniques.	**K3**
CO3	Analyze low-power circuit and logic design techniques.	**K4**
CO4	Evaluate architectural and system-level power optimization methods.	**K4**
CO5	Design low-power and energy-efficient VLSI circuits.	**K5**

25WPL6E4	ERROR CONTROL CODING

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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: 0Periods** **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: On 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**

25WPL6E5	MEASUREMENT AND INSTRUMENTATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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 and Hay. Spectrum Analyzers - Wave analyzers - Resonant wave analyzer, Heterodyne wave analyzer - Harmonic distortion analyzers.		
UNIT – IV	**DIGITAL INSTRUMENTS**	**9 periods**
Digital instruments-Classification of Digital instruments - Digital Frequency meter - 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: On 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**

25WPL7E1	INDUSTRIAL IoT AND INDUSTRY 4.0

PREREQUISITES	CATEGORY	L	T	P	C
NIL		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, BLE, Zigbee, MQTT - 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 Things and Industry 4.0****", CRC Press, 1st edition, 2021*
2	*Alasdair Gilchrist,* ***"Industry 4.0: The Industrial Internet of Things",*** *A press, 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*
	Matt Richardson and Shawn Wallace- ***Getting Started with Raspberry Pi****- O'Reilly Media Publishing, 3rd Edition, 2016*

COURSE OUTCOMES: On 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**

25WPL7E2	NETWORK SECURITY

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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.		

TEXT BOOK:

1	*William Stallings,"**Cryptography and Network security: Principles and practice**", Pearson Education, 7th Edition ,2018*
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: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Articulate the network security concepts, attacks and classical cryptographic techniques.	**K2**
CO2	Exploit the various encryption techniques.	**K2**
CO3	Interpret the mathematical foundations of cryptography and public key algorithms.	**K3**
CO4	Analyze authentication, key management techniques and security protocols.	**K3**
CO5	Summarize security mechanisms at application, transport, and network layers along with system security concepts.	**K2**

25WPL7E3	WIRELESS SENSOR NETWORKS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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*
5	*Carlos de Morais Cordeiro, Dharma Prakash Agarwal, **"Ad hoc and Sensor Network: Theory and Applications"**, 2nd Edition, World Scientific Publishing Co, 2011.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Articulate the MAC protocols and Routing in Ad.hoc networks.	**K2**
CO2	Analyze the Transport layer protocols and QOS in Adhoc networks	**K3**
CO3	Exploit the MAC protocols and Routing in Sensor networks	**K2**
CO4	Analyze various security attacks in Wireless Sensor Networks.	**K3**
CO5	Analyzethe different simulation tools in Wireless Sensor Networks.	**K2**

25WPL7E4	NANO ELECTRONICS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To understand the concepts of Nano electronic devices, fabrication and measurement techniques, tunneling and superconducting devices.	
UNIT – I	**INTRODUCTION TO NANO TECHNOLOGY**	**9 periods**
Microelectronics towards biomolecule electronics - Particles and waves - Wave-particle duality - Wave mechanics - Schrödinger wave equation-Wave mechanics of particles: Atoms and atomic orbitals - Materials for nano electronics- Semiconductors- Crystal lattices: Bonding in crystals- Electron energy bands- Semiconductor hetero structures- Lattice-matched and pseudo-morphic hetero structures - Inorganic-organic hetero structures		
UNIT – II	**FABRICATION AND MEASUREMENT TECHNIQUES**	**9 periods**
Growth, fabrication, and measurement techniques for nanostructures- Bulk crystal and heterostructure growth-Nanolithography, etching, and other means for fabrication of nanostructures and nano devices Techniques for characterization of nanostructures- Spontaneous formation and ordering of nanostructures-Clusters and nano crystals- Methods of nanotube growth- Chemical and biological methods for nano scale fabrication- Fabrication of nano-electromechanical systems.		
UNIT – III	**PROPERTIES OF NANO MOLECULES**	**9 periods**
Dielectrics-Ferroelectrics-Electronic Properties and Quantum Effects-Magneto electronics – Magnetism and Magneto transport in Layered Structures-Organic Molecules – Electronic Structures, Properties, and Reactions-Neurons – The Molecular Basis of their Electrical Excitability-Circuit and System Design Analysis by Diffraction		
UNIT – IV	**NANO STRUCTURE DEVICES**	**9 periods**
Electron transport in semiconductors and nanostructures- Time and length scales of the electrons in solids-Statistics of the electrons in solids and nanostructures- Density of states of electrons in nanostructures-Electron transport in nanostructures-Electrons in traditional Low-dimensional structures Electrons in quantum wells-Electrons in quantum wires- Electrons in quantum dots- Nanostructure devices.		
UNIT – V	**LOGIC DEVICES AND APPLICATIONS**	**9 periods**
Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport Devices Based on Resonant Tunneling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-Quantum Computing Using Superconductors-Carbon Nanotubes for Data Processing Molecular Electronics		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Vladimir V.Mitin, Viatcheslav A Kochelap, Michael A.Stroscio,* ***"Introduction to Nano electronics:Science, Nanotechnology, Engineering, and Applications"****, Cambridge University Press 2011.*
2	*Supriyo Datta,* ***"Lessons from Nanoelectronics:A New Perspective on Transport"****, World Scientific 2012.*

REFERENCES:

1	*George W.Hanson,**"Fundamentals of Nanoelectronics"**, Pearson 2009*
2	*Korkin, Anatoli;Rosei, Federico(Eds.),**"Nanoelectronics and Photonics"**, Springer2008*
3	*Mircea Dragoman, Daniela Dragoman, **"Nanoelectronics: principles and devices"**, CRC Press 2006*
4	*Karl Goser, Peter Glösekötter, Jan Dienstuhl, **"Nano electronics and Nano systems: From Transistors to Molecular and Quantum Devices"**, Springer 2004.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basics of nanotechnology.	**K1**
CO2	Describe the different fabrications methods.	**K2**
CO3	Explain the behavior of nano materials and related structures.	**K2**
CO4	Identify the significance of nano structure devices and logic circuits.	**K3**
CO5	Discuss the different superconducting devices.	**K2**

25WPL7E5	DIGITAL IMAGE PROCESSING

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To learn the fundamental steps and components of image processing and understand image enhancement, restoration, and compression techniques.	
UNIT – I	**DIGITAL IMAGE FUNDAMENTALS**	**9 periods**
Elements of visual perception, Image sensing and acquisition, Sampling and quantization, Basic relationships between pixels.		
UNIT – II	**IMAGE TRANSFORMS**	**9 periods**
2D DFT, Discrete Cosine Transform, Walsh transform, Hadamard transform, Haar transform, Slant transform- Wavelet transforms and its applications.		
UNIT – III	**IMAGE ENHANCEMENT**	**9 periods**
Spatial domain:Gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters. Frequency domain: Filtering, Smoothing and Sharpening frequency domain filters.		
UNIT – IV	**IMAGE RESTORATION AND SEGMENTATION**	**9 periods**
Noise models, Restoration in the presence of noise, Inverse filtering, Wiener filtering. Segmentation: Point, Line and Edge detection, Thresholding, Region-based segmentation.		
UNIT – V	**IMAGE COMPRESSION**	**9 periods**
Fundamentals, Image compression models, Huffman coding, Arithmetic coding, LZW coding, Predictive coding, JPEG and MPEG standards.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Rafael C. Gonzalez, Richard E. Woods, **"Digital Image Processing"**, 4th Edition, Pearson Education, 2018.*
2	*S. Jayaraman, S. Esakkirajan, T. Veerakumar, **"Digital Image Processing"**, 2nd Edition, Tata McGraw Hill, 2015.*

REFERENCES:

1	*Anil K. Jain, **"Fundamentals of Digital Image Processing"**, 1st Edition, Pearson Education, 2015.*
2	*Kenneth R. Castleman, **"Digital Image Processing"**, 1st Edition, Pearson Education, 2007.*
3	*William K. Pratt, **"Digital Image Processing"**, 4th Edition, John Wiley & Sons, 2007.*
4	*Anil K. Jain, **"Fundamentals of Digital Image Processing"**, 1st Edition, Pearson Education, 2015.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply various transforms on digital images for frequency domain analysis.	**K3**
CO2	Evaluate the performance of image enhancement and segmentation algorithms.	**K5**
CO3	Analyze image restoration techniques for noise removal.	**K4**
CO4	Implement image compression algorithms for data storage and transmission.	**K3**
CO5	Understand the fundamentals of digital image acquisition and representation.	**K2**

25WPL7E6	COMPUTER VISION

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To understand the basic concepts and algorithms of computer vision and study the feature detection, matching, and motion analysis.	
UNIT – I	**IMAGE FORMATION**	**9 periods**
Geometric primitives and transformations, Photometric image formation, The digital camera, Camera calibration.		
UNIT – II	**FEATURE DETECTION AND MATCHING**	**9 periods**
Points and patches: Feature detectors, Feature descriptors, Feature matching. Edges: Edge detection, Edge linking. Lines: Hough transform.		
UNIT – III	**SEGMENTATION**	**9 periods**
Active contours, Split and merge, Mean shift and mode seeking, Normalized cuts, Graph cuts and energy-based methods.		
UNIT – IV	**OBJECT RECOGNITION**	**9 periods**
Object detection, Face detection, Pedestrian detection, Face recognition, Instance recognition, Categorization.		
UNIT – V	**MOTION ANALYSIS**	**9 periods**
Motion estimation, Optical flow, Structure from motion, Dense motion estimation, Object tracking, Video surveillance.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*Richard Szeliski,* ***"Computer Vision: Algorithms and Applications"****, 2nd Edition, Springer, 2022.*
2	*D.A. Forsyth and J. Ponce,* ***"Computer Vision: A Modern Approach"****, 2nd Edition, Pearson Education, 2012.*

REFERENCES:

1	*E.R. Davies,* ***"Computer and Machine Vision: Theory, Algorithms, Practicalities"****, 4th Edition, Academic Press, 2012.*
2	*Simon J.D. Prince,* ***"Computer Vision: Models, Learning, and Inference"****, 1st Edition, Cambridge University Press, 2012.*
3	*Gary Bradski and Adrian Kaehler,* ***"Learning OpenCV: Computer Vision with the OpenCV Library"****, 1st Edition, O'Reilly Media, 2008.*
4	*David Marr,* ***"Vision: A Computational Investigation into the Human Representation and Processing of Visual Information"****, 1st Edition, MIT Press, 2010.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Develop algorithms for image alignment and stitching.	**K2**
CO2	Implement object recognition and tracking models for real-world applications.	**K4**
CO3	Analyze feature detection and matching techniques for image understanding.	**K2**
CO4	Evaluate segmentation methods for partitioning images into meaningful regions.	**K3**
CO5	Understand motion estimation and optical flow for video analysis.	**K3**

25WPL7E7	DISPLAY SYSTEMS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objective	To understand the basics of the display systems and to illustrate the recent design practices of the display systems.	
UNIT–I	**INTRODUCTION**	**9Periods**
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 – Photolithography - Pixels, Pixel geometry, Array of Pixel - Size, resolution, Aspectratios, color depth, standard definition.		
UNIT–II	**DISPLAY TECHNOLOGIES**	**9Periods**
Passive and Active matrix driving technology – Direct driving – Transistors witch addressing - Field emission Displays - Plasma display - Application, Display technology dependant issues.		
UNIT–III	**LCD DISPLAYS**	**9Periods**
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 trans reflective types-LCD Panel – Panel interfacing – micro to Gigantic displays.		
UNIT–IV	**ELECTRO LUMINESCENT DISPLAYS**	**9Periods**
Electro luminescence from inorganic PN Junction diode – Display panel structures – Driving pixels-TFT switching - panel interfacing – Electro luminescence from organic semiconductor – Organic display devices - Green technologies in displays - Low power consumption- Applications.		
UNIT–V	**ADVANCED DISPLAY DEVICES**	**9Periods**
Next generation of Flexible Displays - 3D Displays, MEMS Based Displays – Auto stereoscopic 3D Cinematechnology – Quantum dot-based displays – Hybrid displays – Cost effective display marketing.		
Contact Periods: **Lecture:45Periods** **Tutorial:0Periods** **Practical:0Periods** **Total:45Periods**		

TEXTBOOKS:

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	*PeterA.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 Displays**",Wiley,1999*
4	*Recent literature in Display Systems*

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret basic display parameters and light properties.	**K2**
CO2	Compare different technologies used in display systems	**K3**
CO3	Discuss the operation and functionality of TFTs and LCD displays	**K2**
CO4	Analyze the features of various electroluminescent display technologies.	**K4**
CO5	Describe the developments in modern display device technologies.	**K2**

25WPL7E8	PROGRAMMING FPGA USING HDLs

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	To code digital function in Verilog HDL and Systemverilog as synthesizable and non-synthesizable	
UNIT – I	**INTRODUCTION TO VERILOG, GATE AND DATAFLOW MODELING**	**9 Periods**
Hierarchical Modeling – Basic concepts – Modules and ports - Gate Level Modeling - Dataflow Modeling.		
UNIT – II	**BEHAVIORAL MODELING AND TASKS**	**9 Periods**
Behavioral Modeling, Switch Level Modeling, Tasks and Functions: Difference between tasks and functions, declaration, invocation, Useful Modeling Techniques.		
UNIT – III	**SYSTEMVERILOG**	**9 Periods**
Introduction, SystemVerilog declaration spaces, SystemVerilog Literal Values and Built-in Data Types, SystemVerilog User-Defined and Enumerated Types, system Verilog Arrays, Structures and Unions.		
UNIT – IV	**SYSTEM VERILOGMODELING**	**9 Periods**
Systemverilog Procedural Blocks, Tasks and Functions, System Verilog Procedural Statements, Modeling Finite State Machines with SystemVerilog.		
UNIT – V	**INTERFACES AND DESIGN MODEL**	**9 Periods**
SystemVerilog Interfaces, A Complete Design Modeled with SystemVerilog, Behavioral and Transaction Level Modeling.		
Contact Periods: **Lecture:45Periods** **Tutorial:0 Periods** **Practical:0Periods** **Total:45Periods**		

TEXT BOOK:

1	*Samir Palnitkar, "**Verilog HDL**", 2nd Edition, Pearson Education, 2009.*
2	*StuartSutherland, Simon Davidmann, Peter Flake, Forewordby PhilMoorby, "**SystemVerilog for Design Second Edition A Guide to Using SystemVerilog for HardwareDesignand Modelling"**, Springer 2006.*

REFERENCES:

1	*T.R.Padmanabhan, B BalaTripuraSundari, "**Design through Verilog HDL"**, Wiley 2009.*
2	*Zainalabdien Navabi, "**Verilog Digital System Design"**, TMH, 2nd Edition,2005.*
3	*System Verilog 3.1a, Language Reference Manual, Accellera, 2004*
4	*Dr.S Ramachandran, "**Digital VLSI Systems Design A Design Manual for Implementation of Projects on FPGAs and ASICs using Verilog**", Springer, 2014.*
5	*Chris Spear, "**Systemverilog for verification a guide to learning the testbench Language Features**", Springer 2006.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the verilog coding and simulate any digital function using Verilog HDL	**K2**
CO2	Develop modeling based on tasks and functions using Verilog HDL code	**K3**
CO3	Explain the systemverilog modeling	**K2**
CO4	Develop modeling based on FSM using systemverilog HDL code	**K3**
CO5	Apply good coding techniques on systemverilog interfaces and complete design model	**K3**

25WPL7E9	SOFTWARE DEFINED RADIO

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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 inCognitive 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, decideand 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, SDN and NFV.		
Contact Periods: **Lecture: 45Periods Tutorial: 0 Periods Practical: 0Periods Total: 45 Periods**		

TEXT BOOK

1	*Joseph Mitola III, "**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"**, IEEEJournal 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**", JohnWiley, 2003.*
4	*Huseyin Arslan, "**Cognitive Radio, SDR and Adaptive System**", Springer, 2007.*
5	*Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "**Cognitive Radio Communication and Networks**", Elsevier, 2010.*
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: On 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**

25WPL7E10	INTRODUCTION TO MEMS

PREREQUISITES	CATEGORY	L	T	P	C
NIL		3	0	0	3

Course Objectives	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 – Energy Domains and Transducers– Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – 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 - Advanced Lithography - LIGA process -Multi User MEMS Process.		
UNIT – III	**ELECTROSTATIC SENSORS**	**9 periods**
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Magnetic Actuators.		
UNIT – IV	**MAGNETOSTATIC SENSORS**	**9 periods**
Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – 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 and Retinal Scanning Displays (RSD), Grating Light Valve (GLV), Digital Micromirror Devices (DMD), 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 BOOK:

1	*Chang Liu,* ***"Foundations of MEMS"****, Pearson Education Inc., 2nd edition 2006.*
2	*Stephen D Senturia,* ***"Microsystem Design"****, Springer Publication,1st edition 2000*

REFERENCES:

1	*Julian W.Gardner, Vijay K.Varadan, Osama O. Awadel Karim,* ***"Micro sensors MEMS and Smart Devices"****, John Wiby & sons Ltd., 1st edition 2001.*
2	*Mohamed Gad – el – Hak,* ***"MEMS Handbook",*** *CRC Press, 2nd edition 2002.*
3	*Rai - Choudhury P.* ***"MEMS and MOEMS Technology and Applications",*** *PHI Learning Private Limited, 1st edition 2009.*
4	*Sabrie Solomon,* ***"Sensors Handbook,"*** *2nd edition McGraw Hill, 1998.*
5	*Marc F Madou,* ***"Fundamentals of Micro Fabrication",*** *CRC Press, 2nd Edition, 2002.*
6	*Tai Ran Hsu,* ***"MEMS & Micro systems Design and Manufacture"*** *2nd edition Tata McGraw Hill, New Delhi, 2002.*

COURSE OUTCOMES: On 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.	**K3**
CO4	Analyse the various magnetostatic sensors.	**K3**
CO5	Illustrate the case studies of MEMS.	**K3**