Four Year Degree Course in Bachelor of Engineering
Branch: **Electronics & Telecommunication Engineering**
Semester Pattern (Credit Grade System)

Semester : Third																
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**								
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**			
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																
01	3ET1	Engineering Mathematics-III	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	3ET2	Object Oriented Programming	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	3ET3	Electronic Devices and Circuits	4	--	--	4	4	3	80	20	100	40	--	--	--	--
04	3ET4	Instrumentation and Sensors	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	3ET5	Electromagnetic fields	4	1	--	5	5	3	80	20	100	40	--	--	--	--
06	3ET6	Environmental Science	2	--	--	2	--	--	--	--	--	--	-	-	-	-
PRACTICALS / DRAWING / DESIGN																
07	3ETp7	Object Oriented Programming Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	3ETp8	Electronic Devices and Circuits Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	3ETp9	Skill Development Lab-I (Measurements, Testing & Instrumentation)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**24**	**2**	**6**	**32**	**26**	--	--	--	**500**	--	--	--	**200**	**--**
														Total	**700**	

Semester : Fourth																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																	
01	4ET1	Signals and Systems	4	1	--	5	5	3	80	20	100	40	--	--	--	--	
02	4ET2	Network Analysis	4	1	--	5	5	3	80	20	100	40	--	--	--	--	
03	4ET3	Analog Electronics-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
04	4ET4	Digital Electronics	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
05	4ET5	Communication Engg.-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
06	4ET6	Environmental Science	2	--	--	2	--	3	--	--	--	--	--	--	--	--	
PRACTICALS / DRAWING / DESIGN																	
07	4ETp7	Analog Electronics-I Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
08	4ETp8	Digital Electronics Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
09	4ETp9	Communication Engg.-I Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
10	4ETp10	Skill Development Lab-II (Software)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)	
		Total	**24**	**2**	**8**	**34**	**27**	--	--	--	**500**	--	--	--	**250**	**--**	
														Total	**750**		

Semester : Fifth																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																	
01	5ET1	Analog Electronics-II	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	5ET2	Power Electronics & Drives	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	5ET3	Micro Processor & Micro Controller	4	1	--	5	5	3	80	20	100	40	--	--	--	--
04	5ET4	Communication Engg.-II	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	5ET5	Free Elective-I	3	--	--	3	3	3	80	20	100	40	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
06	5ETp6	Analog Electronics-II Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
07	5ETp7	Power Electronics & Drives Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	5ETp8	Micro Processor & Micro Controller Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	5ETp9	Skill Development Lab-III (Simulation)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**21**	**2**	**8**	**31**	**26**	--	--	--	**500**	--	--	--	**250**	**--**
														Total	**750**		

Free Elective-I:

1.Electronic Test Instruments 2. Satellite& Optical Fiber Communication

Semester : Sixth																	
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME									
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY					PRACTICAL				
			Lecture	Tutorial	P/D			Duration Of Paper (Hr.)	Max. Marks Theory Paper	Internal Marks	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
													Int.	Ext.		
THEORY																	
01	6ET1	Microcontroller Programming & Applications	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	6ET2	Control Systems Engineering	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	6ET3	Digital Communication	4	1	--	5	5	3	80	20	100	40	--	--	--	--
04	6ET4	Digital Signal Processing	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	6ET5	Free Elective-II	3	--	--	3	3	3	80	20	100	40	--	--	--	--
06	6ET6	Communication Skills	2	--	--	2	--	--	40	10	50	20	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
07	6ETp7	Digital Communication Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	6ETp8	Digital Signal Processing Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	6ETp9	Communication Skills Lab	--	--	2	2	1	--	--	--	--	--	15	10	25	12
10	6ETp10	Skill Development Lab-IV (Hardware)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**23**	**2**	**8**	**33**	**26**	--	--	--	**550**	--	--	--	**225**	**--**
														Total	**775**		

Free Elective-II:

1.Consumer Electronics

2. Introduction to Wireless Technology

Semester : Seventh																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**	
													Int.	**Ext.**			
THEORY																	
01	7ET1	VLSI Design	4	1	--	5	5	3	80	20	100	40	--	--	--	--	
02	7ET2	Digital Image Processing	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
03	7ET3	Satellite & Optical Fiber Communication	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
04	7ET4	Industrial Management & Quality Control	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
05	7ET5	Professional Elective-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
PRACTICALS / DRAWING / DESIGN																	
06	7ETp6	VLSI Design Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
07	7ETp7	Skill Development Lab-V (Signal & Image Processing)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)	
08	7ETp8	Project	--	--	2	2	--	--	--	--	--	--	--	--	--	--	
09	7ETp9	Seminar	--	--	2	2	2	--	--	--	--	--	50	--	50	25	
		Total	**22**	**1**	**8**	**31**	**26**	--	--	--	**500**	--	--	--	**200**	**--**	
														Total	**700**		

Professional Elective-I:

1. Computer Organization
2. PLC & Automation
3. Smart Sensor
4. Fuzzy Logic &Artificial Neural Network
5. Speech Processing
6. RF Modeling & Antenna

Semester : Eight																	
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME									
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY					PRACTICAL				
			Lecture	Tutorial	P/D			Duration Of Paper (Hr.)	Max. Marks Theory Paper	Internal Marks	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
													Int.	Ext.		
THEORY																	
01	8ET1	UHF & Microwaves	4	--	--	4	4	3	80	20	100	40	--	--	--	--
02	8ET2	Wireless Communication	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	8ET3	Data Communication Network	4	--	--	4	4	3	80	20	100	40	--	--	--	--
04	8ET4	Professional Elective-II	4	--	--	4	4	3	80	20	100	40	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
05	8ETp5	UHF & Microwave Lab	--	--	2	2	1	--	--	-- --	--	--	25	25	50	25
06	8ETp6	Skill Development Lab-VI (Networking)	2	--	2	4	2	--	--	-- --	--	--	50	50	100	25(Int.) 25(Ext)
07	8ETp7	Project	--	--	4	4	6	--	--	--	--	--	75	75	150	75
		Total	**18**	**--**	**8**	**26**	**25**	--	--	--	**400**	--	--	--	**300**	**--**
												Total			**700**	

ProfessinalElective-II:

1. Embedded System & RTOS
2. Automotive Electronics
3. Wireless Sensor Network
4. Biomedical Engineering
5. Data Compression & Encryption
6. Ultra Wide Band Communication

Semester : Third																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**	
													Int.	**Ext.**			
THEORY																	
01	3ET1	Engineering Mathematics-III	4	1	--	5	5	3	80	20	100	40	--	--	--	--	
02	3ET2	Object Oriented Programming	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
03	3ET3	Electronic Devices and Circuits	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
04	3ET4	Instrumentation and Sensors	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
05	3ET5	Electromagnetic fields	4	1	--	5	5	3	80	20	100	40	--	--	--	--	
06	3ET6	Environmental Science	2	--	--	2	--	--	--	--	--	--	-	-	-	-	
PRACTICALS / DRAWING / DESIGN																	
07	3ETp7	Object Oriented Programming Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
08	3ETp8	Electronic Devices and Circuits Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25	
09	3ETp9	Skill Development Lab-I (Measurements, Testing & Instrumentation)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)	
Total			**24**	**2**	**6**	**32**	**26**	--	--	--	**500**	--	--	--	**200**	**--**	
Total															**700**		

Subject (Th): 3ET1 - ENGINEERING MATHEMATICS-III

Course Requisite:

1. (IA1) Engineering Mathematics-I
2. (IB1) Engineering Mathematics-II

Course Objectives:

1. Introduction to geometry of curves, two and three-dimensional regions and calculus of vector-valued functions.
2. To deal with system of differential and difference equations in the study of electrical/electronic and mechanical systems.
3. To equip students with necessary knowledge and skills to enable them to handle mathematical operations, analysis and problems involving complex numbers.
4. Understand the computational details behind certain numerical methods and their convergence.
5. Understand Laplace and Fourier transform

Course Outcomes:

After successfully completing the course, the students will be able to

1. Solve contour integration as applied to analog systems.
2. Comprehend knowledge of complex analysis in terms of complex variables, harmonic functions and conformal mapping.
3. Apply numerical methods to obtain approximate solutions to mathematical problems.
4. Demonstrate the knowledge of differential equations to solve engineering problems of analog systems.
5. Identify and solve certain forms of partial difference equations as applied to discrete systems.
6. Apply Laplace transform to solve differential equations.

	Subject: ENGINEERING MATHEMATICS-III	**L**
Unit-1	**Vector Calculus:** - Scalar and Vector point functions, Differentiation of vectors, Curves in space, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, expansion formulae (without proof), irrotational and solenoidal vector fields. **Fourier transforms:** Fourier sine and Fourier cosine transforms and integrals	10
Unit-2	**Complex Analysis:** - Functions of complex variables, Analytic function, Cauchy-Reimann conditions, Harmonic function, Harmonic conjugate functions, Milne's method. **Conformal Mappings**: Translation, Rotation, Magnification, Inversion and Bilinear Transformation, singular points, expansion of function in Taylor's and Laurent's series, Cauchy's integral theorem and formula, Residue theorem.	08
Unit-3	**Numerical Methods:** **Solution of Nonlinear and Polynomial Equations**: False Position, Newton Raphson Method. **Solution of Linear Systems Equations:** Gauss Elimination method, Gauss Seidel Iterative Method, Relaxation method **Solution of Differential Equations:** Euler's method, Runge-Kutta method, Picards method.	08
Unit-4	**Ordinary Differential Equations**: - Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations.	10
Unit-5	a) **Difference Equation:-** solution of difference equations of first order, solution of difference equations of higher order with constant coefficient. b) **Partial differential equation of first order of following form**- (i) f (p, q) = 0; (ii) f (p, q, z)=0; (iii) f(x, p) = g (y, q); (iv) Pp + Qq =R (Lagrange's Form); (v) Z=px+qy+f(p, q) (Clairaut form)	08

Unit-6	**Laplace transforms**: definition, standard forms, properties of Laplace transform, inverse Laplace transform, Laplace transform of some basic functions, initial and final value theorem, convolution theorem, Solution of linear differential equations using Laplace transform.	08
	Total	**52**

Text Books:

1. Elements of Applied Mathematics by P. N. Wartikar and J. N. Wartikar. Poona Vidhyarthi Publisher
2. Higher Engineering Mathematics by B.S.Grewal. Khanna Publishers
3. Introduction to method of Numerical Analysis- S. S. Shastry, Second Edition, PHI Pvt. Ltd.,New Delhi.

References:

1. A Mathematical Companion for Science and Engineering Students – Brettenbach, Oxford University Press, 2008
2. Advancing Engg. Mathematics, E.K.Kreyzig, John Wiley
3. Numerical Method for Mathematics Science and Engineering, John H. Mathew, PHI
4. Numerical Methods - Principles, Analysis & Algorithms Pal, Oxford University Press, 2008
5. Numerical Methods for Engineers and Scientists – Guha, Oxford University Press 2008

Subject (Th): 3ET2 - OBJECT ORIENTED PROGRAMMING

Course Requisite:

1. (IB3) Computer Programming.

Course Objectives:

1. To learn object oriented concepts and build simple applications using C++ and Java.
2. To understand the basic concepts and techniques which form the object oriented programming paradigm

Course Outcomes:

After successfully completing the course, the students will be able to

1. Justify the basics of object-oriented programming concepts such as data types, functions, classes, objects, constructors, inheritance, overloading etc.
2. Design, implement, test, and debug simple programs in C++.
3. Describe how the class mechanism supports encapsulation and information hiding.
4. Design and test the implementation of Java programming concepts

	Subject: OBJECT ORIENTED PROGRAMMING	**L**
Unit-1	Principles of object oriented Programming: OOP'S paradigm, basic concept of OOP'S, benefits of OOP'S, structure of C++ programming, basic data types, user defined data type, derived data type operator and control statement.	8
Unit-2	Functions classes and object in C++: Functions, Function over loading, Friend Functions, types of classes and its use, concept of object and its implementation, constructor and destructors.	8
Unit-3	Operator and their definition, overloading unary and binary operator, rules for overloading operators, overloading binary operators using friends and string manipulation. Concept of Inheritance in C++	10
Unit-4	Introduction to Java programming, JVM, Java programming constructs: variables, primitive data types, identifier, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.	8
Unit-5	Classes and Objects: Classes, Objects, Creating Objects, Methods, Constructors, Cleaning up unused Objects, Class variable and methods, "this" keyword, Arrays, Command line arguments	8
Unit-6	Multiple Inheritance in Java, Defining interfaces, Extending interfaces, Implementing interfaces, Accessing interface variables.	10
	Total	**52**

Text Books:

1. E Balagurusamy, "Object Oriented Programming Using C++ and JAVA", Tata McGraw-Hill.
2. E Balagurusamy, "Object Oriented Programming Using C++" ,Tata McGraw-Hill.

References:

1. Bjarne Stroustrup, "C++ Programming Language", Pearson Education.
2. H.M.Dietel and P.J.Dietel, "Java How to Program" Pearson Education/PHI, Sixth Edition.
3. Robert Lafore, "Object-Oriented Programming in C++ ",Pearson Education India , (4th Edition).
4. Herbert Schildt , "Java : The Complete Reference" Tata McGraw-Hill (7th Edition).
5. Yeshwant Kanetkar "Let us C++", BPB Publications.
6. Dr. N.B. Vekateswarlu, Dr. E.V. Prasad, "Learn Object Oriented Programming Using Java: An UML Based", S. Chand Publication.

Subject (Th): 3ET3 - ELECTRONIC DEVICES AND CIRCUITS

Course Requisite:

1. (IA2) Engineering Physics

Course Objectives:

1. To provide an overview of the principles and operation of electronic devices.
2. To explore use of electronic devices for various applications in electronic circuits.
3. To analyze various electronic circuits.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Comprehend the knowledge of diode and its applications in rectifier and regulator circuits.
2. Understand basics of BJT, JFET, MOSFET, UJT and their operational parameters.
3. Understand feedback concept, topologies and their applications.
4. Implement and analyze various electronic circuits.

	Subject: ELECTRONIC DEVICES AND CIRCUITS	**L**
Unit-1	**PN diode** : Formation of p-n junction, biasing the diode, current equation and V-I characteristics of diode, static and dynamic resistance, HWR, FWR, theory of C, L, LC and CLC filters and analysis of C-input filter, Zener diodes, its application as voltage regulator, Construction, working and characteristics of LED, photo diode, Schottky diode, and tunnel diode	10
Unit-2	**Bipolar Junction Transistors** : Operation of PNP and NPN transistor, CB, CE and CC configurations with characteristics and parameters, transistor as an amplifier, transistor biasing methods, dc load line, operating point, bias stability, analysis of various dc bias circuits, small signal analysis of voltage divider biased CE amplifiers using h-parameter model.	10
Unit-3	**Feedback amplifiers**: Feedback concept, effects of negative feedback, basic feedback topologies. **Sinusoidal oscillators**: Barkhausen's criteria, Hartley, Colpitts, RC Phase shift, Wien bridge and crystal oscillators.	8
Unit-4	**Multistage Amplifiers**: Need of multistage, direct coupled amplifier, RC coupled amplifier, transformer coupled amplifier, emitter follower, Darlington emitter follower, bootstrapping principle, Cascode stage.	8
Unit-5	**Power Amplifiers:** Classification, Class A, Transformer coupled Class A, harmonic distortion, Class B, Class AB, crossover distortion, capacitor coupled and direct coupled output stages, modifications to improve power amplifier performance, Class C amplifier and analysis.	8
Unit-6	**JFET:** Theory, construction and characteristics: parameters (μ, gm & rd), biasing of JFET amplifiers. **MOSFET**: Theory, construction and characteristics of enhancement & depletion type MOSFET. **UJT**: Theory, construction and characteristics; UJT as relaxation oscillator.	8
	Total	**52**

Text Books:

1. David Bell: Electronic Devices and Circuits, Oxford University Press, 2010.
2. Milliman and Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi.

References:

1. Robert L.Boylestad, "Electronic Devices and Circuit theory", Publ. Pearson Education.
2. Floyd, "Electron Devices" Pearson Asia 5th Edition, 2001.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.

Subject (Th): 3ET4 - INSTRUMENTATION & SENSORS

Course Prerequisites:

1. (1B4) Electrical Engineering

Course Objectives:

1. To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
2. To understand functional elements of instrumentation/measurement systems.
3. To impart the knowledge of static and dynamic characteristics of instruments.
4. To discuss the principle, design and working of transducers.
5. To impart the knowledge of electronic transducers in industrial applications.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Describe various sensors, transducers and their performance specifications.
2. Understand working principle of various transducers.
3. Make comparative study of various transducers and understand their applications in industry.
4. Understand Data Acquisition Systems.

	Subject: INSTRUMENTATION & SENSORS	**L**
Unit-1	**Basics of Transducers** **Transducer**: Definition, Classification, Selection criteria. Errors, loading effects, Transducer Specifications, calibration, Generalized Instrumentation diagram. **Static characteristics:** Accuracy, Precision, Sensitivity, Threshold, Resolution, Repeatability and Hysteresis. **Errors:** Gross error, Systematic error, Random error, Limiting error. **Statistical Parameters:** Arithmetic mean Average deviation Standard deviation. Probable error, Histogram, Normal & Gaussian curve of errors. [T1,T2]	8
Unit-2	**Measurement of Displacement, Liquid Level.** **Measurement of Displacement:** Resistive, Capacitive, Inductive **Measurement of Liquid Level:** Resistive, Capacitive, Inductive, Ultrasonic, Gamma Rays. [T1,T2]	8
Unit-3	**Measurement of Temperature** **Measurement of Temperature: Resistance temperature detector (RTD)**: Principle, types, Configurations, construction and working of RTD, Material for RTD, advantages, disadvantages and applications of RTD. **Thermistors:** Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications. **Thermocouples:** Principle, thermoelectric effect, See beck effect, Peltier effect, laws of thermocouple, cold junction Compensation method, thermopile, thermocouple emf measurement method. **Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its Applications, LM 335. [T1,T2]	10
Unit-4	**Measurement of Pressure, Flow, Humidity.** **Measurement of Pressure: Primary pressure sensors** - elastic elements like bourdon tube, diaphragm, and bellows. **Electrical/Secondary Pressure Transducers:** Capacitive, piezo-electric and its material, variable reluctance, LVDT. **Differential pressure measurement:** Capacitive. **Low Pressure (Vacuum):** Pirani gauge, thermocouple gauge, hot cathode ionization gauge. **Flow Measurement:** ultrasonic, electromagnetic & hotwire Anemometer.	9

	Humidity Measurement: using resistive, Capacitive & Crystal transducers. [T1,T2]	
Unit-5	**Measurement of Velocity, Strain & Miscellaneous Sensors** **Velocity Measurement:** Using photo detectors (both linear & angular velocity), Stroboscope. **Strain Measurement:** Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges. **Miscellaneous Sensors:** Noise (sound) Sensors-Characteristics of sound, levels of sound pressure, sound power and sound intensity. Smart sensors: Objective, block diagram, advantages and disadvantages. [T1,T2,T3]	9
Unit-6	**Data acquisition and applications of Electronic Instruments** **Analog & Digital data acquisition system**.: Generalized block diagram of data acquisition system(DAS), objective of DAS, signal conditioning of inputs, single channel DAS, Multichannel DAS, computer based DAS Digital transducer: optical encoders, shaft encoders pH and blood pressure measurement. [T1,T2,T3]	8
	Total	**52**

Text Books:

1. H. S. Kalsi, Electronic Instrumentation, McGraw Hill Education Pvt Ltd., New Delhi, 1995.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999
3. B.C.Nakra and K.K.Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.

Reference Books:

1. David A. Bell, Electronic Instrumentation and Measurements, Third Edition, Oxford Higher Education,
2. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.
4. Ernest O.Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.

Subject (Th): 3ET5 - ELECTROMAGNETIC FIELDS

Course Requisite:

1. (IA1) Engineering Mathematics-I
2. (IB1) Engineering Mathematics-II
3. (3ET1) Engineering Mathematics-III

Course Objectives:

1. To understand fundamentals of orthogonal coordinate systems and interrelation with 1-D, 2-D & 3-D vectors.
2. To impart knowledge of Static Electric & Magnetic Field and the associated laws.
3. To analyze time varying electric and magnetic fields at various boundary conditions.
4. To understand concepts of propagation of EM waves.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Apply vector calculus to understand the behavior of static electric and magnetic fields.
2. Formulate and solve problems in electrostatics and magnetostatics in dielectric media.
3. Describe and analyze electromagnetic wave propagation in free-space.
4. Analyze plane electromagnetic waves at boundaries between homogeneous media.
5. Analyze the electromagnetic radiation from localized charges considering retardation effects.

	Subject: ELECTROMAGNETIC FIELDS	**L**
Unit-1	**Review of Vector Analysis:** Cartesian, Cylindrical and Spherical Co-ordinate Systems, Vector products, Projection of Vectors, Gradient, Divergence and Curl, line, surface, volume integrals, Divergence Theorem and Stokes theorem.	9
Unit-2	**Electrostatics**: Coulomb's Law, Electric field intensity, Evaluation of Electric field intensity due to line charge, Surface charge and Volume charge distribution, Electric flux and Electric flux density, Gauss Law, Electrostatic potential, Potential gradient, Electric dipole and Polarization.	8
Unit-3	**Magnetostatics:** Biot–Savart Law, Ampere's Circuital Law, Magnetic field intensity, Magnetic field intensity evaluation due to infinite, finite and circular current carrying conductors, Magnetic flux and Flux density, Magnetic dipole and Magnetization.	9
Unit-4	**Boundary Conditions & Maxwell's Equations:** Boundary condition at Dielectric – Conductor interface, Dielectric – Dielectric interface, Boundary conditions for magnetic materials interface, Current continuity equation, Maxwell's equations.	8
Unit-5	**Electromagnetic wave propagation:** Electromagnetic wave equation for free space, lossy dielectric material and perfect conductor, Propagation constant, Attenuation constant & Phase shift constant, Skin depth, Poynting Theorem, Reflection of a plain wave in a normal incidence at Dielectric – Dielectric interface, Dielectric – Conductor interfaces.	10
Unit-6	**Radiation:** Scalar and Vector magnetic potential, Retarded potential, Electric & Magnetic fields, Power radiated and Radiation resistance due to oscillating dipole, Quarter wave monopole & Half wave dipole.	8
	Total	**52**

Text Books:

1. Hayt W.H.: "Engineering Electromagnetic" Tata Mc Grawhill
2. Jordan E.C. and Balamin K.C.: "Electromagnetic Waves and Radiating System " Prentice Hall of India Private Limited

References:

1. Mathew N.O., Sadiku "Principles of Electromagnetics" (Fourth Edition), Oxford University Press
2. Kranss J.D.: "Electromagnetic" Mc Grawhill Books co. (Third Edition)
3. Ramo S. and Whinnery R.: "Fields and Waves in Communication Electronics" John Wiley and sons, New Delhi.
4. Dr. TVS Arun Murthy, "Electromagnetic Fields(Theory & Problems)"S.Chand & Company Ltd.

Subject (Pr): 3ETp7 - OBJECT ORIENTED PROGRAMMING

Course Requisite:

1. (IB3) Computer Programming
2. (3ET2) Object Oriented Programming

Course Objectives:

1. Design, implement, test, and debug simple programs in an object-oriented programming language.
2. Design and test the implementation of C++ programming concepts.
3. Design and test the implementation of java programming concepts.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Justify the basics of object-oriented design and the concepts of encapsulation, abstraction, inheritance, and polymorphism
2. Design, implement, test, and debug simple programs in an object-oriented programming language.
3. Describe how the class mechanism supports encapsulation and information hiding.
4. Design and test the implementation of C++ and java programming concepts.

	Experiment List
Expt-1	Write a C++ program using Scope resolution operator
Expt -2	Write a C++ program to swap two variables a) Using third variable b) Without using third variable
Expt -3	Write a C++ program using function overloading and constructor overloading
Expt -4	Write a C++ program using friend function.
Expt -5	Write a C++ program to overload unary operator for inverting the value of data variable using member function
Expt -6	Write a java program to Calculate Circle Area using Java
Expt -7	Write a program to find Largest and Smallest Number in an Array using java
Expt -8	Write a java program to find factorial of a number
Expt -9	Write a java program to swap two variables a) Using third variable b) Without using third variable
Expt-10	Introduction to MySQL **Objectives:** a) To learn MySQL database b) To learn how to create databases and tables in MySQL server
Expt-11	Introduction to servlet programming in Java **Objectives:** a) To learn servlet concept in advance java b) To learn structure of a servlet

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 3ETp8 - ELECTRONIC DEVICES AND CIRCUITS - LAB

Course Requisite:

1. (IA2) Engineering Physics
2. (3ET3) Electronic Devices and Circuits

Course Objectives:

1. To verify characteristics of various semiconductor devices.
2. To determine and verify various performance parameters of electronic devices and circuits.
3. To provide basic experimental exposure about operation and applications of electronic devices.

Course Outcomes:

1. Acquiring basics of parameters and operation of various semiconductor devices.
2. Implementation of basic circuits using electronic devices.
3. Verification and analysis of performance of electronic circuits.

	Experiment List
Expt-1	To verify V-I characteristics of p-n junction diode and obtain static and dynamic resistance values.
Expt -2	To obtain the efficiency and ripple factor of half-wave, full-wave rectifiers without and with filters (C-input filter).
Expt -3	To verify of Zener diode as a voltage regulator.
Expt -4	To verify characteristics of CE mode of BJT and compute its parameters.
Expt -5	To demonstrate voltage divider biasing of CE mode of BJT and determine operating point.
Expt -6	To Compute theoretical and practical frequency of oscillation of RC Phase shift and Hartley oscillators.
Expt -7	To obtain frequency response of RC coupled amplifier and verify cut off frequencies and bandwidth.
Expt -8	To Compute theoretical and practical gain and efficiency of class B / class AB power amplifier.
Expt -9	To plot the drain and transfer characteristics of JFET (Junction Field Effect Transistor) and calculate rd, gm and μ.
Expt -10	To plot the characteristics of UJT and to calculate the Intrinsic Stand-Off Ratio (η).

* Minimum 8 experiments based on/relevant to the above list.

Subject(Th): 3ETp9 - SKILL DEVELOPMENT LAB-I (Measurements, Testing & Instrumentation)

Course Requisite:

1. (IB4) Electrical Engineering
2. (3ET4) Instrumentation & Sensors

Course Objectives:

1. To understand different types of electronic testing and measuring equipments.
2. To understand use of various signal/function generators and analyzers used in electronics measurements.
3. Use of transducers/sensors for measurements of various physical parameters.
4. To understand PCB design and fabrication.

Course Outcomes:

After successfully completing the course, the students will able to

1. Understand the principles and operation of different measuring instruments
2. Select the appropriate instrument for measurement and observe, read and interpret the values from different measurements.
3. Read the specifications from datasheets and learn the precautions & applications of the instruments.
4. Explore use of various transducers/sensors in measurement of various physical parameters.
5. Design the PCB layout and prepare PCB for given circuit.
6. Develop the skill of mounting /demounting components and testing of developed circuits.

	Theory:	**L**
Unit-1	**Digital Meters and Function/Signal Generators** **(a) Digital Meters**: Resolution, Sensitivity and Accuracy of digital display. Commercial Digital Multimeter- Block Diagram and operation. Voltage, Current, Resistance measurement and component testing using DMM. Auto zeroing, Auto ranging in digital instruments. LCR Q meter- Circuit diagram and operation. Digital frequency meter- Block Diagram and operation. Analog and Digital IC tester. **(b) Function/Signal Generators:** Signal generator-AF and RF type- Block diagram and operation. Function generator and pulse generator- Block diagram and operation. Arbitrary waveform generator- Block diagram and operation, Power supplies- Single, Dual and SMPS.	9
Unit-2	**Oscilloscope and Analyzers :-** **(a)** Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, CRO Probes, Lissajous method of phase measurement, standard specifications of CRO. Oscilloscope operating precautions. Digital storage oscilloscope: Block diagram of Digital storage oscilloscope. Difference between CRO and DSO. **(b) Analyzers-** Concept of time domain and frequency domain instruments, Wave Analyzers, Harmonic Distortion Analyzers, Spectrum Analyzer, Logic analyzer, Network Analyzer.	9
Unit-3	**PCB Design :-** Basics of Electronic Component layout, PCB material, Properties and specifications, Basic manufacturing process of PCB, Soldering and De-soldering Techniques.	8
	Total	**26**

	*Experiment List
Part: A-Electronics Measurement and Testing	
Expt-1	To explore the use of Digital Multi-meter for various parameter measurements and testing of the various components.
Expt -2	To explore the use of LCR- Q meter for the measurement of Resistance (R), Inductance (L), capacitance(C) and quality factor (Q) of a coil using LCR-Q meter.
Expt -3	To explore the front panel controls and specifications of typical CRO and measurement of amplitude, frequency, phase difference of the test signal using CRO and observe Lissagous pattern.
Expt -4	Testing of various components using CRO.
Expt -5	To explore the control panel of AF/RF signal/ function generator available in the lab to observe the various types of signal waveforms along with their range using CRO.
Expt -6	To explore the use of Digital Storage Oscilloscope [DSO] and to verify Half wave/ Full wave/ rectifier and Clamper circuits using DSO
Expt -7	To explore front panel controls and specifications of a typical spectrum analyzer for observing spectrum of various test signals.
Expt -8	Study and explore front panel controls and specifications of a typical spectrum analyzer for observing spectrum of various test signals.
Expt -9	Measurement of Frequency Response of various filters using spectrum analyzer.
Expt -10	To explore the use of Logic analyzer.
Part: B-Instrumentation and Sensors	
Expt -1	Measurement of linear and angular displacement by (i) linear potentiometer (ii) Rotary potentiometer.
Expt -2	Measurement of linear displacement using Photosensitive Transducer (LDR).
Expt -3	Measurement of Temperature using Temperature sensitive transducers.
Expt -4	Strain measurement using strain gauges.
Expt -5	To determine sensitivity of linear variable differential transducers (LVDT).
Expt-6	Measurement of pressure using silicon piezo resistive sensor.
Compulsory Experiment	
	To Design PCB for simple IC based circuit preferably containing all types of basic electronic components.

*Minimum 10 experiments should be conducted based on/relevant to the above list, out of which, minimum 5 experiments should be from Part A, 4 experiments from Part B and one compulsory experiment as a **Mini Project**.

Text Books:

1. David A. Bell- Electronic Instrumentation and Measurements, Third Edition, Oxford Higher Education.
2. K.A.Bakshi, A.V.Bakshi, U.A.Bakshi-"Electronic measurement systems" Technical Publications 01-Jan-2008
3. Bosshart, " Printed Circuit Board" TMH

References:

1. Kalsi Electronic Instruments Tata Mc Graw Hill
2. W.D. Cooper-Modern Electronic Instrumentation & Measurement Techniques Pearson Education, New Delhi
3. Stanley Wolf & Richard Smith Student Reference Manual for Electronic Instrumentation laboratory. Prentice Hall.
4. B.C.Nakra, K. K.Chawdhary-Instrumentation Measurement and Analysis Tata McGraw Hill.

Semester : Fourth																	
Sr. No.	Subject Code	Subject	TEACHING SCHEME					EXAMINATION SCHEME									
			HOURS / WEEK			Total HOURS/WEEK	CREDITS	THEORY					PRACTICAL				
			Lecture	Tutorial	P/D			Duration Of Paper (Hr.)	Max. Marks Theory Paper	Internal Marks	Total	Min. Passing Marks	Max. Marks		Total	Min. Passing Marks
													Int.	Ext.		
THEORY																	
01	4ET1	Signals and Systems	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	4ET2	Network Analysis	4	1	--	5	5	3	80	20	100	40	--	--	--	--
03	4ET3	Analog Electronics-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--
04	4ET4	Digital Electronics	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	4ET5	Communication Engg.-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--
06	4ET6	Environmental Science	2	--	--	2	--	3	--	--	--	--	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
07	4ETp7	Analog Electronics-I Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	4ETp8	Digital Electronics Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	4ETp9	Communication Engg.-I Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
10	4ETp10	Skill Development Lab-II (Software)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**24**	**2**	**8**	**34**	**27**	--	--	--	**500**	--	--	--	**250**	**--**
														Total	**750**		

Subject (Th): 4ET1 - SIGNALS AND SYSTEMS

Course Requisite:

1. (IA1) Engineering Mathematics-I
2. (IB1) Engineering Mathematics-II
3. (3ET1) Engineering Mathematics-III

Course Objectives:

1. Understand the fundamental characteristics of signals and systems.
2. Understand signals and systems in terms of both the time and transform domains.
3. Develop the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Describe signals mathematically and understand how to perform mathematical operations on signals and systems.
2. Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.
3. Classify systems based on their properties and determine the response of LTI system.
4. Analyze system properties based on impulse response and Fourier analysis.
5. Understand the process of sampling and its effects.
6. Apply the Laplace transform and Z- transform for analysis of continuous-time and discrete-time systems.

	Subject: SIGNALS AND SYSTEMS	L
Unit-1	**Signals and Systems**: Energy, Power Signal, Signal Operations, Signal Classification, Signal models, Even and Odd functions, System Classification. **Time-Domain Analysis of Continuous-Time Systems:** System response to Internal condition, Unit Impulse Response, System response to External Input, Classical Solution of Differential Equation, System Stability.	08
Unit-2	**Continuous-Time Signal Analysis -The Fourier Series:** Periodic Signal Representation by Trigonometric Fourier Series, Existence and Convergence of Fourier Series, Exponential Fourier Series, LTIC system response to Periodic inputs, Generalized Fourier Series: Signals as Vectors, Computation of D_n	08
Unit-3	**Continuous-Time Signal Analysis-The Fourier Transform:** Relation between Fourier & Laplace, Aperiodic Signal Representation by Fourier Integral, Properties of Fourier Transform, Signal Transmission Through LTIC Systems, Signal Energy, Data Truncation (Window Functions)	10
Unit-4	**Continuous-Time System Analysis Using Laplace Transform**: Laplace Transform and properties, Inverse transform, Solution of Differential and Integro-Differential Equations, System Realization., Frequency response of LTIC system, The Bilateral Laplace Transform.	08
Unit-5	**Time-Domain Analysis of Discrete-Time Signals & Systems:** Signal Operations, Classification of Discrete-Time Systems, Discrete-Time System Equations, System response to Internal condition, Unit Impulse Response, System response to External Input, Classical Solution of Linear Difference Equations, System Stability. **Sampling & Reconstruction:** Sampling Theorem, Signal Reconstruction, Spectral Sampling.	10
Unit-6	**Fourier Analysis of Discrete-Time Signals:** Discrete-Time Fourier Series (DTFS), Aperiodic Signal Representation by Fourier Integral, Properties of DTFT, LTI-Discrete-Time System Analysis by DTFT, Relationship between DTFT & CTFT, DFT & its properties. **Discrete-Time System Analysis (Z-Transform):** Definition of Z-Transform, Inverse Z-Transform, Relation between Laplace & Z-Transform.	08
	Total	**52**

Text Books:

1. Lathi B. P., “Principles of Linear Systems and Signals” Second Edition (International Version) Oxford University Press.
2. Alan V. Oppenheim & Alan S. Willsky with S. Hamid Nawab, “Signal & Systems” PHI-Publication, Second Edition.

References:

1. Ambardar A., “Analog And Digital Signal Processing” , Thomson Learning-2005.
2. Simon Haykin, Barry Van Veen, “Signals & Systems”, IInd Edition, Wiley Publication.

Subject (Th): 4ET2 - NETWORK ANALYSIS

Course Requisite:

1. (1B4) Electrical Engineering
2. (3ET1) Engineering Mathematics-III

Course Objectives:

1. To understand fundamental concepts of node and mesh analysis for linear circuits.
2. To study graph theory for network analysis.
3. To understand Laplace Transform technique for analysis of linear circuits.
4. To study network theorems and network functions.
5. To study two port network parameters and their inter-relationships.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Analyze electrical circuits using mesh and node analysis.
2. Draw oriented graph of the network to determine their currents and voltages.
3. Apply Laplace Transform for circuit analysis.
4. Apply suitable network theorems to analyze electrical circuits.
5. Relate various two port network and apply two-port network theory for network analysis.

	Subject: NETWORK ANALYSIS	**L**
Unit-1	**Node and Mesh analysis**: Circuit components, assumptions for circuit analysis; Sources of electrical energy, standard input signals; Source transformation, Kirchoff's laws, Node and Mesh analysis, Network equations for RLC networks, Magnetic coupling.	10
Unit-2	**Graph theory and network equations**: Graph of a network, Trees, cotrees and loops, Incidence matrix, Tie set and Cut set of a network, Analysis of a network using Tie set and Cut set matrix, Network equilibrium equations, Duality.	7
Unit-3	**Network Analysis using Laplace Transform**: Review of Laplace transform, Gate function, Impulse function, Laplace transform of periodic signals, Transformed equivalent of inductance, capacitance, mutual inductance, Node and mesh analysis of the transformed circuits. Node admittance matrix and Mesh impedance matrix in transform domain. Solution of transformed circuits including mutually coupled circuits.	8
Unit-4	**Network theorems**: Superposition theorem, Receprocity theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Maximum power transfer theorem, Substitution theorem, Compensation theorem, Tellegen's theorem.	10
Unit-5	**Network functions**: Ports and terminal pairs, Network functions, poles and zeros, Necessary conditions for driving point function, Necessary conditions for transfer function, Application of network analysis in deriving functions, Time domain behaviour from pole-zero plot, driving point and transfer impedance functions of LC networks.	6
Unit-6	**Two port networks**: Open circuit impedance parameters, Short circuit admittance parameters, Transmission parameters, Inverse transmission parameters, Hybrid and Inverse hybrid parameters, Condition for reciprocity and symmetry of a two port network, Interrelationship between parameters, Interconnection of two port networks, Input impedance in terms of two port network parameters, Output impedance, Image impedance.	9
	Total	**52**

Text Books:

1. D. Roy Choudhary, "Networks and Systems", New Age International.

References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall,3rd Edition.
2. W. H. Hayt, J. E. Kemmerly and S. M. Durbin, "Engineering Circuit Analysis", 7th Edition, McGraw-Hill higher education.
3. C. K. Alexander and M. N. O. Sadiku, "Fundamentals of Electric Circuit" McGraw-Hill Companies.inc.
4. I.S.K.V. Iyer, "Circuit Theory", Tata McGraw-Hill Education 1985.

SUBJECT (TH): B4ET3 - ANALOG ELECTRONICS- I

Course Requisite:

1. (3ET3) Electronic Devices and Circuits

Course Objectives:

1. To analyze the behavior of linear wave shaping circuits using RC Networks, diode and BJT.
2. To learn switching characteristics of semiconductor devices.
3. To understand the basics and internal structure of Op-Amp.
4. To analyze linear and non-linear applications of Op-Amp.
5. To understand and apply the functionalities of PLL.

Course Outcomes:

After successfully completing the course, the students will be able to

1. Analyze different wave shaping circuits.
2. Perform evaluation of the switching behavior of semiconductor devices.
3. Comprehend the knowledge of basic concepts and performance parameters of Op-Amp.
4. Use Op-Amp for implementation of linear and non-linear applications.
5. Comprehend the knowledge of PLL, its applications and data converters.

	Subject: ANALOG ELECTRONICS - I	**L**
Unit-1	Linear wave shaping using RC circuits, analysis and calculations of RC low pass and high pass filters, analysis of clipping and clamping circuits using diodes and transistors	08
Unit-2	Switching characteristics of semiconductor devices : Diode as switch, transistor as a switch, characteristics and analysis, FET as a switch, MOS switch, collector coupled bistable, monostable and astable multivibrators.	08
Unit-3	Operational amplifier, block diagram of Op-Amp, differential amplifier configurations, analysis for dual i/p- balanced o/p differential amplifier using h-parameters, constant current source, level shifting, transfer characteristics, frequency response, frequency compensation methods, study of ICuA741, Op-Amp parameters, offset nulling and it's importance.	10
Unit-4	Linear applications of Op-Amp: Inverting and non inverting amplifiers, voltage followers, integrator, differentiator, differential amplifier, instrumentation amplifiers, precision rectifiers, V to I and I to V converters, sinusoidal RC oscillators.	08
Unit-5	Non linear applications of Op-Amp and filter circuits: Clipping and clamping circuits, comparator, zero crossing detector, Schmitt trigger, peak detector, astable, monostable and bistable multivibrators, Butterworth filters using Op-Amp., log and antilog amplifiers.	08
Unit-6	PLL: Operation of phase lock loop system, transfer characteristics, lock range and capture range, study of PLL IC LM 565 and its applications as AM detector, FM detector and frequency translator. A to D converters, D to A converters and their types.	10
	Total	**52**

Text Books:

1. Jacob Millman & Herbert Taub, "Pulse Digital & Switching Waveforms", McGraw Hill International Book Co.
2. Gayakwad R.A., "Op-Amps and Linear Integrated Circuits", Prentice Hall of India Pvt. Ltd., New Delhi.

References:

1. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifier and Linear Integrated Circuits", Sixth Edition, PHI Pub.
2. T.R. Ganesh Babu, B. Suseela, "Linear Integrated Circuits", Third Edition, Scitech Publications.
3. Rao K., "Pulse & Digital Circuits", Pearson Education.
4. Rao K., "Switching Theory & Logic Design", Pearson Education.
5. Dr. R.S. Sedha, "Textbook of Applied Electronics", S. Chand Publications.

SUBJECT (TH): 4ET4 - DIGITAL ELECTRONICS

Course Requisite:

1. (3ET3) Electronics Devices and Circuits.

Course Objectives:

1. To study basic concepts of Boolean algebra, number systems and codes.
2. To study techniques of minimization of Boolean expression.
3. To learn digital logic families and their characteristics.
4. To study the formal procedures for the analysis and design of combinational circuits and sequential circuits.
5. To learn the concept of memories, programmable logic devices and digital ICs.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Use Boolean algebra to solve logic functions, number systems and its conversion.
2. Understand digital logic families and their characteristics.
3. Identify, analyze and design combinational and sequential circuits.
4. Use the knowledge of semiconductor memories, programmable logic devices in digital design.

	Subject: DIGITAL ELECTRONICS	L
Unit-1	Boolean Algebra, Number systems and their conversions, BCD code, Octal Code, Hexadecimal code, Excess-3 code, Gray code, Arithmetic operations using Two's compliment. Study and analysis of Digital Logic Families : RTL, TTL, ECL, IIL, CMOS and their characteristics, tri-state logic, Logic gates	10
Unit-2	Combinational Logic Design: Functions of binary variables, Standard form of logic functions, K-Map up to 5 variables, Don't Care Condition and its effect, Simplification of logic expressions using K-Map, adders and subtractors using logic gates, 4 bit adder/subtractor, BCD adder/subtractor, Look ahead carry adder.	08
Unit-3	Combinational logic design using 74XX/54XX MSI chip series concerning to MUX, DEMUX, Decoders, Encoders, Code Converters, Comparators, Parity Generator/Checker and BCD to Seven Segment Decoder. Combinational logic design using ROM, PLA, PAL.	08
Unit-4	Flip-flops: R-S, J-K, Master slave J-K, D-type, T-type. Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register. Counters: Asynchronous and Synchronous counter, up/down counter, MOD-N counter, Ring counter, Johnson counter, Frequency Division counter.	10
Unit-5	Analysis of Clocked Sequential Networks, Moore and Mealy Machine, State table, State Reduction State Transition diagram, Design of clocked sequential networks.	08
Unit-6	Semiconductor memories and Programmable Logic Devices: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.	08
	Total	**52**

Text Books:

1. M.Morris Mano and M.D.Ciletti, "Digital Design", Pearson Education.
2. R P Jain, "Modern Digital Electronics", TMH.

Reference Books:

1. Wakerly, "Digital Design: Principles and Practices", 3rd edition, Pearson Education, 2004.
2. Charles H. Roth, "Fundamentals of Logic Design", 4th Edition, Jaico Publication
3. Lee S.C,"Digital Circuits and Logic Design", PHI

SUBJECT (TH): 4ET5- COMMUNICATION ENGINEERING –I

Course Requisite:

1. (3ET1) Engineering Mathematics-III
2. (1A2) Engineering Physics

Course Objectives:

1. To understand different modulation and demodulation techniques in analog communication.
2. To interpret the performance of analog communications systems in presence of noise.
3. To understand concept of various antennas and their radiation patterns.
4. To study the fundamentals of transmission lines and their properties.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand the necessity of modulation and identify the various components of analog communication systems.
2. Understand different modulation and demodulation schemes in analog communication systems.
3. Compare and contrast the strengths and weaknesses of various communication systems.
4. Describe the properties and characteristics of Transmission lines and antennas.

	Subject: COMMUNICATION ENGINEERING –I	**L**
Unit-1	**AM Transmitters:** Modulation, need of modulation, AM Modulation, Frequency spectrum, Principles of DSB-FC, DSBSC, SSB-SC modulation and their comparison, Details of DSBFC Transmitter, Generation of DSB-SC by using balanced modulators (FET & Diodes), DSB-SC Transmitter, Generation of SSB-SC by filter method, phase-shift method & third method (weavers). [T1,T2,R2]	10
Unit-2	**AM Receivers:** TRF receiver, Super heterodyne receiver, Details of each block such as RF amplifier, mixer oscillator, IF amplifier, Diode detector, Audio Amplifier. Need and type of AGC, selectivity sensitivity, fidelity Image rejection ration, communication receiver, SNR of DSB-FC, DSB-SC & SSB-SC. [T1,T3,R2]	10
Unit-3	**FM Transmitters:** FM Modulation, Frequency Spectrum, Circuits & Analysis for direct FM generation using FET and varactor diode. Circuit & analysis of Indirect FM generation, Narrow Band and Wide Band FM, their comparison, preemphasis and De-emphasis. Stereo FM Transmitter. [T1,T2]	08
Unit-4	**FM Receivers :** Details of FM receiver blocks such as R.F. amplifier, local oscillator, IF amplifier, Mixer, Audio Amplifier, AGC, Limiter, FM Discriminator, Single Slope and Balanced slope detector, Analysis of Foster Seeley and ratio detectors, Stereo FM receiver, Noise in FM Reception, FM threshold effect. Comparison of performance of AM & FM systems. [T1,T3,R2]	08
Unit-5	**RF Transmission Lines:** Parallel and coaxial transmission line, equivalent circuit of transmission line, standing wave, characteristic(shunt) impedance, quarter wave and half wave length transform, Smith chart, Single stub (shunt) matching using smith chart, balun. [T1,T2, R2]	08
Unit-6	**Antenna Basics & Types of Antenna :** Principle of radiation, antenna power gain, beam width, polarization, bandwidth and radiation resistance, Isotropic radiator, Resonant antenna: Half wave, Folded dipole antenna, Non resonant antenna, antenna arrays, parasitic reflector, parasitic director, design of yagi-uda antenna (up to 5 elements) Long, wire, helical, rhombic, discone, log periodic, loop antenna, low, medium and high frequency antenna. [T1,T2]	08
	Total	**52**

Text Books:

1. Wayne Tomasi, "Electronic Communication Systems" Pearson Education, (Fifth Edition).
2. Kennedy G. "Electronic Communication System" Tata Mc-Graw Hill Co., New Delhi (Third Ed).
3. Taub and Schilling D.L., "Principles of Communication Systems", Mc-Graw Hill Co., New Delhi (Second Ed.).

References:

1. B. P. Lathi, "Modern Digital and Analog Communication systems", 3rd Edition, Oxford Uni. Press, New Delhi.
2. Collins Dennis, Collins John, "Electronic Communications" PHI.

Subject (Pr): 4ETp7 - ANALOG ELECTRONICS- I

Course Requisite:

1. (3ET3) Electronic Devices and Circuits.
2. (4ET3) Analog Electronics-I.

Course Objectives:

1. To verify operation of various wave shaping circuits.
2. To demonstrate linear and non-linear applications of Op-Amp.
3. To analyze multivibrator circuits using BJT and Op-Amp.
4. To understand functions and characteristics of PLL.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Implement wave shaping circuits using passive components, diode and BJT and perform their analysis.
2. Demonstrate linear and non-linear applications of Op-Amp.
3. Implement PLL in certain applications.

	Experiment List
Expt-1	To verify performance of RC low pass and high pass circuit for standard test input signals.
Expt -2	To demonstrate diode as a clipper and clamper for various reference levels.
Expt -3	To verify operation of BJT based astable multivibrator.
Expt -4	To analyze BJT based monostable multivibrator.
Expt -5	To verify Op-Amp IC 741 as an inverting and non- inverting amplifier with a specific gain value.
Expt -6	To demonstrate integrator and differentiator circuit using Op-Amp IC 741.
Expt -7	To verify RC- phase shift oscillator using Op-Amp IC 741.
Expt -8	To verify Op-Amp IC 741 as a Schmitt trigger and calculate the hysteresis voltage.
Expt -9	To verify operation of astable multivibrator using Op-Amp IC 741.
Expt -10	To plot frequency response of first order Butterworth LPF for a specific pass-band gain and cut-off frequency.
Expt-11	To verify characteristics of PLL.
Expt-12	Application of PLL as AM detector/FM detector/frequency translator (Any one application)

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 4ETp8 - DIGITAL ELECTRONICS

Course Requisite:

1. (3ET3) Electronics Devices and Circuits.
2. (4ET4) Digital Electronics.

Course Objectives:

1. To impart the concepts of digital electronics.
2. To provide students basic experimental experiences in the operation of various digital logic Families.
3. To learn the operation of various logic gates and their implementation using digital IC's.
4. To learn the realization of various combinational and sequential circuits.

Course Outcomes:

After successfully completion of the lab course the students will be able to:

1. Apply practically the concepts of digital electronics.
2. Explain the operation and characteristics of various digital logic families.
3. Understand the operation of various logic gates and their implementation using digital IC's.
4. Design and implement various combinational logic circuits.
5. Design and implement various sequential logic circuits.

Expt. No.	Experiment List
Expt-1	To study and verify the operation of various digital logic families.
Expt -2	To study and verify the operation of logic gates.
Expt -3	Design and implementation of Adders and Subtractors using logic gates.
Expt -4	Design and implementation of code converters using logic gates.
Expt -5	Design and implementation of multiplexer using logic gates and IC.
Expt -6	Design and implementation of demultiplexer using logic gates and IC.
Expt -7	Design and implementation of code converters using logic gates.
Expt -8	Design and implementation of Magnitude Comparator using logic gates and IC.
Expt -9	Design and implementation of odd/even parity checker /generator using IC.
Expt -10	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
Expt -11	Construction and verification of ripple counters.
Expt -12	Design and implementation of 3-bit synchronous up/down counter

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 4ETp9 - COMMUNICATION ENGINEERING –I LAB

Course Requisite:

1. (4ET5) Communication Engineering-I.

Course Objectives:

1. To demonstrate the performance of different modulation and demodulation techniques on the basis of various performance parameters.
2. To verify the performance of different analog communication systems.
3. To understand concept of various antennas and their radiation patterns.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Understand the concepts of modulation and demodulation in communication system.
2. Analyze performance characteristics of AM/FM receiver.
3. Demonstrate various antenna's and their radiation pattern.

Expt. No.	Experiment List
Expt-1	To explore the operation of AM Transmitter and Receiver in the communication system.
Expt -2	To estimate the output of Amplitude Modulation and Demodulation process.
Expt -3	To analyze the performance of radio receiver on the basis of sensitivity, selectivity and fidelity of radio receiver.
Expt -4	To explore the operation of FM Transmitter and Receiver.
Expt -5	To estimate the output of Frequency Modulation and Demodulation process.
Expt -6	To explore the generation of SSB-SC by using different methods.
Expt -7	To study the generation of DSB-SC Signal.
Expt -8	To observe the AM & FM frequency spectrum on spectrum analyzer.
Expt -9	To interpret the effect of Pre-emphasis and De-emphasis.
Expt -10	To verify the radiation patterns of various antenna's.

* Minimum 08 experiments based on/relevant to the above list.

Subject (Pr): 4ETp10 - SKILL DEVELOPMENT LAB- II (Software)

Course Requisite:

1. (IB3) Computer Programming.
2. (3ET2) Object Oriented Programming

Course Objectives:

1. To get acquainted with various web development technologies such as HTML, MySQL, Javascript used for building web applications
2. To develop skills in Java programming
3. To explore the skills in Java programming for creation of web based applications

Course Outcomes:

After successfully completing the course, the students will be able to

1. Use Java programming for developing applications.
2. Develop simple web based applications on their own.
3. Handle database applications.

	Theory: SKILL DEVELOPMENT LAB- II (Software)	**L**
Unit-1	Principles of HTML language, developing HTML page using different tags, understanding Javascript, CSS. Developing static and dynamic web page using HTML,CSS, Javascript etc.	8
Unit-2	Servlets in Java programming, creating database connections using servlets. Understanding MySQL and creating tables in database. Accessing databases via Java programming.	8
Unit-3	Structure of a web application, interconnecting user interfaces to servlets via Java programming.	10
	Total	**26**

	Experiment List
Expt-1	Develop a static web page using HTML tags.
Expt -2	Enhance the look and feel of the web page using CSS(Cascaded Style sheets).
Expt -3	Use different JavaScript tags to validate the data entered in web page.
Expt -4	Use JQuery plug-in to enhance the look and feel of the web page.
Expt -5	Learn SQL to create the database.
Expt -6	Write Java programming using servlets to print “Hello World”.
Expt -7	Write Java programming using servlets to create and login into database.
Expt -8	Write Java programming using servlets to access created database.

* Minimum 8 experiments based on/relevant to the above list which lead to design and development of a student’s personal dynamic website as a **Mini Project**.

Text Books:

1. “HTML and CSS: Design And Build Websites”, Jon Duckette, John Wiley & Sons, inc.
2. “Javascript and Jquery: Interactive Front-End Web Development”, Jon Duckett, John Wiley & Sons, inc.
3. “Learning Web Design: A Beginner’s Guide To Html, Css, Javascript, And Web Graphics”, Jennifer Niederst Robbins, O'Reilly Media.
4. “Servlet And Jsp (A Tutorial)”, Budi Kurniawan, Brainysoftware.com.

References:

1. “Learning jQuery”, Alex Libby, Packt Publishing.
2. “HTML, CSS and JavaScript All in One, Sams Teach Yourself: Covering HTML5, CSS3, and jQuery”, Julie C. Meloni, SAM publications.
3. “Learn Object Oriented Programming Using Java: An UMS based”, Dr. N. B. Vekateswarlu, Dr. E.V. Prasad S., Chand Publication.
4. Robert Sheldon and Geoff Moes, “Beginning my SQL”, Wiley Publication.

Semester : Fifth																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																	
01	5ET1	Analog Electronics-II	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	5ET2	Power Electronics & Drives	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	5ET3	Micro Processor & Micro Controller	4	1	--	5	5	3	80	20	100	40	--	--	--	--
04	5ET4	Communication Engg.-II	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	FE5ET5	Free Elective-I	3	--	--	3	3	3	80	20	100	40	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
06	5ETp6	Analog Electronics-II Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
07	5ETp7	Power Electronics & Drives Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	5ETp8	Micro Processor & Micro Controller Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	5ETp9	Skill Development Lab-III (Simulation)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**21**	**2**	**8**	**31**	**26**	--	--	--	**500**	--	--	--	**250**	**--**
														Total	**750**		

Free Elective-I:

1.Electronic Test Instruments 2. Satellite & Optical Fiber Communication

Subject (Th): 5ET1- ANALOG ELECTRONICS – II

Course Requisites:

1. (3ET3) Electronic Devices and Circuits
2. (4ET3) Analog Electronics- I

Course Objectives:

1. To understand and design concepts of voltage regulators.
2. To study concepts of Op-Amp in designing the circuits for linear and non-linear applications.
3. To study and synthesize the waveform generators using IC 8038, 566, 555 and IC 565.
4. To demonstrate applications of Op-Amp in temperature monitoring.

Course Outcomes:

After completing the course, the students will be able to:

1. Acquire and apply knowledge for design of voltage regulator circuits using ICS and discrete components.
2. Analyze and design electronic circuits for various linear and non-linear applications.
3. Design waveform generator circuits using different ICs.
4. Design temperature monitoring system using Op-Amp and sensors.

	Subject: ANALOG ELECTRONICS – II	**L**
Unit-1	Series Voltage Regulator using transistor, overload protection, voltage regulators using IC 723, LM 317, dual tracking regulators using 78xx and 79xx series.	08
Unit-2	Design of scaling, summing, differential amplifier, design of integrator and differentiator, sinusoidal RC oscillators; RC-phase shift, Wein bridge oscillator using IC 741.	10
Unit-3	Design of Op-amp IC 741 based comparator, zero-crossing detector, window detectors, Schmitt trigger, astable multivibrator as square and triangular wave generator, monostable multivibrator, IC 8038 and IC 566 VCO as waveform generators.	10
Unit-4	IC 555 based design of astable, monostable multivibrator and their applications, PLL IC 565 based designs.	08
Unit-5	Design of Butterworth first and second order low pass, high pass, band pass, band stop filters, all pass filter, design of notch filter, design of UJT based relaxation oscillator and triggering circuit.	08
Unit-6	Design of instrumentation amplifier, bridge amplifier, temperature controller /indicator using thermocouple, RTD, thermo sensors AD590, LM35.	08
	Total	**52**

Text Books:

1. R.A. Gayakwad, “OP-AMP and Linear Integrated Circuits”, Prentice Hall/ Pearson Education Publications.

References:

1. Sergio Franco, “Design with Linear Integrated Circuits & Op-Amps”, TMH Publications.
2. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley Intl. Publication.
3. Paul Horowitz, W. Hill, “The art of Electronics”, Cambridge Publications.
4. S.N. Talbar, Dr. T.R. Sontakke, “Electronic Circuit Design”.

Subject (Th): 5ET2- POWER ELECTRONICS AND DRIVES

Course Requisite:

1. (3ET3) Electronic Devices and Circuits.
2. (1B4) Electrical Engineering.

Course Objectives:

1. To introduce power electronics devices; SCR, TRIAC, IGBT, MOSFET and to learn their characteristics.
2. To develop the ability to analyze the dynamics in power electronic converters/drives systems.
3. To study AC-AC, DC-AC, DC-DC converters.
4. To understand the operation of various DC and AC motors.
5. To study different speed control techniques for DC and AC motors.

Course Outcomes:

By the end of the course the student will be able to:

1. Analyze the characteristics of various power electronics devices .
2. Understand SCR firing circuits, commutation techniques.
3. Design and develop power electronic circuits for various applications.
4. Illustrate the operation of various DC and AC motors.
5. Know various applications of power converters in AC and DC drives.

	Subject: POWER ELECTRONICS AND DRIVES	**L**
Unit-1	SCR, Triac, Diac-construction, characteristics, two transistor analogy for turning ON of a SCR, different methods of turning ON of a SCR, turn OFF mechanism, Thyristor firing circuit using UJT. Introduction to GTO, power transistor, power MOSFET, IGBT - their construction & characteristics,	10
Unit-2	Principle of phase control, half wave controlled rectifier, half controlled bridge & fully controlled bridge rectifier for resistive and RL load, derivation for output voltage and current, effect of freewheeling diode, single phase dual converters. Three phase half controlled bridge and fully controlled bridge rectifier	07
Unit-3	Classification of circuit for forced commutation, series inverter, improved series inverter, parallel inverter, output voltage and waveform control, principle of operation for three phase bridge inverter in 120 deg. and 180 deg. mode, single phase transistorized bridge inverter, current source inverter, harmonics reduction techniques.	09
Unit-4	Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper circuit, Jones chopper, step-up chopper and AC chopper. Basic principle of cycloconverter, single phase to single phase cycloconverter.	08
Unit-5	**DC Motor**: Principle of Operation, Types of Motor, Speed Control of Shunt Motor: Flux Control, Armature voltage control, using phase controlled rectifier, Speed Control of Series Motor: Flux Control, Rheostatic Control, chopper control. **Stepper Motor**: Construction, Working, characteristics and applications. Application of power electronic circuit in single phase DC drives.	08
Unit-6	**Single phase induction motor:** Construction, Working, characteristics and applications. **Three phase induction motor**: Working, characteristics, speed control method: Armature voltage, V/F control, rotor control, slip power recovery scheme and applications. **AC servo motor**: Principal of operation and characteristic.	08
	Total	**50**

Text Books:

1. M. Ramamoorthy, Thyristor and their applications.
2. B.L. Theraja: “Electrical Technology”, Volume-2, S. Chand Publications.

References:

1. M. H. Rashid, “Power Electronics Circuits, Devices and Application”, Pearson Edu.
2. Joseph Vithayathil, “Power Electronics: Principles and Applications”, McGraw-Hill.
3. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill.
4. Devdatta Y. Shingare, “A Text book of Industrial & Power Electronics”, Electrotech Pub.
5. Nagrath Kothari, “Electrical Machines”, TMH Publications.

Subject (Th): 5ET3 - MICROPROCESSOR & MICROCONTROLLER

Course Requisite:

1. (4ET3) Digital Electronics.

Course Objectives:

1. To study fundamentals of microprocessor systems.
2. To Understand microprocessor Assembly Language Programming concepts and different data transfer schemes**.**
3. To deal interfacing of different peripheral devices with Microprocessor.
4. To study fundamentals of microcontroller systems.
5. To Understand microcontroller Assembly Language Programming concepts.
6. To study interfacing of different peripheral devices with Microcontroller.

Course Outcomes:

Upon completion of this course, students will demonstrate the ability to :

1. Understand architectural difference between Microprocessor and Microcontroller.
2. Develop Assembly Language Programming concepts of Microprocessor & Microcontroller.
3. Interface different peripheral devices with Microprocessor and Microcontroller.

	Subject: MICROPROCESSOR & MICROCONTROLLER	**L**
Unit-1	**Introduction to Microprocessor** 8085: Architecture and Pin Diagram, Register Structure, Addressing modes, Instruction set of 8085, Timing diagrams.	08
Unit-2	**Assembly Language Programming** Assembly Language Programming of 8085, Stack, Subroutine, Data transfer schemes, Address space partitioning schemes, Interrupt system of 8085.	08
Unit-3	**I/O Interfacing and programming of 8085** Architecture, Programming and interfacing of: PPI 8255, PIT 8254, USART 8251.	08
Unit-4	**Introduction to 8051 Microcontroller** Introduction to 8051 microcontroller; Pin diagram, architecture, Ports Structure, memory organization, SFR's, Counters/Timers, Serial port of 8051. Interrupt structure.	08
Unit-5	**Assembly Language Programming of 8051** Addressing modes, Instruction set of 8051, Assembly language programming examples, counter/timer programming in various modes. Serial communication and its Operating modes.	08
Unit-6	**Interfacing and programming of 8051** Interfacing and programming of external RAM &ROM, keyboard, LCD display, ADC0808 & DAC0808, Stepper motor, DC Motor. Basics of C programming.	10
	Total	**50**

Text Books:

1. Gaonkar R.S. : "Microprocessor Architecture Programming and Applications with the 8085", Penram International Pub.
2. M.A. Mazidi, J.G. Mazidi and R.D. McKinley, "The 8051Microcontroller and Embedded Systems using Assembly and C", Pearson Education (2nd Ed.)

References:

1. K.J. Ayala, "The 8051 Microcontroller", Penram Int. Pubs., 1996

Subject (Th): 5ET4 - COMMUNICATION ENGINEERING –II

Course Requisite:

1. (4ET1) Signals & Systems
2. (IA1) Engineering Mathematics-I

Course Objectives:

1. To understand the fundamentals of Probability theory and random processes.
2. To study principles of Electromagnetic Wave propagation.
3. To study various pulse modulation and demodulation techniques used in transmission of analog signal.
4. To understand the concept of sampling and quantization in digital transmission system.
5. To study multiplexing and basics of telephone switching system.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Apply the concepts of Probability theory in communication systems.
2. Understand the propagation of electromagnetic waves in free space.
3. Analyze the performance of various pulse modulation schemes.
4. Develop the ability to compare and contrast the strengths and weaknesses of various pulse communication systems.
5. Understand switching in telephone networks.

	Subject: COMMUNICATION ENGINEERING –II	**L**
Unit-1	**Probability Theory and Basics of Random Variables:** Introduction to Probability Theory, Axioms of probability. Elementary properties of Probability, Conditional probability, Random variables, Several random variables, Statistical averages, Joint moments, Guassian distribution, Central Limit Theorem, Transformation of random variables. [T1,R2]	08
Unit-2	**Random Processes:** Introduction, Random vectors obtained from random processes, Stationary, Mean, Correlation & Covariance function, Properties of autocorrelation function, Time averages and Ergodicity, Properties of Power spectral density, Cross correlation function, Cross spectral densities, Narrowband Random Process, Envelope and phase of Random Process. [T1,R2]	08
Unit-3	**Wave Propagation :** Electromagnetic waves, Ground waves, Sky waves, ground waves, space waves, Ionosphere, critical frequency, maximum usable frequency, virtual height, skip distance, LOS communication, fading, single hop and multi hop propagation, duct propagation. [R1,R3]	08
Unit-4	**Pulse Analog Modulation:** Band limited & time limited signals, Narrowband signals and systems, Sampling theorem in time domain, Nyquist criteria, Types of sampling- ideal, natural, flat top, Aliasing & Aperture effect. PAM PWM & PPM. [T1,R4]	08
Unit-5	**Digital Transmission of Analog Signal:** Digital representation of Analog signal, PCM Generation and Reconstruction: Quantization, Companding, Quantization Noise, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation. [T1,T2,R4]	10
Unit-6	**Multiplexing and Telephone switching:** Comparison of methods for Analog signal transmission: PCM verses Analog modulation, Comparison of communication systems: Power – Bandwidth Trade-off. Time Division multiplexing, TDM-PCM telephone system, Frequency Division multiplexing, Comparison of TDM and FDM. Telephone switching: Elemental phone system, Central switching, Traffic load and service grade, Hierarchy of switching offices, Common control method of switching, two and four wire connections, Time Division Switching, Space Division Switching, Combined Space and Time Switching. [T2,R4]	10
	Total	**52**

Text Books:

1. Simon Haykin, "Communication System", John Wiley, Eastern Ltd., New York, (Third Ed.), 1994**.**
2. K. Shammugham, "Digital and Analog Communication".

References:

1. Wayne Tomasi, "Electronic Communication Systems" Pearson Education, (Fifth Edition).
2. B. P. Lathi, "Modern Digital and Analog Communication systems" 3rd Ed., Oxford Uni. Press, New Delhi.
3. Kennedy G., "Electronic Communication System" Tata Mc-Graw Hill Co., New Delhi (Third Ed.).
4. Taub and Schilling D.L., "Principles of Communication Systems", Mc-Graw Hill Co., New Delhi (Second Ed.).

Subject (Th): FE5ET5(1) - ELECTRONIC TEST INSTRUMENTS

Course Objectives:

1. To introduce students to the use of various electrical/electronic testing and measuring instruments.
2. To provide students with opportunities to develop basic skills in the use of electronic equipments.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Understand the basic techniques of electronic testing and measuring equipments.
2. Identify electronic instruments, their use and errors associated with the instruments.
3. Explain the use of electronic instruments for testing and measurement in various applications.

	Subject: ELECTRONIC TEST INSTRUMENTS	**L**
Unit-1	Analog meters, digital meters, dc voltmeter, ac voltmeters, RF probes, ammeters, ac ammeters, ohm-meters, 4-wire ohm measurements, multi-meters, meter range, other multi-meter functions: continuity indicators, diode tests, frequency counters, minimum, maximum, average read-outs, capacitance and temperature measurements, specifications	08
Unit-2	Floating and grounded outputs, sine wave sources, imperfections in sine wave sources,: frequency accuracy, frequency stability, amplitude accuracy, distortion, spurious responses, close-in-sidebands , Function Generators: Arbitrary waveform generators, arbitrary waveforms, AM and FM modulation, bursts, Frequency Shift Keying, Frequency sweep, sync output, phase locking, pulse generators, RF signal generators	08
Unit-3	Oscilloscopes: the concept of oscilloscope, digital scope block diagram, sample rate, real time and repetitive sampling, triggering, acquisition/sweep control, vertical amplifier, vertical resolution, ac and dc coupling, bandwidth limit, X-Y display mode, High impedance inputs, 50 ohm inputs, digital acquisition and display techniques, specifications of oscilloscopes, mixed signal oscilloscope, oscilloscope probes, probe compensation, active probes, differential measurements, high voltage probes, current probes	08
Unit-4	Oscilloscope measurements, basic waveform measurements, voltage gain measurements, phase measurements, frequency measurements, digital signal measurements, frequency response measurements, square wave tests, linearity measurements, curve tracer measurement techniques, diode I-V and resistor I-V characteristics, amplitude modulation measurements, power measurements, FFT measurements, basic time domain reflectometry	08
Unit-5	Spectrum and network analyzers: spectrum analyzer, bank-of filters spectrum analyzers, FFT spectrum analyzers, wavemeters, resolution bandwidth, narrow-band and broadband measurements, swept spectrum analyzers, spectrum analyzer measurements, Network Analyzers, distortion analyzers, RF power measurements, RF power meter	08
Unit-6	Logic Analyzers: logic probes, oscilloscope logic measurements, logic analyzers, timing analyzers, glitch detect, state analyzers, data formats, state displays, timing displays, microprocessor measurements, trigger events and sequencing, microprocessor program flow, logic analyzer probing, combined scope and logic analyzer, PC-hosted logic analyzers	08
	Total	**48**

Text Books:

1. Robert A.Witte, Electronic Test Instruments: Analog and Digital, Second Edition, Pearson Education.

Subject (Th): FE5ET5(2) - SATELLITE AND FIBER OPTIC COMMUNICATION

Course Objectives:

1. To understand basics of orbital mechanism, the types of satellite orbits and orbital aspects of satellite communication.
2. To understand the various services of satellite.
3. To introduce and understand optical fiber communication system.
4. To understand and elaborate different components of fibre optic communication system.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand orbital aspects of satellite communication.
2. Know orbital effects in communication system performance.
3. Elaborate the satellite link model.
4. Describe satellite services; GPS.
5. Understand functioning of optical sources and detectors.
6. Describe optical fiber communication system and its performance measures.

	Subject: SATELLITE AND FIBER OPTIC COMMUNICATION	**L**
Unit-1	**Introduction:** Satellite frequency bands, Satellite types-LEO, MEO, GEO, HEO, Kepler's laws, Satellite orbits, Geo-stationary Satellite. Orbital Aspects of Satellite Communication: Orbital period and velocity, Effect of orbital inclination, Azimuth and Elevation, Converge angle and Slant range, Orbital effect in communication system performance. [T1,R1]	08
Unit-2	**Satellite Channels:** Electromagnetic field propagation, Atmospheric losses, Receiver noise, Carrier to Noise ratio, Satellite system link model: Uplink, Downlink, Cross link, Transponder, Satellite system parameters, Satellite link analysis. [R1]	08
Unit-3	**Satellite Services:** Satellite Navigation and Global Positioning System (GPS): Radio and Satellite navigation, Position, Location in GPS, GPS receivers and codes, GPS navigation message and signal levels, Timing accuracy, GPS receiver operation, Differential GPS. [T1]	08
Unit-4	**Optical Fiber Communication System:** Basic optical laws and definitions, Optical fiber modes and configurations, N.A. Attenuation: Units, absorption, scattering losses radioactive losses, core and cladding losses. Material dispersion, wave guide dispersion, intermodal dispersion. [T2,R2]	08
Unit-5	**Optical Sources:** Light Emitting Diodes: Structure, Light source materials. Laser Diodes: Structure, threshold conditions, Modulations of laser diodes. Light source linearity, reliability considerations. [T2,R2]	08
Unit-6	**Optical Detectors:** Physical principles of photodiodes, Photo detector noise, Detectors response time, Avalanche multiplication noise, Temperature effect on avalanche gain. [T2,R2]	08
	Total	**48**

Text Books:

1. Pratt Timothy and Bostian W.Charles, "Satellite Communication", Willey Int. Pub., New York.
2. G. Keiser, "Optical Fibre Communication", McGraw Hill International.

References:

1. Robert M Gagliardi, "Satellite Communication", CBS Pub.
2. Seniors J. M., "Optical Fibre Communication and Applications", Prentice Hall of India Pvt. Ltd., New Delhi.

Subject (Pr): 5ETp6- ANALOG ELECTRONICS - II LAB

Course Requisite:

1. (3ET3) Electronic Devices and Circuits
2. (4ET3) Analog Electronics- I
3. (5ET1) Analog Electronics- II

Course Objectives:

1. To understand characteristics, and data sheets of ICs; IC741, IC555, IC565, IC566, IC8038.
2. To develop knowledge for designing various linear and non linear applications by using IC741or equivalent.
3. To design voltage regulator.
4. To design waveform generator circuits using various ICs.
5. To understand functionalities of PLL and its use in frequency multiplier.

Course Outcomes:

After completing the course, the students will be able to:

1. Design various linear and non linear applications by using IC 741.
2. Design voltage regulators using discrete components and ICs.
3. Implement various waveform generators using IC555, IC565, IC566, IC8038.
4. Design frequency multiplier using IC565.

	Experiment List
Expt- 01	Design transistorized series voltage regulator for V_o = 15 V at 100 mA. Input Voltage applied is 25$\pm$10%V with r_o= 10 Ohm.
Expt- 02	Design a low voltage variable regulator for output voltage of 2 to 7 V using IC 723.
Expt -03	Design a summing amplifier using IC 741 for $V_0 = V_1 + 2V_2 - 6V_3$.
Expt -04	Design a Schmitt trigger with input 5V rms, 10 KHz frequency for specific threshold voltage levels.
Expt -05	Design of integrator and differentiator for cut-off frequencies f_o=1KHz.
Expt -06	Design of sinusoidal RC phase shift oscillator for f_o=1KHz using Op-Amp IC 741.
Expt -07	Design and setup a Wien-bridge oscillator for a frequency of 1KHz using Op-Amp IC 741.
Expt -08	Design the square and triangular wave generator using IC 741 for f_o=2 KHz.
Expt -09	Design a Butterworth high pass filter for the following specifications with supply $\pm$ 15V: 1) Filter pass band gain 10 2) Stop band gain: 40 dB/decade 3) Cut–off frequency 22kHz.
Expt-10	Design an instrumentation amplifier with Gain 10.
Expt-11	Design function generator for sine wave, triangular and square wave for output frequency of 10 KHz using IC 8038.
Expt-12	Design a monostable multivibrator using IC555 for a pulse width of 1ms and 5V amplitude.
Expt-13	Design a frequency multiplier using PLL IC565 to multiply input frequency by a factor of 2.

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 5ETp7- POWER ELECTRONICS & DRIVES LAB

Course Requisite:

1. (1B4) Electrical Engineering.
2. (3ET3) Electronic Devices and Circuits.
3. (5ET2) Power Electronics & Drives.

Course Objectives:

The course aims to:

1. To understand the characteristics of power electronic devices like SCR, TRIAC, MOSFET.
2. To verify the effect of firing angle in phase controlled converters.
3. To understand the turn off mechanism of SCR.
4. To examine the basic working principle of DC and AC Motors.
5. To understand speed control techniques of DC and AC motors.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Analyze the characteristics of various power electronics devices .
2. Understand SCR firing circuits, commutation techniques..
3. Design and develop power electronic circuits for various applications.
4. Illustrate the operation of various DC and AC motors.
5. Use different speed control techniques for DC and AC motors.
6. Understand the operation of various DC and AC motors.

	Experiment List
Expt- 01	To verify the characteristics of SCR. Obj: 1. To plot V-I characteristics of SCR. 2. To measure Latching and Holding current of SCR.
Expt- 02	To verify the characteristics of DIAC/TRIAC. Obj: 1.To plot V-I characteristics of DIAC/TRIAC when MT1 is +ve w.r.t. MT2. 2. To plot V-I characteristics of DIAC/TRIAC when MT1 is -ve w.r.t. MT2.
Expt -03	To verify the characteristics of Power MOSFET. Obj: 1. To plot V-I characteristics of Power MOSFET
Expt -04	To verify the effect of firing angle on output voltage in single phase half wave/ Full wave controlled rectifier Obj:- 1. To study basic working of single phase half wave/ Full wave controlled rectifier 2. To study the effect of firing angle on output voltage
Expt -05	To verify the working of SCR Commutation Obj:- 1. To examine class A, class B, class C, class D and class E commutation of SCR 2. To draw the waveforms at different points for commutation circuit
Expt -06	To verify the working of basic /improved series inverter Obj:- 1. To examine the basic working principle of series inverter 2. To examine the basic working principle of improved series inverter
Expt -07	To verify the working of parallel inverter Obj:- 1. To examine the basic working principle of parallel inverter 2. To analyze working of parallel inverter with class C commutation
Expt -08	To verify the basic working principle of Jones chopper Obj:- 1. To examine the basic working principle of Jones chopper 2. To observe & plot waveforms at different points
Expt -09	To verify the speed control of D.C. shunt motor. Obj:- 1. To examine the basic method of speed controlling of D.C. motor. 2. To observe and plot the speed vs. current characteristics.
Expt-10	To perform load test on D.C. series motor. Obj:- 1. To examine the basic working principle of D.C. series motor. 2. To observe and plot the various characteristics of D.C. Series motor.
Expt-11	To use TRIAC in the speed control of universal motor. Obj: 1. To observe and plot speed Vs. voltage characteristics of universal motor.
Expt-12	To perform load test on 3 phase Induction Motor. Obj:- 1. To study the basic working of 3 phase Induction Motor. 2. To examine various characteristics of 3 phase Induction Motor.

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 5ETp8- MICROPROCESSOR & MICROCONTROLLER LAB

Course Requisite:

1. (5ET3) Microprocessor and Microcontroller.

Course Objectives:

1. To familiarize students with the architecture and Instruction set of Intel 8085microprocessor and 8051 microcontroller.
2. To provide practical hands on experience with Assembly Language Programming of 8085 and 8051.
3. To familiarize the students with interfacing of various peripheral devices with 8085 and 8051.

Course Outcomes:

1. Develop skill of writing programs in ALP for various applications of 8085 & 8051.
2. Interface various peripherals with 8085 & 8051.

	Experiment List
Expt- 01	Write and execute 8085 µp ALP for Addition and Subtraction of two 8 bit numbers from memory& Store result at next location of memory.
Expt- 02	Write and execute 8085 µp ALP for Multiplication of two 8 bits from memory & Store result in memory.
Expt -03	Write and execute 8085 µp ALP for addition of series of 8 bit numbers from memory & Store result in memory.
Expt -04	Write and execute 8085 µp ALP for smallest/largest number from an array of memory.
Expt -05	Write and execute ALP for sorting array in ascending/descending order from memory.
Expt -06	Interface 8255 PPI with 8085, CWR address is 0BH & write ALP to generate square wave of 50% duty cycle on port A.
Expt -07	Write a program in assembly language for 8051 to toggle port P1 continuously and debug and simulate it using Keil software.
Expt -08	Write a Program to interface LED to any one pin of port P1 and ON & OFF it 100 times.
Expt -09	Write a program to interface SEVEN SEGMENT display to 8051 and display all hexadecimal number repeatedly on it.
Expt-10	Interface a DC Motor with Microcontroller 8051 and rotate it clockwise and anticlockwise for same duration using assembly language.
Expt-11	Write a program to interface STEPPER Motor with 8051 and rotate it clockwise and anticlockwise for same duration using assembly language.
Expt-12	Write a program to interface 16x2 LCD Display with 8051 and Display a word/sentence on it.
Expt- 13	Interface Matrix Hex Keypad with 8051 Microcontroller using assembly language.

* Minimum 5 experiments each on 8085 and 8051 respectively based on/relevant to the above list.

Subject (Pr): 5ETp9 - SKILL DEVELOPMENT LAB-III (Simulation).

Course Requisite:

1. (4ET1) Signals & Systems.
2. (4ET5) Communication Engineering-I.

Course Objectives:

1. To familiarize the students in introducing and exploring MATLAB & SIMULINK / SCILAB & XCOS environment.
2. To enable the students on how to approach for solving Engineering problems using simulation tools.
3. To provide a foundation in use of these software for real time applications.
4. To prepare the students to use MATLAB & SIMULINK / SCILAB & XCOS in their project works.

Course Outcomes:

On completion of this course the student should be able to:

1. Use MATLAB & SIMULINK / SCILAB & XCOS for interactive computations.
2. Able to use basic flow controls (if-else, for, while) and familiarize with strings and matrices and their use.
3. Able to write program scripts, functions and simulate experimental models using the MATLAB & SIMULINK / SCILAB & XCOS development environment.
4. Able to generate different plots and explore results to draw valid conclusions and inferences in engineering problems.

	Subject: SKILL DEVELOPMENT LAB-III (Simulation)	**L**
Unit-1	Fundamentals of MATLAB / SCILAB: MATLAB Environment, operators, data types, variables, arrays, characters and strings, structures, built-in functions, input-output data handling, script writing, creating functions, conditional statements, introduction to toolboxes.	09
Unit-2	Graphics in MATLAB / SCILAB: Plotting data, legends and markers, 3D mesh and surface plot, use of other special plots: error graphs, scatter plot, polar plot, quiver plot etc. Graphical User Interface (GUI): Creating and displaying a GUI, GUI components, Panels and button groups, dialog boxes, menus	09
Unit-3	Simulink/XCOS: Simulink Environment, resources in Simulink (Blockset), model creation and design, Introduction to S-Function.	08
	Total	**26**

Text Books:

1. Stephen J. Chapman, "MATLAB Programming for Engineers", 4th edition, Cengage Learning.
2. Philippe Roux (Author), Claude Gomez (Preface), Perrine Mathieu (Translator), "Scilab from Theory to Practice - I. Fundamentals", Scilab Enterprise.

References:

1. Brian R. Hunt, Ronald L. Lipsman, Johathan M. Rosenberg, "A Guide to MATLAB for Beginners and Experienced Users" 3rd edition Cambridge.
2. Dr. M. Affouf, "Scilab by Example", Create Space Independent Publishing Platform.

	Experiment List
Expt- 01	Signals and their properties. a. To represent basic signals in MATLAB/SCILAB like impulse, step, ramp, sinusoidal and exponential. b. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling and time-shifting) in MATLAB/SCILAB.
Expt- 02	System and their properties. a. To identify a given system as linear or non-linear. b. To explore the time variance and time invariance property of a given system. c. To explore causality and non-causality property of a system.
Expt -03	Analyze LTI system response. a. To demonstrate convolution and correlation of two continuous-time signals. b. To demonstrate convolution and correlation of two discrete-time signals.
Expt -04	Sampling and signal reconstruction a. To demonstrate the time domain sampling of band limited signals (Nyquist theorem). b. To demonstrate the time domain sampling of non-band limited signals and antialiasing filter. c. To demonstrate the signal reconstruction using zero-order hold and first-order hold filters.
Expt -05	Simulation of Amplitude Modulator and Demodulator using MATLAB/SCILAB: a. To generate the amplitude modulated signal (AM wave) by using given message signal and carrier signals in MATLAB software b. To demodulate the AM wave using envelope detector principle
Expt -06	Simulation of Amplitude Modulator and Demodulator using Simulink/XCOS: To generate amplitude modulated wave using Simulink/XCOS and demodulate the modulated wave.
Expt -07	Simulation of AM-DSBSC Modulator and Demodulator using MATLAB/SCILAB: a. To generate the AM-DSBSC modulated signal (DSBSC wave) by using given message signal and carrier signals b. To demodulate the DSBSC wave using synchronous detector
Expt -08	Simulation of AM-DSBSC Modulator and Demodulator using Simulink/XCOS: To generate DSB-SC Modulated wave using Simulink/XCOS and demodulate the modulated signal.
Expt -09	Simulation of Frequency Modulator and Demodulator using MATLAB/SCILAB: a. To generate frequency modulated signal and observe the characteristics of FM wave. b. To demodulate a Frequency Modulated signal.
Expt-10	To measure the performance Characteristics of Receiver: Sensitivity, Selectivity, and Fidelity using MATLAB/SCILAB.
Expt-11	Simulation of Frequency Modulator and Demodulator using Simulink/XCOS: To generate frequency modulated and demodulated signal using communication block set of Simulink/XCOS

* Minimum 10 experiments based on/relevant to the above list.

Semester : Sixth																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																	
01	6ET1	Microcontroller Programming & Applications	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	6ET2	Control Systems Engineering	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	6ET3	Digital Communication	4	1	--	5	5	3	80	20	100	40	--	--	--	--
04	6ET4	Digital Signal Processing	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	FE6ET5	Free Elective-II	3	--	--	3	3	3	80	20	100	40	--	--	--	--
06	6ET6	Communication Skills	2	--	--	2	--	--	40	10	50	20	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
07	6ETp7	Digital Communication Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
08	6ETp8	Digital Signal Processing Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
09	6ETp9	Communication Skills Lab	--	--	2	2	1	--	--	--	--	--	15	10	25	12
10	6ETp10	Skill Development Lab-IV (Hardware)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
		Total	**23**	**2**	**8**	**33**	**26**	--	--	--	**550**	--	--	--	**225**	**--**
														Total	**775**		

Free Elective-II:

1. Consumer Electronics
2. Introduction to Wireless Technology

Subject (Th): 6ET1- MICROCONTROLLER PROGRAMMING & APPLICATIONS

Course Requisite:

1. (4ET4) Digital Electronics.
2. (5ET3) Microprocessor & Microcontroller.
3. (3ET2) Object Oriented Programming.

Course Objectives:

1. To familiarize with various members of AVR family and its architecture.
2. To understand AVR assembly language instructions.
3. To develop logic in assembly and C programming for AVR.
4. To understand in built peripherals of AVR microcontroller.
5. To make a system by interfacing different IO devices.
6. To be familiar with advanced serial protocols.

Course Outcomes:

After completing the course, the students will be able to:

1. Use various members of AVR family.
2. Program AVR Microcontroller in assembly language and C language.
3. Use different inbuilt block of AVR.
4. Implement a system for dedicated applications.
5. Understand different serial protocols and IDE tools for AVR.

	Subject: MICROCONTROLLER PROGRAMMING & APPLICATIONS	**L**
Unit-1	Introduction to AVR Microcontroller: AVR microcontroller, History, Features and AVR family and its inbuilt Peripherals, Architecture: signal description, registers of AVR, Data Memory, data formats and directives, RISC architecture in AVR.	08
Unit-2	Instruction Set and Addressing Modes: Load and Store instruction, Data transfer instruction, Arithmetic instruction, logical and compare instruction rotate and shift instruction, branch instruction and looping, call instruction and stack, bit-accessible instruction, accessing EEPROM, and addressing modes of AVR.	08
Unit-3	AVR Programming: AVR advanced assembly language programming, Micros, AVR programming in C: Data types, I/O programming, logical operation, data convergence program, data serialization and memory allocation in C.	08
Unit-4	Peripherals of AVR microcontroller, Memory, Flash, SRAM, EEPROM, I/O Ports structure, Timer Structure, Watch dog timer, UART, Interrupt Structure, Serial Ports, Analog to Digital convertors.	08
Unit-5	AVR Application and Programming in C: LCD and keyboard, Sensors, relay, opto-isolator and stepper motor, Timer, Interrupts and serial port programming, Input capture and wave generation, PWM programming and DC motor control.	08
Unit-6	Serial Bus Protocol: SPI bus protocol, SPI programming in AVR, MAX2221 interfacing and programming, I2C bus protocol, I2C programming in AVR, DS1307 RTC interface and Programming, ISA bus, IrDA Data link, CAN bus, AVR System Development Tool: Code assembler, Code simulator, Evaluation boards, AVR emulator, Device Programmer.	08
	Total	**48**

Text Books:

1. "AVR Microcontroller and Embedded systems using assembly and C", Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi, Pearson Education, Inc. publishing as Prentice Hall 2013.
2. "Programming and Customizing the AVR Microcontroller", Dhananjay V. Gadre, McGraw Hill Education (India) Private Limited 2003.

References:

1. "Tiny AVR microcontroller Projects for the Evil Genius", Dhananjay V. Gadre and Nehul Malhotra, Tata McGraw Hill Education (India) Private Limited.
2. "Embedded C Program and the Atmel AVR", Bartnett. Cox and O'Cull, Delmar Cengage learning.
3. "Embedded C", Michal J. Pont, Addison Wesley Pearson Education.

Subject (Th): 6ET2- CONTROL SYSTEMS ENGINEERING

Course Requisite:

1. (IA1) Engineering Mathematics-I
2. (IB1) Engineering Mathematics-II
3. (3ET1) Engineering Mathematics-III

Course Objectives:

1. To understand the fundamental concepts of Control systems and mathematical modeling of the physical systems.
2. To study time response of the LTI system and its stability analysis.
3. To know concept of frequency response of the LTI system,
4. To study State Variable Analysis of the system.
5. To carry out analysis and stability of the digital control system.

Course Outcomes:

At the end of the course the student will be able to:

1. Determine transfer function models of electrical, mechanical and electromechanical systems.
2. Determine specified transfer functions from block diagrams and signal flow graph.
3. Determine transient response and steady state response parameters.
4. Analyze stability/relative stability of the LTI system.
5. Determine the state model and the response of the system using state variable method.
6. Analyze the response of the discrete time system.

	Subject: CONTROL SYSTEMS ENGINEERING	**L**
Unit-1	**Introduction:** Basic definition, Closed and open loop systems, Transfer function, Mathematical models of the physical systems (Electrical, Mechanical, Electromechanical), block diagram representation, block diagram reduction technique, signal flow graphs, basic control actions.	10
Unit-2	**Time Response Analysis:** Standard test signals, Time response of first order and second order system, impulse response function, Transient domain specifications, Steady state analysis: steady state error and error constants, dynamic error coefficients.	07
Unit-3	**1.Stability Analysis:** Concept of stability, necessary conditions for stability, Routh stability criterion, Relative stability analysis. **2. Roots Locus Technique:** Introduction, Root locus concepts, Construction of root locus, construction rules, Stability analysis of systems using root locus, Concept of dominant closed loop pole pair, Root contour, Effect of addition of open loop zeros & poles.	09
Unit-4	**Frequency response analysis:** Introduction, correlation between time and frequency response, Polar plots, Bode plots, general procedure for construction, Gain margin and phase margin, Stability analysis of systems using Bode plots, Nyquist stability criterion, relative stability analysis.	10
Unit-5	**State Variable Analysis:** Concepts of state, state variables and state space, Space model representation of LTI systems using physical, phase and canonical variables, Diagonalization, Relationship between state variable model and transfer function, state transition matrix and its computation, Solution of state equations, Controllability and observability.	09
Unit-6	**Digital Control Systems :** Introduction, Representation of sampled data (Discrete) systems, sampling, signal reconstruction, Zero order hold, Pulse Transform functions of open loop, closed loop systems with different sampler locations, Z transform analysis of sampled data control systems, Digital controllers, Z and S domain relationship, stability analysis of discrete time system using bilinear transformation.	06
	Total	**51**

Text Books:

1. Nagrath I. J. and M. Gopal, “Control Systems Engineering”, 5th Edition New Age International.

References:

1. K. Ogata,"Modern Control Engineering", PHI, Fourth Edition.
2. F. Golnaraghi and B. C.Kuo, “Automatic Control Systems", 9th edition, JohnWiley & Sons, inc.
3. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th edition, Pearson Education.
4. John J. D’Azzo and Constantine H. Houpis Stuart N. Sheldon, "Linear Control System Analysis and Design with Matlab", 5th edition, Marcel Dekker Inc.
5. M. Gopal, "Digital Control Systems Principles & Design", TMH.
6. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.
7. Bhattarcharya, "Control System Engineering", 2nd Edition, Pearson Education.
8. Norman, "Control System Engineering", John Wiley & sons, 3rd edition.

Subject (Th): 6ET3- DIGITAL COMMUNICATION

Course Requisite:

1. (4ET1) Signal and System
2. (4ET5) Communication Engineering I
3. (5ET4) Communication Engineering II

Course Objectives:

1. To study basic building blocks of digital communication system.
2. To learn information theory and theoretical bounds on the data rates of digital communication.
3. To understand and analyze communication channel.
4. To study and analyze different digital modulation techniques.
5. To study baseband transmission of the signal.
6. To understand importance of channel encoding and decoding in digital communication.
7. To study multiple access schemes and spread spectrum communication system.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand basic building blocks of digital communication system and formatting of digital signal.
2. Understand concepts of information theory and analyze information transmission over communication channel.
3. Analyze performance of different digital modulation techniques.
4. Understand methods to mitigate inter symbol interference in baseband transmission system.
5. Implement different error control coding schemes for the reliable transmission.
6. Understand various multiple access schemes and spreading techniques.

	Subject: DIGITAL COMMUNICATION	**L**
Unit-1	**Introduction to Digital Communication System:** Functional Blocks of Digital Communication System; Source Encoder and Decoder, Channel Encoder and Decoder, Modulator and Demodulator. **Line Coding:** Need for Line coding, Properties of Line Coding, Unipolar RZ and NRZ, Polar RZ and NRZ, Bipolar NRZ (AMI), Split Phase Manchester Coding, Polar Quaternary NRZ Coding, HDB3 Coding. Scrambler and Unscrambler.	08
Unit-2	**Information Theory:** Measure of Information, Entropy and Information Rate of Long Independent and Dependent Sequences, Markoff Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources. Source Encoding: Huffman Encoding, Shannon's Encoding Algorithm, Shannon-Fano Algorithm. **Discrete Communication Channel:** Noiseless Channel, Deterministic Channel, Binary Symmetric Channel, Rate of Information Transfer over Discrete Channel, Capacity of Discrete Memoryless Channel. **Continuous Channel:** Shannon Hartley Theorem for channel capacity, Signal to Noise Ratio – Bandwidth Tradeoff.	10
Unit-3	**Bandpass Modulation and Demodulation techniques:** BPSK, BFSK, ASK and DPSK generation and reception, Signal space diagram, PSD and Bandwidth of BPSK and BFSK systems, QPSK and MSK Transmitter and Receiver, Signal space diagram, PSD and Bandwidth of QPSK and MSK, Probability of Error of ASK, BPSK and BFSK systems, Comparison of Digital modulation systems. **Coherent Detection:** Integrate and Dump Filter (SNR and Probability of Error), Optimum Filter (Transfer function and Probability of Error), Matched Filter (Impulse response and Probability of Error).	10
Unit-4	**Base Band Transmission:** Base Band Binary PAM systems, Inter Symbol Interference, Base Band Pulse Shaping and Nyquist Criterion, Eye Diagram, Correlative Coding: Duobinary Encoder with Pre-coder, Modified Duobinary Encoder, Modified Duobinary Encoder with Pre-coder.	08

	Equalization: Need for equalization, Transversal Equalizer (Problems Expected), Preset Equalizer, Adaptive Equalizer, Clock and Carrier Synchronization.	
Unit-5	**Error Control Coding:** Introduction to Error Control Coding, Types of Errors, Methods of Controlling Errors, **Linear Block Codes:** Matrix Description of Linear Block codes, Hamming Distance, Hamming Weight, Minimum Hamming Distance, Hamming Codes, Encoder for Linear Block code, Syndrome Decoding, Syndrome Decoder for (n, k) Linear Block Code, Error Detection and Correction capability of Linear Block Codes (Derivation expected). **Cyclic Codes:** Properties of Cyclic Codes, Systematic and Non-Systematic generator Matrix, Parity Check Matrices for Cyclic Codes, Encoders for Cyclic Codes, Syndrome Decoding for Cyclic Codes. **Convolution Codes:** Time Domain Approach and Transform domain approach for convolution code generation, Code Tree and Code Trellis for Convolution code.	10
Unit-6	**Multiple Access Schemes and Spread Spectrum Communication:** Multiple Access schemes: Time Division Multiple Access, Frequency Division Multiple Access, Code Division Multiple Access, Space Division Multiple Access. **Spread Spectrum Systems:** Notion of Spread Spectrum, PN Sequence Generation (Problems Expected), Direct Sequence Spread Spectrum (DSSS), Jamming Margin, Processing Gain, Eb/No Ratio, Frequency Hopped Spread Spectrum, Slow and Fast frequency Hopping.	06
	Total	**52**

Text Books:

1. Shanmugam K.S., "Digital & Analog Communication Systems", John Wiley & Sons, New York, 1996.
2. Lathi B. P., "Modern Digital and Communication Systems", Holt Rinchart and Winston Inc., New York, 1993.
3. Simon Haykin, "Digital Communication", John Wiley and Sons,Pvt. Ltd., Singapore.

References:

1. Proakis J. K., "Digital Communication", Mc-Graw Hill Book Co., London (Second Edition).
2. Taub, Herbert, Schilling D. L., "Principles of Communication Systems", Mc-Graw Hill International Book Co., Tokyo.
3. W.C.Y. Lee, "Mobile Cellular Telecommunications Systems", Mc-Graw Hill International Editions, 1990.
4. Glover and Grant, "Digital Communication", Prentice Hall Publication.

Subject (Th): 6ET4- DIGITAL SIGNAL PROCESSING

Course Requisite:

1. (4ET1) Signals and Systems.

Course Objectives:

1. Learn discrete signal and system fundamentals.
2. Learn the discrete-time signals in the frequency domain, using z-transform and DFT.
3. Understand the implementation of the DFT in terms of the FFT,
4. Learn the basic forms and design of FIR and IIR filters.
5. Learn the application filter bank in multi rate DSP.
6. Become aware of some applications of digital signal processing.

Course Outcomes:

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

1. Manipulate the discrete time signals and identify the type system.
2. Compute the z-transform of a sequence, identify its region of convergence, and compute the inverse z-transform.
3. Evaluate the Fourier transform of a signal.
4. Design FIR and IIR filters.
5. Understand the concepts of Multirate Digital Signal Processing and need of Filter banks.
6. Understand the architecture of DSP processor TMS320C54XX.

	Subject: DIGITAL SIGNAL PROCESSING	L
Unit-1	Discrete time signals and system: Classification of signals, singularity function, amplitude and phase spectra, simple manipulation, Classification of systems, representations of systems, analog to digital conversion of signal.	10
Unit-2	*Z*- transform: mapping of s-plane to *Z*-plane, Region of Conversion and its properties, Properties of *Z*-transform, evaluation of inverse *Z*-transform using long division method, PFE method and residue method, difference equation and its relation with system function, impulse response and frequency response .	09
Unit-3	Discrete and Fast Fourier Transform: Discrete convolution, Discrete Time Fourier Transforms (DTFT), Fast Fourier Transform (FFT), Computing an Inverse DFT by Doing a Direct DFT. Fast convolution, correlation.	09
Unit-4	Finite Impulse Response (FIR) filters: Magnitude and Phase response of digital filter, Frequency Response of linear phase FIR filter, Design techniques for FIR filter: Fourier series method, windowing method using Rectangular window, Half band digital filter. Realization of basic structure FIR system: Direct form, Cascade, linear phase.	08
Unit-5	Infinite Impulse Response (IIR) filters: IIR filter design by approximation of derivatives, impulse invariant method, Bilinear transformation method, Butterworth filter and Chebyshev filter. Realization of basic structure IIR system: Direct form I, Direct form II, Cascade and parallel.	08
Unit-6	Multirate Digital Signal Processing: Sampling, Sampling rate conversion, signal flow graph, filter structure, polyphase decomposition, digital filter design, multilevel filter bank. Overview and architecture of DSP processor TMS320C54XX.	08
	Total	**52**

Text Books:

1. S. Salivahanan, A. Vallavaraj, “Digital Signal Processing”, Tata McGraw-Hill Education, 2001.

References:

1. Oppenheim & Schafer, “Discrete time Processing”, PHI.
2. Proakis & Manolakis D.G., “Digital Signal Processing”, PHI.
3. Mitra S.K., “Digital Signal Processing”, TMH.
4. Roman Kuc, “Digital Signal Processing”, MGH.
5. Ifeacher E.C., Jervis B. W., “Digital Signal Processing”, Addison Wesley.
6. P. P. Vaidyanathan, “DSP and Multirate Systems”, PHI.

Subject (Th): FE6ET5 (1) - CONSUMER ELECTRONICS

Course Objectives:

1. To gain knowledge and competencies regarding various electronics devices /systems used in field of consumer electronics.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand audio and video systems commonly used in consumer electronics.
2. Explain the working of commonly used electronic appliances.
3. Describe recording and reproduction systems.
4. Acquire knowledge of working principle of calculator and In-Car-Computers
5. Observe occupational and safety practices in consumer electronics.

	Subject (Th): CONSUMER ELECTRONICS	**L**
Unit-1	**Audio Systems**: Microphones, Loudspeakers, Speaker baffle and enclosure, Acoustics, Mono, Stereo, Quad, Amplifying Systems, Equalizers and Mixers, Electronic Music Synthesizers, Commercial Sound, Theater Sound System.	08
Unit-2	**Video Systems and Displays**: Colour TV standards and systems, TFT, Plasma, HDTV, Digital TV, Remote Controls, Video Telephone and Video Conferencing.	08
Unit-3	**Domestic Appliances:** Washing machines, Microwave ovens, Air-conditioners and Refrigerators, Computers Office System: FAX, Xerox, Telephone Switching System, Mobile Radio System.	08
Unit-4	**Recording and Reproduction Systems**: Disc recording and reproduction, Magnetic recording and reproduction, Video disc recording and play back, Distortion and Noise reduction in Audio and Video System.	08
Unit-5	**Power Supplies and other systems**: SMPS, UPS and Preventive Maintenance, Set Top Boxes, Remote controls, Bar codes, ATM, Dish washers	08
Unit-6	**Calculators:** Structure, internal organization, servicing; **In-Car-Computers**: electronic ignition, electronic ignition lock system, Antilock Braking System (ABS), Electronically controlled Suspension (ECS), Instrument panel displays, ultrasonic car safely belt system, Air Bag System, Vehicle proximity detection system, car navigation system.	08
	Total	**48**

Text Books:

1. S.P.Bali, “Consumer Electronics”, Pearson Ed 2005.

Subject (Th): FE6ET5 (2) - INTRODUCTION TO WIRELESS TECHNOLOGY

Course Objectives:

1. To be aware of evolution in wireless technology.
2. To study the fundamentals of cellular radio system.
3. To understand operation of various 2nd and 3rd generation cellular systems; GSM, IS95, CDMA2000, WCDMA.
4. To study wireless data communication networks.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Describe evolution of wireless networks.
2. Understand fundamentals of cellular radio system.
3. Demonstrate various 2nd and 3rd generation wireless cellular and data communication networks.

	Subject (Th): INTRODUCTION TO WIRELESS TECHNOLOGY	**L**
Unit-1	**Overview of Wireless Networks:** Evolution of voice oriented and data oriented wireless networks, different generations of wireless networks (1G, 2G, 3G & beyond), comparison of wired and wireless media, radio propagation mechanism, Effects of multipath and Doppler: multipath fading, multiple delay spread, Doppler spectrum. [T1]	08
Unit-2	**Cellular Technology:** Cellular Topology- cellular concept, cellular hierarchy, cell fundamentals, Evolution of Mobile Systems (1G, 2G, 3G), Signal-to-interference ratio. Capacity Expansion: cell splitting and cell sectoring. Channel allocation techniques: Fixed, Dynamic & Hybrid channel allocation, channel borrowing technique. Handoff Management: Architectural issues in handoff, types of handoff, handoff algorithms. [T1]	08
Unit-3	**GSM System:** GSM Network Architecture, GSM Call Procedures: Registration procedure, call establishment, Handoff in GSM, GSM Signaling Protocol Architecture: Physical layer: power and power control, physical packet burst, frame hierarchy in GSM, Hand Off Procedures, Logical channels in GSM. [T1]	08
Unit-4	**CDMA Digital Cellular Standard (IS-95):** IS-95 Forward Channel, IS-95 Reverse Channel, packet and frame formats, mobility and radio recourse management: soft handoff and power control. **CDMA2000 and WCDMA:** Forward and Reverse Channel in CDMA2000 and WCDMA, Hand Off and Power Control in CDMA2000 and WCDMA. [T1]	08
Unit-5	**Wireless Local Area Network (WLAN):** IEEE 802 architecture, IEEE 802.11 architecture and Services, IEEE 802.11 medium access control, MAC frame format, 802.11 physical layer, 802.11 standards. [T2]	08
Unit-6	**Wireless PAN (WPAN-802.15):** Overview of 802.15, Bluetooth, Bluetooth protocol stack, usage models, piconets and scatternets, radio specification, baseband specifications: physical links, packets, payload format, error correction, logical channels, channel control, link manager specification. [T2]	08
	Total	**48**

Text Books:

1. K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks", Pearson Education Asia Publication (2002).
2. William Stallings, "Wireless Communications & Networks", Prentice-Hall India, Second Edition.

Subject (Th): 6ET6- COMMUNICATION SKILLS

Course Objectives:

1. Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
2. Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range while organizing their ideas logically on a topic.
3. Listen/view and comprehend different spoken discourses/excerpts in different accents
4. Read different genres of texts adopting various reading strategies.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Acquire knowledge about the various principles of communication.
2. Learn the importance of verbal and non-verbal communication in the professional world.
3. Imbibe the knowledge of effective classroom speaking and presentation.
4. Learning the nuances of effective writing by using short and crisp sentences.
5. Synthesize and apply appropriate and effective conflict management strategies.

	Subject: COMMUNICATION SKILLS	**L**
Unit-1	Comprehension over an unseen passage Comprehension – A - word study: Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly misspelled words, understanding of the given passage. Comprehension - B - Structure study: Simple and compound sentences, type of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only – but also, if clause, since, may, can, could, would, too etc. Active and passive forms, negative and interrogative, punctuation and capitalization.	10
Unit-2	Theoretical background - importance of communication, its process, model of communication its components & barriers. Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), and important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectiveness and subject content. Non-verbal communication, types of graphics and pictorial devices.	10
Unit-3	Specific formats for written communication like – business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day to day written communication like applications, notices, minutes, quotations, orders, enquiries etc. Oral communications - Important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews, methodology of conduction of meetings, seminars, symposia, conference and workshop.	10
	Total	**30**

Text Books:

1. Krishna Mohan, Meera Banerjee, "Developing Communication Skills", MacMillan India Limited.
2. Chrissie Wright (Editor), "Handbook of Practical Communication Skills", Jaico Publishing House.

References:

1. Raman Sharma, "Technical Communication", Oxford University Press.
2. F. Frank Candlin, "General English for Technical Students", University of London Press Ltd.

Subject (Pr): 6ETp7 – DIGITAL COMMUNICATION LAB

Course Requisite:

1. (4ET5) Communication Engineering I
2. (5ET4) Communication Engineering II
3. (6ET3) Digital Communication

Note: Lab includes the experiments on the contents of following subjects

1. (5ET4) Communication Engineering II,
2. (6ET3) Digital Communication.

Course Objectives:

1. To understand various Pulse communication systems for transmission of analog signals.
2. To enable the students to understand different line coding used for representation of digital wave forms.
3. To understand operation of Scrambler and Unscrambler.
4. To study error correction and detection methods used in digital communication systems.
5. To understand Bandpass Modulation and Demodulation techniques.
6. To understand baseband transmission of signal.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Describe various line codes used for representation of digital waveforms.
2. Demonstrate different working blocks of digital communication system.
3. Analyze the performance of digital communication system.
4. Apply various error control coding techniques in digital communication.

	Experiment List
Expt-1	To verify the operation of Pulse Amplitude Modulation PAM and Demodulation.
Expt -2	To verify the operation of Pulse Width Modulation (PWM) and Demodulation.
Expt -3	To verify the operation of Pulse Code Modulation (PCM) and Demodulation.
Expt -4	To verify the output of Delta Modulation and Demodulation process.
Expt -5	To explore Time Division Multiplexing (TDM) Technique as a application of PAM.
Expt -6	To implement various line coding schemes in MATLAB/SCILAB and observe their spectrum.
Expt -7	Implementation of Scrambler and Unscrambler.
Expt -8	Extraction and recovery of data in Base Band digital Transmission and Measurement of bit error rate.
Expt -9	To analyze the performance of baseband system using Eye diagram.
Expt -10	Implementation of cyclic Encoding and Decoding of BCD bit Sequence.
Expt -11	
Expt -12	To analyze the performance of Amplitude Shift keying (ASK).
Expt -13	To analyze and compare performance of 1) Phase Shift Keying (PSK). 2) Differential Phase Shift Keying (DPSK). 3) Quadrature Phase Shift Keying (QPSK)
Expt -14	Generation of PN sequence and to determine auto and cross correlation..
Expt -15	To implement Shanon-Fano / Huffman coding using MATLAB.

* Minimum 10 experiments based on/relevant to the above list.

Subject (Pr): 6ETp8- DIGITAL SIGNAL PROCESSING LAB

Course Requisite:

1. (4ET1) Signals & Systems.
2. (6ET4) Digital Signal Processing.

Course Objectives:

1 To use software to visualize the real time signal processing applications.
2 To manipulate the discrete time signals and identify the type of given system.
3 To identify the discrete time signals in frequency domain, using z-transform and Fourier Transform.
4 Learn the basic forms and design of FIR and IIR filters.
5 To become aware of DSP processor TMS320C54XX.

Course Outcomes:

After successful completion of this course the student will be able to

1. Generate different plots and explore results to draw valid conclusions and inferences in DSP problems.
2. Enable on how to approach for requirement of digital signal processing and digital system design using simulation tools.
3. Familiarize with the concepts of Multirate Digital Signal Processing.
4. Understand the architecture of digital filter and DSP processor.

	Experiment List
Expt- 01	Study of Signal Processing Function used in MATLAB/SCILAB. a. To study basics of MATLAB. b. To study the basic commands used in MATLAB for signal processing.
Expt- 02	Generate basic discrete signals: unit impulse, unit step sequence, unit ramp sequence, real exponential signal sinusoidal signal a. To acquire the knowledge of basic discrete signals used in Digital Signal Processing. b. To generate & plot basic discrete signal in MATLAB.
Expt -03	System and their properties. a. To identify a given system as linear or non-linear. b. To explore the time variance and time invariance properties of a given system. c. To explore causality and non-causality properties of a system.
Expt -04	Plot impulse response of the given difference equation: a. To understand impulse response of the system described by a given difference equation. b. To analyze LTI system response.
Expt -05	Find the Linear Convolution and Circular convolution of sequence a. To evaluate the response of the system for given input. b. To understand the circular symmetry property of convolution.
Expt -06	Calculate of convolution of two sequences using DFT and IDFT. a. To evaluate the convolution of given sequences. b. To demonstrate the time domain and frequency domain representation of signal.
Expt -07	Determine the stability, Pole Zero plot of given transfer function. a. To demonstrate pole zero plot of given transfer function. b. To identify the stability using complex Z-plane
Expt -08	FIR filter design using Rectangular window a. To design the FIR filter for given specifications. b. To demonstrate the phase and frequency response of high pass, low pass, band pass and band stop filter.
Expt -09	Filter design using Butterworth approximations with impulse Invariance method. a. To explore the formulation of Butterworth approximation. b. To understand the order of filter for required specification. c. To identify the relation between s-domain transfer function with z-domain transfer function.

Expt-10	Multirate Digital Signal Processing, a. To demonstrate upsampling and downsampling of a given signal. b. To demonstrate interpolation and decimation of a given signal.
Expt-11	TMS 320C6711 DSP processor, a. To verify the signal processing operation using hardware. b. To understand the hardware implementation of digital system.

* Minimum 08 experiments based on/relevant to the above list.

Subject (Pr):6ETp9- COMMUNICATION SKILLS LAB

Course Requisite:

1. (6ET6) Communication Skills.

Course Objectives:

1. To improve the students fluency in English.
2. To enable to respond appropriately in different socio-cultural and professional contexts.
3. To communicate ideas relevantly and coherently in writing.
4. Imbibe the knowledge of effective speaking and presentation.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Accomplish sound vocabulary and its proper use contextually.
2. Speak clearly, confidently, comprehensibly.
3. Listen/view and comprehend different spoken discourses/excerpts in different accents
4. Write cohesively and coherently and flawlessly avoiding grammatical errors

	Experiment List
Expt-1	Listening Comprehension
Expt -2	Reading Comprehension
Expt -3	Vocabulary: Synonyms And Antonyms
Expt -4	Jumbled Sentences
Expt -5	Correction of Grammatical Errors
Expt -6	Group Discussion
Expt -7	Personal Interview
Expt -8	Presentation Skills

* Minimum 08 experiments based on/relevant to the above list.

Subject (PR): 6ETp10- SKILL DEVELOPMENT LAB-IV (Hardware)

Course Requisite:

1. (3ET4) Instrumentation and Sensors
2. (5ET2) Power Electronics & Drives
3. (5ET3) Micro Processor & Micro Controller
4. (6ET1) Micro Controller Programming & Applications

Course Objectives:

1. To familiarize with interfacing of different IO devices, sensors and actuators.
2. To develop program logic with "C" language using IDE tools.
3. To be able to use different communication modes.
4. To enable the students to design a microcontroller based system.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Use different interfacing devices, sensors and actuators.
2. Write programs in "C" using different integrated development tools.
3. Use different communication modes and different models.
4. Design a microcontroller based systems using different IO device, sensors and actuators.

	Subject: SKILL DEVELOPMENT LAB-IV	**L**
Unit-1	Different input devices, switches, keypads, ADC, DAC, RTC, external memory, touch screen etc. Sensors: Temperature, Humidity, Light, Sound etc. Display devices: LED, 7 segment, Dot matrix, LCD, GLCD etc. Motors: DC motors, Stepper Motors, Servo Motors etc. Relay, Optoisolator, ULN 2803, L293D etc.	09
Unit-2	**Communication protocols and Wireless Modules** Serial Protocols: RS 232/423/485, I^2C, CAN, USB, SPI, USART, UART etc. Parallel protocols: PCI and PCI-X Bus Wireless protocols: IrDA, Bluetooth, Zig-bee, Wi-Fi etc. Wireless modules: RF, IR, Wi-Fi, Bluetooth, Zig-bee, X-bee, RFID, GSM etc.	09
Unit-3	**Programming and Interfacing of Microcontroller** Understanding architecture of AVR Microcontroller, its memory, timers and counters, Software development tools IDE, Simple Programming in embedded C, Timer programming, Interrupt programming, Serial port programming etc. in embedded C.	08
	Total	**26**

	Experiment List
Expt-1	LED interfacing with microcontroller using timer with interrupt
Expt -2	LCD and Keyboard interfacing with microcontroller in 4 bit and 8 bit mode
Expt -3	ADC interfacing using I^2C bus with microcontroller
Expt -4	DAC interfacing using I^2C bus with microcontroller
Expt -5	Stepper motor, DC and servo motor interfacing with microcontroller
Expt -6	Serial communication using RS232 with or without interrupt
Expt -7	RTC and 7-segment display interface with microcontroller
Expt -8	Memory interfaces using SPI to store and retrieve data with microcontroller
Expt -9	Sensors and actuators interface with microcontroller
Expt -10	Case study -A **Mini Project** based on above list of the experiments in a group of students.

Text Books:

1. "AVR Microcontroller and Embedded systems using assembly and C", Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi, Pearson Education, Inc. publishing as Prentice Hall.
2. "Programming and Customizing the AVR Microcontroller", Dhananjay V. Gadre, McGraw Hill Education (India) Private Limited.
3. "Tiny AVR Microcontroller Projects for the Evil Genius", Dhananjay V. Gadre and Nehu lMalhotra, Tata McGraw Hill Education (India) Private Limited.
4. "Embedded C Program and the Atmel AVR", Bartnett. Cox and O'Cull, Delmar Cengage.
5. "Embedded C", Michal J. Pont, Addison Wesley Pearson Education.

Semester : Seventh																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**
													Int.	**Ext.**		
THEORY																	
01	7ET1	VLSI Design	4	1	--	5	5	3	80	20	100	40	--	--	--	--
02	7ET2	Digital Image Processing	4	--	--	4	4	3	80	20	100	40	--	--	--	--
03	7ET3	Satellite & Optical Fiber Communication	4	--	--	4	4	3	80	20	100	40	--	--	--	--
04	7ET4	Industrial Management & Quality Control	4	--	--	4	4	3	80	20	100	40	--	--	--	--
05	7ET5	Professional Elective-I	4	--	--	4	4	3	80	20	100	40	--	--	--	--
PRACTICALS / DRAWING / DESIGN																	
06	7ETp6	VLSI Design Lab	--	--	2	2	1	--	--	--	--	--	25	25	50	25
07	7ETp7	Skill Development Lab-V (Signal & Image Processing)	2	--	2	4	2	--	--	--	--	--	50	50	100	25(Int.) 25(Ext)
08	7ETp8	Project	--	--	2	2	--	--	--	--	--	--	--	--	--	--
09	7ETp9	Seminar	--	--	2	2	2	--	--	--	--	--	50	--	50	25
		Total	**22**	**1**	**8**	**31**	**26**	--	--	--	**500**	--	--	--	**200**	**--**
														Total	**700**		

Professional Elective-I:

1. Computer Organization
2. PLC & Automation
3. Smart Sensor
4. Fuzzy Logic & Artificial Neural Network
5. Speech Processing
6. RF Modeling & Antenna

Subject (Th): 7ET1- VLSI DESIGN

Course Prerequisites:

1. (3ET3) Electronic Devices & Circuits.
2. (4ET4) Digital Electronics.

Course Objectives:

1. To study CMOS transistor theory and performance parameters.
2. To learn design of digital VLSI circuits, computer aided simulation and synthesis tools on programmable chips (FPGA/CPLD) using Verilog HDL.
3. To be aware of manufacturing process in VLSI technology.
4. To study layout design rules for size & power optimization.

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Gain knowledge about the trends in VLSI semiconductor technology and it's impacts on scaling and performance.
2. Draw Layout, Stick diagrams of simple CMOS Circuits
3. Understand Front & Back end design aspects of simple VLSI Digital circuits
4. Model digital circuits with Verilog HDL, simulate, synthesize and prototype in PLDs.

	Subject: VLSI DESIGN	**L**
Unit-1	**CMOS Circuit Design-I:** MOS structure capacitance, channel capacitance, junction capacitance, MOS Transistor Switches, CMOS Logic gates, CMOS Inverter-DC Characteristics, CMOS combinational logic design. Delays: RC delay model, Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts. [T1, T2, R1]	09
Unit-2	**CMOS Circuit Design-II:** Clocked Latch and Flip-Flop Circuits, CMOS Transmission Gates (Pass Gates), Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits. Review of basic features of CPLD & FPGA architecture. [T1, T2, R1]	09
Unit-3	**CMOS Technology & Design Rules:** CMOS fabrication processing steps, p-well CMOS Process, n-well CMOS Process, Twin well process, Silicon-on-Insulator Process, CMOS Process enhancements –interconnect, circuit elements, CMOS Lambda-based Design Rules, Stick Diagrams, Physical layout of simple CMOS logic gates. [T1, T2, R2, R3, R6]	08
Unit-4	**VLSI Clocking & Low Power CMOS Circuits:** Clock skew, Clock distribution techniques, clock jitter. CMOS clocking styles, Clock generation, stabilization and distribution.. Various components of power dissipation in CMOS, Architectures for low power, Limits on low power design through voltage scaling. [T1, T4, R1]	06
Unit-5	**Digital System Design using Verilog HDL-1:** VLSI Design Flow, module, ports, Data types, compiler directives, operators, Propagation delay(Inertial and Transport), Gate-Level Modeling, dataflow modeling, structural modeling, using combinational and sequential circuits examples. [T3, R4, R5]	08
Unit-6	**Digital system design using Verilog HDL-2 :** Behavioral Modeling, initial and always statement, procedural assignment, Timing controls, conditional statement, loops, sequential and parallel blocks, Generate blocks, task and functions, Procedural continuous assignments, overriding parameters, Test bench, using combinational and sequential circuits and state machines examples. [T3, R4, R5]	08
	Total	**48**

Text Books:

1. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits : Analysis and Design", Third Edition, MH, 2002.
2. Neil H. Weste, D. Harris, "Principles of CMOS VLSI design A Circuit & System Perspective". 4th Edition, Pearson(Addison-Wesley), 2011.
3. Samir Palnitkar, "Verilog HDL: A guide to Design and Synthesis", 2nd edition, Prentice Hall PTR, 2003.
4. Wayne Wolfe, "Modern VLSI Design: IP based Approach", 4th Edition, PHI.

Reference Books:

1. Jan M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd edition, Pearson.
2. S.K. Ghandhi, "VLSI Fabrication Principles", John Wiley Inc., New York, 1994 (2nd Edition).
3. Plummer, Deal, Griffin, "Silicon VLSI Technology: Fundamentals, Practice & Modeling" PH, 2001.
4. Michael Ciletti, "Advance digital design with the Verilog HDL", Pearson publication.
5. Navabi Z., "Verilog Digital System Design", McGraw-Hill Publishing, New York, 1999.
6. S.M. Sze (Ed), "VLSI Technology", McGraw Hill.

Subject (Th): 7ET2- DIGITAL IMAGE PROCESSING

Course Requisite:

1. (4ET1) Signals and Systems.
2. (6ET4) Digital Signal Processing.

Course Objectives:

To understand and gain complete knowledge about :

1. The fundamentals of digital image processing
2. Image transform used in digital image processing
3. Image enhancement techniques used in digital image processing
4. Image restoration techniques and methods used in digital image processing
5. Image compression and Segmentation used in digital image processing.

Course Outcomes:

On completion of this module the student will be able to:

1. Analyze general terminology of digital image processing.
2. Examine various types of images, intensity transformations and spatial filtering.
3. Develop Fourier transform for image processing in frequency domain.
4. Evaluate the methodologies for image segmentation, Compression and restoration etc.
5. Implement image process and analysis algorithms.
6. Apply image processing algorithms in practical applications.

	Subject: DIGITAL IMAGE PROCESSING	**L**
Unit-1	**Introduction to digital image processing**: Digital Image Fundamental, Elements of Visual Perception, Simple Image Model, Sampling and Quantization, Basic Relationships between Pixel Imaging Geometry, Gray scale image representation.	09
Unit-2	**Image Transforms:** Introduction to the Fourier Transform, DFT, Properties of Two Dimensional Fourier Transform, FFT, Hadamard, Harr, DCT, Slant Transform.	09
Unit-3	**Image Enhancement:** Basic Techniques, Enhancement by point processing, Spatial Filtering, Enhancement in Frequency domain, histogram based processing, homomorphic filtering.	09
Unit-4	**Image Restoration:** Degradation model, Diagonalisation concept, Algebraic approach to Restoration. Inverse filtering, Weiner (CNS) filtering Restoration in Spatial domain, Basic morphological concept, morphological principles, binary morphology, Basic concepts of erosion and dilation.	08
Unit-5	**Image Compression:** Fundamentals, Image compression models, Elements of Information theory, Lossy and predictive methods, vector quantization, runlength coding, Huffman coding, and lossless compression, compression standards.	09
Unit-6	**Image Segmentation:** Detection of discontinuities, Edge Linking and boundary detection, Thresholding, Regional oriented Segmentation.	08
	Total	**52**

Text Books:

1. Gonzalez and Woods, “Digital Image Processing”, Addison / Wesley.
2. A. K. Jain, “Digital Image Processing”, PHI.

References:

1. Sanjay Sharma, “Digital Image Processing”, S. K. Katariya & Sons, New Delhi.
2. William K. Pratt, “Digital Image Processing”, 3rd ed., John Wiley and Sons Publications.

Subject (Th): 7ET3- SATELLITE AND FIBER OPTIC COMMUNICATION

Course Requisite:

1. (4ET5) Communication Engineering- I.
2. (5ET4) Communication Engineering- II.
3. (6ET3) Digital Communication.

Course Objectives:

1. To understand basics of orbital mechanism, the types of satellite orbits and orbital aspects of satellite communication.
2. To understand the various services of satellite.
3. To introduce and understand optical fiber communication system.
4. To understand and elaborate different components of fibre optic communication system.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand orbital aspects of satellite communication.
2. Know orbital effects in communication system performance.
3. Elaborate the satellite link model.
4. Describe satellite services; VSAT, GPS.
5. Understand functioning of optical sources and detectors.
6. Describe optical fiber communication system and its performance measures.

	Subject: SATELLITE AND FIBER OPTIC COMMUNICATION	**L**
Unit-1	**Introduction:** Satellite frequency bands, Satellite types-LEO, MEO, GEO, HEO, Kepler's laws, Satellite orbits, Geo-stationary Satellite. Orbital Aspects of Satellite Communication: Orbital period and velocity, Effect of orbital inclination, Azimuth and Elevation, Converge angle and Slant range, Orbit determination, Orbital effect in communication system performance. [T1,R3]	08
Unit-2	**Satellite Channels:** Electromagnetic field propagation, Atmospheric losses, Receiver noise, Carrier to Noise ratio, Satellite system link model: Uplink, Downlink, Cross link, Transponder, Satellite system parameters, Satellite link analysis, Frequency reuse and depolarization. [R3]	08
Unit-3	**Satellite Services:** Very Small Aperture Satellite (VSAT): Overview of VSAT system, Network architecture, Access control protocols, Signal format, Modulation coding and interference issues, VSAT antennas, Transmitter and Receiver, Link analysis for VSAT network. Satellite Navigation and Global Positioning System (GPS): Radio and Satellite navigation, Position, Location in GPS, GPS receivers and codes, GPS navigation message and signal levels, Timing accuracy, GPS receiver operation, Differential GPS. [T1]	08
Unit-4	**Optical Fiber Communication System:** Basic optical laws and definitions, Optical fiber modes and configurations, N.A. Attenuation: Units, absorption, scattering losses radioactive losses, core and cladding losses. Material dispersion, wave guide dispersion, intermodal dispersion. [T2,R1]	08
Unit-5	**Optical Sources:** Light Emitting Diodes: Structure, Light source materials. Laser Diodes: Structure, threshold conditions, Modulations of laser diodes. Light source linearity, reliability considerations. [T2,R1]	08
Unit-6	**Optical Detectors:** Physical principles of photodiodes, Photo detector noise, Detectors response time, Avalanche multiplication noise, Temperature effect on avalanche gain. [T2,R1]	08
	Total	**48**

Text Books:

1. Pratt Timothy and Bostian W.Charles, "Satellite Communication", Willey Int. Pub., New York.
2. G. Keiser, "Optical Fibre Communication", McGraw Hill International.

References:

1. Seniors J. M., “Optical Fibre Communication and Applications”, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Dennis Roddy, “Satellite Communication”, McGraw Hill Int, New York.
3. Robert M Gagliardi, “Satellite Communication”, CBS Pub.
4. Anil K, Maini and Varsha Agrawal, “Satellite Communication”, Wiley pub.

Subject (Th): 7ET4- INDUSTIRIAL MANAGEMENT AND QUALITY CONTROL

Course requisites:

1. (6ET6) Communication Skills.

Course Objectives:

1. To understand management, administration and organization in terms of principles and functions.
2. To interpret marketing, materials, production, finance and personnel management.
3. To understand project report, concept of budget and their components.
4. To study concept of quality, business ethics and analyze various quality control techniques.

Course Outcomes:

After completing the course, the students will be able to:

1. Practice the fundamental principles and functions of business management.
2. Recognize and apply knowledge of marketing and materials management.
3. Interpret and evaluate personnel management and evaluation methods of job rating.
4. Evaluate balance sheet, costing and budgetary aspects, project report, profit and loss statement and ratio analysis.
5. Identify factors controlling quality of design and conformance.
6. Apply professional ethics, Kaizen, Quality Circles, ISO-9000 series and TQM in organization.

	Subject: INDUSTIRIAL MANAGEMENT AND QUALITY CONTROL	**L**
Unit-1	**Principles and Techniques of Management** : Meaning of and differences among business management, administration and organization, Principles of management, functions of management, planning, organization structure and relationships, direction, co-ordination, control, motivation, delegation and decentralization, communication, leadership and decision making.	08
Unit-2	**Market and Materials Management :** A) Marketing strategy, market research, consumer behavior, advertising and sales promotion, channels of distribution, pricing of products. B) Classes of material, scope of material control, scope of purchasing department, purchasing procedures, order procedures, inventory control, introduction to production planning and control, types of production, process planning.	10
Unit-3	**Personnel Management :**Meaning and functions of personnel management, recruitment, selection, promotion, wages and salary administration, training and development, functions and scope of trade unions in Indian industries. Welfare of labour, Problems of labour turn over & retention. **Merit Rating:** Job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes.	08
Unit-4	**Project and Financial Management:** A) Case studies of project report, preparation of profit and loss statement and balance sheet, ratio analysis. B) Principles of costing, cost sheet preparation, variance analysis, meaning and application of various budgets, types of budgets and their importance.	08
Unit-5	**Quality Control :** Concept of quality and quality control, elements of quality, factors controlling quality of design and conformance, process control, inspection planning and scheduling, 7QC (Seven Quality Control) techniques, vendor inspection, sampling inspection, sampling plans, Quality audit system.	10
Unit-6	**Quality Management and Professional Ethics :**Concepts and applications of Kaizen, quality circle, ISO 9000 series, just-in-time, quality planning and total quality management, elements of TQM, Quality Circles. Professional business ethics: concept, need, importance, ethical business codes and values.	08
	Total	**52**

Text Books:

1. O.P.Khanna, “Industrial Engineering and Management”, Dhanpat Rai Publications.
2. Telsang Martand.T., “Industrial and Business Management”, S.Chand Publications.
3. Anil Bhat, Arya Kumar, “Management: Principles, Processes and Practices”, Oxford University Press.
4. Bharat Wakhlu, “Total Quality”, S. Chand Publications.
5. Armand V. Feigenbaum, “Total Quality Control”, Tata Mc-Hill Education.

References:

1. Virendra Sherlekar, S.A. Sherlekar, “Principles of Businiess Management”, Himalaya Publishing House.
2. Bose D. Chandra, “Fundamentals of Financial Management”, PHI Learning Publications.
3. Abdul Matheen, “Project Management”, Laxmi Publications.

Subject (Th): (7ET5-1) COMPUTER ORGANIZATION

Course Requisite:

1. (4ET4) Digital Electronics
2. (5ET3) Microprocessor & Microcontroller

Course Objectives:

To understand and gain complete knowledge about:

1. Understand the computer components, bus interconnections and different types of memories.
2. Learn the different types of data transfer techniques.
3. Understand the different types of instruction formats and addressing modes.
4. Aware of the difference between the RISC and CISC architecture.
5. Learn the concepts of microinstruction its sequencing and execution.
6. Understand the multiple processor organizations.

Course Outcomes:

On completion of this module the student should be able to:

1. Design different types of memory systems.
2. Perform different types of floating point arithmetic operations.
3. Design ALU as per the requirement.
4. Understand difference between the Pentium and power PC.
5. Design Micro-programmed control unit as per the requirement.
6. Design multiprocessor based systems.

	Subject: COMPUTER ORGANIZATION	**L**
Unit-1	Computer components & functions. Interconnection structures, Bus Interconnection, PCI, Computer memory system overview, semiconductor main memory, chip logic, error correction, cache memory, elements of cache design, Associative mapping, Advanced DRAM organization, magnetic disk, RAID, CD-ROM.	09
Unit-2	External devices, I/O modules, Programmed I/O, DMA, Interrupt I/O, I/O channels & IOPs, SCSI & firewire interfaces. Operating system overview, Integer representation and arithmetic, Booths's algorithm, Floating point representation and arithmetic, Precision considerations, guard bits, rounding, quiet and signaling NaNs, denormalised numbers, Little, Big and Bi-Endian.	09
Unit-3	ALU: Machine instruction characteristics, operand types, operation types, Addressing modes, Instruction formats, CPU structure, processor organization, register organization, instruction cycle, instruction pipelining, Branch prediction.	09
Unit-4	RISC machine, Instruction Execution characteristics, Register file concept, Compiler based register optimization, RICS architecture, RISC pipelining, RISC v/s CISC, Case study SPARC, superscalar overview, Design issues in instruction level parallelism and machine parallelism, Case study of PowerPC.	08
Unit-5	Control unit operation: Micro-operations, control of the processor, Hardwired implementation. Micro-programmed control: Concepts, microinstruction sequencing and execution, Applications of microprogramming.	09
Unit-6	Multiple processor organizations, Symmetric processors, Mainframe SMP, Cache coherence and MESI protocol, clusters, Non-uniform Memory access, vector computation.	08
	Total	**52**

Text Books:

1. William Stallings, "Computer Organization & Architecture", 5/e (Pearson Education).
2. A. S. Tanenbaum, "Structured Computer Organization", 4/e, McGrawHill (ISE).

References:

1. C. Hamacher, R Zaky, "Computer Organization", 5/e, McGraw Hill (ISE).
2. J.P.Hayes, "Computer Architecture & Organization", 4/e, McGraw Hil (ISE).
3. M.Mano & C. Kime, "Logic & Computer design fundamentals", (2 e), Pearson Education.

Subject (Th): (7ET5-2) PLC AND AUTOMATION

Course Requisite:

1. (3ET4) Instrumentation and Sensors.
2. (5ET2) Power Electronics & Drives.

Course Objectives:

1. To understand Basic Architecture of PLC.
2. To study Different input/output peripherals and communication standards used with PLC.
3. To study Basic Instructions used for Ladder programming.
4. To develop skills to write basic PLC programs.
5. To know SCADA and its application in industrial automation.

Course Outcome:

By the end of this course, the students shall be able to:

1. Describe working of various blocks of basic industrial automation system.
2. Interface the peripherals with PLC.
3. Develop PLC programs for various Applications.
4. Application of SCADA in industrial automation.

	Subject: PLC AND AUTOMATION	**L**
Unit-1	**PLC Basic:** Introduction to PLC, Need of PLC, Types of PLC, Block diagram, processor section, solid state memory, Input modules & output module (Analog, Digital, Discrete). Advantages and limitations of Automation.	09
Unit-2	**Input/Output Devices:** Mechanical switches, proximity switches, encoders, Transducer and Sensor- RTD, Thermistors, Thermocouple, Displacement, position, motion sensor, pressure, liquid level detector, fluid flow measurement, optical sensors. Relays, directional control valve, motors, stepper motors.	09
Unit-3	**PLC Functions:** Symbols of ladder diagram, Symbols of I/O Devices, PLC Timer functions, PLC Counter functions, Comparison functions, data handling functions, Bit functions, data move functions, skip & bypass IO functions.	08
Unit-4	**PLC Programming for Electronic Application:** Types of programming language, Development of ladder diagrams: Various types for ladder programming, flowchart, ladder programming for logic gets, flip- flop (JK, RS, D, T), Up down counters, ladders programming for various industrial process.	08
Unit-5	**PLC Programming for Industrial Automation:** Design and development of ladder logic diagram of DOL starter, star delta converter, forward reverse of motor, temperature control of motor, switching appliance using sensor, on delay timer, ladders programming for various industrial process.	08
Unit-6	**SCADA:** Introduction to supervisory control: Introduction, Block diagram, what is real time, scan interval, Communications in SCADA- types & methods used, Remote Terminal Unit (RTU), and Industrial Application of SCADA system.	08
	Total	**50**

Text Books :

1. "Programmable logic controllers principle and application", John W. Webb, PHI publication.
2. "Process Control Instrumentation Technology", Curtis Johnson PHI publication.
3. "SCADA supervisory control and data acquisition", Stuart A. Boyer, ISA Publication.

Reference Books

1. "PLCs & SCADA: Theory and Practice", Rajesh Mehra and Vikrant Vijay, Laxmi Publications,
2. "Programmable Logic Controllers", John R Hackworth, Pearson education
3. "Introduction to programmable logic controllers", Gary A Dunning.
4. "Mitsubishi FX programmable logic controllers Application and programming" by John Ridley

Subject (Th): (7ET5-3) SMART SENSORS

Course Requisite:

1. (3ET4) Instrumentation and Sensors
2. (5ET3) Micro Processor & Micro Controller

Course Objectives:

1. To acquire fundamental knowledge of Smart Sensors.
2. Understand the nature of sensors, their operation & some aspects related to noise and interference.
3. Study the interfacing of different sensors with microcontroller unit (MCU).
4. Understand use of MCUs/DSPs to Increase Sensor Intelligence.
5. To identify applications of smart sensors in various fields.

Course Outcomes:

After successful completion the course, the students will be able to:

1. Recognize different types of sensors.
2. Describe the characteristics and operation of smart sensors.
3. Interface the sensors with MCU.
4. Analyze MCUs/DSPs to improve the sensor IQ.
5. Discriminate various control techniques for smart sensors

	Subject: SMART SENSORS	**L**
Unit-1	**Smart Sensor and the Nature of Semiconductor Sensor Output:** Mechanical-Electronic Transitions in Sensing, Nature of Sensors, Integration of Micromachining and Microelectronics, Sensor Output Characteristics, Wheatstone bridge, Piezoresistivity in Silicon, Semiconductor Sensor Definitions, Static versus Dynamic Operation, Noise/Interference Aspects.	08
Unit-2	**Sensing Technologies:** Capacitive Sensing, Piezoelectric Sensing, Hall Effect, Chemical sensors, Improving Sensor Characteristics, Digital Output Sensors, Incremental Optical Encoders, Digital Techniques, Low-Power, Low-Voltage Sensors, combined Solution: Micromachining and Microelectronics.	09
Unit-3	**Getting Sensor Information into the MCU**: Amplification and Signal Conditioning, Instrumentation Amplifiers, Switched-Capacitor Amplifier, Barometer Application Circuit, 4-20 mA Signal Transmitter, Inherent Power Supply Rejection, Separate Versus Integrated Signal Conditioning, Digital Conversion, A/D Converters, Performance of A/D Converters, Implications of A/D Accuracy and Errors.	09
Unit-4	**MCUs/DSPs to Increase Sensor IQ:** MCU Control, MCUs for Sensor Interface Peripherals, Memory, Input/output, Onboard A/D Conversion, Power-Saving Capability, Local Voltage or Current Regulation, Modular MCU Design, DSP Control, Algorithms Versus Lookup Tables, Linearization, PWM Control, Auto zero and Auto range, Diagnostics, Indirect (Computed, Not Sensed) Versus Direct Sensing, Sensor Integration.	09
Unit-5	**Control Techniques:** Programmable Logic Controllers, Open Versus Closed-Loop Systems, PID Control, State Machines, Fuzzy Logic, Neural Networks, Combined Fuzzy Logic and Neural Networks, Adaptive Control, Observers for Sensing, Other Control Areas, RISC Versus CISC, Combined CISC, RISC and DSP, The Impact of Artificial Intelligence.	09
Unit-6	**Transceivers, Transponders, and Telemetry:** The RF Spectrum, Spread Spectrum, Wireless Data and Communications, Wireless Local Area Networks, FAX/ Modems, Wireless Zone Sensing, Optical Signal Transmission, RF Sensing Surface Acoustical Wave Devices, Radar, Remote Emissions Sensing, Remote Keyless Entry, Intelligent Transportation System, RF-ID, Telemetry, RF MEMS.	08
	Total	**52**

Text Books:

1. "Understanding Smart Sensors", Randy Frank, 2nd Edition, House Boston, London.

Subject (Th): (7ET5-4) FUZZY LOGIC AND NEURAL NETWORKS

Course Requisite :

1. (6ET2) Control Systems Engineering

Course Objectives::

1. To study fundamental concepts of Artificial Neural Network (ANN).
2. To understand various learning rules for ANN and different supervised and unsupervised learning networks.
3. To study fundamental concepts of Fuzzy Logic(FL), fuzzification and defuzzification.
4. To understand different supervised and unsupervised learning networks.
5. To learn applications of FL for pattern recognition and control.

Course Outcomes:

After successful completion the course the student will be able to:

1. Develop algorithms for supervised and unsupervised ANN.
2. Implement the ANN concepts to solve real life problems.
3. Analyze the ANN network.
4. Develop algorithms in fuzzy logic for applications such as pattern recognition.
5. Implement the fuzzy logic concepts to solve real life problems.

	Subject : FUZZY LOGIC AND NEURAL NETWORKS	**L**
Unit-1	**Introduction:** Biological Neurons and their artificial models, introduction to neural computing, Components of neuron, input and output weight, threshold, weight factors, transfer functions, concepts of supervised and unsupervised learning.	07
Unit-2	**Supervised Learning:** Linear separability, Single layer network. **Perceptron:** Training algorithm and limitations. **Multilayer Network:** Architecture of feed forward network, Learning rule, generalized delta rule, learning function. Error Back propagation algorithm (EBPA), Learning factors.	09
Unit-3	**Unsupervised Learning:** Introduction, Clustering and similarity measures, Winner Take all learning, recall mode, outstar learning rule , Self organizing map, Counter propagation networks. **Recurrent associative memories**: basic concepts, discrete time Hopfield network, storage and retrieval algorithm.	09
Unit-4	**Introduction:** Uncertainty in information, basic concepts of Fuzzy sets, operations on fuzzy sets, properties. **Fuzzy relations :** operations, properties, fuzzy Cartesian product and composition, tolerance and equivalence relations .	08
Unit-5	**Membership functions:** Features, fuzzification, membership value assignments methods: intuition, inference, rank ordering, Fuzzy Rule based systems: linguistic hedges , rulebased systems, graphical technique of inference. **Defuzzification:** Lambda-cuts for Fuzzy sets and Fuzzy relations, Defuzzification methods.	10
Unit-6	**Fuzzy pattern Recognition:** feature analysis, partitioning of feature space, single sample identification, multifeature pattern recognition. **Simple Fuzzy logic controller (FLC):** Assumptions in a Fuzzy control system design, simple FLC, general FLCs, simple examples.	08
	Total	**51**

Text Books:

1. J.M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House.
2. Timothy Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill International Edition.

References:

1. Meherotra Kishan, Mohan C.K., Ranka Sanjay, “Elements of artificial neural networks”, Penram Int. Pub., Mumbai.
2. G. J. Klir and Bo Yoan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", PHI publications.

Subject (Th): (7ET5-5) SPEECH PROCESSING.

Course Requisite :

1. (4ET1) Signals & Systems.
2. (6ET4) Digital Signal Processing.

Course Objectives:

1. To be able to relate human physiology and anatomy with signal processing paradigms.
2. To acquire the knowledge of speech generation and speech recognition models.
3. To understand methods/techniques used in speech signal estimation & detection.

Course Outcomes:

After successfully completing the course students will be able to:

1. Illustrate how the speech production is modeled.
2. Summarize the techniques involved in collecting the features from the speech signal in time and frequency domain.
3. Compare the techniques involved in speech and speaker detection.
4. Summarize the various speech coding techniques.
5. Apply techniques/methods used for speech enhancement and speech recognition.

	Subject : SPEECH PROCESSING	**L**
Unit-1	**Speech Production and Acoustic Phonetics:** The process of speech production, Acoustic theory of speech production, Digital models of speech signals of speech signal, Articulator phonetics, Acoustic Phonetics, Co- articulation, Prosody.	08
Unit-2	**Speech Analysis:** Time and frequency domain analysis of speech, Linear predictive coding (LPC) analysis, Cepstral analysis, Speech parameter (pitch) estimation.	09
Unit-3	**Speech Synthesis:** Principles of speech synthesis, Articulatory synthesis, Formant synthesis and LPC synthesis.	09
Unit-4	**Coding of Speech Signals:** Introduction, Quantization, Speech redundancies, Time domain waveform coding, Linear predictive coding, Linear delta modulation, Adaptive delta modulation, Adaptive differential pulse code modulation, Filter bank analysis, Phase vocoders and Channel vocoders.	10
Unit-5	**Speech Enhancement:** Introduction, Nature of interfering sounds, speech enhancement techniques, spectral subtraction and filtering, harmonic filtering, Spectral subtraction, Adaptive noise cancellation	09
Unit-6	**Speech Recognition:** Introduction, Baye's rule, Segmental feature extraction, MFCC, DTW, HMM approaches for speech recognition.	07
	Total	**52**

Text Books:

1. "Speech Communications: Human & Machine", Douglas O'Shaughnessy, Universities Press.
2. "Digital Processing of Speech Signals", Rabiner and Schafer, Prentice Hall, 1978.

References:

1. "Discrete-Time Speech Signal Processing: Principles and Practice", Thomas F. Quatieri, Publisher: Prentice Hall.
2. "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Nelson Morgan and Ben Gold, John Wiley & Sons.
3. "Speech Analysis Synthesis and Perception", J. L. Flanagan, Second edition, Springer-Verlag (1972).
4. "Speech and Audio Signal Processing", Gold & Morgan, 1999, Wiley and Sons.

Subject (Th) - (7ET5-6) RF MODELING & ANTENNA

Course Requisite :

1. (3ET5) Electromagnetic fields.
2. (8ET1) UHF & Microwave.

Course Objectives:

1. To impart the knowledge in modeling of RF system design.
2. To acquire knowledge of fundamental principles and techniques of antenna theory.
3. To study characteristics of different antenna types.

Course Outcomes:

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

1. Acquire the concepts of active and passive components in RF domain.
2. Understand design of RF Filters.
3. Analyze the radiation mechanisms of commonly used antennas.
4. Demonstrate knowledge of antennas commonly used in Communication Engineering.
5. Discriminate antennas on the basis of their electrical characteristics.

	Subject: RF MODELING & ANTENNA	**L**
Unit-1	**Behavior of Active and Passive Components in RF range**: Frequency Spectrum, hazards of Electromagnetic Radiations, and fundamentals of radio frequency design, High Frequency behavior, equivalent circuit and frequency response of resistor, capacitor, inductor, diode, BJT, and FET, Characteristics, structure and applications of coaxial line, stripline, microstrip line, and coplanar lines.	09
Unit-2	**Filter Design**: Analysis of infinite periodic structures terminated Periodic structures, k-β diagrams and wave velocities, Image Parameter Method: Image impedances and transfer functions for two port networks, constant-k filter sections, m-derived filter sections, and composite filters, Insertion Loss Method: Characterization by power loss ratio, maximally flat, equal ripple, and linear phase low pass filter prototype, Filter transformations: impedances, frequency scaling, and band pass and band stop, Richard's transformation, Kuroda's identity, impedance, and admittance inverters.	09
Unit-3	**Fundamentals of Antenna**: Conceptual understanding and radiation mechanism, Fundamental Parameters of Antennas: Radiation pattern, radiation power density, radiation intensity , beam width, directivity, antenna efficiency, gain, beam efficiency, bandwidth, input impedance, antenna radiation efficiency, antenna vector effective length and equivalent areas, maximum directivity and maximum effective areas, Friss transmission equation, antenna temperature, Vector potential A for an electric current source J, vector potential F for an magnetic current source M, electric and magnetic fields for electric J and Magnetic M current sources and concept of near and far field radiation.	10
Unit-4	**Wire Antennas: Infinitesimal dipole and small dipole**: Radiation field, near field, far field directivity, region separation, Finite Length dipole: Basic parameters of half wavelength dipole, folded dipole, Monopole antenna, Ground Effects, Linear elements near or on infinite perfect conductors, Loop antennas: Basic parameters.	08
Unit-5	**Antenna Arrays**: Linear arrays, planner arrays, and circular arrays, Array of two isotropic point sources, non-isotropic sources, Principle of pattern multiplication, Linear arrays of n elements, broadside, radiation pattern, directivity, beam width and null directions, array factor, Antenna analysis using Binomial, Dolph-Tschebyscheff, Yagi Uda antenna.	08
Unit-6	**Special types of antennas**: Frequency Independent Antennas: Log periodic and helical antennas Microstrip Antennas: Characteristics, applications and limitations, Reflector Antennas and Horn Antennas: Characteristics, applications and limitations.	08
	Total	**52**

Text Books:

1. Costantine A. Balanis, “Antenna Theory Analysis And Design”, John Wiley Publication
2. John D. Kraus, “ Antennas”, Tata McGraw Hill publication
3. David M Pozar, “Microwave Engineering”, John Wieley and Sons, Inc. Hobokenh, New Jersey, Fourth Edition, 2012

References:

1. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata McGraw Hill,New Delhi, Second Edition, 2009
2. Reinhold Ludwig and Pavel Bretchko, “RF Circuit Design”, Pearson Education Asia.

Subject (Pr): 7ETp6- VLSI DESIGN LAB

Course Requisite : 1. (7ET1) VLSI Design.
Course Objectives: 1. To design digital VLSI circuits using computer aided simulation and synthesis tools. 2. To verify various design parameters of digital VLSI circuits using appropriate ASIC design tool. 3. To develop Verilog code for various combinational and sequential digital circuits and implement on programmable chips (FPGA/CPLD) using Verilog HDL.
Course Outcomes: At the end of the course the student will be able to: 1. Understand Front & Back end design aspects of simple VLSI Digital circuits 2. Model digital circuits with Verilog HDL, simulate, synthesize and prototype in PLDs.

Section A - VLSI Back End Design programs

The experiments in this section are to be designed and implemented using Cadence / Mentor Graphics / Synopsys / Microwind CAD tools.

	Experiment List
Expt-1	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of CMOS Inverter on silicon using appropriate ASIC design tool.
Expt -2	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of two input NAND and NOR logic gates on silicon using appropriate ASIC design tool.
Expt -3	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of D-flip-flop with reset on silicon using appropriate ASIC design tool.
Expt -4	Layout, physical verification, placement & route for design, static timing analysis, Parametric analysis of 4-bit shift register with enable on silicon using appropriate ASIC design tool.

Section B - VLSI Front End Design programs

The experiments in this section are to be designed and implemented using Cadence / Mentor Graphics / Synopsys / CAD tools with Verilog HDL code entry.

	Experiment List
Expt-5	To write Verilog code for 2-to-4 decoder and simulate with test bench, synthesis, implement on PLD.
Expt -6	To write Verilog code for 8-to-1 Multiplexer and simulate with test bench, synthesis, implement on PLD.
Expt -7	To write Verilog code for D flip-flop with reset and simulate with test bench, synthesis, implement on PLD.
Expt -8	To write Verilog code for BCD counter along with seven segment decoder to display count on seven segment display and simulate with test bench, synthesis, implement on PLD. The clock input to counter should be connected to suitable push button key on CPLD/FPGA kit.
Expt -9	To write Verilog code for any suitable sequence detector and simulate with test bench, synthesis, implement on PLD.

* Minimum 08 experiments based on/relevant to the above list.

Subject (Pr): 7ETp7- SKILL DEVELOPMENT LAB -V (Signal and Image Processing)

Course Requisite:

1. (4ET1) Signals and Systems
2. (5ETp9) Skill Development Lab-III (Simulation)
3. (6ET3) Digital Communication
4. (6ET4) Digital Signal Processing
5. (7ET2) Digital Image Processing

Course Objectives:

To understand and gain complete knowledge about:

1. Design and implementation of signal processing in communication systems.
2. Simulation and performance evaluation of digital communication systems.
3. Design and implementation of algorithms to perform basic image processing operations.
4. Performance evaluation of image processing algorithms and systems.

Course Outcomes:

After successful completion of the course, students will be able to

1. Apply signal processing algorithm in various communication systems.
2. Identify the sustainability of communication system.
3. Evaluate the methodologies for image pre-processing and post processing.
4. Apply image processing algorithms in practical applications.

	Subject: SKILL DEVELOPMENT LAB-V (Signal and Image Processing)	**L**
Unit-1	Signal Processing in Communication Systems using MATLAB/SCILAB: Monte Carlo simulation of a binary communication system. Multiamplitude signal transmission. Communication system design for band limited channel: Signal design for zero and controlled ISI. Linear equalizers, adaptive linear equalizers. Probability of error for Quadrature Amplitude Modulation in an AWGN Channel. Channel Coding: linear block codes.	8
Unit-2	Image Preprocessing using MATLAB/SCILAB: Working with images, Image types, Image importing and exporting, displaying images, finding image characteristics, converting image formats, Applying image enhancement techniques, Adjusting image intensity, Enhancing images using arithmetic operations, Rotating images, Cropping and resizing images, Block processing, Image convolution and correlation, Spatial domain filtering, Frequency domain filtering.	8
Unit-3	Feature Extraction and Segmentation using MATLAB/SCILAB: Transforms, Reducing noise, Deblurring images, Correcting background illumination, Image thresholding, Edge detection, Watershed segmentation, Morphological operations, Performance evaluation and ROC analysis.	8
	Total	**24**

Text Books:

1. John G.Proakis and Masoud Salehi, "Contemporary Communication System using MATLAB" Northeastern University, Vikas publication house.
2. Gonzalez and Woods, "Digital Image Processing Using MATLAB, McGraw Hill , II Edition.
3. William Pratt, "Digital Image Processing", III Edition, John Wiley & Sons Publication.

Experiment List:

Expt-1	Use Monte Carlo simulation to estimate and plot probability of error versus signal to noise ratio for a binary communication system that employs correlators or match filters.
Expt-2	Simulate the theoretical expression for probability of error for the optimum detector in M-level PAM system and plot the probability of error versus signal to noise ratio for M=2, 4,8,16.
Expt-3	Design a digital implementation of the transmitter and receiver filter $G_T(f)$ and $G_R(f)$ such that their product is equal to the spectrum of duobinary pulse and $G_R(f)$ is the matched filter to $G_T(f)$.

Expt-4	Simulate an adaptive equalizer based on the LMS algorithm
Expt-5	Perform Monte Carlo simulation of 16-QAM communication system using a rectangular signal constellation.
Expt-6	Simulate the program segment for generator matrix for a (10,4) linear block code and determine all code words and minimum weight of the code.
Expt-7	To develop a code for resizing and rotating an image
Expt-8	To develop a code for enhancing the input image using different enhancement techniques.
Expt-9	To develop a code for Histogram equalization.
Expt-10	Implement low pass, high pass filtering over input image in spatial domain.
Expt-11	Implement low pass, high pass filtering over input image in frequency domain.
Expt-12	Implement salt and pepper noise removal using a simple median filter
Expt-13	To develop a code for calculating DFT and DCT images.
Expt-14	To implement global and local thresholding for segmentation of image
Expt-15	To develop a code for edge detection using derivative filter mask with Prewitt, Sobel and Laplacian operators.
Expt-16	To demonstrate image morphology using boundary extraction and interior filling.
Expt-17	To develop a code for detection of brain tumor using Watershed segmentation.

* Minimum 12 experiments based on/relevant to the above list.

Semester : Eight																	
Sr. No.	**Subject Code**	**Subject**	**TEACHING SCHEME**					**EXAMINATION SCHEME**									
			HOURS / WEEK			**Total HOURS/WEEK**	**CREDITS**	**THEORY**					**PRACTICAL**				
			Lecture	**Tutorial**	**P/D**			**Duration Of Paper (Hr.)**	**Max. Marks Theory Paper**	**Internal Marks**	**Total**	**Min. Passing Marks**	**Max. Marks**		**Total**	**Min. Passing Marks**	
													Int.	**Ext.**			
THEORY																	
01	8ET1	UHF & Microwaves	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
02	8ET2	Wireless Communication	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
03	8ET3	Data Communication Network	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
04	8ET4	Professional Elective-II	4	--	--	4	4	3	80	20	100	40	--	--	--	--	
PRACTICALS / DRAWING / DESIGN																	
05	8ETp5	UHF & Microwaves Lab	--	--	2	2	1	--	--	-- --	--	--	25	25	50	25	
06	8ETp6	Skill Development Lab-VI (Networking)	2	--	2	4	2	--	--	-- --	--	--	50	50	100	25(Int.) 25(Ext)	
07	8ETp7	Project	--	--	4	4	6	--	--	--	--	--	75	75	150	75	
		Total	**18**	**--**	**8**	**26**	**25**	--	--	--	**400**	--	--	--	**300**	**--**	
														Total	**700**		

Professional Elective-II :

1. Embedded System & RTOS
2. Automotive Electronics
3. Wireless Sensor Network
4. Biomedical Engineering
5. Data Compression & Encryption
6. Ultra Wide Band Communication

Subject (Th): 8ET1- UHF & MICROWAVES

Course Requisite:

1. (3ET5) Electromagnetic fields.

Course Objectives: To learn:

1. Basic concepts of Microwave active and passive devices.
2. Transmission characteristic of microwave through waveguide and microstrip line.
3. Measurement of microwave parameters.

Course Outcomes:

At the end of the course students will be able to:

1. Understand operations of microwave active and passive devices.
2. Describe characteristics of microwave propagation through transmission line.
3. Use S-parameters for characterization of microwave devices.
4. Measure various parameters of microwave system.

	Subject: UHF & MICROWAVES	**L**
Unit-1	**Microwave Tubes:** Introduction to microwave Engg. and applications, advantages, frequency bands, Limitation of Conventional devices at high frequency, Microwave Tubes: Two cavity, Multicavity klystron, and reflex klystron, Cylindrical Cavity Magnetron, TWT & Backward Wave Oscillator.	08
Unit-2	**Semiconductor Microwave Devices:** Gunn diode: RWH theory, Gunn domain, modes of Gunn oscillation, Negative resistance amplifier (principle), Parametric amplifiers: operation & types, Principle of operation of IMPATT, TRAPATT diodes, & MASER.	08
Unit-3	**Waveguide system and Microstrip lines:** Transmission line equation and solution, reflection and transmission coefficient, VSWR. **Waveguides:** Rectangular Wave guide, Circular Waveguide, Power losses and power handling capacity of rectangular waveguide , Attenuation in wave guides, Introduction to microstrip lines and its types, characteristic impedance, losses in microstrip lines.	10
Unit-4	**Microwave Resonator:** Series and parallel resonant circuits (RLC), transmission line resonators ($\lambda/2$, ($\lambda/4$) open-short circuited line, Cavity resonators: rectangular and circular cavities, resonant frequency, and quality factor of resonators, Fabry-Perot resonator.	08
Unit-5	**Microwave passive components & Scattering matrix:** Microwave passive components, terminator, Attenuator, phase shifter, Scattering matrix formulation, Two hole directional coupler, E-plane tee, H-plane tee, Magic tee and its scattering matrix,. Microwave propagation in ferrites, devices employing Faraday rotation: Isolator, Gyrator & Circulator.	08
Unit-6	**Microwave Measurements:** Frequency Measurements, Power Measurements, Attenuation Measurements, VSWR Measurements, Impedance Measurements, insertion Loss Measurements, Dielectric constant Measurements.	08
	Total	**50**

Text Books:

1. Liao, Samuel Y., "Microwave Devices & Circuits", Tata Mc-Graw Hill Co. Ltd., New Delhi.
2. David M Pozar, "Microwave Engineering" Wiely 3 rd Edition.
3. Collin, Robert E., "Foundations for Microwave Engineering", Mc- Graw Hill, New York.

References:

1. Kennedy G., “Electronics Communication Systems”, Tata Mc-Graw Hill Book Co.,New Delhi..
2. K.C. Gupta, “Microwave Engineering”, New Age.
3. Reich, Scolnik, Ordung, Krangs, “Microwave Principles”, PHI.
4. M.L. Sisodiya and G.S. Raghuwanshi, “Microwave Circuits and Passive devices”, John Wiley & Sons Ltd.
5. Mathew M. Radmanesh, “RF and Microwave Electronics – Illustrated”, Prentice Hall.

Subject (Th): 8ET2- WIRELESS COMMUNICATION

Course Requisite:

1. (4ET5) Communication Engineering-I.
2. (6ET3) Digital Communication.
3. (7ET2) Data Communication Network.

Course Objectives:

1. To understand basics of Cellular System.
2. To study the design fundamentals of cellular radio system, capacity & Coverage improvement techniques.
3. To understand mobile radio propagation mechanism and fading.
4. To understand operation of various 2nd and 3rd generation cellular systems; GSM, IS95, CDMA2000, WCDMA and LTE.
5. To study various wireless data communication networks; WiMAX, WLAN and Bluetooth.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Illustrate the evolution of cellular mobile system and understand cellular concepts.
2. Use design fundamentals of cellular radio system.
3. Understand propagation mechanism and fading in mobile radio system.
4. Demonstrate concepts of various 2nd and 3rd generation cellular systems and wireless data communication networks.

	Subject (Th): WIRELESS COMMUNICATION.	**L**
Unit-1	**Cellular Fundamentals:** Evolution of Mobile Systems (1G, 2G, 3G, 4G), Cellular Concept, Cell Fundamentals, Cellular Telephone System, Timing Diagram of Call Processing in Cellular System, Channel Allocation Techniques, Hand off Strategies, Types of Hand off. [T1,T2,R1]	08
Unit-2	**Cellular Radio System Design Fundamentals:** Frequency Reuse, Co-channel Reuse Ratio, Co-channel Interference and System Capacity, Adjacent Channel Interference, Improving Coverage and Capacity in Cellular System: Cell Splitting, Sectoring, Repeater for Range Extension, Microcell Zone, Trunking and Grade of Services. [T1,T2, R1]	08
Unit-3	**Mobile Radio Propagation Mechanism:** Basic Propagation Mechanism: Reflection, Diffraction and Scattering. Small Scale Fading and Multipath: Factors Influencing Small Scale Fading. Parameters of Mobile Multipath Channel. Types of Small Scale Fading: Fading Effect Due to Multipath Time Delay Spread, Fading Effect Due to Doppler Spread. [T1]	08
Unit-4	**GSM System:** GSM Network Architecture, GSM Signaling Protocol Architecture, Identifiers in GSM System, GSM Channels, Frame Structure, Speech Coding, Authentication and Security, GSM Call Procedures, GSM Hand Off Procedures. [T3,T1]	08
Unit-5	**CDMA Digital Cellular Standard (IS-95):** Architecture of CDMA System, CDMA Air Interface, IS-95 Forward Channel, IS-95 Reverse Channel, CDMA Call Processing, Power control in CDMA System, Hand Of in CDMA. Comparison of CDMA and GSM. **WCDMA/UMTS:** WCDMA Air Interface, Attributes of WCDMA System, Forward WCDMA Channel, Reverse WCDMA Channel. **CDMA2000:** Forward and Reverse Channel, Hand Off and Power Control. [T3,T1]	08
Unit-6	**3GPP Long-Term Evolution:** Frequency Bands and Spectrum Flexibility, Network Structure, Protocol Structure, PHY and MAC Layer Overview. Physical Layer Procedure: Establishing a connection, Retransmission and reliability, Scheduling, Power control, Handover [T4] **WiMAX /IEEE 802.16:** WiMAX versus Existing Cellular System, System	08

	Overview, Link Control: Establishing a connection, Scheduling and resource Request, QoS, Power Control, Handover and Mobility Support. [T4] **Wireless Local Area Network:** Wi-Fi, Advantages and Disadvantages, WLAN Topology, IEEE 802.11 standard, IEEE 802.11 Architecture and Services, IEEE 802.11 family and its Standards. [R1,R2] **Bluetooth:** Overall Architecture, Protocol Stack, Physical Connection, MAC Mechanism, Frame Formats, connection Management. [T2,R1]	
	Total	**48**

Text Books:

1. Theodore S. Rappaport, "Wireless Communications: Principles &Practice", Second edition, Pearson Education (2002).
2. K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks", Pearson Education Asia Publication (2002).
3. T. L. Singal, "Wireless Communication". McGraw Hill Education.
4. A. F. Molisch, "Wireless Communications", Second Edition, Wiley Publication.

References:

1. G. S. Rao, "Mobile Cellular Communication", Pearson Education.
2. Upena Dalal, "Wireless communication", Oxford University Press.
1. William CY Lee, "Mobile Cellular Telecommunications", (second edition) McGraw Hill Inc.

Subject (Th): 8ET3- DATA COMMUNICATION NETWORK

Course Requisite:

1. (5ET4) Communication Engg.-II.
1. (6ET3) Digital Communication.

Course Objectives:

1. To understand the general principles of network design and compare the different network topologies.
2. To understand the general principles of switching and various routing algorithms.
3. To acquire the knowledge of functions and protocols of OSI and TCP/IP models.
4. To understand security issues in data network.

Course Outcomes:

After successfully completion of this course, students should be able to:

1. Identify different types of network devices and their functions within a network.
2. Describe different types of network topologies and protocols.
3. Differentiate the layers of the OSI and TCP/IP model.
4. Understand various types of routing algorithms and concepts of IP addresses.
5. Deal with security issues in data network.

	Subject: DATA COMMUNICATION NETWORK	**L**
Unit-1	**Data Communication Network:** A brief history of Internet, Protocols and Standards, Standard Organizations, Need for Protocol Architecture, OSI Reference Model, Overview of TCP/IP architecture, Addresses in TCP/IP. **Types of Network:** LAN, MAN, WAN. **Network connecting Devices:** Hubs, Repeater, Bridges, Switches, Routers, Gateways. **Network Topology:** Mesh, Bus, Tree, Ring, Star. [T1, T3]	08
Unit-2	**Data Link Control Protocols:** Need for Flow control, Stop and Wait Flow Control, Sliding Window Flow Control, Stop and wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, Transmission efficiency of ARQ protocols. **Multiple Access Control Protocols:** Random Access Techniques: ALOHA, Slotted ALOHA. Contention Techniques: CSMA, CSMA/ CD (IEEE 802.3), CSMA/CA. Controlled Access Techniques: Polling, Token Passing. **Medium Access Control Protocols:** Token Bus (IEEE 802.4), Token Ring (IEEE 802.5). [T1,T2]	08
Unit-3	**Network Layer Logical Addressing:** Network layer Issues, IPV4 addresses, Class full addressing, Classless addressing (Problems expected), IPv4: Datagram, Fragmentation, Checksum, Address Resolution Protocol(ARP), IPv6 addresses, IPv6 Packet format, Comparison between IPv4 and IPv6**.** **[**T1]	08
Unit-4	**Network Layer Routing:** Alternate routing in circuit switched network, Fixed Routing, Flooding, and Random Routing in Packet Switched networks. **Least Cost Algorithms:** Dijkstra's Algorithm (Problems expected), Bellman Ford Algorithm (Problems expected). **Traffic Control:** Leaky bucket algorithm, Token bucket algorithm. **Transport Layer:** User datagram protocol (UDP), Transmission control protocol (TCP). [T1,T3]	08
Unit-5	**Application Layer:** Name Space, Domain Name System (DNS), Distribution of Name Space, DNS in the Internet, Resolution. Remote Login**:** TELNET, Electronic Mail: SMTP, POP, FTP, World Wide Web, HTTP. **[**T1]	08
Unit-6	**Network Security:** Security services, Message confidentiality, Message integrity, Message authentication, Digital Signature, Entity Authentication, Key Management. **[**T1]	08
	Total	**48**

Text Books:

1. B. Forouzan, "Data Communications and Networking", 4th Edition, McGraw-Hill.
2. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, Inc.
3. William Stallings, "Data and Computer Communication", 8th Edition, Pearson Education, Inc.

Reference Books:

1. James F. Kuross, Keith W. Ross, "Computer Networking A Top-Down Approach Featuring the Internet", Third Edition, Addison Wesley, 2004.
2. Nader F. Mir, "Computer and Communication Networks", Pearson Education,2007.
3. Comer, "Computer Networks and Internets with Internet Applications", Fourth Edition, Pearson Education, 2003.

Subject (Th): (8ET4-1) EMBEDDED SYSTEM AND RTOS

Course Requisite :

1. (4ET4) Digital Electronics.
2. (5ET3) Microprocessor and Microcontroller.

Course Objectives:

1. To acquaint students with knowledge of embedded processor, its hardware and software.
2. To provide skills in embedded C programming.
3. To understand real time operating systems, inter-task communication and embedded software development tools.
4. To learn concurrent system on a real-time operating system.

Course Outcomes:

After completion of the course the students will be able to:

1. Distinguish real-time embedded systems from other systems.
2. Describe fundamentals of embedded based firmware design.
3. Evaluate the need for real-time operating system.
4. Develop real-time algorithm for task scheduling.
5. Summarize technique used for product enclosure design and development.
6. Specify, design and implement a small embedded system.

	Subject: EMBEDDED SYSTEM AND RTOS	**L**
Unit-1	**Introduction to Embedded Systems:** Definition of Embedded System, Comparison between Embedded Systems and General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Purpose of Embedded System. **Building Blocks of Embedded System:** Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, PCB and Passive Components. Characteristic and Quality Attributes of Embedded Systems.	09
Unit-2	**Hardware Software Co-Design and Program Modules:** Fundamental issues in hardware software Co-Design, Computational models in Embedded Design, Introduction to UML, Hardware Software trade-Off. **Embedded Hardware Design and Development**: Analog and Digital Electronic components, VLSI and Integrated Circuit Design EDA tools.	08
Unit-3	**Embedded Firmware Design and Development:** Embedded firmware design approaches, Embedded Firmware Development languages, Programming in Embedded C.	09
Unit-4	**RTOS based Embedded System Design:** Operating System basic, Types of Operating Systems, Task, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication and Synchronization, Device Driver, How to Choose an RTOS.	10
Unit-5	**Integration and Testing of Embedded Hardware and Firmware:** Integration of Hardware and Firmware. **Product Enclosure Design and Development:** Product Enclosure Design tools, Product Enclosure Development techniques.	09
Unit-6	**Embedded Product Development Life Cycle:** Objectives, Phases of EDLC, Modeling of EDLC, **Design Case Studies:** Digital Camera, Battery Operated Smart Card Reader.	07
	Total	**52**

Text Books:

1. Shibu. K. V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
2. Frank Vahid, "Embedded System Design Unified Hardware and Software".

References:

1. Steve Heath, "Embedded System Design", Elsevier, 2005.
2. David E. Simon, "An Embedded Software Primer", Pearson Education, 2003.

Subject (Th): (8ET4-2) AUTOMOTIVE ELECTRONICS

Course Requisite:

1. (3ET4) Instrumentation and Sensors.
2. (5ET3) Microprocessor & Microcontroller.
3. (7ET2) Data Communication Network.

Course Objectives:

1. To gain the fundamental knowledge of electrical and electronics components used for vehicle operations.
2. To study applications of sensors and actuators used in vehicle systems.
3. To understand use of microprocessors/microcontrollers in vehicle control systems.
4. To study various communication protocols used in automotive electronics.
5. To study fundamentals of diagnostics procedures of electronic systems in automobiles.
6. To gain information on modern safety system for vehicles.

Course Outcomes:

After completion of the course students will be able to:

1. Demonstrate the knowledge of automotive systems for vehicles.
2. Illustrate the use of sensors and actuators in vehicles.
3. Identify the use of microcontrollers/microprocessor for automotive applications.
4. Summarize communication protocols used in automotive electronics.
5. Use diagnostic procedures and sequence for fault finding to give corrective measures.
6. Demonstrate the knowledge of system safety in automobiles.

	Subject: AUTOMOTIVE ELECTRONICS	**L**
Unit-1	**Automotive Systems:** Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Automotive Transmission fundamentals, Vehicle braking fundamentals, Steering Control and Steering system basics, Fundamentals of electronically controlled power steering & its types.	09
Unit-2	**Automotive Sensors and Actuators**: Sensors: characteristics, response, error, Redundancy of sensors in ECUs, Examples of sensors for: Accelerometers, wheel speed, brake pressure, Vehicle speed, Throttle position, Temperature, Mass air flow (MAF), Airbag system, and lambda sensor. Actuators: Solenoids, motors, and piezoelectric force generators, Relays, Automatic transmission control system.	08
Unit-3	**Microcontrollers/Microprocessors in Automotive domain & ECU Design Cycle:** Introduction to Microcontrollers/Microprocessors in Automotive Domain, Criteria to choose the right microcontroller/processor for various automotive applications, ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on Chassis, Infotainment, Body Electronics.	09
Unit-4	**Automotive Communication protocols, Infotainment systems:** Overview of Automotive communication protocols: CAN, LIN, Flex Ray, MOST Ethernet, Communication interface with ECUs and with infotainment gadgets, Infotainment Systems: Application of Telematics in Automotive domain, GPS, GPRS.	09
Unit-5	**Diagnostics** Fundamentals, Basic wiring system and multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Diagnostic procedures and sequence, On board and off board diagnostics in Automobiles, OBDII.	08
Unit-6	**Safety Systems in Automobiles:** Active Safety Systems: ABS, TCS, ESP, Brake assist etc. Passive Safety Systems: Airbag, Advanced Driver Assistance (ADAS), Examples of assistance applications: Lane Departure Warning, Collision Warning, Automatic, Cruise Control, Pedestrian Protection, headlight Control.	09
	Total	**52**

Text Books:

1. Tom Denton, "Automobile Electrical and Electronics Systems", 3rd Edition, Elsevier, 2004.
2. Allan Bonnick, "Automotive Computer Controlled Systems Diagnostic Tools and Techniques", Elsevier Science, 2001.
3. Tom Denton, "Advanced Automotive Fault Diagnosis", 2nd Edition, Elsevier, 2006.

References:

1. A K Babu, "Automotive Electrical and Electronics", Khanna publication, 2001.
2. Iqbal Husain, "Electric and Hybrid Vehicles: Design fundamentals", CRC Press, 2003.
3. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
4. Terence Rybak, Mark Stefika, "Automotive Electromagnetic Compatibility (EMC)", Springer 2004.

Subject (Th): - (8ET4-3) WIRELESS SENSOR NETWORK

Course Requisite:

1. (8ET2) Wireless Communication
2. (7ET2) Data Communication Network

Course Objectives:

1. To study architecture and environment for wireless sensor network.
2. To understand the mutual relationships and dependencies between different protocols and architectural decisions by offering an in-depth investigation of relevant protocol mechanisms.
3. To study principle and architecture of existing Middleware for sensor networks.
4. To understand the design issues and requirements of network management.
5. To review various sensor network platforms, operating systems for wireless sensor network.

Course Outcome:

By the end of this course, the students shall be able to:

1. Understand wireless sensor technology and its architecture.
2. Identify and review various sensor network protocols.
3. To understand various types of Middleware used in WSN.
4. Understand the network management design issues and differentiate various operating systems used in wireless sensor network.

	Subject: WIRELESS SENSOR NETWORK	**L**
Unit-1	Introduction and overview of Wireless Sensor Networks, Commercial and Scientific applications of Wireless Sensor Networks, Basic Wireless Sensor Technology, Sensor Taxonomy, Wireless Network environment, Wireless Network trends	08
Unit-2	Radio technology primer, Available wireless technologies, Wireless Sensors Networks Protocols, Physical Layer, Fundamentals of Medium Access Control Protocols for Wireless Sensor Networks, MAC protocols for WSN, Case Study, IEEE 802.15 4LR WPAN, Standard case study.	08
Unit-3	Sensors Network Protocols, Data dissemination and gathering, Routing challenges and design issues in wireless sensor, Routing strategies in WSN.	08
Unit-4	Protocols: Transport control protocols for wireless sensors Networks, Traditional transport control protocol, transport protocol design issues, examples of existing transport control protocol, performance of TCP.	08
Unit-5	Middleware for Sensors Networks, WSN middleware principles, Middleware architecture, existing middleware. Network Management for wireless sensor Networks, Requirements, Design issues, Examples of management Architecture	08
Unit-6	Operating Systems for WSN: Operating System Design Issues, Examples of Operating Systems, TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, PicOS. Performance and Traffic Management: Design issues, Performance Metrics and Modeling.	08
	Total	**48**

Text Books :

1. "Wireless sensor Networks: Technology, Protocols, and Application", Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Interscience Publication.

Reference Books :

1. "Wireless Sensor Networks" C.S. Raghavendra, Krishna M. Sivalingam, Taieb F. Znati, Springer Edition.
2. "Computer Network", Andrew Tanenbaum, 4th ed, Pearson Education.

Subject (Th): (8ET4-4) BIOMEDICAL ENGINEERING

Course Objectives:

1. Understanding role of engineers in medical field
2. Studying various electrical signals generated in human body.
3. To study various electrodes, recorders and problems for recording biomedical signals.
4. Study different medical imaging systems.
5. Introduction to patient care & safety
6. Introduction of various life saving instruments.

Course Outcome:

By the end of this course, the students shall be able to:

1. Understand the importance and association of engineering with medical field.
2. Understand the significance of various human signals and recording techniques.
3. Familiarize with various medical imaging systems, various life saving equipments.
4. Conceptualize patient care & safety requirements and its importance.

	Subject: BIOMEDICAL ENGINEERING	**L**
Unit-1	**Introduction to Biomedical Engineering:** Physiological system of heart, Man instrument system, Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Bio potential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory: skin contact impedance measurement of skin contact impedance, motion artifacts, Nernst Equation.	09
Unit-2	**Biomedical Recorders and Measurement:** Biomedical recorders for EEG, ECG, EMG, Measurement of Blood Pressure: Direct method, Indirect methods- The Rheographic method, Ultrasonic Doppler shift method, Square wave electromagnetic Blood flow meter, Measurement of Heart rate, Measurement of pulse rate.	09
Unit-3	**Medical Imaging System:** Instrumentation for diagnostics X-rays, X- rays basics properties, X-ray machine, Special imaging techniques, Computerized Axial Tomography (CAT), Ultrasonic imaging system: Physics of Ultrasound, Biological effect of ultrasound. Ultrasonics: A-scan, M-scan, B-scan, Real-time ultrasonic imaging systems.	08
Unit-4	**Therapeutic Equipments:** Need of Physiological and electrotherapy equipments. Cardiac pacemakers, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy Machines: Short wave, Microwave, Ultrasonic.	08
Unit-5	**Patient Care and Monitoring and Safety :** System concepts, Bedside patient monitors, central monitors, Intensive care monitoring. Biotelemetry: Single channel and Multichannel bio-telemetry, telephonic data transmission PATIENT SAFETY: Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards.	08
Unit-6	***Anaesthesia Machines & Ventilators:** Anaesthesia Machines: Need for anaesthesia, Delivery of anaesthesia, anaesthesia machine & patient breathing circuit Ventilators: Mechanics of respiration, Artificial ventilation, Ventilators, Ventilator Terms, Microprocessor controlled Ventilators.	08
	Total	**50**

Text Books :

1. Khandpur R.S. “Handbook of Biomedical Instrumentation”, Tata Mc-Graw Hill, New Delhi.
2. Cromwell L. & Wiebell. F. J., “Biomedical Instrumentation”, PHI Publications.

Reference Books

1. Webstar J.G., “Medical Instrumentation”, Third ed. John Wiely & Sons.
2. Carr & Brown, “Introduction to Biomedical Equipment Technology”, Prentice Hall.

Subject (Th): (8ET4-5) DATA COMPRESSION & ENCRYPTION

Course Requisite:

1. (6ET3) Digital Communication.

Course Objectives:

1. To familiarize students with different data compression techniques for text, audio, image and video compression.
2. To equip students with fundamental knowledge of various data encryption and authentication techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

1. Demonstrate the knowledge of lossy and lossless data compression techniques commonly used.
2. Develop the statistical basis and analyze performance metrics for lossy and lossless data compression.
3. Demonstrate use of various private and public key encryption techniques used in cryptosystems.
4. Identify need of digital signatures and authentication protocols.
5. Categorize various intruders and intrusion detection techniques.
6. Classify various viruses, related threats and countermeasures.

	Subject: DATA COMPRESSION & ENCRYPTION.	**L**
Unit-1	**Text Compression:** Shannon Fano Coding, Huffmann coding, Arithmetic coding and dictionary techniques- LZW, family algorithms, Entropy measures of performance and Quality measures.	08
Unit-2	**Audio Compression:** Digital Audio, Lossy sound compression, μ-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.	09
Unit-3	**Image And Video Compression:** Lossless techniques of image compression, gray codes, Two dimensional image transforms, JPEG, JPEG 2000, Predictive Techniques PCM and DPCM. Video compression and MPEG industry standard.	09
Unit-4	**Conventional Encryption:** Introduction, Types of attacks, Steganography, Data Encryption Standards, Block Cipher Principle, S-box design, triple DES with two three keys.	09
Unit-5	**Public Key Encryption and Number Theory:** Euler's theorem, Chinese remainder theorem, Principle of public key cryptography, RSA algorithm, Diffie-Hellman Key Exchange. Elliptic curve cryptology, message authentication and Hash functions, Hash and Mac algorithms, Digital signatures.	09
Unit-6	**System Security & Case Studies:** Intruders, Viruses, Worms, firewall design, antivirus techniques, digital Immune systems, Certificate based & Biometric authentication, Secure Electronic Payment System.	08
	Total	**52**

Text Books:

1. "Data Compression", David Salomon, Springer Publication, 4th Edition.
2. "Introduction to Data Compression", Khalid Sayood, Morgan Kaufmann Series, 3rd Edition
3. "Cryptography and Network Security", William Stallings, Pearson Education Asia Publication,
4. "Cryptography and Network Security", Behrouz Forouzan, McGraw-Hill, 1st Edition.

References:

1. "The Data Compression Book", Mark Nelson, BPB publication, 2nd Edition.
2. "Applied Cryptography", Bruce Schnerer, John Willey & Sons Inc. Publication, 2nd Edition.
3. "Cryptography & Network Security", Atul Kahate, Tata McGraw Hill, 2nd Edition.
4. "Cryptography and Network Security", Behrouz A. Forouzan , Special Indian Addition, SIE.
5. "Network Security & Cryptography", Bernard Menezes, Cenage Learning.

Subject (Th): (8ET4-6) ULTRA WIDE BAND COMMUNICATION

Course Requisite:

1. (6ET3) Digital Communication
2. (8ET2) Wireless Communication

Course Objectives:

1. To equip students with fundamental knowledge of UWB Technology.
2. To acquire knowledge of UWB signal propagation in wireless channel.
3. To focuses on the basic techniques that concerns the UWB communication systems and its existence with other communication system.

Course Outcomes:

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

1. Understand the advantages of wireless communication systems in ultra high frequency band.
2. Understand UWB signal propagation characteristics and the required signal processing at transmitter and receiver.
3. Understand the UWB channel modeling and analysis.
4. Identify UWB Communication Standards and its application.

	Subject: ULTRA WIDE BAND COMMUNICATION	**L**
Unit-1	UWB Definition, FCC Mask, Gaussian pulse and its higher derivatives, Hermite Pulses, Legandre Pulses. Modulation Schemes: Impulse Radio Scheme, Multi-Carrier Schemes. Data Modulation: Pulse Amplitude Modulation, On–Off Keying, Pulse Position Modulation.	08
Unit-2	Rake Receive, Rake Receiver Types, Detection Techniques, Synchronization in UWB Systems. UWB Antennas, UWB Antenna Characteristics, Antenna Types.	08
Unit-3	UWB wireless Channel: Impulse Response Modeling of UWB Wireless Channels, The IEEE UWB Channel Model, Frequency Modeling of UWB Channels, Comparison of Time and Frequency Models.	08
Unit-4	UWB Communication Standards and Systems, UWB standardization in wireless personal area networks, DS-UWB proposal, MB-OFDM UWB proposal.	08
Unit-5	Beam forming for UWB signals: radar UWB array systems, Wireless positioning and location: GPS techniques, Positioning techniques time resolution issues, UWB positioning and communications.	08
Unit-6	UWB Interference, IEEE802-11.a Interference, Method of Signal to Interference Ratio Calculation, Interference of UWB to Existing OFDM System, Interference of UWB to Narrowband Systems, Interference to WiMAX, Interference Reduction.	08
	Total	**48**

Text Books:

1. Ian Oppermann, Matti Hamalainen and Jari Iinatti, “UWB Theory and Applications”, John Wiley & Sons Ltd, 2004.
2. Homayoun Nikookar and Ramjee Prasad, “Introduction to Ultra Wideband for Wireless Communications”, Springer Book e-ISBN: 978-1-4020-6633-7.

References:

1. M. Ghavami, L. B. Michael and R. Kohno, “Ultra Wideband Signals and Systems in Communication Engineering”, 2nd Edition, John Wiley & Sons, NY, USA, 2007.
2. Jeffrey H. Reed, “An Introduction to Ultra Wideband Communication Systems”, Prentice Hall Inc., NJ, USA, 2005.

Subject (Pr): 8ETp5- UHF & MICROWAVE LAB

Course Requisite:

1. (3ET5) Electromagnetic fields.
2. (8ET1)UHF & Microwave

Course Objectives:

1. To study various microwave components and devices.
2. To understand transmission characteristics of microwave.
3. To understand measurement of various microwave parameters.
4. To study and analyze performance metric of microwave antenna .

Course Outcomes:

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

1. Identify various microwave components.
2. Demonstrate characteristics of microwave generated by various microwave sources and propagated through rectangular/circular waveguide.
3. Measure transmission parameters of microwave propagation through rectangular/circular waveguide.
4. Measure various parameters of microwave antenna.

	Experiment List
Expt-1	Study of Microwave components commonly used in Microwave systems.
Expt -2	Measurement of guide wavelength of microwave signal in a rectangular/circular waveguide.
Expt -3	To determine the characteristics of Reflex Klystron.
Expt -4	To find the characteristics of Gunn Diode Oscillator.
Expt -5	To measure directivity and coupling factor of directional coupler.
Expt -6	To determine the microwave power measurement of Reflex Klystron.
Expt -7	Measurement of gain of Horn antenna.
Expt -8	To verify measurement of impedance of Horn antenna with that obtained using smith chart.
Expt-9	Measurement of VSWR using slotted line with open / short load conditions.
Expt-10	Measurement of insertion loss and isolation loss of circulator.
Expt-11	Measurement of dielectric constant of a given substrate.

* Minimum 08 experiments based on/relevant to the above list.

Subject (Pr): 8ETp6- SKILL DEVELOPMENT LAB-VI (Networking)

Course Requisite:

1. (8ET3) Data Communication Network

Course Objectives:

1. To make aware about the partitioning and formatting of Hard disk and installation of Operating System.
2. To analyze the performance of Networking devices.
3. To develop the ability to install and configure Wired and Wireless Routers.
4. To become familiar with the Networking topologies through simulation.
5. To experiment with the basic protocols of computer networks.

Course Outcomes:

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

1. Install, configure and operate various computer networks, networking devices and protocols.
2. Analyze the performance of computer networks using simulation softwares.

	Subject: Practical of Data Communication Network	**L**
Unit-1	**Hard Disk Drive installation and upgrading:** Objectives of Disk Drive Partitioning; Preparing a Bootable CD; FDISK; Types of Partition; Partition Operations: Delete, Copy, Merge, Format, Resize and Move Partition; NTFS to FAT32 Converter; Installation of Operating System. **Ethernet Technologies:** Ethernet Cabling Types; Overview of Twisted-Pair Cabling; Categories of Ethernet.	8
Unit-2	**Setting Up a Router and Devices:** Installing Hardware and Drivers; Interacting with External Devices through Device Stage; Preparing to Install and Configure a Router; Installing and Configuring a Wireless Router. **Creating the Wireless Network:** Configuring, Enabling or Disabling Network Adapters; Connecting to a Hidden Wireless Network; Setting Up an Ad Hoc Wireless Network between Computers; Exporting and Importing Wireless Network Settings; Setting the Network Location. **Packet Capture Software:** Installation of Wireshark; Interface overview; Sniffing and analysis of Packets.	8
Unit-3	**Sharing and Working with Devices:** Sharing a Printer with Computers on Home Network; Sharing a Removable Disk Drive; Transferring Files via Bluetooth. **Keeping the Network Secure:** Windows Defender; Windows Firewall; Protecting Your Computer from Viruses and Other Security Threats. **Packet Tracer:** Installation of Packet Tracer; Interface overview; Configuration of various networking devices; Creating a Simple Network Topology; Configuring Routing with Packet Tracer.	8
	Total	**24**

L - No. of Lectures required

Text Books:

1. Todd Lammle, "CCNA Routing and Switching Study Guide", John Wiley & Sons, Inc. 2013.
2. Jesin A., "Packet Tracer Network Simulator Simulate an unlimited number of devices on a network using Packet Tracer", Packt Publishing Ltd. 2014.
3. Anish Nath, "Packet Analysis with Wireshark", Packt Publishing Ltd. 2015.
4. Ciprian Adrian Rusen and 7 Tutorials, "Network Your Computers & Devices Step by Step", Octal Publishing, Inc. 2010.

	Experiment List
Expt-1	Format and partition the hard disk of Personal Computer (PC). Check Network Interface Card and install network driver.
Expt-2	Study various Components of the Computer Network. Crimping practice with straight and cross CAT 5 cables and Create a simple LAN with two PCs using a single crossover cable. Check the network connection with the Ping command.
Expt-3	Create a simple LAN with multiple PCs using an Ethernet switch/hub and a straight-through cable to connect each PC. Check the network connection with the Ping command.
Expt-4	Installation and accessing Remote Computer desktop and share printer between PCs on local area network.

Expt-5	Map a logical Drive and use Universal Naming Convention (UNC) to share available resources.
Expt-6	Sharing File and Folder with various security levels between two PCs.
Expt-7	To telnet from one PC to another PC on Local area network and to remotely shutdown the other PC.
Expt-8	Configuration of different networking devices using Packet tracer software. a) Hub b) Switches c) Bridges d) Router e) Gateway
Expt-9	To configure various Network topology using Packet Tracer Software. a) Bus b) Ring c) Mesh d) Star
Expt-10	To configure Network using Dijkstra's algorithm using Packet tracer software.
Expt-11	Dynamic Host Configuration Protocol (DHCP) Router Configuration.
Expt-12	To create scenario and study the performance of network with CSMA/CA protocol and compare with CSMA/CD protocols.
Expt-13	To install and configure wireless access points.
Expt-14	To install any one open source packet capture software like Wireshark and analyze traffic with it.

* Minimum 12 experiments based on/relevant to the above list.