SEMESTER – VII

DATA COMMUNICATION					
Course Code	ET710		Credits	4	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	1	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 150 marks	25	25	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An introduction to the concept of OSI model, TCP/IP , identifying different network topologies and Protocols.
2. An understanding of Data link layer protocols & technologies.
3. An understanding of the Routing algorithms, flow control & Congestion Control
4. An understanding of Internet Protocols & Transport Protocols
5. Familiarization with various Networking Devices & their functions within a network

Course Outcomes:

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

CO1	Explain the functions of the various layers of OSI Model, networking devices and protocols of data communication.
CO2	Apply the various line coding techniques, flow and error control techniques.
CO3	Classify and compare the services of the layers of the OSI model.
CO4	Analyze various networks based on their applications.

UNIT -1	
OSI Model: Layered architecture of OSI model, TCP/IP architecture. **Data communication concepts**: Parallel and Serial transmission, Asynchronous and Synchronous transmission, Line coding-NRZ, RZ, AMI, HDB3, B8ZS. **Modems**: Types of modems, Scrambler and Descrambler. **LAN systems**: Architecture: Bus, Ring, Tree, Star, Fast Ethernet, Token ring. Ethernet: Contention access, CSMA, CSMA/CD Physical Layer: Interface-RS232, DTE-DCE interface, Null Modems.	10hrs
UNIT -2	
Data Link Layer: Frame design consideration, flow control, error control (stop and wait mechanism, sliding window), sequence numbering of frames, piggybacking acknowledgement. **Data link protocols:** BISYNC, transmission frames, protocol operation, HDLC, Flow and error control in HDLC, framing in HDLC, transparency in HDLC, HDLC protocol operations, comparison of BISYNC and HDLC **Switching:** switching networks, circuits switching, space division switching, time division switching, packet switching (datagram and virtual circuit [SVC, PVC]), message switching.	10hrs
UNIT -3	
Networking Devices: Repeaters, Bridges, Routers, Firewall. **Network Layer:** Services, virtual circuits and datagram subnet, routing algorithms (shortest path, flooding, flow based, distance vector, link state), congestion control, choke packets, load shedding, jitter control, flow specifications, traffic shaping (leaky bucket and token bucket algorithm) **Internet protocols**: IPv4, CIDR, NAT, OSPF, BGP, IPv6	10hrs
UNIT -4	
Transport protocols: Transport service: Services provided to the upper layer, connection establishment, connection release, multiplexing, flow control and buffering, crash recovery, Comparison of internet transport protocols (TCP and UDP). **ATM**: ATM architecture- virtual connection, identifiers, cells, connection establishment and release. **ISDN**: IDN, ISDN, ISDN channels (B, D, H), ISDN interfaces (BRI and PRI). **Application Layer:** DNS, DHCP, Telnet,electronic mail, HTTP.	10 hrs

TEXTBOOKS	
1	Behrouz A. Forouzan,Data Communication & Networking- Tata Mc-Graw Hill, 2ed.
2	Prakash C. Gupta, Data Communication and computer networks- PHI.
3	Andrew S. Tanenbaum,Computer networks , PHI, 4ed.

REFERENCES

1	Achyut S Godbole,Data Communication and Networks , Tata McGraw.
2	William Stallings, Data and Computer Communications, Prentice Hall, 8ed

ROBOTICS					
Course Code	**ET721**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125marks	**25**	**0**	**100**	**0**	**0**

Course Objectives: The course aims to provide the student with:

1. An understanding of all the subsystems and components of a robot.
2. An ability to select appropriate sensors, actuators and end effectors for robots
3. An ability to analyze the kinematics and motion planning of robotic systems.
4. An understanding of control strategies employed in robot platforms

Course Outcomes:

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

CO1	Explain working principle behind various types of actuation systems and sensors, different robot architectures and applications and control techniques used in robotic systems	
CO2	Evaluate appropriate end effectors, sensors and motion strategies for given robotic application	
CO3	Solve problems related to robot specifications, actuators, robot kinematics and control.	
CO4	Propose robotic solutions for a given application	.

UNIT -1	
Basic Concepts in (Fundamentals of) robotics: Automation and robotics, Robot applications. **Different classifications of robot**: By application, by coordinate system, by actuation system, by control method and by programming method. **Robot anatomy**: links and joints, Joint notation scheme. Degree of Freedom. Robot resolution, accuracy and repeatability. Concept of workspace. **Drive systems**: Pneumatic and hydraulic systems. Electric: Relation between torque and voltage. AC and DC Servo motors, Stepper motors, BLDC motors. Electronic control of motors. **Robot End Effectors**: Grippers and Tools.	10hrs
UNIT -2	
Kinematics: Coordinate frames, mapping and transforms, description of objects in space, transformation of vectors, fundamental rotation matrices, **Direct Kinematic model**: Kinematic modelling of manipulator **Inverse Kinematics**: Solvability of inverse kinematic models, solution techniques, closed form solution **Trajectory planning**: Definitions and planning tasks, joint space techniques, cartesian space techniques, joint space v/s cartesian space.	10hrs
UNIT -3	
Manipulator Dynamics: Determination of Robotic Joint Torques, Langrage-Eulerformulation two approaches, Example with 2 link Manipulator. **Control Scheme:** Partitioned control Scheme. **Analysis of wheeled robots and Biped robots:** Introduction, Staircase Ascending (SSP),Power Consumption, Dynamic Balances. **Sensors:** Characteristics of a sensor, Classification of Sensors, Touch sensors, PositionSensors: Potentiometer, LVDT, Optical Encoders, Force/Moment sensors, Range Sensor,Proximity Sensors- Inductive sensor, capacitive sensor, Hall effect sensor, Passive Sensor:RCC	10hrs
UNIT -4	
Machine Vision: Introduction, Sensing & Digitizing function, Imaging devices, Lightingtechniques, Image storage, Image processing and analysis, Image Data reduction,Segmentation, Feature extraction, Object recognition, Training the vision system, Roboticapplications. **Motion planning:** Gross/Free Space Motion Planning **Find path problems using:** Visibility Graph, Voronoi diagram, Cell Decomposition,Tangent-Graph Technique. **Dynamic Motion Planning Problems:** Path Velocity Decomposition, Accessibility Graph,Relative velocity scheme, Incremental planning, Artificial Potential field approach, reactivecontrol scheme.	10 hrs

TEXTBOOKS	
1	John J. Craig; Introduction to Robotics, Mechanics & Control; Pearson Education Inc.
2	Roland Siegwart, Illah R. Nourbakhsh - Introduction to Autonomous Mobile Robots, MIT Press, 2ed.

REFERENCES	
1	S. K. Saha; Introduction to Robotics, 2nd Ed.; McGrawHill
2	Peter Corke; Robotics Vision and Control; Springer.
3	M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odrey; Industrial Robotics Technology: programming and Applications; McGrawHill
4	Mittal & Nagrath; Robotics and Control; McGrawHill

MACHINE LEARNING					
Course Code	ET722		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An understanding of the basic concepts of classification, clustering, predication and regression
2. Knowledge of the advanced methods of classification and clustering
3. An ability to compute the classification accuracy
4. An understanding of the concept of dimensionality reduction

Course Outcomes:

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

CO1	Explain the basic and advanced concepts of classification and clustering
CO2	Design and implement machine learning solutions to classification, regression, and clustering problems.
CO3	Evaluate and interpret the results of the algorithms
CO4	Compute the classification accuracy

UNIT -1	
Basic Concepts (Theory and Numerical): Data mining and Machine Learning, Supervised and Unsupervised Learning, Classification and Prediction, Issues Regarding Classification and Prediction, Bayesian Classification, Decision Tree induction, Rule-Based Classification, Model Evaluation and Selection, Techniques to improve Classification Accuracy, Techniques to Improve Classification Accuracy	10hrs
UNIT -2	
Classification: Advanced Methods (Theory and Numerical): Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, Classification Using Frequent Patterns, Lazy Learners, Other classification Methods: Genetic Algorithms, Rough set and Fuzzy set Approach Prediction: Linear (Simple & Multiple), Non-Linear, Logistic Regression, Accuracy and Error Measure: Confusion Matrix, Precision and Recall	10hrs
UNIT -3	
Cluster Analysis: Basic Concepts and Methods (Theory and Numerical): Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of Clustering	10hrs
UNIT -4	
Advanced Cluster Analysis: Probabilistic Model-Based Clustering, Clustering High-Dimensional Data, Clustering Graph and Network Data, Clustering with Constraints Outlier Detection, Dimensionality Reduction (PCA & LDA with numerical)	10 hrs

TEXTBOOKS	
1	J. Han and M. Kamber, "Data Mining: Concepts and Techniques", Third Edition, Elsevier

REFERENCES	
1	M. H. Dunham. Data Mining: Introductory and Advanced Topics, 1e, Pearson Education. 2010
2	Cios, K.J., Pedrycz, W., Swiniarski, R.W., Kurgan, L. "Data Mining A Knowledge Discovery Approach", Springer, 2007
3	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "Introduction to Statistical Learning", Springer, 2013.
4	Richard Duda, Peter Hart, David Stork, "Pattern Classification", John Wiley & Sons,2nd Ed., 2001.

WAVELETS AND MULTIRATE SIGNAL PROCESSING					
Course Code	**ET723**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125marks	**25**	**0**	**100**	**0**	**0**

Course Objectives: The course aims to provide the student with:

1. An ability to analyze signal in time and frequency domain.
2. An understanding of orthonormality, sampling rate conversion and short time Fourier transform.
3. An ability to perform multi resolution analysis using filter banks.
4. An understanding of various continuous and discrete wavelet families.

Course Outcomes:

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

CO1	Explain the application of orthonormal basis in signal transformations.
CO2	Design a filter bank for analyzing signal.
CO3	Perform multiresolution analysis of a signal using Haar Wavelet.
CO4	Identify the importance of vanishing moments in construction of wavelets.

UNIT -1	
Introduction to Transformations: Need for Transformations, Inner Products, Orthogonal Transforms, Orthonormality, Basis: Orthogonal and Biorthogonal, Subspace, Span. **Overview of some basic transforms:** Z-Transform, Fourier series, Fourier Transform: Continuous and Discrete, Short Time Fourier Transform, Windowing Methods. **Introduction to Rate Converters:** Interpolator, Decimator, Properties, Effect of Interpolation and Decimation in frequency domain. **Disadvantage of:** Fourier Transform, STFT and Windowing Methods.	10hrs
UNIT -2	
Piecewise constant approximation: the Haar wavelet, Building up the concept of dyadic Multiresolution Analysis (MRA), Relating dyadic MRA to filter banks, Elements of multirate systems and two-band filter bank design for dyadic wavelets.	10hrs
UNIT -3	
Families of wavelets: Orthogonal and biorthogonal wavelets, Daubechies' family of wavelets in detail, vanishing moments and regularity. Conjugate Quadrature Filter Banks (CQF) and their design, Dyadic MRA more formally; Data compression - fingerprint compression standards, JPEG-2000 standards. **The Uncertainty Principle, and its implications:** the fundamental issue in this subject - the problem and the challenge that Nature imposes. The importance of the Gaussian function: the Gabor Transform and its generalization; time, frequency and scale - their interplay.	10hrs
UNIT -4	
The Continuous Wavelet Transform (CWT),Condition of admissibility and its implications, Application of the CWT in wideband correlation processing, Journey from the CWT to the DWT: Discretization in steps, Discretization of scale - generalized filter bank. Discretization of translation - generalized output sampling, Discretization of time/ space (independent variable) - sampled inputs.	10 hrs

TEXTBOOKS	
1	Raghuveer M.Rao , Ajit S. Bapardikar; Wavelet transforms- Introduction to theory and applications; Person Education.
2	P. P. Vaidyanathan; Multirate Systems and Filter Banks; Pearson Education.
3	L. Prasad, S.S. Iyengar; Wavelet Analysis with Applications to Image Processing.; CRC Press

REFERENCES	
1	Howard L. Resnikoff, Raymond O. Wells; Wavelet Analysis: The Scalable Structure of Information; Springer
2	G. Strang, T. Nguyen; Wavelets and filter banks; Wellesley-Cambridge Press.
3	K.P. Soman and K.L. Ramchandran; Insight into Wavelets from theory to practice; Prentice Hall.

CONSUMER ELECTRONICS					
Course Code	**ET724**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125marks	**25**	**0**	**100**	**0**	**0**

Course Objectives:

The course aims to provide the student with:

1.An understanding of basic characteristics of sound, microphones, loudspeakers, sound recording with its reproduction and public address systems.

2. An understanding of signal generation to test various sections of TV receiver.

3. An introduction to various electronic household and office appliances.

4. An understanding of the concepts and techniques in marketing.

Course Outcomes:

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

CO1	Explain the concepts related to sound recording and reproduction, TV systems, electrical appliances, marketing planning and strategy.
CO2	Demonstrate safety awareness and take precautionary measures while

	handling electronic equipments.
CO3	Analyze consumer electronic circuits for fault and performance degradation.
CO4	Design sound recording and reproduction circuits and formulate a marketing plan including marketing objectives, marketing mix, strategies.

UNIT -1	
Electro acoustical Transducers: Microphones, Loudspeakers, Pick-up characteristics, specifications and applications. **Sound Recording and Reproduction**: Principle and Block schematic of disc recording system, magnetic recording system, optical recording system, compact disc and video recording. **Audio Amplifier and subsystems**: Audio mixers, tone controls, Graphic equalizers, Features of Hi-Fi and stereo systems, Dolby system, Public Address systems.	10hrs
UNIT -2	
Testing, Alignment and Servicing of Television Receivers: Testing and Alignment of TV receivers, TV Wobbuloscope, Video Pattern Generators, Colour bar generator, Vectroscope, Tuners. **Cable Television**: Modern cable TV system, cable TV converter, Cable systems, Satellite Television, Direct to home TV, LED TV. **Digital television**: Digital Television Systems, Digital TV Signals, Digitized video parameters. **Projection Television**: Basic projection television systems, front and rear projection, LCD & Laser Projection system. **High Definition television systems**: HDTV Systems, HDTV standards and compatibility.	10hrs
UNIT -3	
Modern home appliances with electronic control: Microwave oven, washing machine, Air-conditioner, DVD, Digital Camera, Remote control, Refrigerator, Iron. Working principle of photocopying, fax machine, risograph, solar water heater and solar cooling. **Maintenance and safety measures**: Electricity in home: electric lighting, electric heating. Dangers of Electricity and Safety Precautions.	10hrs
UNIT -4	
Marketing planning: Importance of marketing planning, steps involved in marketing planning process scanning the marketing environment and spotting the business opportunities, setting the market objectives. **Marketing strategy**: the meaning and significance of marketing strategy, formulating the marketing strategy. Techniques and Practices for mass production for reliable production. **Costing**: Overview of costing and marketing communication. Entrepreneurship Awareness. **Patents**: Introduction to patents.	10 hrs

TEXTBOOKS	
1	B.R.Gupta, V. Singhal, Consumer Electronics, S. K. Kataria & Sons, 5ed,2006
2	R G Gupta, Audio and video systems,Tata McGraw-Hill Education, 2ed, 2010
3	S.P. Bali, Consumer Electronics , Pearson Educatio, India, 1ed,2004.

REFERENCES	
1	V S Ramaswamy, J Namakumari, Marketing management planning, implementation and control, Macmillan (2007)
2	Tom Duncan, Electronics for Today and Tomorrow,Trans-Atlantic Publications, Inc.; 2 edition .
3	R G Gupta, Television engineering and video systems , Tata McGraw-Hill Education,2005
4	H S Kalsi, Electronic Instrumentation, TMH, Sixth reprint,2006

HARDWARE DESCRIPTION LANGUAGE					
Course Code	**ET725**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125marks	**25**	**0**	**100**	**0**	**0**

Course Objectives: The course aims to provide the student with:

1. Learn the Syntax of Verilog HDL and System C.
2. Learn to write Verilog Hardware Description Language programs.
3. Learn to write System C programs.
4. Learn the general architecture of FPGAs.

Course Outcomes:

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

CO1	Explain the syntax and semantics of Verilog HDL and System C.
CO2	Explain the general architecture of FPGA's.
CO3	Write programs to design circuits using Verilog Hardware Description Language.
CO4	Write programs in System C language.

UNIT -1	
Emergence of HDLs, Design Flow using HDLs, Importance of HDLs. Hierarchical ModelingConcepts: Modules, Instances. Data Types: Nets, Registers, Vectors, Arrays, Integer, Real, and Time, Memories, Parameters, Strings.Modules and Ports.Gate Level Modeling: Design of Ripple Carry Adder, Shift Register using DFF, Multiplexer,Demultiplexer, Decoder, Encoder. Test benches to verify the Functionality.	10hrs
UNIT -2	
Dataflow Modeling: Continuous assignment (assign) statement, assignment delay, implicit assignmentdelay, and net declaration delay for continuous assignment statements. Define expressions, operators,and operands. Operator types for all possible operations—arithmetic, logical, relational, equality,bitwise, reduction, shift, concatenation, and conditional.	10hrs
UNIT -3	
Behavioral Modeling: Structured procedures, always and initial. Blocking and	

non-blocking procedural assignments. Conditional statements using if and else. Multiway branching, using case, casex, and casez statements, Loopingstatements such as while, for, repeat, and forever. Definition of sequential and parallel blocks.	10hrs
UNIT -4	
Tasks and functions in Verilog, Finite State Machine using Verilog. Examples of design using Verilog HDL. System C Design Methodology. Syntax and semantics of System C. Data Types in SystemC.Examples of Design in System C FPGA's: Design Flow for Designing with FPGA, General Architecture of FPGAs.	10 hrs

TEXTBOOKS	
1	S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis",Prentice Hall (NJ,USA), 1996.
2	J. Bhasker, "Verilog HDL Synthesis - A Practical Primer", Star Galaxy Publishing, Allentown,PA) 1998..
3	J Bhasker, System C primer ,Star Galaxy Publishing ,2 ed, 2010.

REFERENCES	
1	"IEEE std 1364-95, Verilog Language Reference Manual", IEEE Press (NY,USA), 1995.
2	Grötker, Liao, Swan, and Martin "System Design with SystemC"; by ISBN 1-4010-7072-1
3	System C Version 2.0 User's Guide

DATA COMMUNICATION LAB					
Course Code	**ET730**		**Credits**	**1**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**0**	**0**	**2**	**30hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 50 marks	**0**	**25**	**0**	**0**	**25**

Course Objectives:

The course aims to provide the student with:

1. An understanding of the working principle of various communication protocols.
2. Analysis of the various routing algorithms.
3. An understanding of the concept of data transfer between nodes.

Course Outcomes:

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

CO1	Explain details and functionality of layered network architecture.
CO2	Apply mathematical foundations to solve computational problems in data communication between nodes
CO3	Analyze performance of various communication protocols.
CO4	Practice packet /file transmission between nodes.

List of experiments to be conducted

1, Study of NRZ-L encoding method of serial communication.

2. Study of NRZ-I encoding method of serial communication.

3. Study of RZ encoding method of serial communication.

4. Study of MANCHESTER encoding method of serial communication.

5. Study of DIFFERENTIAL MANCHESTER encoding method of serial communication.

6. Study of AMI encoding method of serial communication.

7.To create, name a VLAN in a switch and to transfer port of time to verify its functionality and delete the VLAN.

8. To create, name a VLAN using switch and to transfer range of ports at a time to verify its functionality and delete the VLAN.

9. To connect two switches to increase the number of ports in a vlan using trunking.

10. To create a network to exchange data between two PC's working on different networks using router.

FOURTH YEAR ELECTRONICS AND TELECOMMUNICATION ENGINEERING PROGRAM
SYLLABUS, REVISED COURSE (2019-2020)

SEMESTER – VIII

ADVANCED COMMUNICATION ENGINEERING					
Course Code	ET810		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives: The course aims to provide the student with:

1. An understanding of orbiting satellites, satellite orbital mechanics and their parameters, satellite subsystems and earth station equipment.
2. Conceptual knowledge of factors affecting the satellite link design, multiple access schemes, Global Positioning systems and VSAT systems.
3. An understanding of basic concepts of ray and mode theory of light propagation through optical fibers, fiber impairments and fiber joints.
4. Knowledge of construction and working of Optical Sources and Photo-detectors, WDM concepts.

Course Outcomes:

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

CO1	Explain the theoretical and mathematical concepts of satellite and optical communication.
CO2	Analyze performance of satellite and optical communication under different scenarios.
CO3	Analyze efficacy of modulation and multiple access methods for maximum user access in optical and satellite communication.
CO4	Design satellite and optical link taking into consideration power budget for efficient performance in terms of BER and SNR.

UNIT -1	
Satellite Orbits: Satellite Communication System basics, Types of orbits, location of satellite with respect to earth, orbital parameters , Look angles, earth coverage and slant range, eclipse effects, orbital perturbations, satellite placement in geostationary orbit, Station keeping and Satellite Stabilization. **Satellite Subsystems:** Electric power supply, Altitude and Orbit Control, Propulsion Subsystem, Communication Subsystem (Repeaters/Transponders), Antenna Subsystems, Telemetry-TrackingCommand and Monitoring, Thermal Control Subsystem, Structure Subsystem. **Earth Station:** Types of Earth Station, Design Considerations and Earth system subsystems.	10hrs
UNIT -2	
Satellite Link Design: Link design equations, system noise temperature, C/N and G/T Ratio, Uplink design, complete Link design, Frequency considerations, Propagation Considerations , interference related problems, earth station parameters. **Multiple Access:** Frequency Division Multiple access, Time Division Multiple access, TDMA Frame, Burst and Superframe structure, FDMA v/s TDMA, Satellite switched TDMA, Beam Hopping TDMA, Space division Multiple Access. **VSAT satellite systems:** VSAT concept, VSAT/ Wireless local loop networks. VSAT network architectures, multiple access methods, Applications of VSAT networks. **Global positioning Satellite systems:** GPS segments, Working principle, GPS signal structure, GPS Positioning services and positioning modes, Trilateration method.	10hrs
UNIT -3	
Overview of optical fiber communication: Key elements of optical fiber systems. **Transmission Theory:** Ray theory transmission- Snell's law, skew rays. Optical fiber modes and configurations, single mode fibers, graded index fiber structures, cut-off wavelength, mode-field diameter, mode theory(derivations), basic concepts and classification of attenuation and dispersion (no derivation for intramodal dispersion). **Optical fiber joints:** Fiber to fiber joints, fiber misalignments, Fiber splicing.	10hrs
UNIT -4	
Optical Sources: Energy bands, direct and indirect bandgap. **LED structures:** edge emitter LEDs and surface emitter LEDs, Quantum efficiency and LED power, modulation of LED. **Laser diodes:** absorption, emission of radiation, population inversion, laser diode modes and threshold conditions, Fabry-Perot Laser diode, distributed feedback Laser diode. **Photo-detectors:** PN photodiode, PIN photodiode, Avalanche Photodiode, Quantum efficiency, responsivity, cut-off wavelength. **WDM concepts and components:** Operational principles and standards	10 hrs

of WDM.	

TEXTBOOKS	
1	D. C. Agarwal; Satellite Communications, 6th Edition, Khanna Publishers
2	Timothy Pratt, Charles Bostian, Jeremy Allnutt; Satellite Communications, 2nd Edition,Wiley Publications
3	Anil K Maini, Varsha Agarwal; Satellite Communications; Wiley Publications.

REFERENCES	
1	Gerd Keiser; Optical Fiber Communication, 4th Edition, McGraw Hill Publications.
2	John M Senior; Optical Fiber Communications, 5th Edition, Pearson Education.

PROCESS CONTROL INSTRUMENTATION					
Course Code	**ET821**		**Credits**	**3**	
Scheme of Instruction	**L**	**T**	**P**	**TOTAL**	
Hours/ Week	**3**	**0**	**0**	**40hrs/sem**	
Scheme of Examination	**IA**	**TW**	**TM**	**P**	**O**
TOTAL = 125marks	**25**	**0**	**100**	**0**	**0**

Course Objectives: The course aims to provide the student with:

1. An understanding of various Industrial Process Control Mechanisms.
2. Theoretical and practical training in the operation and maintenance of automated process control.
3. An understanding of various devices to measure physical processes in Industries.
4. An overview of Industrial Controller modes

Course Outcomes:

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

CO1	Explain Process Control Instruments used in Industry.
CO2	Evaluate appropriate sensor for given application.
CO3	Design at block system level a complete instrumentation system for a given application
CO4	Evaluate Actuators and controllers for an instrumentation system

UNIT -1	
I**ntroduction to Process Control:** Introduction; control systems; process control block diagram; servomechanisms; control system evaluation; on off control; analog and digital control; process characteristics. **Sensors:** Sensor time response. Overview of Thermal sensors: RTD, thermistors, thermocouples. Overview of Mechanical sensors: Strain, motion, pressure, and flow. Optical sensors: Photodetectors, pyrometers, applications: design consideration of all sensors.	10hrs
UNIT -2	
Analog and digital signal conditioning; Analog signal conditioning: Linearization, Conversion, SCR and TRIAC. Final Control: Introduction; final control operation; Signal conversion. **Actuators:** Electrical, pneumatic, and hydraulic; Control elements: mechanical; electrical; Fluid valves; Control valve type; Control valve sizing; Process instrumentation. **Discrete state process control:** Introduction; definition; characteristics of the system; relay controllers.	10hrs
UNIT -3	
Controller Principles: Introduction; overview of control system parameters; continuous controller modes: proportional, integral, derivative control modes; composite control modes: PI, PD, PID; Telemetry: pneumatic telemetering system; electronic telemetry system; electrical electronic telemetering system. Analog /digital controllers: Introduction; electronic, pneumatic, digital controller; design considerations.	10hrs
UNIT -4	
Computer in process control: Data logging; supervisory control; computer-based controller; digital controller for a turbine and generator. Introduction to process loops; simple control schemes for level, flow, temperature as applied to reactor, heat exchanger. Overview of signal recorders: chart recorder, fiber optic recorder, magnetic recorder, UV Recorder, printing processes: Risograph, laser printers; Process control networks: Modbus communication RS485/RS422. **Applications of PLC to process control:** Traffic generation, water-bottle plant; Microprocessor/microcontroller application in process instrumentation: Microprocessor/microcontroller control of a petrol engine, microprocessor/ microcontroller based data logger; process loop tuning.	10 hrs

TEXTBOOKS	
1	Curtis D. Johnson; Process Control Instrumentation Technology, 7th Edition; Pearson Education
2	Alan S. Morris; Principles of Measurement and Instrumentation, 3rd Ed.; Butterworth-Heinemann (Reed Educational and Professional Publishing Ltd) 2001 .
3	C. Rangan, G. Sarma, V. Mani; Instrumentation Devices and Systems, TMH

REFERENCES	
1	S. K. Singh; Industrial Instrumentation and control; TMH
2	Donald P. Eckman; Automatic process control; Wiley
3	B. C. Kuo; Digital control systems; Oxford University Press

RF DESIGN					
Course Code	ET822		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An introduction to passive components used in RF design and their characteristics.
2. An ability to design high frequency and low noise amplifiers for RF applications.
3. An ability to design RF subsystems such as mixers, oscillators and PLL's.
4. An introduction to various RF architectures used in modern cellular networks.

Course Outcomes:

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

CO1	Explain the RF system, noises, modulation, amplifier and oscillator.
CO2	Apply concepts the RF system, noises, modulation, amplifier and oscillator to RF design.
CO3	Analyze matching networks using passive elements and appropriate topology.
CO4	Design amplifiers, Mixers, PLL's and frequency synthesizers for RF applications.

UNIT -1	
I**ntroduction**: RF systems – basic architectures, Transmission media and reflections, Maximum power transfer. **Distributed Systems**: Transmission lines, reflection coefficient, Lossy transmission lines **Basic concepts of RF Design**: Effect of nonlinearity, cascaded nonlinear stages . Intersymbol interference **Ramdom processes and noise**: Random processes, Noise Sensitivity and Dynamic range, Passive impedance transformation	10hrs
UNIT -2	
Modulation and Detection:Analog modulation: Amplitude modulation, Phase and frequency modulation, **Digital modulation**: Basic concepts, Binary modulation, Quadrature modulation **Power Efficiency of Modulation schemes**: Constant and variable envelope signals, spectral regrowth, Noncoherent detection	10hrs
UNIT -3	
Transreceiver Architectures: Basic concept **Receiver architectures**: Heterodyne receiver, Homodyne receiver, Image Reject receiver, Digital IF receiver, Subsampling receiver **Transmitter Architectures** : Direct Conversion transmitters, Two step transmitters. **Low Noise Amplifiers and Mixer: Low Noise Amplifiers:** Basic concept, Input matching, Bipolar LNAs. **Downconversion Mixers**: Basic concept, Bipolar Mixers	10hrs
UNIT -4	
Oscillators: Basic concept, Basic LC oscillator topologies, voltage controlled oscillators, Effect of phase noise in RF communication, Q of an oscillator. **Frequency Synthesizer**: Phase Locked Loop: Basic concept, Basic PLL, Charge pump PLL, Type I and Type II PLLs. **Power Amplifier**: Linear and Nonlinear PAs, Classification of Power Amplifiers: Class A, B and C	10 hrs

TEXTBOOKS	
1	Behzad Razavi; RF Microelectronics; Prentice Hall Communication Engineering and Emerging Technologies Series, Prentice-Hall of India Pvt. Ltd., New Delhi
2	Thomas H. Lee; The Design of CMOS Radio-Frequency Integrated Circuits; Cambridge University Press, Second Edition 2004.

REFERENCES	
1	David M. Pozar; Microwave Engineering, Third Edition, John Wiley & Sons (ASIA) PTE. Ltd.

HIGH PERFORMANCE COMPUTER ARCHITECTURE					
Course Code	ET823		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An understanding of the concepts of High performance computing and Computer architecture
2. An ability to differentiate between computer organization and architecture
3. An understanding of the concepts of Multi-core processors and pipelining
4. An understanding of different types of memories and memory management techniques
5. An understanding of the concepts of Basic Principle of Message Passing Programming
6. An understanding of the fundamentals of Grid and Cloud computing

Course Outcomes:

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

CO1	Explain the concept of high performance computing and its applications.
CO2	Understand the concept of pipelining, memory organization and management.
CO3	Apply parallel computing algorithms in practical applications and measurethe performance of the system.
CO4	Analyse the working of GPU and CPU and understand the concepts of Grid and Cloud computing.

UNIT -1	
Introduction to High performance computing(HPC): Need for HPC. Components of parallel computing systems. Multiprocessor vs multicore architectures. Sequential vs Parallel Computing. Basic Concepts of Computing: Program, Process, Thread, Instruction Levels of Parallelism: Data, Instruction, thread and process level, Classification of parallel architectures: Flynn's classification (SISD, SIMD, MIMD, MISD). Interconnection topologies, Programming models Computer organization v/s Architecture: Structure and Function, RISC and CISC Processors, Basic concept of Superscalar architecture Applications of Parallel Computing	10hrs
UNIT -2	
Basic concepts of Pipelining and types. Hazards and resolution techniques Types of memory: Primary, Secondary, Cache Memory hierarchy, Cache coherence Memory management: Swapping, Partitioning, Paging, Virtual Memory, TLB, Segmentation, page replacement policies	10hrs
UNIT -3	
Shared (Barrier, Mutual Exclusion) Distributed memory (UMA UNUMA, Loosely and Tightly coupled) Data Dependencies Algorithms for Parallel Processing: Matrix multiplication, Parallel Sorting algorithms Introduction to Performance Measures: Speedup and Efficiency, Amdahl's Law, Gustafson's-Barsis Law	10hrs
UNIT -4	
Multicore organization: Heterogeneous and homogeneous, Example (Intel core i7 and ARM cortex A15). General –Purpose GPU,CUDA basics, GPU vs CPU, GPU Architecture Overview. Basic Principle of Message Passing Programming, Building Blocks: Send and Receive Operations, Message Passing Interface (MPI) . Parallel processing using Grid and Cloud computing.	10 hrs

TEXTBOOKS	
1	Sanjay Razdan,Fundamentals of parallel computing, First edition, Narosa Publication
2	M. Sasikumar,Introduction to Parallel Processing, Second Edition, PHI Publication.
3	William Stallings,Computer Organization and Architecture, Tenth Edition, Pearson Education
4	Michael J. Quinn, Parallel Programming in C with MPI and OpenMP, First Edition, McGraw-Hill Publication
5	Ananth Grama,Introduction to Parallel Computing, Second Edition, Pearson Education

REFERENCES	
1	Kailash Jayaswal,Cloud Computing: Black Book , Edition: 2014, Dreamtech Press
2	Kai Hwang,Distributed and Cloud Computing- Edition: 2012, Elsevier

SECURE COMMUNICATION					
Course Code	ET824		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An understanding of the fundamentals of cryptography
2.Knowledge about the various encryption techniques.
3.An understanding of the concept of Public key cryptography.
4.An ability to learn about message authentication and hash functions
5.An ability to impart knowledge on Network security

Course Outcomes:

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

CO1	Identify and describe the fundamentals of a secure network and Analyse the various encryption techniques in modern cryptography	
CO2	Illustrate various Public key cryptographic techniques	
CO3	Evaluate the various message authentication codes and cryptographic Hash Functions	
CO4	Discuss Digital Signatures,Authentication Applications and security issues related to internet and networks	.

UNIT -1	
Introduction of Secure Network:Key points(service, mechanisms and attacks),OSI security architecture, Security attacks, security services, security mechanisms, a model for network. Classical encryption techniques: Symmetric cipher model substitution techniques,Transposition techniques, rotor machines,steganography and numerical on different ciphers. Block Ciphers and DES(Data Encryption Standards):Block cipher principles, Data encryption standards, strength of DES, Block cipher design principles, Block ciphermodes of operation problems on DES.	10hrs
UNIT -2	
Public-Key Cryptography and RSA: Principles of public-key cryptosystems, RSA algorithm and numerical on RSA.Key Management; Other Public Key Crypto Systems:Diffie-Hellman key exchange, numericals. **Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Requirements of Cryptographic Hash functions **Message Authentication codes:**Message Authentication Requirements,Message Authentication Functions and Message Authenticaion code.	10hrs
UNIT -3	
Digital Signature and Authentication Protocol: Digital signature properties and Digital Signature Requirements, Digital signature standard. **Authentication Applications:** Kerberos: Kerberos Version 4,Kerberos Version5.Comparison of Kerberos version 4 and Kerberos version 5. **X.509 authentication service:**-X.509 Definition ,X.509 Certificates format,X.509 Authentication procedures. Firewalls: Definition,Firewall Characteristics,Types of Firewalls and Firewall Configurations	10hrs
UNIT -4	
Electronic Mail Security: Pretty good privacy(PGP Cryptographic Functions,Transmission and Reception of PGP Message,General format of PGP Message,PGP Message Generation,PGP Message Reception), S/MIME Functions IP Security: Overview, IP security architecture,IP Security Policy, ESP(encapsulating security pay load).	10 hrs

TEXTBOOKS	
1	William Stallings, Cryptography and Network Security, 4th edition, Prentice Hall of India, 2008.

REFERENCES	
1	C. Kaufman, R. Perlman, and M. Speciner, Network Security: PrivateCommunication in a Public World, 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2002.
2	William Stallings , “Network Security Essentials Applications and Standards”, 2nd ed., Pearson Education, 2003

SYSTEM VERIFICATION AND VALIDATION					
Course Code	ET825		Credits	3	
Scheme of Instruction	L	T	P	TOTAL	
Hours/ Week	3	0	0	40hrs/sem	
Scheme of Examination	IA	TW	TM	P	O
TOTAL = 125marks	25	0	100	0	0

Course Objectives:

The course aims to provide the student with:

1. An understanding of basic theory and techniques for verification of digital circuits and systems.
2. An ability to understand the theory of testing combinational and sequential logic circuits.
3. An ability to perform fault simulation and detect faults.
4. An understanding of different techniques in Scan Chain Test and Built in Self-Test (BIST)

Course Outcomes:

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

CO1	Explain the basic theory and techniques of System Verification.
CO2	Explain different Scan Chain Based Test and BIST techniques.
CO3	Perform Fault Simulation for Digital circuits
CO4	Generate Test Patterns for combinational circuit

UNIT -1	
Verification :Binary Decision Diagram :Introduction and construction ,Reduction rules andAlgorithms, ROBDDs , Operation on BDDs and its Algorithms , Representation of SequentialCircuits . **Temporal Logic:**Introduction and Basic Operators,Syntax and Semantics of LTL, CTL and CLT* ,Equivalence and Expressive Power . **Model Checking:** Introduction to Verification, Specification and Modelling, Model CheckingAlgorithm, Symbolic Model Checking	10hrs
UNIT -2	
Automata and its use in Verification, Automata Theoretic Model Checking, Practical Examples with SMV Test Introduction to Digital Testing :Introduction, Test process and Test economics , Functional vs. Structural Testing Defects, Errors, Faults and Fault Modeling (mainly stuck at fault modeling) . Fault Equivalence, Fault Dominance, Fault Collapsing and Checkpoint Theorem	10hrs
UNIT -3	

Fault Simulation and Testability Measures :Circuit Modeling and Algorithms for Fault Simulation , Serial Fault Simulation, Parallel Fault Simulation , Deductive Fault Simulation Concurrent Fault Simulation . Combinational SCOAP Measures and Sequential SCOAP Measures . **Combinational Circuit Test Pattern Generation** :Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras ,Standard ATPG Algorithms,D-Calculus and D-Algorithm,Basics of PODEM and FAN.	10hrs
UNIT -4	
Sequential Circuit Testing and Scan Chains :ATPG for Single-Clock Synchronous Circuits Use of Nine-Valued Logic and Time-Frame Expansion Methods Complexity of Sequential ATPG. Scan Chain based Sequential Circuit Testing Scan Cell Design, Design variations of Scan Chains, Sequential Testing based on Scan Chains, Overheads of Scan Design Partial-ScanDesign **Built in Self test (BIST)** :Introduction to BIST architecture, BIST Test Pattern Generation, Response Compaction and Response Analysis . Memory BIST March Test BIST with MISR Neighborhood Pattern Sensitive Fault Test Transparent Memory BIST	10 hrs

TEXTBOOKS	
1	M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning aboutsystems, Cambridge University Press, 2 nd Edition, 2004.
2	Bushnell and Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal Circuits, Kluwer Academic Publishers, 2000.
3	Hideo Fujiwara, “Logical testing and design for testability”, The MIT Press.

REFERENCES

1	Michael Huth and Mark Ryan, “Logic in Computer Science: Modelling and Reasoningabout Systems”, 2 nd edition, Cambridge University Press, New York, NY, USA.
2	Ashok K. Sharma, “Advanced Semiconductor Memories: Architectures, Designs, andApplications”, Wiley-IEEE Press, 2002.
3	https://nptel.ac.in/courses/106103016/
4	https://nptel.ac.in/courses/106103116/