Rashtreeya Sikshana Samithi Trust

R. V. COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to VTU, Belgaum)

R.V Vidyaniketan Post, Mysore Road

Bangalore-560 059

Scheme & Syllabus

V & VI Semester B.E

Instrumentation Technology

(2012 Scheme)

VISION

Achieving academic excellence in Instrumentation Technology by adopting interdisciplinary research with a focus on sustainable and inclusive technologies.

MISSION

M1: To create an environment for students to excel in domain areas and get motivated to involve in interdisciplinary research by utilizing state of the art infrastructure.

M2: To impart technical knowledge, encourage experiential learning and develop future professional leaders.

M3: To establish industry-academia networking and develop industry-ready students and future entrepreneurs, to meet societal & industrial challenges.

M4: To motivate lifelong learning and research in sustainable technologies to find improved solutions for the betterment of society.

Program Educational Objectives (PEOs)

PEO1: Apply Instrumentation, Electronics, Controls and Automation concepts to develop technical solutions for industrial problems.

PEO2: Exhibit competency in adapting to various industrial challenges and work in inter-disciplinary projects with team spirit and professional ethics for achieving organizational goals.

PEO3: Pursue higher education in technology or management and achieve professional excellence by imbibing leadership qualities and communication skills.

PEO4: Become entrepreneurs with a focus on sustainable technologies and develop innovative solutions to meet industrial and societal needs.

Program Specific Outcomes (PSO)

PSO1: Design, analyze and practice the instrumentation, controls and automation concepts and techniques required for industrial and/or research pursuits resulting in product development, publications or patents.

PSO2: Demonstrate the knowledge of basic science, mathematics, electronic system design and programming for real-time applications, towards developing industrial solutions and become technology leaders of future.

Program Outcomes

PO1:	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization for the solution of complex engineering problem.
PO2:	**Problem analysis**: Identify, formulate, research, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3:	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PO4:	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5:	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.
PO6:	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess Societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:	**Communication**: Communicate effectively on complex engineering activities with engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11:	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a

	member and leader in a team, to manage projects and in multidisciplinary environments.
PO12:	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

FIFTH SEMESTER								
Sl. No.	**Course Code**	**Course**	**BoS**	**Credit Allocation**				**Total Credits**
				L	**T**	**P**	**S**	
1	12HSM51	Management and Organizational Behavior	HSS	3	0	0	0	3
2	12IT52	Signal and Systems	IT	3	1	0	1	5
3	12IT53	Advanced Control Systems	IT	3	0	1	1	5
4	12IT54	Data Acquisition and Virtual Instrumentation	IT	3	0	1	1	5
5	12IT5AX	Elective A	IT	3	1	0	1	5
6	12IT5BX	Elective B	IT	3	0	0	0	3
		Total No. of Credits		18	2	2	4	**26**
		No. Of Hrs.		**18**	**04**	**04**	**16**	**42**

SIXTH SEMESTER								
Sl. No.	**Course Code**	**Course**	**BoS**	**Credit Allocation**				**Total Credits**
				L	**T**	**P**	**S**	
1	12HSI61	Intellectual Property Rights & Entrepreneurship	HSS	3	0	0	0	3
2	12IT62	Computer Communication Networks	IT	3	1	0	0	4
3	12IT63	Automatic Process Control And Signal Conditioning Techniques	IT	3	0	1	1	5
4	12IT64	Digital Signal Processing	IT	3	0	1	1	5
5	12XXE65	Elective Emerging Technology	IT	2	0	0	0	2
6	12IT6CX	Elective C	IT	3	0	0	1	4
7	12IT6DX	Elective D	IT	3	0	0	0	3
		Total No. of Credits		**20**	**2**	**1**	**3**	**26**
		No. Of Hrs.		**20**	**04**	**02**	**12**	**38**

FIFTH SEMESTER ELECTIVES

Elective-A		Elective-B	
Course Code	**Title of the Subject**	**Course Code**	**Title of the Subject**
12IT5A1	Control System Components	12IT5B1	Image processing
12IT5A2	Biomedical Instrumentation	12IT5B2	Robotics
12IT5A3	Power Electronics	12IT5B3	Probability Statistics and Queuing
12IT5A4	Computer Organization and Architecture	12IT5B4	OOPs and C++

SIXTH SEMESTER ELECTIVES

Elective-C		Elective-D	
Course Code	**Title of the Subject**	**Course Code**	**Title of the Subject**
12IT6C1	Analytical Instrumentation	12IT6D1	Java &J2EE
12IT6C2	Lasers in Optical Instrumentation	12IT6D2	Advanced Microcontrollers and Applications
12IT6C3	Product Design Technology	12IT6D3	Imaging Techniques
12IT6C4	Aircraft Instrumentation	12IT6D4	Communication Systems

V Semester MANAGEMENT& ORGANIZATIONAL BEHAVIOR		
Course Code :12HSM51		**CIE Marks : 100**
Periods/Week : 3:0:0:0 (L+T+P+S)		**SEE Marks :100**
Credits : 03		**Exam Hours :3 Hrs**

UNIT - I	
Introduction to Management: Management Functions, Roles & Skills, Management History – Classical Approach: Scientific Management & Administrative Theory, Quantitative Approach: Operations Research, Behavioral Approach: Hawthorne Studies, Contemporary Approach: Systems Theory, Overview of Social Responsibility & Managerial Ethics, Case Study.	**6 Hrs**
UNIT - II	
Foundations of Planning: Types of Goals &Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate & Competitive Strategies, Decision Making Process, Types of Decisions& Decision Making Conditions, Case Study.	**4 Hrs**
Organizational Structure & Design: Designing Organizational Structure: Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Mechanistic &Organic Structures, Organizational Design: Traditional & Contemporary, Case Study.	**4 Hrs**
UNIT - III	
Understanding Organizational Behavior: Attitudes, Job Satisfaction& Organizational Commitment, Cognitive Dissonance Theory, Personality: MBTI & Big Five Model, Emotional Intelligence, Perception & Factors Influencing Perception, Attribution Theory, Learning: Classical & Operant Conditioning, Social Learning & Shaping Behavior, Case Study.	**6 Hrs**
UNIT - IV	
Managing Teams: Groups & Stages of Group Development, Group Structure, Processes & Tasks, Work Team & Types of Work Teams, Case Study.	**2 Hrs**
Motivating Employees: Early Theories of Motivation: Maslow's Hierarchy of Needs Theory, McGregor's Theory X& Theory Y, Herzberg's Two Factor Theory& McClelland's Three Needs Theory, Contemporary Theories of Motivation: Adam's Equity Theory & Vroom's Expectancy Theory, Case Study.	**4 Hrs**
UNIT - V	
Managers as Leaders: Early Leadership Theories: Trait Theories, Behavioral Theories: Ohio State Studies, University of Michigan Studies, Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: The Fiedler Model, Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership, Case Study.	**4 Hrs**
Introduction to Controlling: The Control Process, Controlling for Organizational Performance & Tools for Measuring Organizational Performance, Case Study.	**2 Hrs**

Course Outcomes:

1. Understand the principles of management theory & recognize the characteristics of an organization.
2. Demonstrate the importance of key performance areas in strategic management & decision-making process.
3. Design appropriate organizational structures and possess an ability to conceive organizational dynamics.
4. Evaluate leadership practices in organizations & Implement the right one that would enable systems orientation.

Reference Books:

1. Stephen Robbins, Mary Coulter & Neharika Vohra, Management, Pearson Education Publications, 10th Edition, ISBN: 978-81-317-2720-1.
2. James Stoner, Edward Freeman & Daniel Gilbert Jr, Management, PHI, 6th Edition, ISBN: 81-203-0981-2.
3. Stephen Robbins, Timothy Judge& Seema Sanghi, Organizational Behavior, Pearson Education Publications, 13th Edition, ISBN: 978-81-317-2121-6.

Scheme of Continuous Internal Evaluation (CIE):

CIE consists of three tests, each for 45 Marks, (15 Marks for Quiz + 30 Marks for Descriptive – inclusive of case studies) out of which, the best two will be considered. In addition, there will be one seminar on emerging topics in Management and Organizational Behavior for 10 Marks.

Scheme of Semester End Examination (SEE):

The question paper consists of Part A and Part B. Part A will be for 20 Marks covering the complete syllabus and is compulsory. Part B will be for 80 Marks and will consist of five questions, inclusive of case studies, carrying 16 Marks each. All five questions from Part B will have an internal choice and one of the two have to be answered compulsorily.

V SEMESTER SIGNALS AND SYSTEMS		
Course Code: 12IT52		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:1		**SEE Marks: 100**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Understand the fundamental properties of linear systems.
2. Use of linear systems tools, especially transform analysis and convolution for LTI Systems.
3. To analyze and predict the behavior of linear systems in Time, Frequency and Z-Domain.
4. Analysis of gain for the importance of linear systems analysis.

Unit – I	**07 Hrs**
Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems.	
Unit – II	**07 Hrs**
Time-domain representations for LTI systems: Convolution: impulse response representation for LTI systems. Properties of impulse response representation for LTI systems, Block diagram representations.	
Unit – III	**07 Hrs**
Z-Transform: Introduction, Z – transform, properties of ROC, properties of Z – transform, inversion of Z – transform.	
Unit – IV	**07 Hrs**
Z-Transforms: Transform analysis of LTI Systems, unilateral Z-Transform and its application to solve difference equations.	
Unit – V	**07 Hrs**
Fourier representation for signals: Introduction, Fourier series (derivation of series excluded) and Fourier transforms (derivations of transforms are excluded) and the properties of Discrete-time Fourier Transform and Continuous time Fourier Transform and Frequency response of LTI systems.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**1 credit (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Understand and comprehend about the signals, systems and transform.
2. Apply the concepts of signals and transforms to analyze the system.
3. Apply the concept to evaluate the system.
4. Create a mathematical model for a given equation.

Reference Books:

1. Simon Haykin, "Signals and Systems", John Wiley India Pvt. Ltd., 2ndEdn, 2008, ISBN: 0471138207
2. Michael Roberts, "Fundamentals of Signals & Systems", 2nd Edition, Tata Mc Graw-Hill, 2010, ISBN: 0070702217.
3. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd Edition, 1997. Indian Reprint 2002, ISBN: 0136511759.
4. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006. ISBN: 0-07-030641-9.
5. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005, ISBN: 0195158334.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V Semester ADVANCED CONTROL SYSTEM		
Course Code: 12IT53		**CIE Marks: 100+50**
Hrs/Week: L:T:P:S : 3:0:1:1		**SEE Marks: 100+50**
Credits: 05		**SEE Duration: 3 +3 Hrs**

Course Learning Objectives:

1. Defining and differentiation between linear and nonlinear control systems.
2. Developing a mathematical model for the different mechanical, electrical and electromechanical systems.
3. Definition of discrete systems, definition of Z-Transform, application of Z-transform for control systems, stability analysis in Z-plane for different systems.
4. Study and design of optical and adaptive control systems, verification of controllability and observability of control Systems and placing of poles in the desired locations in time domain.

Unit – I	**07 Hrs**
Function Analysis of Non Linear Control Systems: Introduction to Nonlinear control systems, Examples, Describing Function Analysis of Nonlinear control systems, Examples, Stability of nonlinear control systems, Examples Problem on stability of nonlinear control systems.	
Unit – II	**07 Hrs**
Discrete Time Systems and the Z-Transform Method: Introduction to discrete systems, Examples, Review of Z-Transforms, Examples, and Pulse transfer Function, Examples on Pulse Transfer Function, Stability analysis in the Z-plane, Examples.	
Unit – III	**07 Hrs**
State Space Analysis of Control Systems: State Space Representation of Systems, Examples, Time Invariant state Equations, Examples, Solving the time invariant state equations, Examples, State Equations, Transfer Matrix with Examples, Linear Time Invariant Systems, Examples, State Space representation of Discrete time systems, Solving discrete time state Equation.	
Unit – IV	**07 Hrs**
Optimal and Adaptive Control Systems: Introduction to optimal and Adaptive Control systems, optimal control system based on Quadratic performance indexes, Problems on control systems based on quadratic performance indexes. Examples, Controllability, Examples, Observability for Continuous system.	

Unit – V	07 Hrs
Pole placement Design and State Observers for both Continuous and Discrete Systems: Introduction, Stability improvement by state feedback, Necessary and sufficient conditions for arbitrary Pole-placement, State regulator design and Design of State observers.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**1 credit (4hrs/ week)**
Laboratory Experiments: 1. Determine and perform the response of a 2nd order system, using RLC circuit, for a step input. Determine rise time, overshoot, and settling time for over damped, under damped & critically damped conditions. Verify using theoretically calculated values. 2. Determine and perform the response of lead, lag and lead-lag circuits. 3. Design and performing experiment of relay driving circuits using photo devices, LDR and Opto-couplers. 4. Determine and perform the response of p, pi and PID controller for step input. 5. Using MATLAB software, plot the root locus with and without compensation for a given transfer function and verify using theoretical values. 6. Using MATLAB software, plot the Bode-plot with and without compensation for a given transfer function and verify using theoretical values. 7. Using MATLAB software, plot the Nyquist diagram for the given transfer function and verify using theoretical calculations. 8. Using MATLAB software, Plot unit step response and three dimensional plots for a closed loop system for different damping ratios. 9. For each of the given second order systems, find damping ration, Natural frequency, Ts, Tp, Tr, % overshoot, and plot the step response using MATLAB. 10. Using MATLAB software, plot the unit step response and to obtain rise time, peak time, max overshoot and settling time for a higher order system.	
Course outcomes: 1. To understand concepts of different nonlinear control systems. 2. Apply different techniques of stability analysis 3. To analyze the performance of systems 4. To design and test the circuit/system for practical usage both by using hardware and software.	

Reference Books

1. K.Ogata**,** Modern Control Engineering**,** PHI Learning, 5th edition, 2009, ISBN: 978-0136156734
2. K.Ogata, Discrete Time Control Systems, PHI Learning, 2nd edition, 2009, ISBN: 978-8177581713.
3. I.J. Nagrath & M. Gopal, Control Systems Engineering, New Age International publisher, 5th Edition, 2008, ISBN: 978-1848290037
4. Rao.V.Dukkipati., Analysis and Design of Control Systems using MATLAB –New Age Int.(P) Ltd, New Delhi, 2009, ISBN: 978-8122418090

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Continuous Internal Evaluation for Practicals:

In the laboratory students must perform atleast 8 of the above experiments, out of which one major experiment and one minor experiment will be questioned during lab exam.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Evaluation for Practicals:

In the lab exam the student is required to answer and perform two questions.

V SEMESTER

DATA ACQUISITION AND VIRTUAL INSTRUMENTATION		
Course Code: 12IT54		**CIE Marks: 100+50**
Hrs/Week: L:T:P:S : 3:0:1:1		**SEE Marks: 100+50**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Understanding the difference between conventional and graphical programming
2. Differentiating the real time and virtual instrument.
3. Introducing the basics of LabVIEW and programming concepts.
4. Analyzing the basics of data acquisition and learning the concepts of data acquisition with LabVIEW

Unit – I	**07 Hrs**
Fundamentals of Virtual Instrumentation: Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. **Software Overview:** Lab VIEW , Graphical user interfaces - Controls and Indicators Data types - Data flow programming - Editing - Debugging and Running Virtual instrument - Graphical programming pallets - and their configuration VIs and sub-VIs Typical examples-VIs.	
Unit – II	**07 Hrs**
Programming Structure: FOR loops, WHILE loop, CASE structure, formula node, Sequence structures – Introduction to **Arrays and Clusters:** Array operations Cluster Functions, Graphs and charts, local and global variables.	
Unit – III	**07 Hrs**
State Machines : Introduction, Definition of State Machine, A Simple State Machine, Event Structures. **File Input/Output:** Introduction, File Formats, File I/O Functions, Path Functions, Sample VIs to Demonstrate File WRITE and READ Function **String Handling:** Introduction, String Functions, LabVIEW String Formats, Typical examples.	
Unit – IV	**07 Hrs**
Basics of Data Acquisition: Introduction to data acquisition Classification of Signals, Analog Interfacing Connecting signal to board , Analog Input/output techniques digital I/O, counters and timers, **DAQ Hardware configuration:** Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants **Interfacing Instruments: GPIB and RS232 :** Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, RS232C/RS485 Interfacing, Standard commands for Programmable Instruments, VISA **Standard bus architectures**: ISA, PCI, VME and PXI.	

Unit – V	07 Hrs
Advanced Topics In Lab View: Use of analysis tools and application of VI: Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Inter-Process Communication, Notifier, Queue, Semaphore, Data Sockets, Programmatically Printing Front Panels **Simulation of systems using VI:** Development of Control system, Image acquisition and processing, Motion control.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**1 credit (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Remember and understand the fundamentals of Virtual Instrumentation and data Acquisition.
2. Apply the theoretical concepts to realize practical systems.
3. Analyze and evaluate the performance of Virtual Instrumentation Systems.
4. Create a VI system to solve real time problems using data acquisition.

LABORATORY EXPERIMENTS

1. Realization of logic function
2. To match the number and generate a sine wave
3. Interface using General Purpose Interfacing Board
4. To perform serial communication
5. For data acquisition from different sensors
6. Processing collected data and analyzing parameters and storing the results
7. To perform the control system design
8. Acquisition and processing of a biomedical signal and processing
9. Programming using Image Processing concept

Reference Books

1. Sanjay Gupta & Joseph John**,** Virtual Instrumentation Using Lab View, Tata Mc Graw Hill Publisher Ltd., 2nd Edition, New Delhi, 2010, ISBN : 978-0070700284
2. Lisa. K. Wills**, "**LabVIEW for Everyone**",** Prentice Hall of India, 2nd Edition, 2008, ISBN : 978-0132681940
3. Garry Johnson, Richard Jennings, LabVIEW Graphical Programming,4th Edition McGraw Hill Professional, 17-Jul-2006 ,ISBN No-978-1259005336.
4. Jovitha Jerome, "Virtual instrumentation Using LabVIEW", 4th Edition, PHI Learning Pvt.Ltd., 2010, ISBN: 978-8120340305.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self learning component on emerging technologies.

Scheme of Continuous Internal Evaluation for Practicals:

In the laboratory students must perform atleast 8 of the above experiments, out of which one major experiment and one minor experiment will be questioned during lab exam.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.
Scheme of Semester End Evaluation for Practical:
In the lab exam the student is required to answer and perform two questions.

V SEMESTER

CONTROL SYSTEM COMPONENTS (Elective)		
Course Code: 12IT5A1		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:1		**SEE Marks: 100**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Transfer Functions, block diagrams, voltage relations, drive circuits of the electrical machines analysis.
2. Compilation of above relations for the efficient working of the Motors used in Electro pneumatic systems.
3. Electric machine design for the electro pneumatic / Hydraulic application.
4. Working principles of final control elements in applied electro pneumatic field.

Unit – I	07 Hrs
Introduction: Introduction to general block diagram of closed loop control system, introduction to the principle of electromagnetic conversion, Basic structure of electric Machines **Servomotors:** DC servomotors: its working principle and operation, AC servomotor: its working principle and operation, Derivation and Transfer function and block diagram, Problems on the transfer functions. **Synchros:** Introduction to synchros: principle of operation, Voltage relations, applications of synchros, Problems on voltage relations.	
Unit – II	**07 Hrs**
Stepper motors: Introduction to stepper motor, variable reluctance stepper motor its operation, Permanent magnet stepper motor its operation, Drive circuits for the stepper motors : unipolar and bipolar drive circuits, Problems on drive circuits **Synchronous machines** Operation principle of synchronous machines, Speed control of synchronous motor, Frequency control of synchronous machines, Self-controlled control and closed loop control.	
Unit – III	**07 Hrs**
Hydraulic / Pneumatic Control Elements: Control valves: principle of operation, Selection of control valves, Performance of control valves, Sizing of control valves Valve petitioners: their operation and types of petitioners.	

Unit – IV	07 Hrs
Types of control valves: Types of control valves: basic construction of valves, Quick exhaust valve: its operation, Time delay valve, Shuttle valve, Twin pressure valve, Two way valves.	
Unit – V	**07 Hrs**
Actuators: Sizing & selection criteria, Types - Electro-mechanical (rack & pinion, rotary output, quarter-turn linear output), Electro-hydraulic (actuator with jet pipe control, servo valve operated actuator), Pneumatic (spring/diaphragm, piston, rotary valve, cylinder) type actuator. **Logic used in Industrial logic circuits:** Terms for relays, Its symbols, Types of relays, Operation of relays, Relay Ladder logic.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Derive the Transfer function and Block diagram for AC servo motor & DC servomotors.
2. Design an Electro mechanical circuit, Electro Pneumatic circuit, stepper motor drive circuit
3. Develop an interest to design new modeled systems more and more continually.
4. Implement and simulate the circuits and validate its functionality in real time systems.

Reference Books

1. P.C. Sen, principles of electric Machines and Power Electronics, Wiley Publications, 2nd edition, 2007, ISBN: 978-8126511013
2. B G Liptak, Instrument Engineers handbook, Schilton Book Company ,3rd edition, ISBN: 978-0849399701
3. Kilian, modern control technology: components and systems, Cengage learning, 3rd edition, 2008, ISBN: 978-8131504178
4. Thomas E Kissell, industrial electronics, 6th edition, PHI ltd., 2009, ISBN: 978-812032260
5. I J Nagrath and Gopal, Control Systems Engineering, New Age publishers 2009, 6th edition, ISBN: 978-8122420081

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

BIOMEDICAL INSTRUMENTATION (Elective)		
Course Code: 12IT5A2		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:1		**SEE Marks: 100**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To design and analyze a data acquisition system for bio-electrical signals.
2. To design methods for noise and interference cancellation in electro-physiological signals acquisition systems.
3. To design biomedical instrumentation amplifier suitable for ECG, EEG, EMG, EOG.
4. To study the instrumentation concerned with measuring the blood flow, blood pressure, heart rate, oxygen saturation etc.

Unit – I	**07 Hrs**
Fundamentals: Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	
Unit – II	**07 Hrs**
Electrocardiograph: Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG),Block diagram description of an Electrocardiograph, ECG lead Systems, Multi-channel ECG machine **Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG.	
Unit – III	**07 Hrs**
Patient Monitoring System: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement ,Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method **Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter.	

Unit – IV	07 Hrs
Blood Flow Meters: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters **Cardiac Pacemakers and Defibrillators** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator. Defibrillator electrodes, DC defibrillator with synchronizer.	
Unit – V	**07 Hrs**
Pulmonary Function Analyzer: Pulmonary function measurement, Spirometry, Pneumotachometer, Measurement of volume by Nitrogen washout technique. **Hemodialysis machines:** Function of kidneys, Artificial kidney, Dialyzers, Hemodialysis machine, Portable kidney machines.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**4hrs/ week**

Course outcomes:
After going through this course the student will be able to:

1. Remember and understand the basic concepts of a Biomedical instrumentation system
2. Apply the basic principles to the design of a sophisticated instrumentation system
3. Analysis and evaluation of the need for different diagnostic and therapeutic instruments.
4. Design or create a system for measurement of biomedical parameters.

Reference Books:

1. R. S. Khandpur , Handbook of Biomedical Instrumentation, Tata McGraw-Hill ,2nd Edition, 2008, ISBN: 9780070473553.
2. Leslie Cromwell & others, Biomedical Instrumentation and Measurements, Wiley Publications, 2nd Edition, 2010, ISBN: 9780130771315.
3. J. G. Webster, Medical instrumentation: Application and Design, Wiley Publications, 3rd Edition, 2008, ISBN: 9788126511068.
4. Richard Aston, Principles of Biomedical Instrumentation and Measurement, Prentice Hall of India, 4th Edition, 2005, ISBN: 9780675209434.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self learning component on emerging technologies.

Scheme of Semester End Examination:
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

POWER ELECTRONICS (Elective)		
Course Code: 12IT5A3		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:1		**SEE Marks: 100**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To differentiate various power electronics circuits
2. To understand the basics of the power electronics circuit operation.
3. To become aware of various convertors.
4. To know fundamentals of chopper circuits and voltage controllers.

Unit – I	**06 Hrs**
Introduction: Applications of power electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits, Peripheral effects.	
Unit – II	**06 Hrs**
Power Transistor: Power BJT's, Switching characteristics, Switching limits, Base derive control, Power MOSFET's, Switching characteristics, Gate drive, IGBT's, Isolation of gate and base drives.	
Unit – III	**07 Hrs**
Introduction To Thyristors: Principle of operation states anode-cathode characteristics, Two transistor model. Turn-on Methods, Dynamic Turn-on and turn-off characteristics, Gate characteristics, Gate trigger circuits, di / dt and dv / dt protection, Thyristor firing circuits.	
Unit – IV	**06Hrs**
Controlled Rectifiers: Introduction, Principles of phase controlled converter operation, 1φ fully controlled converters, Duel converters, 1φ semi converters (all converters with R & RL load).	
Unit – V	**08 Hrs**
AC Voltage Controllers: Introduction, Principles of on and off control, Principles of phase control, Single phase controllers with restive loads and Inductive loads. **DC Choppers:** Introduction, Principles of step down and step up choppers, Step down chopper with RL loads, Chopper classification.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**(1 credit)** **4hrs/week)**

Course outcomes:

After going through this course the student will be able to

1. Remember and understand the basic concepts of different power electronics circuits
2. Apply the concept to design power electronics circuits such as inverters, choppers and rectifiers.
3. Analysis and evaluate the various power converter circuits.
4. Design power electronics circuits for a real time applications.

Reference Books

1. M . H . Rashid , "Power Electronics" , 3rd edition , PH I / Pearson publisher 2004. ISBN:100123820367
2. M . D. Singhand Kanchandani K.B ,"Power Electronics", TMH publisher , 2 nd Ed . 2007 ISBN:0070583897
3. L Uma Anand ,"Power Electronics, Essentials and Applications", John Wile y India Pvt. Ltd , 2009 . ISBN:978812651945
4. Daniel W. Hart, "Power Electronics", McGraw H ill, 2 0 1 0 . ISBN:9780071321204
5. V Nattarasuand R.S . Anandamurhty, "Power Electronics", Pearson /Sanguine Publisher, 2006, ISBN: 9788131732403

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

COMPUTER ORGANIZATION AND ARCHITECTURE (Elective)		
Course Code: 12IT5A4		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:1		**SEE Marks: 100**
Credits: 05		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Illustrate how Computer Systems work & its basic principles, analyze the system performance.
2. Analyze the concepts behind advanced pipelining techniques. The current state of art in memory system design.
3. Understanding the concept of programs as sequences of machine instructions and relationship between assembly language and machine language.
4. Develop skill in assembly language programming, understanding the relationship between high-level compiled languages and assembly language.

Unit – I	**07 Hrs**
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus Structures, Performance- Instruction Set: CISC and RISC. **Machine Instructions and Programs:** Memory Locations And Addresses, Memory Operations, Instructions And Instruction Sequencing, Addressing Modes, Basic Input/Output Operations, Stack And Queues, Subroutines, Additional Instructions.	
Unit – II	**07 Hrs**
Data Representation: Data Type, Compliments, Fixed And Floating Point Representations, Character Representation. **Basic Computer Organization and Design:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycles Memory Reference Instructions, Input/Output and Interrupt Configurations.	
Unit – III	**07 Hrs**
Computer Arithmetic - Addition and Subtraction, Multiplication Algorithms, Hardware Implementation for Signed- Magnitude Data, Hardware Algorithm, Booth Multiplier, Array Multiplier, Division Algorithm, Floating Point Arithmetic Operations, Decimal Arithmetic Unit, Decimal Arithmetic Operations.	
Unit – IV	**07 Hrs**
Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer - Strobe Control, Handshaking, Asynchronous Serial Transfer, Asynchronous Communication Interface, First In First Out Buffer, Modes of Data Transfer, Priority Interrupt- Daisy Chaining Priority, Parallel Priority Interrupt, Direct Memory Access (DMA), Input Output Processor (IOP), Serial Communication.	
Unit – V	**07 Hrs**

Pipelining: Basic concepts of pipelining, Data Hazards-Operand Forwarding, Side Effects, Instruction Hazards, Influence on Instruction Sets- Addressing modes, Condition codes, Superscalar operation, Performance Considerations. **Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory- Associative Mapping, Direct Mapping, Set Associative Mapping, Writing into Cache, Cache Initialization, Virtual Memory, Memory Management Hardware.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Understand the basics of Computer Organization and analyze it on various architecture requirements.
2. Apply the concepts and interpret recent architecture advancements.
3. Develop hardware requirements for a system.
4. Present architecture requirements for a complex application.

Reference Books

1. V. C. Hamacher, Z. G. Vranesic and S. G. Zaky, "Computer Organization", 5th Edition, McGraw Hill, 2002, ISBN: 9780071007429.
2. M.Morris Mano, "Computer System Architecture", Pearson Education India, 3rd Edition,2003, ISBN : 81-7808-687-5.
3. William Stallings, "Computer Organization and Architecture: Designing for Performance", 8th Edition, Pearson Education India. 2010, ISBN : 9789332518704.
4. A. S. Tanenbaum, "Structured Computer Organization", 5th Edition, Prentice Hall of India, 2009, ISBN: 0130959901.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks (15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

IMAGE PROCESSING (Elective)		
Course Code: 12IT5B1		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Analyze basic concepts and methodologies of Digital Image processing
2. Analyze image enhancement and restoration techniques. Perform image restoration using convolution, discrete linear operators and filters.
3. Construct image features, segmentation and texture from an image.
4. Analyze the different techniques in image compression.

Unit – I	**07 Hrs**
Digital Image Fundamentals Introduction to Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.	
Unit – II	**07 Hrs**
Image Enhancement in Spatial domain Some Basic Gray Level Transformations, Histogram Processing: Histogram equalization, Histogram specification, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. **Image Enhancement in the Frequency Domain** Properties of DFT, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters and Homomorphic Filtering.	
Unit – III	**07 Hrs**
Image Segmentation Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region Based Segmentation.	
Unit – IV	**07 Hrs**
Image Compression Fundamentals: Coding redundancy, spatial and temporal redundancy, irrelevant information, measuring image information, fidelity criteria, image compression models, some basic compression methods: Huffman coding, Arithmetic coding, LZW coding, Run- length coding, bit-plane coding.	
Unit – V	**07 Hrs**
Morphological image processing Preliminaries, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation, Some Basic Morphological Algorithms: Boundary extraction, hole filling, extraction of connected components, convex hull, thinning and thickening.	

Course outcomes:

After going through this course the student will be able to

1. Describe the processes and hardware of image acquisition.
2. Apply pre-processing operations in image enhancement.
3. Compare various image segmentation and feature extraction operations.
4. Implement basic algorithms for image compression.

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, 3rd Edition, 2008, ISBN: 978-81-317-2695-2.
2. Chanda, D. Dutta Majumdar, "Digital Image Processing and Analysis", PHI, 2003, ISBN: 8120316185.
3. Tinku Acharya and Ajoy K Ray,"Image Processing:Principles & Applications",John Wiley & Sons, 2005, ISBN: 978-0-471-71998-4.
4. John C Russ,"The Image Processing Handbook",CRC Press,6th edition,2011, ISBN:978-1-4398-4045-0.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 45 marks(15 marks for quiz+ 30 marks for test), out of which best of two will be considered. In addition there will be one seminar on new topics/ model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

ROBOTICS (Elective)		
Course Code: 12IT5B2		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Obtain a basic knowledge of kinematics involved in making of robots.
2. To acquire basic exposure to trajectory managements of the motion of robots.
3. To understand the working knowledge of Cameras and their usage in robotics.
4. To get an idea of different sensors and their applications

Unit – I	**07 Hrs**
Robot Arm Kinematics: The direct Kinematics Problem, Rotation Matrices, Composite Rotation Matrix, Rotation matrix about an arbitrary axis, Rotation matrix with Euler angle representation, Geometric interpretation of Homogeneous transformation matrices, composite homogeneous transformation matrix, Links joints and their parameters. **Basics of Kinematics :** Kinematic equations for manipulators, Other specifications of the locations of the End-Effector, Classification of Manipulators, The inverse Kinematics problem, Inverse Transform Technique for Euler Angles Solution.	
Unit – II	**07 Hrs**
Planning of Manipulator Trajectories: Introduction, General considerations on Trajectory planning, joint-interpolated Trajectories, calculation of a 4-3-4 Joint trajectory, Cubic Spline Trajectory. Sensing: Range sensing, Triangulation, Structured Lighting Approach, Time-of-Flight range finders. **Sensors :** Proximity sensing, Inductive sensors, Hall effect sensors, Capacitive Sensors, Ultrasonic sensors, Optical Proximity Sensors, Touch sensors, Binary sensors, Analog sensors, Force and Torque sensing, Elements of a Wrist sensor.	
Unit – III	**07 Hrs**
Low-level Vision: Image acquisition, illumination Techniques, imaging geometry.	
Unit – IV	**07 Hrs**
Camera: Camera model, camera calibration, stereo imaging, some basic relationships between pixels, Neighbors of a Pixel, connectivity, distance measures, Preprocessing, Spatial-Domain methods.	
Unit – V	**07 Hrs**

Higher-Level Vision: Segmentation, Edge Linking and Boundary detection, Thresholding.	

Course outcomes:

After going through this course the student will be able to

1. Classify the manipulators depending on the basics of kinematics.
2. Build sensors based on proximity.
3. Acquire and analyze images based on illumination techniques and imaging geometry.
4. Analyze higher level vision based on illumination.

Reference Books

1. K.S.Fu, R.C.Gonzalez, C.S.G. Lee , Robotics control sensing Vision and Intelligence ,2nd Edition McGh, 1987, ISBN : 9780070226265
2. John J. Craig, Introduction to Robotics Mechanics and control –2nd Edition , Pearson education, 2003, ISBN: 978-0201543612
3. Y.Koren "Robotics for engineers"-1st edition , Mc Gh, 1985.
4. Mikell, P.Grooves Roger "Industrial robotics.", 1st Edition Mitchell Weiss, 1986, ISBN: 978-0070249899

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 45 marks (15 marks for quiz+ 30 marks for test), out of which best of two will be considered. In addition there will be one seminar on new topics/ model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER

PROBABILITY STATISTICS AND QUEING (Elective)		
Course Code: 12IT5B3		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Statistics concerns data, their collections, analysis and interpretation.
2. Probability and statistics are used in wide variety of scientific investigations involving randomness.
3. The course helps in constructing and analyzing mathematical models for random phenomena.
4. Describe about data distribution and its analysis through regression and analysis of variance.

Unit – I	**07 Hrs**
Introduction: Motivation, Probability Models, Sample Space, Events, Algebra of Events, Probability Axioms, Combinatorial Problems, Conditional Probability Independence of Events, Bayes Rules.	
Unit – II	**07 Hrs**
Random Variables: Introduction, Random variables types, functions of random variables, Probability mass functions.	
Unit – III	**07 Hrs**
Random Variables: The Probability distribution functions, cumulative distribution function, expected values of x. Moments, moment generating function, Discrete Distributions, binomial distribution.	
Unit – IV	**07 Hrs**
Random Variables: Poisson distribution, Geometric distribution, continuous distribution ,normal distribution, exponential distribution	
Unit – V	**07 Hrs**
Regression and Analysis of Variance Introduction, Least-squares Curve Fitting, The Coefficients of Determination, Confidence Intervals in Linear Regression, Trend Detection and Slop estimation, Correlation Analysis, Simple Non-Linear Regression.	

Course outcomes:

After going through this course the student will be able to

1. Collect data with reference to specific problem, their collections, analysis and interpretation.
2. Scientific investigations of randomness in defined problems
3. To construct and analyze mathematical models for random phenomena.
4. Data distribution and its analysis through regression and analysis of variance.

Reference Books:

1. Kishore S Trivedi "Probability & Statistics with Reliability, Queuing and Computer Science Applications ", Wiley Publications, Section Edition, 2012, ISBN: 0471791563
2. Arnold O Allen, "Probability, Statistics and Queuing Theory with Computer Science Applications ", Second Edition, ELSEVIER Publications, 2012, ISBN: 978-0-12-051051-1.
3. Murray R.Spiegel, "Probability and Statistics", McGrawHill, Schaum's Outline Series, ISBN: 0071485848/2007-11-09/577.
4. A.Papoulis and S.Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", McGrawHill 4th Edition, ISBN:0073660116.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation/Assignment etc. for 10 marks**.**

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

V SEMESTER OOPS AND C++ (Elective)		
Course Code: 12IT5B4		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Explain C++ functions and concepts related to good modular design.
2. Illustrate the concepts of inheritance and polymorphism.
3. Demonstrate the ability to overload operators in C++.
4. Demonstrate the use of text file input/output develop object oriented program to any complex problem

Unit – I	**07 Hrs**
The Basic Language: The C++ program - preprocessor directives, comments and input/output. C++ data types - pointer types, string types, const qualifier, reference types, bool type, enumeration types. Typedef names, volatile qualifier, new and delete operators, type conversions. **Functions**: Overview, function prototype, argument passing, returning a value, recursion, inline functions, and pointers to functions. Lifetime and scope, global objects and functions, local objects and dynamically allocated objects. Overloaded function declarations, the three steps of overload resolution, argument type conversions.	
Unit – II	**07 Hrs**
Classes and objects: Introducing C++ classes, constructors and destructors, classes, structures and classes,Parameterized constructors, static class members - static data members, static operator, nested classes, passing objects to functions, returning objects, object assignment.	
Unit – III	**07 Hrs**
Operator overloading: Introduction Defining operator overloading unary operators overloading binary operators Rules for operator overloading Data conversion Binary overloading operator like arithmetic, comparison, arithmetic assignment overloading the binary operators using Friends	
Unit – IV	**07 Hrs**
Inheritance: Introduction defining Derived Classes single Inheritance Multilevel Inheritance Multiple Inheritance Hierarchical Inheritance Hybrid Inheritance Derived Class Constructors Overriding member function **Virtual functions** : Introduction to Virtual Function Normal Member function accessed with pointer Virtual function accessed with pointer early and late binding, pure virtual functions - abstract classes friend function static function	

Unit – V	07 Hrs
The Input/Output stream library: Introduction C++ Streams C++ stream classes Unformatted I/O Operation Formatted console I/O operation Managing output with manipulator. **Data structure:** Introduction to data structure Types of data structure Linear and Non linear Data structure Stacks Queues Recursion	

Course outcomes:

1. Remember and understand the basic concepts of OOPS.
2. Apply the concept of OOPS to realize the existing algorithms.
3. Analyze the given program for debugging to obtain correct output.
4. Create a suitable application to solve real world problems.

Reference Books

1. Rober Lafore , ," Object Oriented Programming in C++ ",Sams Publisher, 4th Edition, 2002 ISBN: 978-8131722824.
2. Stanley B. Lippman and Josee Lajore, "C++ Primer", Pearson Publications, 4th Edition, 2005, ISBN: 978-8131710777.
3. Bjarne Stroustrup, "The C++ programming language", Pearson Publications , 3rd Edition, 2002, ISBN: 978-8131705216.
4. E.Balaguruswamy , "Object Oriented Programming with C++ ", Tata McGraw-Hill Companies, 5th edition, 2011, ISBN: 978-0071072830.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation/Assignment etc. for 10 marks**.**

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP						
Subject Code	**: 12HSI61**			**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T: P:S 3:0:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**03**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: Students are expected to :

1. To build awareness on the various forms of IPR and to educate on the link between technology innovation and IPR.
2. To encourage invention, investment and innovation and disclosure of new Technology and to recognize and reward innovativeness.
3. To promote linkages with industries and stimulate research through developing and utilizing novel technologies.
4. To trigger the entrepreneurial thinking amongst the student community and to provide necessary inputs and motivation for promoting entrepreneurial careers.

Unit – I	**08 Hrs**
Introduction: Types of Intellectual Property, International Scenario in IPR: WIPO, WTO, TRIPS. **Patents:** Introduction, Object of patent; Scope and salient features of patent; patentable inventions, inventions are not patentable, Patent Procedure- Overview, Rights and obligations of patentee; Transfer of Patent Rights; Government use of inventions; Biotechnology patents, protection of traditional knowledge, Infringement of patents and remedy, Case study **Trade Secrets:** Definition, Significance, Tools to protect Trade secrets in India.	
Unit – II	**05 Hrs**
Trade Marks: Basic concepts, Definition, function and different kinds of Trade marks Different forms of trade mark; Registrable and non- registrable marks .Basic principles of registration of trade mark; Deceptive similarity; Assignment and transmission; Trade mark and ECO Label, Passing off; Offences and penalties. Infringement of trade mark with Case study	
Unit – III	**08 Hrs**
Industrial Design: Introduction, Need for Protection of Industrial Designs, Subject Matter of Protection and Requirements. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies , Case study	
Copy Right: Introduction, Nature and scope, Subject matter, Related or allied rights, the works in which copy right subsists, Rights conferred by copy right, Copy right protection in India, transfer of copy rights, right of broad casting organizations and of performer, computer soft ware and IPR and Case Studies. **Intellectual property and cyberspace:** Emergence of cyber-crime ; Grant in software patent and Copyright in software; Software piracy; Trademarks issues related to Internet (Domain name, Data protection in cyberspace;; Salient features of Information Technology Act; IPR	

provisions in IT Act; Internet policy of Government.

Unit – IV

Entrepreneur and Entrepreneurship: Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an entrepreneur and a manager, Functions of an entrepreneur, types of entrepreneur, Entrepreneur, Concept of Entrepreneurship ,Growth of entrepreneurship in India, Role of Entrepreneurship in economic development, overview on entrepreneurial development models, Case discussions on a couple of successful entrepreneurs.

Unit – V

Micro Small & Medium Enterprises (MSME): Definition, Characteristics, Need and rationale, Objectives, Scope, role of MSME in Economic Development, Advantages of MSME, Steps to start an MSME – Government policy towards MSME, Impact of Liberalization, Privatisation & Globalization on MSME, Effect of WTO / GATT.
Sustainability and MSME.

Institutional Support to entrepreneurs: Over view on National and State Agencies. Identification of Business Opportunities: Market Feasibility studies; Technical Feasibility Studies; Financial Feasibility Studies and Social Feasibility studies.

Course Outcomes:

1. Identify and understand the applicable source, scope and limitations of the core Intellectual Property disciplines such as Patent, Copyright, Trademark and Trade secret Law.
2. Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights
3. Demonstrate and develop basic skills of legal reasoning, individual critical thinking and group interaction, as well as interpretative, analytical and argumentative skills in oral and written forms of communication.
4. Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career

Reference Books:

1. Dr G.B Reddy, "Intellectual Property Rights and the Law' Gogia Law Agency, 7th Edn.,2008
2. Prabuddha Ganguly, "Intellectual Property Rights: Unleashing Knowledge Economy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1st Edition, 2001. ISBN: 0074638602.
3. Rodney Ryder – Intellectual Property and the Internet.
4. Rahul Matthan – The law relating to Computers and the Internet.
5. S.R Myneni, "Law of Intellectual Property", Asia Law House, Hyderabad, 2001, SKU –664773841.
6. SS Khanka ,Entrepreneurial Development , S Chand & Co, 2008,ISBN:81-219-1801
7. Entrepreneurship Development & Small Business Enterprises – Poornima M Charantimath , Pearson Education ,2007 ,ISBN: 81-7758-260-7.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal

choice and one of the two have to be answered.

VI SEMESTER COMPUTER COMMUNICATION NETWORKS		
Course Code: 12IT62		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:1:0:0		**SEE Marks: 100**
Credits: 04		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To introduce the various layers of OSI and TCP/IP communication models.
2. To understand the data rate of the channels, decide on cables based on bandwidth requirements.
3. To understand the concepts of networking protocols and their security issues.
4. To introduce the hardware and software components of networking.

Unit – I	07 Hrs
Introduction: Data Communications, Networks, Protocols and Standards, Layered tasks, OSI model, Layers in the OSI model, TCP/IP protocol suite, Comparison of reference models **The Physical Layer:** Transmission impairments, Data rate limits, Performance, Multiplexing, FDM, WDM and TDM, Circuit switching, Packet switching.	
Unit – II	**07 Hrs**
The Data Link Layer: Data link layer design issues, Error -detecting codes, Error - Correcting codes, Elementary Data Link Protocols, Sliding Window Protocols.	
Unit – III	**07 Hrs**
The Medium Access Control (MAC) Sublayer: ALOHA, Carrier Sense Multiple Access (CSMA) protocols, Ethernet: Ethernet cabling, Manchester encoding, Ethernet MAC sub layer protocol, Binary exponential Back off algorithm, Ethernet performance.	
Unit – IV	**08 Hrs**
The Network Layer: Network Layer Design Issues, Routing Algorithms: Optimality principle, Shortest path routing, Flooding, Distance vector routing, Link state routing, Hierarchical routing, General principles of congestion control, Network layer in the Internet: IP protocol, IP address, IPv6.	
Unit – V	**06 Hrs**
Network Security: Introduction to Cryptography, substitution Ciphers, transposition Ciphers, Symmetric Key algorithm: DES, AES, Cipher modes, other ciphers cryptanalysis, Public key algorithm: RSA algorithm, Firewall	

Course outcomes:

After going through this course the student will be able to

1. Understand and remember the fundamentals of computer communication networks and their securities.
2. Apply the various networking protocols for different networking scenarios.
3. Analyze the different networking algorithms.
4. Evaluate the model for improved communication network using different algorithms.

Reference Books:

1. Andrews S. Tanenbaum, "Computer Networks", PHI Publication, 5thEdition, 2010, ISBN 978-0132126953.
2. Behrouz A Forouzan, "Data Communications and Networking", Tata McGraw-Hill, McGraw-Hill , 4th Edition, 2006, ISBN 978-0073250328.
3. W Stallings, "Data and Computer Communications", Pearson Education ,8th Edition, 2011, ISBN 978-8131715369
4. Wayne Tomasi, "Introduction to Data Communications and Networking", Pearson Education,1st Edition, 2011, ISBN 978-81-31709306

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation/Assignment etc. for 10 marks

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER

AUTOMATIC PROCESS CONTROL AND SIGNAL CONDITIONING TECHNIQUES		
Course Code: 12IT63		**CIE Marks: 100+50**
Hrs/Week: L:T:P:S : 3:0:1:1		**SEE Marks: 100+50**
Credits: 05		**SEE Duration: 3+3 Hrs**

Course Learning Objectives:

1. Learn the concepts involved in automatic control systems development for various industrial processes.
2. Designing different types of analog & digital signal conditioning circuits for standard transducers.
3. Designing electronic P, I, D, PI, PD, PID controllers.
4. Learn the techniques of control loop tuning & the language of ISA symbols & P&ID.

Unit – I	
Introduction to Process control: Introduction, control systems, process control block diagram, control system evaluation, analog and digital processing, problems.	**07 Hrs**
Unit – II	
Analog signal conditioning: Introduction to Principles of analog signal conditioning, Op Amp circuits in Instrumentation, problems. **Digital signal conditioning:** Introduction, converters, Data acquisition systems, Problems and algorithms.	**07 Hrs**
Unit – III	
Controller principles: Introduction, Process characteristics, control system parameters, ıtinuous controller modes, composite control modes.	**07 Hrs**
Unit – IV	
Analog controllers: Introduction, General features, Electronic controllers. **Digital controllers:** Introduction, computers in Process controls, controller software.	**07 Hrs**
Unit – V	
Control loop characteristics: Introduction, Control system configurations, Process loop tuning methods, P&ID Symbols, ISA Flow Diagrams.	**07 Hrs**
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Remember and understand the basic processes & concepts for various industrial control systems.
2. Apply the concepts of signal conditioning circuits and systems for designing controller.
3. Analyze and evaluate performance of controllers and their digital implementation.
4. Create ISA flow diagrams and analyze process loops tuning for industrial application.

Reference Books

1.Curtis D. Johnson, Process Control Instrumentation Technology, 7th Edition Prentice hall of India, 2012, ISBN 81-7758-410-3

2.Bela G. Liptak, "Instrument Engineers Handbook, Process Measurement" volume 1, "Process Control", volume-2, Chilton Book Company/ Rad-nor, 3rd edition, 2010, ISBN-81-7956-540-8.

3.S. K. Singh, "Computer Aided Process Control", 2nd print, Prentice Hall of India, 2010, ISBN-81-203-2282-7.

4.Kirk & Rimboi, "Instrumentation", 2nd edition, PHI, 2010, ISBN 81-7758-410-5.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily**.**

VI SEMESTER

DIGITAL SIGNAL PROCESSING		
Course Code: 12IT64		**CIE Marks: 100+50**
Hrs/Week: L:T:P:S : 3:0:1:1		**SEE Marks: 100+50**
Credits: 05		**SEE Duration: 3 +3Hrs**

Course Learning Objectives:

1. Analyze continuous and discrete-time signals, their properties and representations using mathematical and computational skills.
2. Illustrate time-domain representation concepts related to difference equations, impulse response and convolution, etc.
3. Design of digital filter, transform-domain processing and importance of Signal Processors.
4. Understand the practical implementations of the theoretical concepts.

Unit – I	**07 Hrs**
Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT.	
Unit – II	**07 Hrs**
Use of DFT in linear filtering, overlap-save and overlap-add method. Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms.	
Unit – III	**07 Hrs**
Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form I and direct form II systems, cascade, lattice, ladder and parallel realization.	
Unit – IV	**07 Hrs**
IIR filter design: Design of analog filters –Butterworth and Chebyshev filters, analog to analog frequency transformations. **Design of IIR filters from analog filters** (Butterworth and Chebyshev) -impulse invariance method, backward difference ,Forward difference, and bilinear transformation method, Matched z transforms, Verification for stability and linearity during mapping	
Unit – V	**07 Hrs**
FIR filter design: Introduction to FIR filters, design of FIR filters using -Rectangular, Hamming and Bartlet windows, FIR filter design using frequency sampling technique.	
Practicals	

1. Sampling Theorem Verification 2. Linear Convolution, Circular Convolution, Cross Correlation & Auto Corretaion 3. Linear Convolution Using FFT 4. Correlation Using FFT 5. Spectrum Using FFT 6. Design & Test Fir Filter Using Windowing Method Hamming Window Lowpass Filter. 7. Design & Test Fir Filter Using Frequency Sampling Method 8. Design & Test Butterworth 1st And 2nd Order Low Pass Filter 9. Design & Test Butterworth 1st And 2nd Order High Pass Filter 10. Design & Test Chebyshev 1st And 2nd Order Low Pass Filter 11. Design & Test Chebyshev 1st And 2nd Order High Pass Filter 12. Dual Tone Multi Frequency All the experiments must be executed in Mat Lab and C language using DSP Processor.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus.	**(4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Appreciate or explain that the digital signal processing as an essential tool for the current advancement in the areas of control systems, biomedical instrumentation, communication engineering etc.
2. Apply their knowledge of signal processing to solve the real time problems associated with convolution theorems, filter designs, feedback systems and quantization processes.
3. Realize and design various IIR and FIR filters, DFT, IDFT.
4. Analyze the analytical problems associated to DFT Properties.

Reference Books

1. Proakis & Monalakis, "Digital signal processing, Principles Algorithms & Applications", Pearson education, 4th Edition, New Delhi, 2007, ISBN: 9780131873742.
2. Oppenheim & Schaffer,"Discrete Time Signal Processing", PHI, 2003, ISBN: 0-13-754920-2.
3. Lee Tan, "Digital Signal Processing", Elsivier publications, 2007, ISBN: 10: 0124158935.
4. Sanjith Kumar Mithra," "Digital Signal Processing", Mc Graw Hill, International edition, 2011 ISBN-0071289461, 9780071289467.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks(15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Continuous Internal Evaluation for Practicals:

In the laboratory students must perform atleast 8 of the above experiments, out of which one major experiment and one minor experiment will be questioned during lab exam.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

Scheme of Semester End Evaluation for Practicals:
In the lab exam the student is required to answer and perform two questions.

EMERGING TECHNOLOGY
Development of Control and Instrumentation Application Using ANDROID

Course Code: 12IT65		**CIE Marks: 50**
Hrs/Week: L:T:P:S :2:0:0:0		**SEE Marks: NIL**
Credits: 02		**SEE Duration: NIL**

Course Learning Objectives:

1. To give the introduction to Android.
2. To learn the basic Programming with Android.
3. To know Asynchronous Task, HTTP and Network Handling in Android.
4. To familiarize with Service API's in Android.

Unit – I	**12Hrs**
Introduction to Android, Basics of Programming with Android, Activities, Broadcast Receivers and Services, Async Task.	
Unit – II	**12Hrs**
HTTP, Network Handling in Android, Service API, REST framework, consuming REST API in Android, Wifi Manager, Bluetooth Manager.	

Course outcomes:

Remember and Understanding the basic concepts and technique of Android platform and Java, XML programming and SQL database.

Apply the Concept and technique to design an android application using Java and XML code.

Design a new Application and test with real time application.

Suggested Reference Books:

1. Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming ANDROID", O'Reilly Media, 2011,ISBN:978-1-4493-8969-7.

Scheme of Continuous Internal Evaluation:

CIE consists of 2 phases
Phase1: Test + Assignment=20+5=25
Phase2: Test + Assignment =20+5=25
Total=25+25=50Marks

Scheme of Semester End Examination:
There is no SEE for this course.

EMERGING TECHNOLOGY Information Communication Technology (ICT) for Health Care		
Course Code: 12IT65		**CIE Marks:50**
Hrs/Week: L:T:P:S : 2:0:0:0		**SEE Marks: NIL**
Credits: 02		**SEE Duration: NIL**

Course Learning Objectives:

1. Better acceptance of ICT in health care.
2. Increased awareness on eHealth among medical professionals and citizens.
3. Ensuring top-quality health care for citizens through ICT solutions.

Unit – I	12Hrs
Introduction, The e-Healthcare Information: Nature and Trends, Securing e-Healthcare information, Breaches of Privacy and Confidentiality in e-Healthcare, Laws and Standards for e-Healthcare Information.	
Unit – II	**12Hrs**
Concept and context For securing e-Healthcare information, Telemedicine Implementation, Visualisation of Medical Data.	

Course outcomes:

1. Helps strengthen Health Management Information Systems.
2. Demonstrate knowledge and understanding of HI concepts, principles and Practice.
3. Display mastery of principles and techniques for the specialized areas of secure storage, manipulation and retrieval of health related data;
4. Display expertise with emerging technologies for health information systems
5. Recognize the role of informatics to support the advance professional skill for
6. Decision support systems.

Reference Books

1. Charles A Shoniregun, KudakwasheDube, Fredrick Mtenzi " Electronic Healthcare Information Security",Springer Science & Business Media, 2010, ISBN:9780387849195.

Scheme of Continuous Internal Evaluation:

CIE consists of 2 phases
Phase1: Test + Assignment = 20+5=25
Phase2: Test + Assignment = 20+5=25
Total= 25+25 =50Marks

Scheme of Semester End Examination:
There is no SEE for this course.

VI SEMESTER ANALYTICAL INSTRUMENTATION (Elective)		
Course Code: 12IT6C1		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:1		**SEE Marks: 100**
Credits: 04		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To study the principle and operation of different types of spectroscopy.
2. To discuss quantitative and qualitative analysis in visible, Ultraviolet and infrared absorption.
3. To gain knowledge about the working principle of X-ray spectroscopy, different types of detectors used for analysis.
4. To be familiar with the principle, working and instrumentation of NMR spectroscopy and mass spectrometry.

Unit – I	**07 Hrs**
Introduction: Types of analytical methods, Instruments for analysis, Electromagnetic radiation, its properties and interaction with matter. **Spectroscopy:** Introduction to spectroscopy: Visible spectroscopy, theory of spectrophotometry and colorimetry, Deviations from Beers law, Instrumentation. UV spectroscopy: Instrumentation, General applications of UV absorption spectroscopy. Infrared spectrophotometry: Introduction, range of infrared radiation, Instrumentation, Single beam and Double beam spectrophotometers.	
Unit – II	**07 Hrs**
Atomic absorption spectroscopy: Principle, Differences between Atomic Absorption spectroscopy and Flame emission spectroscopy, Advantages of Atomic Absorption spectroscopy over Flame emission spectroscopy, Instrumentation, Interferences, Qualitative and Quantitative analysis of Atomic Absorption spectroscopy. **Emission Spectrography:** Introduction: Theory, Instrumentation, Spectrographs, Applications of Emission Spectroscopy, Advantages and Disadvantages of Emission spectroscopy.	
Unit – III	**07 Hrs**
X-ray techniques: Introduction to X-ray absorption, General theory, Instrumentation, Non-dispersive instruments, X-ray diffraction and its applications**.** **Nuclear radiation measurements:** Radiation detectors: Ionization chamber, GM counter, Proportional counter, Scintillation counter and Semiconductor detector**.**	
Unit – IV	**07 Hrs**

Gas chromatography: Introduction, Gas chromatography, Instrumentation, Types of columns and detectors,Applications of Gas chromatography. **High Performance Liquid Chromatography:** Introduction, Principle, Instrumentation, Apparatus and materials, Applications of High Performance Liquid Chromatography.	
Unit – V	**07 Hrs**
Nuclear Magnetic Resonance spectroscopy: Introduction, Principle, Instrumentation, Applications and Limitations of NMR. **Mass spectrometry:** Theory of mass spectrometry, Instrumentation: Ion sources, Inlet systems, mass analyzers: single beam, double beam, quadrapole and time of flight, applications.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Remember and understand the basic principles of different types of spectroscopies.
2. Apply the basic concept to realize the theoretical design for analytical instruments.
3. Analysis and evaluation of the performance of different analytical instruments.
4. Design or create an analytical system using appropriate sources and detectors for a particular application.

Reference Books

1. Gurdeep R. Chatwal, Sham K. Anand, "Instrumental Methods of Chemical Analysis", Himalaya Publishing house, 6th Edition, 2007, ISBN:9788183181204.
2. Douglas A Skoog, F. James Holler, Stanley R. Crouch "Principles of Instrumentation Analysis", Thomson Brooks, 6th Edition, 2006, ISBN:978-0495125709.
3. Galen W Ewing "Instrumental Methods of Chemical Analysis", Mc-Graw Hill, 5th Edition, 1985, ISBN: 978-0070662773.
4. Douglas A Skoog, Donald M, "Fundamentals of analytical chemistry", Thomson Publication, 8th Edition, 2003, ISBN: 978-0030355462.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks(15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER LASERS IN OPTICAL INSTRUMENTAION (Elective)		
Course Code: 12IT6C2		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:1`		**SEE Marks: 100**
Credits: 04		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To learn the fundamentals of LASERs
2. To interpret the design and industrial importance of LASERs.
3. To understand the principles of working technologies of various LASERs and Optical instruments
4. To acquire knowledge about the design fundamentals of fiber optics and optical sensors and their utility

Unit – I	**09 Hrs**
LASERS: Principles, classification, construction of Ruby, He-Ne, Nd-YAG, semiconductor, Argon and Carbon dioxide lasers. application of lasers in engineering and medicine, safety with lasers.	
Unit – II	**09 Hrs**
Characteristics of stabilization, Q-switching and mode locking, frequency stabilization, Line shape function, lasing threshold **Optoelectronic devices and components:** Photo diodes, PIN diodes, solar cells, LED's phototransistors, opto-isolators, photo-couplers.	
Unit – III	**09 Hrs**
Laser instruments: Laser interferometry, velocimetry, pulse echo technique, beam modulation telemetry and holography, application of holography, laser welding, laser machining and laser spectroscopy.	
Unit – IV	**09 Hrs**
Fiber optics: Light Modulation schemes, optical fibers, intermodal dispersion, graded index fiber, low dispersive fibers, Fiber losses, fiber materials, integrated optics, optical bistability, laser printing, optical disc systems.	
Unit – V	**09 Hrs**
Optical fiber sensors: Multimode passive and active fiber sensors, phase modulated sensors, fiber optic gyroscope, **Polarization:** Polarimetric sensors, polarization, and rotation sensors.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Understand and remember the basic fundamentals of LASER and Fiber optics.
2. Apply LASER as source in designing various Optoelectronic instruments.
3. Analyze various Fiber optic and LASERS involved in sensor applications.
4. Assess the LASER design solutions in complex optoelectronic devices.

Reference Books

1. Wilson and Hawkes, “Laser principles and applications”, Prentice Hall of India, 7th Edition, 1987, ISBN: 978-0135237052.
2. Wilson & Hawkes, “Optoelectronics”, Prentice Hall of India, 2th Edition, 1997, ISBN 8120310187.
3. A.J.Rogers, “Essentials of Opto Electronics with Applications”, CRC Press. 1th Edition, 1997, ISBN: 978-0412408908.
4. I.Ravikumar, Bala N. Saraswathi, “Principles of Optical Communication & Opto Electronics”, Lakshmi Publications, 2010, ISBN 978-8170085614.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks(15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily

VI SEMESTER
PRODUCT DESIGN TECHNOLOGY
(Elective)

Course Code: 12IT6C3		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:1		**SEE Marks: 100**
Credits: 04		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To develop skills and concepts on economic product development and development of Organization
2. To understand customer needs and converting them to specifications.
3. To know the PCB testing procedures and PC based automation of PCB making for large numbered PCBs.
4. To design automatic soldering techniques.

Unit – I	**07 Hrs**
Introduction: Characteristics of successful product development, who Designs and develops products, duration and cost of product development, the challenges of product development **Development Processes And Organizations:** A generic development process, concept development: the front-end process, adapting the generic product development process. **Product Planning:** The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning.	
Unit – II	**07 Hrs**
Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. **Product Specifications:** What are specifications, when are specifications established, establishing target specifications, setting the final specifications. **Concept Generation and Selection:** The activity of concept generation, clarifies the problem search externally, search internally, explore systematically, and reflect on the results and the process**.** Concept screening, concept scoring.	
Unit – III	**07 Hrs**
PCB Technology: Introduction to PCB, Types of PCB, PCB layout design and artwork generation Using CAD. Properties of copper clad sheets, materials used for fabrication of copper clad sheet, PCB fim, properties of film, film master preparation.	

Unit – IV	07 Hrs
Image Transfer, **Etching Process, Tin coating, Drilling:** Transfer of Image on to the copper clad sheet, wet &dry film techniques, Etching, Types of etchants, etching process. Tin coating. Drilling. **Multilayer PCB Design:** Introduction, multilayer PCB design and test consideration, multilayered construction, equipment, laminating process, further processing	
Unit – V	**07 Hrs**
M**echanical Machining Operations Solders And Soldering Techniques:** Introduction, Grinding, milling, principal of solder connection, solder alloys, solder fluxes, deferent soldering techniques, solder mask, Reflow of soldering practice.	
Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus	**(1 credit) (4hrs/ week)**

Course outcomes:

1. To understand principles and concepts of effective product design
2. Apply concept of adaptive and original redesign of engineering and consumer products
3. To develop pattern transfer and Etching
4. To Implement Multilayer PCB design and Artwork

Reference Books

1. Karl.T.Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGrawHill, 5th Edition, 2011, ISBN : 978 - 0073404776
2. C Chitale and R C Gupta, "Product Design and Manufacturing", PHI, 5th Edition. 2011, ISBN : 978 - 8120342828
3. Timjones, "New Product Development", Butterworth Heinmann, Oxford. UCI, 1996, ISBN : 978 – 0750624275.
4. Walter C Boshart, "Printed circuit Boards: Design and Technology", 29th reprint, McGraw-Hill, 2009, ISBN : 978 – 0074515495.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks(15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily**.**

VI SEMESTER AIRCRAFT INSTRUMENTATION (Elective)		
Course Code: 12IT6C4		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:1		**SEE Marks: 100**
Credits: 04		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To understand qualitative and quantitative displays of an aircraft.
2. Gain knowledge on air data instruments and how they are incorporated in an aircraft.
3. To develop the knowledge of safety aspects of an aircraft such as warning systems.
4. To learn more about gyroscope and its related flight instruments. Give better view of engine instruments and ways to improve its efficiency

Unit – I	**07 Hrs**
Introduction: Instrument displays-Qualitative and quantitative displays, Director displays, instruments grouping **Integrated Display Systems:** head-up display, flight detector system **Air Data Instruments**: Standard Atmosphere (ISA), basic air data system, pitot-static probe, heating circuit element, Mach/air speed indicator	
Unit – II	**07 Hrs**
Vertical Air Speed Indicators: Instantaneous Vertical Airspeed indicator, air temperature indicator, air data altering system, Mach/warning system, altitude alert system **Direct Reading Compasses:** Terrestrial magnetism, Compass construction, errors in indication, air craft magnetism, components of magnetism	
Unit – III	**07 Hrs**
Gyroscopic Flight Instruments: The gyroscope and its properties, Determining direction of precession, limitations of gyroscope, gyro horizon, erection systems for gyro horizons, errors due to acceleration and turning, direction indicator, Turn and Bank indicator	
Unit – IV	**07 Hrs**
Engine Instruments: Pressure measurements indicating systems, pressure switches, temperature measurements, indicating systems: variable resistance systems, sensor units, Wheatstone bridge systems **Fuel Quantity and Indicating system:** Capacitance type systems, basic indicating systems, effects of fuel temperature changes, measurement of fuel quantity by weight	
Unit – V	**07 Hrs**
Engine Power and Control instruments: RPM measurement, generator and indicating system, exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement, integrated flow meter systems.	

Self Study: Case study, design and emerging technologies to be discussed pertaining to the course and beyond syllabus	**(1 credit) (4hrs/ week)**

Course outcomes:

After going through this course the student will be able to

1. Understand the concept of different types of instrument, displays and indicators.
2. Appraise the elements of Aircraft Instrumentation and Integration of the system to meet the control Navigation and operational requirements of the Aircrafts.
3. Analyze and evaluate the performance of Aircraft control system and interpret the results.
4. Interpreted Case Studies with the theory learnt and hence develop a system concept operational in latest aircraft instrumentation.

Reference Books

1. E H J Pallet, Pitman and sons "Aircraft instruments and integrated systems", 2nd Edition, 1992, ISBN: 0582086272.
2. C.A. Williams, "Aircraft Instruments", Galgotia Publications, New Delhi, ISBN 817598080X, 9788175980808
3. Bhaskar Roy,"Aircraft Propulsion", Elsevier publications, New Delhi, 2011, ISBN: 9788131214213
4. W. H. Coulthard, Pitman and sons, "Aircraft Instrumentation Design", 2nd edition, , 1952,ISBN:13: 978B0007J54Z2.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 40 marks(15 marks for quiz+ 25 marks for test), out of which best of two will be considered. In addition 20 marks to be earned through self Learning component on emerging technologies.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER JAVA & J2EE (Elective)		
Course Code: 12IT6D1		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To learn the fundamentals of JAVA language.
2. To interpret the industrial importance of JAVA applications
3. To understand the usage of various JAVA applets
4. To acquire the design fundamentals of J2EE packages

Unit – I	**06 Hrs**
Introduction to Java : Java and Java applications, Java Development Kit (JDK), Java is interpreted, Byte Code, JVM Object-oriented programming, Simple Java programs. Data types and other tokens: Boolean variables, int, long, char, operators, arrays, white spaces, literals, assigning values, Creating and destroying objects, Access specifiers. **Operators and Expressions:** Arithmetic Operators, Bitwise operators, Relational operators, The Assignment Operator, The ? Operator, Operator Precedence, Logical expression, Type casting, Strings. Control Statements: Selection statements, iteration statements, Jump Statements.	
Unit – II	**07 Hrs**
Classes, Inheritance, Exceptions, Applets : Classes: Classes in Java, Declaring a class, Class name, Super classes, Constructors, Creating instances of class, Inner classes. Inheritance: Simple, multiple, and multilevel inheritance, Overriding, overloading. **Exception handling:** Exception handling in Java.The Applet Class: Two types of Applets, Applet basics, Applet Architecture, An Applet skeleton, Simple Applet display methods, Requesting repainting, Using the Status Window, The HTML APPLET tag, Passing parameters to Applets, Get Documentbase() and get Codebase(), Aplet Context and show Document(), The Audio Clip Interface, The AppletStub Interface, Output to the Console.	
Unit – III	**07 Hrs**
Multi Threaded Programming, Event Handling : Multi Threaded Programming: What are threads? How to make the classes threadable, Extending threads, Implementing runnable, Synchronization, Changing state of the thread, Bounded buffer problems, read-write problem, producer-consumer problems. **Event Handling:** Two event handling mechanisms, The delegation event model, Event classes, Sources of events, Event listener interfaces, Using the delegation event model, Adapter classes, Inner classes.	
Unit – IV	**07 Hrs**

Swings: The origins of Swing, Two key Swing features, Components and Containers, The Swing Packages, A simple Swing Application, Create a Swing Applet, Jlabel and ImageIcon, JTextField,The Swing Buttons, JTabbedpane, JScrollPane, JList, JComboBox, JTable.	
Unit – V	**07 Hrs**
Java 2 Enterprise Edition Overview, Database Access: Overview of J2EE and J2SE.The Concept of JDBC, JDBC Driver Types, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Associating the JDBC/ODBC Bridge with the Database, Statement Objects, Result Set, Transaction Processing, Metadata, Data types, Exceptions.	

Course outcomes:

After going through this course the student will be able to

1. Understand the basic concepts of programming using Java
2. Use the Java SDK environment to create, debug and run Java and applet programs.
3. Design and build robust and maintainable java applications by event-based GUI handling principles.
4. Create real time industry problems through advance JAVA programming.

Reference Books

1. Herbert Schildt,"Java The Complete Reference", 7th Edition, Tata McGraw Hill, 2007. ISBN:978007160631
2. Jim Keogh, " J2EE The Complete Reference", Tata McGraw Hill, 2007. ISBN: 9780070529120
3. Stephanie Bodoff et al, "The J2EE Tutorial", 2nd Edition, Pearson Education, 2004. ISBN:0131872486
4. 4. Y. Daniel Liang, "Introduction to JAVA Programming", 6th Edition, Pearson Education, 2007. ISBN:0132130807

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 45 marks(15 marks for quiz+ 30 marks for test), out of which best of two will be considered. In addition there will be one seminar on new topics/ model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER
ADVANCED MICROCONTROLLERS AND APPLICATIONS
(Elective)

Course Code: 12IT6D2		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. Learn the need for advanced microcontrollers.
2. Understand the families of MSP430 – 16-bit Microcontroller.3.Analyse CPU architecture, Instruction set, Interrupt mechanisms of MSP430
3. Write the assembly language and "C programming of MSP-430
4. Understand the On-chip peripherals such as WDT, Comparator, Op-Amp, Timer,Basic Timer, Real Time Clock (RTC), ADC, DAC and Digital I/O.

Unit – I	**07 Hrs**
Motivation for advanced microcontrollers – Low Power embedded systems, On-chip peripherals, low-power RF capabilities. Examples of applications. **Embedded Electronic Systems and Microcontrollers :** What Are Embedded Systems, Approaches to Embedded Systems , Small Microcontrollers , Anatomy of a Typical Small Microcontroller	
Unit – II	**07 Hrs**
MSP430 RISC CPU architecture: Compiler-friendly features, Instruction set, Clock system, Memory subsystem. Key differentiating factors between different MSP430 families, Understanding the muxing scheme of the MSP430 pins	
Unit – III	**07 Hrs**
Functions, Interrupts and Low Power modes: Functions and subroutines, Interrupts, Low Power modes of operation. **Digital I/O** –Digital Input and Output: Parallel ports, programming examples.	
Unit – IV	**07 Hrs**
Development for Programming MSP430: Development Environment , The C Programming Language , Aspects of C for Embedded Systems , Assembly Language , Access to the Microcontroller for Programming and Debugging	
Unit – V	**07 Hrs**
On-chip peripherals: Watchdog Timer, Comparator, Op-Amp, Basic Timer, ADC, DAC, SD16 **Case Studies and Applications:** MSP430 for Security Applications, Use of MSP430 for Wireless Sensor Networking, Low-Power RF circuits and Pulse Width Modulation (PWM) in Power Supplies	

Course outcomes:

After going through this course the student will be able to

1. Understand the basic fundamentals of communication systems.
2. Apply the concepts of communication systems to realize the theoretical design.
3. Analyze the performance and evaluate various modulation techniques.
4. Create a modulation system using the pros and cons of different modulation techniques

Reference Books

1. John .H. Davies, "MSP430 Microcontroller Basics", Elsevier Publications, 2008, ISBN: 978-0-7506-8276-3.
2. K. Uma Rao, Dr. Andhe Pallavi, "The 8051 and MSP430 Microcontrollers", Elsevier Publications, 2012, ISBN: 9789381269459
3. Chris Nagy, "Embedded Systems Design using TI MSP430", Elsevier Publications, 2003, ISBN: 0-7506-7623-X
4. Online Course materials from: *www.ti.com* › TI University Program

Scheme of Continuous Internal Evaluation:

CIE consists of Three Internal tests, each for 45 marks (15 marks for quiz+ 30 marks for test), out of which best of two will be considered. In addition there will be one seminar on new topics/ model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER
IMAGING TECHNIQUES
(Elective)

Course Code: 12IT6D3		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To give an idea about generation and to impart knowledge about various X-Ray diagnostic methods.
2. To study the principles of ultra sound imaging.
3. To create an awareness about medical imaging using radio nucleides.
4. To give the concept and application of MRI.

Unit – I	**07 Hrs**
X-Ray Imaging: Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation.	
Unit – II	**07 Hrs**
X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction. Recent developments – Digital radiography, Digital subtraction angiography (DSA). **Computed Tomography**: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Image artifacts, Spiral CT.	
Unit – III	**07 Hrs**
Ultrasound Imaging: Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers. Pulse echo systems-Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Doppler methods, Colour Doppler flow imaging, Biological effects of ultrasound.	
Unit – IV	**07 Hrs**
Radionuclide Imaging: Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Radionuclide imaging systems-Rectilinear scanner, Scintillation camera, SPECT, PET, Applications.	

Unit – V	07 Hrs
Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance, Fourier spectrum of the NMR signal, Relaxation times, Magnet, Room temperature and magnetic field gradients, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Blood flow imaging, Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields, Imaging safety, Functional MRI, Applications.	

Course outcomes:

After going through this course the student will be able to

1. Apply particular imaging technique for particular application.
2. Gain knowledge about various medical imaging techniques.
3. Apply various imaging techniques with respect to medical diagnosis.
4. Gain knowledge about the safety standards to be followed with respect to imaging.

Reference Books

1. K.Kirk Shung, Michael B. Smith and Banjamin Tsui, 'Principles of Medical Imaging' - Academic Press, 1992, ISBN: 978-0126409703.
2. R. S. Khandpur , Handbook of Biomedical Instrumentation, Tata McGraw-Hill ,2nd Edition, 2008, ISBN 978-0070473553.
3. Paul Suetens, 'Fundamentals of Medical Imaging', Cambridge University Press, 2nd Edition, 2009, ISBN: 978-0521519151.
4. Jerry L Prince & Jonathan M Links, "Medical Imaging Signals and systems", Pearson Prentice Hall,1st Edition, 2008, **ISBN**-13: 978-0130653536

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation/Assignment etc. for 10 marks**.**

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

VI SEMESTER

COMMUNICATION SYSTEMS (Elective)		
Course Code: 12IT6D4		**CIE Marks: 100**
Hrs/Week: L:T:P:S : 3:0:0:0		**SEE Marks: 100**
Credits: 03		**SEE Duration: 3 Hrs**

Course Learning Objectives:

1. To introduce communication system concepts.
2. To study various amplitude, Angle modulation and demodulation systems.
3. To understand depth analysis in noise performance of various receivers.
4. To analyze various pulse modulation and demodulation systems.

Unit – I	**07 Hrs**
Introduction: Communication Process, Primary communication resources, Sources of Information system, Communication Networks, Communication Channels, Modulation Process, Analog and Digital types of Communication, Shannon's Information capacity theorem	
Unit – II	**07 Hrs**
Block diagram of communication system, Need for modulation, Types of modulation, Amplitude Modulation: Time domain and frequency domain description of AM, single tone modulation, power relations in AM waves, Generation of AM waves: square law Modulator, Switching modulator.	
Unit – III	**07 Hrs**
Amplitude Modulated Waves: Demodulation of AM waves: Square law detector, Envelope detector. AM Radio broadcasting: AM Transmitters, AM Receivers, Frequency division multiplexing. **DSB Modulation:** Double side band suppressed carrier modulation, time domain and frequency domain description.	
Unit – IV	**07 Hrs**
SSB and VSB Modulation: Time domain and Frequency domain description of SSB modulated waves, Generation of SSB waves, Demodulation of SSB waves .Time domain and frequency domain description of VSB modulated waves, Generation of VSB Modulated wave, Envelope detection of a VSB Wave pulse Carrier, Comparison of AM techniques.	
Unit – V	**07 Hrs**
Angle Modulation: Basic concepts of Phase and Frequency Modulation, Single tone frequency modulation, Narrow band FM, Wide band FM, Generation of FM waves: Indirect FM, Direct FM. **Noise in Analog Modulation:** AM Receiver model, Noise in DSB and SSB system, Signal to Noise Ratios for Coherent Reception, Noise in AM receivers using Envelope Detection, FM receiver model, Noise in FM reception, Threshold Effect, Pre-emphasis and De-emphasis in FM.	

Course outcomes:

After going through this course the student will be able to

1. Understand the basic fundamentals of communication systems.
2. Apply the concepts of communication systems to realize the theoretical design.
3. Analyze the performance and evaluate various modulation techniques.
4. Create a modulation system using the pros and cons of different modulation techniques

Reference Books

1. Roy Blake, "Electronic Communication Systems", Delmar Cengage Learning, 2nd Edition, 2006, ISBN: 978-8131503072.
2. George Kennedy, "Electronic Communication Systems", TATA McGraw-Hill, 5th Edition, 2011, ISBN: 978-0071077828.
3. Simon Haykin, "Communication systems", Willey Publication, 3rd Edition, 2007, ISBN: 978-8126513666.
4. R P Singh and S D Sapre, "Communication Systems- Analog and Digital", TATA McGraw-Hill, 3rd Edition, 2008,ISBN-13: 978-0-07-063454-1/ ISBN-10:0-07-063454-8.

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation/Assignment etc. for 10 marks**.**

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily