R.V.COLLEGE OF ENGINEERING

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059

Bachelor of Engineering (B.E.)

Scheme and Syllabus for V & VI Semesters

2016 SCHEME

ELECTRONICS & INSTRUMENTATION ENGINEERING

Department Vision

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

Department Mission

- 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.
- To impart technical knowledge, encourage experiential learning and develop future professional leaders.
- To establish industry-academia networking and develop industry-ready students and future entrepreneurs, to meet societal & industrial challenges.
- 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 (PSOs)

PSO	Description
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.

Lead Society: International Society of Automation (ISA)

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2016 SCHEME

ELECTRONICS & INSTRUMENTATION ENGINEERING

ABBREVIATIONS

SL. NO.	ABBREVIATION	MEANING
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	CS	Computer Science and Engineering
5.	CV	Civil Engineering
6.	CHY	Chemistry
7.	EC	Electronics and Communication Engineering
8.	EE	Electrical and Electronics Engineering
9.	ES	Engineering Science
10.	HSS	Humanities and Social Sciences
11.	ME	Mechanical Engineering
12.	PHY	Engineering Physics
13.	SEE	Semester End Examination
14.	MAT	Engineering Mathematics
15.	PCE	Professional Core Elective
16.	GE	Global Elective

INDEX

R V COLLEGE OF ENGINEERNG, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION

ENGINEERING

FIFTH SEMESTER CREDIT SCHEME

Sl. No.	Course Code	Course Title	BOS	Credit Allocation				Total Credits
				L	T	P	S	
1.	16HEM51	Foundations of Management and Economics	HSS	2	0	0	0	2
2.	16EI52	VLSI Technology	EI	3	0	1	1	5
3.	16EI53	Digital Signal Processing & Applications	EI	3	0	1	1	5
4.	16EI54	Non-Linear Control Systems	EI	3	0	0	0	3
5.	16EI55	OOPS with C++ & Data Structure	EI	3	1	0	0	4
6.	16EI5AX	Elective A (PE)	EI	3	0	0	1	4
7.	16G5BXX	Elective B (OE)	Respective BoS	4	0	0	0	4
Total number of Credits								**27**
Total Number of Hours / Week				**21**	**2**	**4**	**12****	**27**

SIXTH SEMESTER CREDIT SCHEME								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				L	**T**	**P**	**S**	
1.	16HSI61	IPR & Entrepreneurship	HSS	3	0	0	0	3
2.	16EI62	Virtual Instrumentation & Data acquisition	EI	3	0	1	1	5
3.	16EI63	Automatic Process Control and Modelling Techniques	EI	3	0	1	1	5
4.	16EI64	Communication Systems	EI	3	1	0	0	4
5.	16EI6CX	Elective C (PE)	EI	3	0	0	1	4
6.	16EI6DX	Elective D(PE)	EI	4	0	0	0	4
7.	16G6EXX	Elective E(OE)	Respective BoS	3	0	0	0	3
8.	16HS68	Professional Practice-III (Employability Skills and Professional Development of Engineers)	HSS	1	0	0	0	1
Total number of Credits								**29**
Total Number of Hours / Week				**23**	**2**	**4**	**12****	**29**

** Non-contact hours

V Sem		
GROUP A: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16EI5A1	Computer Organization & Architecture
2.	16EI5A2	Biomedical Instrumentation
3.	16EI5A3	Micro Electro-Mechanical Systems and Applications
4.	16EI5A4	Image Processing

GROUP B: GLOBAL ELECTIVES				
Sl. No.	**Host Dept**	**Course Code**	**Course Title**	**Credits**
1.	BT	16G5B01	Bioinformatics	4
2.	CH	16G5B02	Fuel Cell Technology	4
3.	CV	16G5B03	Geoinformatics	4
4.	CSE	16G5B04	Graph Theory	4
5.	ECE	16G5B05	Artificial Neural Networks & Deep Learning	4
6.	EEE	16G5B06	Hybrid Electric Vehicles	4
7.	IEM	16G5B07	Optimization Techniques	4
8.	E&I	16G5B08	Sensors & Applications	4
9.	ISE	16G5B09	Introduction To Management Information Systems	4
10.	ME	16G5B10	Industrial Automation	4
11.	TCE	16G5B11	Telecommunication Systems	4
12.	MAT	16G5B12	Computational Advanced Numerical Methods	4
13.	AE	16G5B13	Basics of Aerospace Engineering	4

VI Sem		
GROUP C: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16EI6C1	Computer Communication Networks
2.	16EI6C2	Advanced Signal Processing
3.	16EI6C3	Lasers Instrumentation and Application
4.	16EI6C4	Java Programming
GROUP D: PROFESSIONAL CORE ELECTIVES		
1.	16EI6D1	Analytical Instrumentation
2.	16EI6D2	Automotive Electronics
3.	16EI6D3	Application Specific Integrated Circuits (ASIC)
4.	16EI6D4	Aircraft Instrumentation

GROUP E: GLOBAL ELECTIVES				
Sl. No.	**Host Dept**	**Course Code**	**Course Title**	**Credits**
1.	BT	16G6E01	Bioinspired Engineering	3
2.	CH	16G6E02	Green Technology	3
3.	CV	16G6E03	Solid Waste Management	3
4.	CSE	16G6E04	Introduction to Web Programming	3
5.	ECE	16G6E05	Automotive Electronics	3
6.	EEE	16G6E06	Industrial Electronics	3
7.	IEM	16G6E07	Project Management	3
8.	E&I	16G6E08	Virtual Instrumentation	3
9.	ISE	16G6E09	Introduction to Mobile Application Development	3
10.	ME	16G6E10	Automotive Engineering	3
11.	TCE	16G6E11	Mobile Network System and Standards	3
12.	MAT	16G6E12	Partial Differential Equations	3
13.	AE	16G6E13	Aircraft Systems	3

V Semester **FOUNDATIONS OF MANAGEMENT AND ECONOMICS** **(Theory)** **(Common to BT, CHE, CV,E&I, IEM, ME)**		
Course Code:16HEM51		**CIE Marks:** 50
Credits: L:T:P:S: 2:0:0:0		**SEE Marks:** 50
Hours: 23L		**SEE Duration:** 02Hrs

Course Learning Objectives: The students will be able to	
1	Understand the evolution of management thought.
2	Acquire knowledge of the functions of Management.
3	Gain basic knowledge of essentials of Micro economics and Macroeconomics.
4	Understand the concepts of macroeconomics relevant to different organizational contexts.

UNIT-I	
Introduction to Management: Management Functions, Roles & Skills, Management History – Classical Approach: Scientific Management & Administrative Theory, Quantitative Approach: Operations Research, Behavioural Approach: Hawthorne Studies, Contemporary Approach: Systems & Contingency Theory.	**04 Hrs**
UNIT-II	
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate & Competitive Strategies.	**02 Hrs**
Organizational Structure & Design: Overview of Designing Organizational Structure: Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures.	**03 Hrs**
UNIT-III	
Motivating Employees: Early Theories of Motivation: Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory, Contemporary Theories of Motivation: Adam's Equity & Vroom's Expectancy Theory.	**03 Hrs**
Managers as Leaders: Behavioural Theories: Ohio State & University of Michigan Studies, Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership.	**03 Hrs**
UNIT-IV	
Introduction to Economics: Concept of Economy and its working, basic problems of an Economy, Market mechanism to solve economic problems, Government and the economy, **Essentials of Micro Economics:** Concept and scope, tools of Microeconomics, themes of microeconomics, Decisions: some central themes, Markets: Some central themes, Uses of Microeconomics.	**04 Hrs**
UNIT-V	
Essentials of Macroeconomics: Prices and inflation, Exchange rate, Gross domestic product(GDP) , components of GDP, the Labour Market, Money and banks, Interest rate, Macroeconomic models- an overview, Growth theory, The classical model, Keynesian cross model, IS-LM-model, The AS-AD-model, The complete Keynesian model, The neo-classical synthesis, Exchange rate determination and the Mundell-Fleming model.	**04 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the principles of management theory & recognize the characteristics of an organization.
CO2:	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO3:	Select & Implement the right leadership practices in organizations that would enable systems orientation.
CO4:	Understand the basic concepts and principles of Micro economics and Macroeconomics

Reference Books	
1.	Management, Stephen Robbins, Mary Coulter &NeharikaVohra, 10th Edition, 2001, Pearson Education Publications, ISBN: 978-81-317-2720-1.
2.	Management,James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 1999, PHI, ISBN: 81-203-0981-2.
3.	Microeconomics,Douglas Bernheim B & Michael D Whinston, 5thEdition, 2009, TMHPub.Co.Ltd, ISBN: 13:978-0-07-008056-0.
4.	Macroeconomics: Theory and Policy,Dwivedi.D.N, 3rd Edition, 2010,McGraw Hill Education; ISBN-13: 978-0070091450.
5.	Essentials of Macroeconomics, (www.bookboon.com), Peter Jochumzen, 1st Edition. 2010, e-book, ISBN:978-87-7681-558-5.

Continuous Internal Evaluation (CIE); Theory (50 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 05 marks adding up to 15 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 25 marks each and the sum of the marks scored from three tests is reduced to 30. The marks component for Assignment is 05. The total marks of CIE are 50.

Semester End Evaluation (SEE); Theory (50 Marks)

SEE for 50 marks are executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 10 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 08 marks adding up to 40 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2	**1**		**2**	**2**			**1**			**2**	**2**	
CO3	**1**							**2**	**2**	**2**	**1**	
CO4	**1**	**2**				**2**						**2**

Low-1 Medium-2 High-3

V Semester		
VLSI TECHNOLOGY (Theory and Practice)		
Course Code:16EI52		**CIE Marks:** 100+50
Credits/Week: L:T:P:S:3:0:1:1		**SEE Marks:** 100+50
Hours:35L		**SEE Duration:** 03Hrs+03Hrs

Course Learning Objectives: The students will be able to	
1	To understand the evolution of VLSI technology & fabrication process of MOS Device.
2	To study the structure of MOSFET under different bias and its characteristics.
3	Mathematically understand the concept of CMOS Inverter, estimation of CMOS delay.
4	To describe the working of digital CMOS circuits (both combinational and sequential).
5	To understand the concept of CMOS analog design and small signal equivalent circuits.
6	Get exposure to Low power design techniques.

UNIT-I	
Introduction: Overview of VLSI Design methodologies, Moore's law, VLSI design flow, Design hierarchy, Concept of regularity modularity and locality, VLSI design styles. **Fabrication of MOSFETs:** Fabrication flow basic steps, Fabrication of NMOS transistor, CMOS nwell, pwell and twin tub process.	**07 Hrs**
UNIT-II	
MOS Transistor: MOS structure, MOS under external bias, structure and operation of MOSFET, I-V characteristics, channel length modulation, MOSFET trans conductance and output conductance, NMOS inverter and it's working.	**07 Hrs**
UNIT-III	
CMOS Inverter: Introduction, CMOS inverter DC characteristics. Design parameters of CMOS inverter. Symmetric CMOS inverter. Switching characteristics of CMOS inverter. Estimation of CMOS inverter delay. **MOS design Process:** Stick diagram and layouts for NMOS inverter, CMOS inverter, 2 input NAND gate and NOR gate.	**07 Hrs**
UNIT-IV	
Digital CMOS Design: **Combinational circuits:** CMOS Logic Circuits, Complex Logic circuits, CMOS Transmission Gates, Static CMOS design, rationed logic, pass transistor logic. **Sequential Circuits:** Behaviour of bi-stable element, SR latch, clocked latch and flip flop circuits, D triggered and edge triggered.	**07 Hrs**
UNIT-V	
Analog CMOS Design: Basic Concepts, Common source stage with resistive load, Common gate, source follower, basic differential pair (qualitative and quantitative analysis only) and Gilbert cell. **Introduction to Low Power VLSI:** Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.	**07 Hrs**

Lab Experiments:

Analog Design

1. To design a CMOS Inverter with given specification and simulate for DC analysis and transient analysis.
2. Design and simulation of static characteristics of two input NOR and OR Gates.
3. To design a common source amplifier and simulate for DC analysis, AC analysis and transient analysis.
4. To design a common drain amplifier and simulate for DC analysis, AC analysis and transient analysis.
5. To design a single stage Differential Amplifier with given specifications and verifying the following for Schematic: i) DC Analysis ii) AC Analysis iii) Transient Analysis.

Digital Design

1. To Compile and simulate the Verilog Code for a CMOS inverter circuit and observe the waveform.
2. To write Verilog Code for the Buffer circuit and Test Bench for Verification, observe the waveform.
3. To write Verilog Code for the Transmission gate circuit and Test Bench for Verification, observe the waveform.
4. To write Verilog Code for various Flip flop circuits and Test Bench for Verification, observe the waveform.

Open End Experiment

1. Layout for CMOS inverter, Layout of NAND and NOR gate.
2. Parallel adders, serial adders, R-2R DAC, SAR ADC.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of VLSI design.
CO2:	Apply the fundamentals concepts of VLSI to analog and digital circuits.
CO3:	Analyze and evaluate the performance characteristics of MOSFETs.
CO4:	Design of CMOS Analog and Digital circuits.

Reference Books	
1	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2004, Tata McGraw Hill, ISBN: 978-1-4020-7234-5.
2	Basic VLSI Design, Douglas A. Pucknell, Kamran Esharghain, 3rd Edition, 2005, PHI, ISBN: 978-81-203-0986-9.
3	Design of CMOS Analog IC, Behzad Razavi, 2nd Edition, 2016, McGraw Hill Education ISBN-13: 978-0072524932.
4	CMOS VLSI Design: A circuits and systems perspective, Neil H Weste and David Harris, 4th Edition, 2015, Pearson, ISBN-10: 0321547748, ISBN-13: 978-0321547743.

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total CIE for theory is 100.

Laboratory- 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory – 100 Marks

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks cov-

ering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**3**
CO2	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**2**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**2**
CO4	**2**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**1**	**-**	**2**

Low-1 Medium-2 High-3

V Semester		
DIGITAL SIGNAL PROCESSING AND APPLICATIONS (Theory and Practice)		
Course Code:16EI53		**CIE Marks:** 100+50

Credits/Week: L:T:P:S: 3:0:1:1		**SEE Marks:** 100+50
Hours:35L		**SEE Duration:** 03Hrs+03Hrs

Course Learning Objectives: The students will be able to	
1	Analyze the time domain and frequency domain representations of discrete-time signals using DFT and their properties.
2	Apply efficient method for calculating the DFT & IDFT.
3	Design and implement IIR and FIR digital filters.
4	Realize the various structures for discrete time systems.

UNIT-I	
Introduction: **Signals, Systems and Signal processing:** Basic Elements of Digital Signal Processing System, Advantages of Digital over Analog Signal Processing. Classification of Signals, Concept of Frequency in Continuous-Time and Discrete–Time Signals, Analog to Digital and Digital to Analog Conversion. **Discrete Fourier Transforms (DFT):** Frequency domain sampling of spectrum and reconstruction of discrete time signals, DFT as a linear transformation, relationship of DFT with other transforms, Properties of DFT and their significance.	**07 Hrs**
UNIT-II	
Linear Filtering methods based on DFT: Use of DFT in linear filtering, Filtering of Long Data sequences: Overlap-add and Overlap-save method. **Efficient computation of the DFT (FFT algorithms):** Direct computation of DFT, Radix-2 FFT algorithms for the computation of DFT and IDFT using decimation-in-time and decimation-in-frequency algorithms. Applications of FFT Algorithms: Efficient Computation of DFT of two real sequences, Use of FFT algorithm in linear filtering and Correlation.	**07 Hrs**
UNIT-III	
Implementation of discrete-time systems: Structures for IIR and FIR systems-direct form -I and direct form- II systems, cascade, parallel, lattice, Lattice and Ladder and Linear phase realization. **Design of analog filters:** Butterworth and Chebyshev filters, Frequency transformation in the analog domain. Frequency transformation in the digital domain.	**07 Hrs**
UNIT-IV	
Design of IIR filters from analog filters (Butterworth and Chebyshev): Forward difference, backward difference, Impulse invariance method, bilinear transformation method and Matched z transform method, Verification for stability and linearity during mapping.	**07 Hrs**
UNIT-V	
FIR filter design: Introduction to FIR filters, Design of FIR filters using Rectangular, Hamming, Hanning, Kaiser and Bartlet windows, FIR filter design using frequency sampling technique. **Applications of Digital Signal Processing:** Dual-Tone Multi frequency Signal Detection, Musical Sound Processing.	**07 Hrs**

Lab Experiments

1. Sampling Theorem Verification
2. Verification of Linear Convolution Using MatLab and Code Composer Studio

3. Verification of Circular Convolution Using MatLab and Code Composer Studio
4. Spectrum Using FFT
5. Dual Tone Multi Frequency (DTMF)
6. Design of FIR Filter (Hamming and Kaiser window)
7. Design & test Butterworth I & II order low/High pass filter
8. Design & test Chebyshev I & II order Low/High pass filter
9. Design Of FIR Filter (LP/HP) Using Windowing Technique on DSK6713
10. IIR Filter (LP/HP) Implementation on DSK6713

All the experiments must be executed in MATLAB and C language using DSP Processor.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic concepts of Digital Signal processing.
CO2:	Apply the various DSP techniques to perform signal processing.
CO3:	Analyze signals using the Discrete Fourier Transform and Inverse Discrete Fourier Transform.
CO4:	Design & implementation of the filters for the required specifications and evaluate the digital signal processing algorithms using simulation tool and DSP processors.

Reference Books	
1	Digital Signal Processing, Sanjith Kumar Mithra, 4th Edition, 2011, McGraw Hill, ISBN: 978-0-07-338049-0.
2	Digital signal processing, Principles Algorithms & Applications, John G. Proakis & Dimitris K Manolakis, 4th Edition, 2013, Pearson New International Edition, ISBN: 1292038160, 9781292038162.
3	Discrete Time Signal Processing, Oppenheim & Schaffer, 3rd Edition, 2013, Pearson New International Edition, ISBN: 1292038152, 9781292038155.
4	Digital Signal Processing, Lee Tan, 2007, Elsevier publications, ISBN: 978-0124158935.

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total CIE for theory is 100.

Laboratory- 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory – 100 Marks

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO2	**1**	**1**	**2**	**3**	**1**	**1**	**-**	**1**	**2**	**3**	**1**	**1**
CO3	**2**	**1**	**2**	**3**	**1**	**-**	**1**	**-**	**2**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**2**	**1**	**1**

Low-1 Medium-2 High-3

V Semester
NON-LINEAR CONTROL SYSTEMS (Theory)

Course Code:16EI54		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:0		**SEE Marks:** 100
Hours:36L		**SEE Duration:** 03Hrs

Course Learning Objectives: The students will be able to	
1	To understand basics of linear and nonlinear control systems, state space analysis and pole placement.
2	To understand different analysis techniques.
3	To create and analyze state space models.
4	To develop state space models.

UNIT-I	
Advanced controllers: Introduction, Advantages of modern control systems. **Controllers**: Properties of controllers-Proportional, Integral & Derivative. **Classification of controllers**: Proportional, Integral, Derivative, Comparison of different controllers. **Composite controller**: Proportional Integral, Proportional Derivative, & Proportional Integral and Derivative Controllers, limitations of linear control systems.	**06 Hrs**
UNIT-II	
Nonlinear systems: Introduction, properties of nonlinear systems. **Classification of nonlinear systems**: Incidental nonlinearity, Intentional nonlinearity. **Describing Function:** Introduction, basics of describing function analysis, Types of relays, Derivation of describing function for relays, Stability criteria in terms of describing function.	**08 Hrs**
UNIT-III	
State space analysis: Introduction, Concept of state, state space model from transfer function, Determination of transfer function from state equation. **Decomposition of transfer function**: Series decomposition, parallel decomposition-simple poles, repeated poles.	**08 Hrs**
UNIT-IV	
Solution of state equation: Introduction, classical power series method, State Transition Matrix, Properties of state transition matrix, Caley Hamilton theorem, Sylvester interpolation formula. **Solution of non-homogeneous state equation with input:** classical solution of differential equation, Concept of controllability and observability.	**07 Hrs**
UNIT-V	
Pole placement technique: Introduction, Necessary and sufficient conditions for arbitrary pole placement, Determination matrix k, concept of state observer, full order state observer, dual problem, necessary and sufficient condition for state observation, and determination of state observer gain matrix. Advanced Applications of Control Systems- A Modular and Scalable wheeled mobile ROBOT, The MARS Sorjouner ROVER, Deep Space1, Experimental unmanned Vehicle (XUV).	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Have a good understanding of linear, nonlinear, continuous & discrete control systems, dynamic system modelling and analysis.
CO2:	Apply the concepts of dynamic modelling, stability, pole-placement of control systems.
CO3:	Analyze and evaluate dynamic control systems.

CO4:	Develop/Create solutions for control systems problems.

Reference Books	
1	Advanced Control Systems, B.N.Sarkar, 1st Edition, 2013, PHI, ISBN: 8120347102-9788120347106.
2	Advanced Control Systems, Dr.K.M.Soni, P.M. Tiwari, Ayushi Sharma, 4th Edition 2013, S.K.Kataria & Sons, ISBN: 978-81-907386-0-6.
3	Advanced control Theory, Nagoor Kani, 2nd Edition, 2014, RBA Publications, ISBN: 4567146603, 1234567146601.
4	Design and Analysis of Control Systems, Arthur G.O. Mutambara, 2nd Edition, 2017, CRC Press Book, ISBN: 9781315140940.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**2**	**-**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**2**
CO2	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**2**
CO3	**2**	**2**	**2**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**1**	**1**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**

Low-1 Medium-2 High-3

V Semester		
OOPS WITH C++ & DATA STRUCTURE (Theory)		
Course Code: 16EI55		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:1:0:0		**SEE Marks:** 100
Hours:36L+24T		**SEE Duration:** 03Hrs

Course Learning Objectives: The students will be able to	
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
5	Explain different types of data structure algorithm.

UNIT-I	
Concepts of OOP: Introduction OOP, Procedural Vs. Object Oriented Programming, Principles of OOP, Benefits and applications of OOP.C++ Basics: Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures. **C++ Functions & Structure:** Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments. Structure with structure, Pre-processor directories.	**08 Hrs**
UNIT-II	
Objects and Classes: Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors. **Operator overloading:** Unary operator, Binary Operator, Overloading assignment operator, type conversion.	**07 Hrs**
UNIT-III	
Inheritance: Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class. **Polymorphism**: Pointers in C++, Pointers and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism.	**07 Hrs**
UNIT-IV	
I/O Management & **File management**: Concept of streams, C_{in} and C_{out} objects, C++ stream classes, Unformatted and formatted I/O, manipulators, File stream, C++ File stream classes, File management functions, File modes, Binary and random Files. **Templates and exceptions:** Function Template, Class Template, Exception.	**07 Hrs**
UNIT-V	
Data structure: Introduction to data structure. Linear Data Structure: Stacks, Queue, Links Lists, Sorting, Searching, Binary Trees Algorithm, Heap and Programming.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand various concept object oriented programming language using C++.
CO2:	Apply knowledge of functions, class, operator overloading concept to the analysis and design of simple C++ program.
CO3:	Analyse real world problems and solve them implementing features of data structures.
CO4:	Design, implement, test, debug, and document programs in C and C++.

Reference Books	
1.	Object Oriented Programming in C++, Robert Lafore, 7th Edition, 2017, McGraw Hill Education, ISBN: 978-9352607990.
2.	Object Oriented Programming with C++, E. Balaguruswamy, 6th Edition, 2013, McGraw Hill Education, ISBN: 978-1259029936.
3.	Data Structures in C++, Yeswanth P Kanetkar, 5th Edition, 2003, BPB Publications ISBN: 978-8176567077.

4.	Thinking In C++, Bruce Eckel, 2nd Edition, Volume 1 & 2, 2000, Pearson Education India, ISBN: 978-8131706619.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO - PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO2	**1**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

Low-1 Medium-2 High-3

V Semester		
COMPUTER ORGANIZATION AND ARCHITECTURE **(Group A:Professional Core Elective)**		
Course Code:16EI5A1		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:1		**SEE Marks:** 100
Hours:36L		**SEE Duration:**03Hrs

Course Learning Objectives: The students will be able to	
1	Illustrate how Computer Systems work & its basic principles and analyse the system performance.
2	Analyse the concepts behind advanced pipelining techniques and 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	
Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi computers, RISC v/s CISC, Von-Neumann architecture and Harvard architecture. **Basic processing unit:** Some Fundamental Concepts, Register Transfers, Performing an Arithmetic or Logic Operation, Fetching a Word from Memory, Storing a Word in Memory.	**07 Hrs**
UNIT-II	
Computer arithmetic: Addition and subtraction, multiplication algorithms, hardware implementations for signed-magnitude data, hardware algorithm, booth multiplier, division algorithm, floating point arithmetic operation.	**08 Hrs**
UNIT-III	
Memory: Concepts of semiconductor memory, CPU- memory interaction, organization of memory modules, Cache memory and associate memory, direct mapping, set associate mapping, writing into cache, Virtual memory. **Secondary storage** and type of storage devices, Introduction to buses and connecting I/O devices to CPU and memory, Introduction to RISC and CISC paradigm, Design issues of a RISC processor and example of an existing RISC processor.	**08 Hrs**
UNIT-IV	
Input/output processing: Introduction to input/output processing, working with video display unit and keyboard and routine to control them, Programmed controlled I/O transfer, Interrupt controlled I/O transfer, DMA controller, I/O processor.	**07 Hrs**
UNIT-V	
Pipelining: Introduction to pipelining and pipeline hazards, design issues of pipeline architecture Instruction level parallelism and advanced issues, superscalar operations, performance consideration.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic concepts of computer organization & architecture.
CO2:	Apply computer architecture theory to solve the basic functional problem of computer.
CO3:	Analyze performance issues in processor algorithms, memory, pipeline, I/O Operation of a Digital computer.
CO4:	Design a hardware component for an embedded system of a digital computer.

Reference Books	
1	Computer Organization, V. C. Hamacher, Z. G. Vranesic and S. G. Zaky,5th Edition, 2002, McGraw Hill, ISBN: 9780071007429.
2	Computer System Architecture, M.Morris Mano, 3rd Edition, 2017, Pearson Education India, ISBN: 978-9332585607
3	Computer Organization and Architecture: Designing for Performance, William Stallings, 8th Edition, 2010, Pearson Education India, ISBN: 9789332518704.
4	Structured Computer Organization, A. S. Tanenbaum, 6th Edition, 2013, Prentice Hall of India, ISBN: 978-8120347205.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**
CO4	**1**	**2**	**1**	**3**	**1**	**-**	**-**	**2**	**3**	**3**	**-**	**-**

Low-1 Medium-2 High-3

V Semester		
BIOMEDICAL INSTRUMENTATION (Group A:Professional Core Elective)		
Course Code: 16EI5A2		**CIE Marks: 100**
Credits/Week: L:T:P:S : 3:0:0:1		**SEE Marks: 100**
Hours: 36L		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Study the basic biomedical signals and the instrumentation to measure them.
2	Provide an insight into the working principle of instruments to measure the vital physiological parameters.
3	Understand the need of critical care diagnostics during emergencies like pacemakers and defibrillators.
4	Describe the working of pulmonary function analyser and hemodialysis machines.

UNIT-I	
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.	**07 Hrs**
UNIT-II	
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.	**08 Hrs**
UNIT-III	
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.	**08 Hrs**
UNIT-IV	
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.	**07 Hrs**
UNIT-V	
Pulmonary Function Analyser: Pulmonary function measurement, Spirometry, Pneumotachometer, Measurement of volume by Nitrogen washout technique. **Haemodialysis machines:** Function of kidneys, Artificial kidney, Dialyzers, Haemodialysis machine, Portable kidney machines.	**06 Hrs**

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

CO1:	Understand the sources of biomedical signals and basic biomedical instruments.
CO2:	Apply concepts for the design of biomedical devices
CO3:	Analyze the methods of acquisition and signal conditioning to be applied to the physiological parameters.
CO4:	Develop instrumentation for measuring and monitoring biomedical parameters.

Reference Books	
1	Handbook of Biomedical Instrumentation, R. S. Khandpur,3rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553.
2	Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2nd Edition, Reprint 2015, ISBN: 9780130771315.
3	Medical instrumentation: Application and Design, J. G. Webster, 3rd Edition, Reprint 2015, Wiley Publications, ISBN: 9788126511068.
4	Principles of Biomedical Instrumentation and Measurement, Richard Aston, 4th Edition, 2005, Prentice Hall of India, ISBN: 9780675209434.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**2**	**2**	**-**	**1**
CO2	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**1**
CO3	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**2**
CO4	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**2**

Low-1 Medium-2 High-3

V Semester		
MICRO ELECTRO-MECHANICAL SYSTEMS AND APPLICATIONS (Group A:Professional Core Elective)		
Course Code:16EI5A3		**CIE Marks:** 100
Credits/Week: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand the rudiments of Micro fabrication techniques.
2	Identify and associate the various sensors and actuators to applications.
3	Analyze different materials used for MEMS.
4	Design applications of MEMS to disciplines.

UNIT-I	
Overview of MEMS & Microsystems and working principles of Microsystems: MEMS and Microsystems, Typical MEMS and microsystem products, Evolution of microfabrication, Microsystems and microelectronics, Multidisciplinary nature of Microsystems, Design and manufacture, Applications of Microsystems in automotive, healthcare, aerospace and other industries. Working Principle of Biomedical and biosensors Microsystems.	**07 Hrs**
UNIT-II	
Working principle of Microsystems: Micro sensors: Acoustic, Chemical, Optical and Thermal. **Micro actuation:** Using thermal forces, shapememory alloys Piezoelectric crystals and electrostatic forces, MEMS with micro actuators: Micro grippers, micro motors, micro valves and micro pumps, micro accelerometers, microfluidics**.** **Introduction to Scaling:** Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, Scaling in electromagnetic forces and scaling in fluid mechanics.	**07 Hrs**
UNIT-III	
Materials for MEMS and Microsystems: Substrates and wafers, Active substrate materials, Silicon as substrate material, Silicon Compounds, Si-Piezoresistors, GaAs, Quartz, Piezoelectric Crystals, Polymers and packaging materials. Three level of Microsystem packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem packaging. Essential packaging technologies: die preparation, Surface bonding, Wire bonding, Sealing.3D packaging.	**07 Hrs**
UNIT-IV	
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PVD-Sputtering, Deposition of Epiaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	**07 Hrs**
UNIT-V	
Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors. **Overview, Application, Fabrication Process In Applications:** Silicon Capacitive Accelerometer, Piezoresistive Pressure sensor, Electrostatic Comb drive, Portable blood analyser, Piezo electric Inkjet Print head, Micro-mirror array for Video projection	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the operation of micro devices, micro systems and their applications.
CO2:	Apply the principle of material science to sensor design.
CO3:	Analyze the materials used for sensor designs.
CO4:	Conceptualize and design micro devices, micro systems.
Reference Books	

1	MEMS & Micro systems Design and Manufacture, Tai Ran Tsu, 2nd Edition, 2012, Tata McGraw Hill New Delhi, ISBN-13:978-0-07-048709-3.
2	Foundations of MEMS, Chang Liu, 2012, Pearson Education Inc. ISBN-13:978-0-13-249736-7.
3	Smart Material Systems and MEMS, Vijay K Varadan, K.J. Vinoy, S.Gopalakrishnan, 2006, Wiley-India, ISBN-978-81-265-3170-7.
4	Micro and Smart Systems, G.K Ananthasuresh, K.J. Vinoy, K.N.Bhat, V.K.Aatre, 2015, Wiley Publications, ISBN-:978-81-265-2715-1.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**-**	**1**

Low-1 Medium-2 High-3

V Semester		
IMAGE PROCESSING **(Group A:Professional Core Elective)**		
Course Code:16EI5A4		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:1		**SEE Marks:** 100
Hours:36L		**SEE Duration:** 3 Hrs
Course Learning Objectives: The students will be able to		
1	Understand the principles of image enhancement, segmentation, compression and morphological processing.	
2	Discuss various techniques of image enhancement in Spatial and Frequency domain.	
3	Develop and analyse various algorithms of different techniques used in biomedical image processing.	
4	Apply different concepts and techniques of image processing for various medical applications.	

UNIT-I	
Digital Image Fundamentals: Introduction to Digital Image Processing, Examples of fields that use 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.	**05 Hrs**
UNIT-II	
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:** Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters and Homomorphic Filtering.	**10 Hrs**
UNIT-III	
Image Segmentation : Point, line and edge detection, Edge linking and boundary detection. Thresholding: Basic Global thresholding, Multiple thresholding, Variable thresholding. Region Based Segmentation: Region growing, Region splitting and merging.	**10 Hrs**
UNIT-IV	
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.	**06 Hrs**
UNIT-V	
Morphological image processing Preliminaries, Dilation and Erosion, Opening and Closing, Some Basic Morphological Algorithms: Boundary extraction, hole filling.	**05 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of Digital image processing steps.
CO2:	Evaluate algorithms for image analysis based on segmentation, shape & texture, and morphology.
CO3:	Analyze the different image processing algorithms of enhancement, segmentation, compression and morphological image processing for a particular application.
CO4:	Develop the necessary skill base to explore and implement Digital Image Processing algorithms.

Reference Books	
1	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, Education, 3rd Edition, 2011, Pearson, ISBN: 978-81-317-2695-2.
2	Fundamentals of Digital Image Processing, Anil K. Jain, 2010 Edition, Prentice Hall of India, ISBN 13: 9788120309296.
3	Image Processing, Analysis and Machine Vision, Milan Sonka, Vaclav Hlavac & Roger Boyle, 4th Edition, 2015, ISBN-13: 9781133593607.
4	The Image Processing Handbook, John C Russ, 6th Edition, 2011, CRC Press, ISBN: 978-1-4398-4045-0.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	**1**	-	-	-	-	**1**	-	-	-	-	**1**
CO2	-	**2**	-	**1**	-	-	-	-	-	-	-	**2**
CO3	**1**	**1**	**1**	-	-	-	-	-	-	-	-	**2**
CO4	**2**	**1**	-	-	**1**	-	-	-	-	-	-	**2**

Low-1 Medium-2 High-3

V Semester		
BIOINFORMATICS **(Group B: Global Elective)**		
Course Code:16G5B01		**CIE Marks:** 100
Credits:L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours:04		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Understand the underlying technologies of Bioinformatics and Programming
2	Explore the various algorithms behind the computational genomics and proteomic structural bioinformatics, modeling and simulation of molecular systems.
3	Apply the tools and techniques that are exclusively designed as data analytics to investigate the significant meaning hidden behind the high throughput biological data.
4	Analyze and evaluate the outcome of tools and techniques employed in the processes of biological data preprocessing and data mining.

Unit-I	
Biomolecules: Introduction to Biomolecules. Structure, Types and Functions of Carbohydrates, Lipids, Nucleic Acids and Proteins. Genetic code, Codon degeneracy, Genes and Genomes. **Bioinformatics & Biological Databases:** Introduction to Bioinformatics, Goals, Scope, Applications in biological science and medicine. Biological databases – Sequence, structure, Special Databases and applications - Genome, Microarray, Metabolic pathway, motif, and domain databases. Mapping databases – genome wide maps. Chromosome specific human maps.	**09 Hrs**
Unit – II	
Sequence Alignment: Introduction, Types of sequence alignments - Pairwise and Multiple sequence alignment, Alignment algorithms (Needleman & Wunch, Smith & Waterman and Progressive global alignment). Database Similarity Searching- Scoring matrices – BLOSSUM and PAM, Basic Local Alignment Search Tool (BLAST), and FASTA. Next Generation Sequencing – Alignment and Assembly. **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based & Character-Based Methods and Phylogenetic Tree evaluation.	**09 Hrs**
Unit -III	
Predictive methods: Predicting secondary structure of RNA, Protein and Genes – algorithms to predict secondary structure of RNA, Protein and Gene. Prediction of Tertiary structure of Protein, Protein identity and Physical properties of protein. **Molecular Modeling and Drug Designing:** Introduction to Molecular Modeling. Methods of Molecular Modeling and Force Fields used in Molecular Modeling. Drug designing process - deriving Pharmacophore, Receptor Mapping, Estimating Receptor-Ligand interactions and Molecular Docking.	**09 Hrs**
Unit –IV	
Perl: Introduction to Perl, writing and executing a Perl program. Operators, Variables and Special variables. Data Types – Scalar, Array and Associative array. Regular Expressions (REGEX), Components of REGEX - Operators, Metacharacters and Modifiers. Subroutines – types of functions, defining and calling functions in Perl, calling function - call by value and call by reference. Object Oriented Programming in Perl–Class and object, Polymorphism, inheritance and encapsulation. Perl Package – writing and calling package. Perl Module – writing and calling module.	**09 Hrs**
Unit –V	
BioPerl: Introduction to BioPerl, BioPerl Modules, Applications of BioPerl – Sequence retrieval from Database and submission of sequence to online Database, Indexing and accessing local databases, Transforming formats of database record, Sequence alignments BioPerl and Sequence Analysis - Pair wise and Multiple sequence alignment, Restriction mapping. Identifying restriction enzyme sites, acid cleavage sites, searching for genes and other structures on genomic DNA, Parsing BLAST and FASTA results. BioPerl and	**09 Hrs**

phylogenetic analysis, BioPerl and Phylogenetic tree manipulation, creating graphics for Sequence display and Annotation.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the Architecture and Schema of online databases including structure of records in these databases.
CO2:	Explore the Mind crunching Algorithms, which are used to make predictions in Biology, Chemical Engineering, and Medicine.
CO3:	Apply the principles of Bioinformatics and Programming to the problems related to process simulation and process engineering in Biological system.
CO4:	Use Bioinformatics tools and Next Generation Technologies to model and simulate biological phenomenon.

Reference Books	
1	T. Christiansen, B. D. Foy, L. Wall, J. Orwant, Programming Perl: Unmatched power for text processing and scripting, O'Reilly Media, Inc., 4thEdition, 2012, ISBN-13: 978-0596004927
2	B. Haubold, T. Weihe, Introduction to Computational Biology: An Evolutionary Approach, new age publishers, Paperback Edition, 2009, ISBN-13: 978-8184890624
3	C. Bessant, I. Shadforth, D. Oakley, Building Bioinformatics Solutions: with Perl, R and MySQL, Oxford University Press, 1st edition, 2009, ISBN
4	D. C. Young. Computational Drug Design: A Guide for Computational and Medicinal Chemists,Wiley-Interscience, 1st edition, 2009, ISBN-13: 978-0470126851.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**1**	**2**	**-**
CO2	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**
CO4	**1**	**2**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**-**

High-3 : Medium-2 : Low-1

V Semester		
FUEL CELL TECHNOLOGY (Group B: Global Elective)		
Course Code: 16G5B02		**CIE Marks:** 100
Credits: L:T:P:S:: 4:0:0:0		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Recall the concept of fuel cells
2	Distinguish various types of fuel cells and their functionalities
3	Know the applications of fuel cells in various domains
4	Understand the characterization of fuel cells

UNIT-I	
Introduction: Fuel cell definition, historical developments, working principle of fuel cell, components of fuel cell, EMF of the cell, Fuel Cell Reactions, fuels for cells and their properties.	**09Hrs**
UNIT-II	
Fuel Cell Types: Classification of fuel cells, alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, advantages and disadvantages of each .	**09Hrs**
UNIT-III	
Fuel Cell Reaction Kinetics: activation kinetics, open circuit voltage, intrinsic maximum efficiency, voltage efficiency, Faradaic efficiency, overall efficiency, over-voltages and Tafel equation.	**09Hrs**
UNIT-IV	
Fuel Cell Characterization: current – voltage curve, in-situ characterization, current – voltage measurement, current interrupt measurement, cyclic voltammetry, electrochemical impedance spectroscopy and ex-situ characterization techniques.	**09Hrs**
UNIT-V	
Applications of Fuel Cells: applications of fuel cells in various sectors, hydrogen production, storage, handling and safety issues.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Understand the fundamentals and characteristics of fuel cells
2	Apply chemical engineering principles to distinguish fuel cells from conventional energy systems
3	Analyze the performance of fuel cells using different characterization techniques
4	Evaluate the possibility of integrating fuel cell systems with conventional energy systems

Reference Books	
1.	Fuel Cells – Principles and Applications, Viswanathan and M Aulice Scibioh, 1st Edition, 2009, Universities Press, ISBN – 13: 978 1420 060287
2.	Fuel Cell Systems Explained, James Larminie and Andrew Dicks, 2nd Edition, 2003, John Wiley & Sons, ISBN – 978 0470 848579

3.	Fuel Cell Fundamentals, O 'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, 1st Edition, 2006, Wiley, New York, ISBN – 978 0470 258439
4.	Recent Trends in Fuel Cell Science and Technology, Basu. S, 1st Edition, 2007, Springer, ISBN – 978 0387 688152

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**
CO2	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**
CO4	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**2**

High-3 : Medium-2 : Low-1

V Semester		
GEOINFORMATICS **(Group B: Global Elective)**		
Course Code:16G5B03		**CIE Marks**: 100
Hrs/Week: L:T:P:S: 4:0:0:0		**SEE Marks**: 100
Credits: 48L		**SEE Duration**: 3Hrs

Course Learning Objectives: The students will be able to	
1	To understand concept of using photographic data to determine relative positions of points
2	To study the use of electromagnetic energy for acquiring qualitative and quantitative land information
3	To analyze the data gathered from various sensors and interpret for various applications
4	To understand the various applications of RS, GIS and GPS

UNIT-I	
Remote Sensing- Definition, types of remote sensing, components of remote sensing, Electromagnetic Spectrum, Black body, Atmospheric windows, energy interaction with earth surface features. spectral reflectance curve- physical basis for spectra reflectance curve, false color composite. Platforms and sensors. Sensor resolutions. Types of satellites- Indian and other remote sensing satellites (IRS, IKONS and Landsat). Concept of image interpretation and analysis - Principle of visual interpretation, recognition elements. Fundamentals of image rectification. Digital Image classification - supervised and unsupervised	**10 Hrs**
UNIT-II	
Photogrammetry: Introduction types of Photogrammetry, Advantages of Photogrammetry, Introduction to digital Photogrammetry. Locating points from two phases determination of focal length. **Aerial Photogrammetry:** Advantages over ground survey methods - geometry of vertical phographs, scales of vertical photograph. Ground coordination- relief displacement, scale ground coordinates – flight planning	**10 Hrs**
UNIT-III	
Geographic Information System- Introduction, Functions and advantages, sources of data for GIS. Database – Types, advantages and disadvantages. Data Management – Transformation, Projection and Coordinate systems. Data input methods, Data Analysis.- overlay operations, network analysis, spatial analysis. Outputs and map generation. . Introduction to GPS- components and working principles	**10 Hrs**
UNIT-IV	
Applications of GIS, Remote Sensing and GPS: Case studies on Water Resources engineering and management (prioritization of river basins, water perspective zones and its mapping), **Case studies on applications of GIS and RS in** highway alignment, Optimization of routes, accident analysis, Environmental related studies. **Case studies on applications of GIS and RS in** Disaster Management (Case studies on post disaster management - Earthquake and tsunami and pre disaster management - Landslides and floods) Urban Planning & Management - mapping of zones, layouts and infrastructures.	**09 Hrs**
UNIT-V	
Applications of GIS, Remote Sensing and GPS: Land use land cover (LULC) mapping. Case studies on infrastructure planning and management- Case studies on urban sprawl. Change detection studies – case studies on forests and urban area. Case studies on agriculture. **Applications of geo-informatics in natural resources management: Geo Technical case Studies**, site suitability analysis for various applications.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Understand the principle of Remote Sensing (RS) and Geographical Information Systems (GIS) data acquisition and its applications.
2	Apply RS and GIS technologies in various fields of engineering and social needs.
3	Analyze and evaluate the information obtained by applying RS and GIS technologies.

4	Create a feasible solution in the different fields of application of RS and GIS.

Reference Books	
1.	Geographic Information System-An Introduction,Tor Bernharadsen, 3rd Edition, Wiley India Pvt. Ltd. New Delhi , 2009.
2.	Principles of Remote sensing and Image Interpretation, Lillesand and Kiefer, 5th Edition, John Wiley Publishers, New Delhi, 2007.
3.	Remote Sensing and GIS, Bhatta B, Oxford University Press, New Delhi, 2008
4.	Remote Sensing, Robert A. Schowengerdt, 3rd Edition, Elsevier India Pvt Ltd, New Delhi, 2009

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	1	-	-	-	-	-	-
CO2	2	1	-	-	1	1	-	-	-	-	-	-
CO3	2	2	1	-	2	1	1	-	-	-	-	1
CO4	2	2	1	-	3	2	2	-	-	-	1	1

Low-1 Medium-2 High-3

V Semester		
GRAPH THEORY **(Group B : Global Elective)**		
Course Code:16G5B04		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand the basics of graph theory and their various properties.
2	Model problems using graphs and to solve these problems algorithmically.
3	Apply graph theory concepts to solve real world applications like routing, TSP/traffic control, etc.
4	Optimize the solutions to real problems like transport problems etc.,

UNIT-I	
Introduction to graph theory Introduction, Mathematical preliminaries, definitions and examples of graphs, degrees and regular graphs, sub graphs, directed graphs, in degrees and out degrees in digraphs. **Basic concepts in graph theory** Paths and cycles, connectivity, homomorphism and isomorphism of graphs, connectivity in digraphs.	**09 Hrs**
UNIT-II	
Graph representations, Trees, Forests Adjacency matrix of a graph, Incidence matrix of a graph, Adjacency lists, Trees and properties of trees, Characterization of trees, Centers of trees, Rooted trees, Binary threes, Spanning trees and forests, Spanning trees of complete graphs, An application to electrical networks, Minimum cost spanning trees.	**09 Hrs**
UNIT-III	
Fundamental properties of graphs and digraphs Bipartite graphs, Eulerian graphs, Hamiltonian graphs, Hamiltonian cycles in weighted graphs, Eulerian digraphs. **Planar graphs, Connectivity and Flows** Embedding in surfaces, Euler's formula, Characterization of planar graphs, Kuratowski's theorem, Dual of a planar graphs.	**09 Hrs**
UNIT-IV	
Matchings and Factors Min-Max theorem, Independent sets and covers, Dominating sets, maximum bipartite matching. **Coloring of graphs** The chromatic number of a graph, Results for general graphs, The chromatic polynomial of a graph, Basic properties of chromatic polynomial, chordal graphs, powers of graphs, Edge coloring of graphs	**09 Hrs**
UNIT-V	
Graph algorithms Graph connectivity algorithms, Breadth first search and Depth first search, Shortest path algorithms, Dijikstra's shortest path algorithm, Minimum cost spanning tree algorithms, Algorithm of Kruskal's and Prim's.	**09Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the basics of graph theory.
CO2.	Analyse the significance of graph theory in different engineering disciplines
CO3.	Demonstrate algorithms used in interdisciplinary engineering domains.
CO4.	Evaluate or synthesize any real world applications using graph theory.

Reference Books	
1.	Introduction to graph theory, Douglas B. West, 2nd Edition, 2001, PHI, ISBN- 9780130144003, ISBN-0130144002.
2.	Graph Theory, modeling, Applications and Algorithms, Geir Agnarsson, Raymond Greenlaw, Pearson Education, 1st Edition,2008, ISBN- 978-81-317-1728-8.
3.	Introduction to Algorithms ,Cormen T.H., Leiserson C. E, Rivest R.L., Stein C. , 3rd Edition, 2010,PHI, ISBN:9780262033848

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**
CO2	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO3	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO4	**2**	**2**	**3**	**2**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**1**

Low-1 Medium-2 High-3

V Semester		
ARTIFICIAL NEURAL NETWORKS &DEEP LEARNING (Group B: Global Elective)		
Course Code: 16G5B05		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours: 46L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Define what is Neural Network and model a Neuron and Express both Artificial Intelligence and Neural Network
2	Analyze ANN learning, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning and Boltzmann learning
3	Implement Simple perception, Perception learning algorithm, Modified Perception learning algorithm, and Adaptive linear combiner, Continuous perception, learning in continuous perception.
4	Analyze the limitation of Single layer Perceptron and Develop MLP with 2 hidden layers, Develop Delta learning rule of the output layer and Multilayer feed forward neural network with continuous perceptions,

UNIT-I	
Introduction to Neural Networks: Neural Network, Human Brain, Models of Neuron, Neural networks viewed as directed graphs, Biological Neural Network, Artificial neuron, Artificial Neural Network architecture, ANN learning, analysis and applications, Historical notes.	**08 Hrs**
UNIT-II	
Learning Processes: Introduction, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzmann learning, credit assignment problem, learning with and without teacher, learning tasks, Memory and Adaptation.	**10 Hrs**
UNIT-III	
Single layer Perception: Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm, Modified Perception learning algorithm, Adaptive linear combiner, Continuous perception, Learning in continuous perception. Limitation of Perception.	**10 Hrs**
UNIT-IV	
Multi-Layer Perceptron Networks: Introduction, MLP with 2 hidden layers, Simple layer of a MLP, Delta learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions, Generalized delta learning rule, Back propagation algorithm	**10 Hrs**
UNIT-V	
Introduction to Deep learning: Neuro architectures as necessary building blocks for the DL techniques, Deep Learning & Neocognitron, Deep Convolutional Neural Networks, Recurrent Neural Networks (RNN), feature extraction, Deep Belief Networks, Restricted Boltzman Machines, Autoencoders, Training of Deep neural Networks, Applications and examples (Google, image/speech recognition)	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Model Neuron and Neural Network, and to analyze ANN learning, and its applications.
CO2:	Perform Pattern Recognition, Linear classification.
CO3:	Develop different single layer/multiple layer Perception learning algorithms
CO4:	Design of another class of layered networks using deep learning principles.

Reference Books	
1.	Neural Network- A Comprehensive Foundation , Simon Haykins, 2nd Edition, 1999, Pearson Prentice Hall, ISBN-13: 978-0-13-147139-9
2.	Introduction to Artificial Neural Systems, Zurada and Jacek M, 1992, West Publishing Company, ISBN: 9780534954604
3.	Learning & Soft Computing, Vojislav Kecman, 1st Edition, 2004, Pearson Education, ISBN:0-262-11255-8
4.	Neural Networks Design, M T Hagan, H B Demoth, M Beale, 2002, Thomson Learning, ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO2	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO3	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**

Low-1 Medium-2 High-3

V Semester		
HYBRID ELECTRIC VEHICLES **(Group B: Global Elective)**		
Course Code : 16G5B06		**CIE Marks : 100**
Credits : L:T:P:S 4:0:0:0		**SEE Marks : 100**
Hours : 45L		**SEE Duration : 3Hrs**

Course Learning Objectives: The students will be able to,	
1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2	Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
3	Analyze various electric drives suitable for hybrid electric vehicles and Different energy storage technologies used for hybrid electric vehicles and their control.
4	Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

UNIT-I	
Introduction: Sustainable Transportation, A Brief History of HEVs, Why EVs Emerged and Failed, Architectures of HEVs, Interdisciplinary Nature of HEVs, State of the Art of HEVs, Challenges and Key Technology of HEVs. **Hybridization of the Automobile:** Vehicle Basics, Basics of the EV, Basics of the HEV, Basics of Plug-In Hybrid Electric Vehicle (PHEV), Basics of Fuel Cell Vehicles (FCVs).	**07 Hrs**
UNIT-II	
HEV Fundamentals: Introduction, Vehicle Model, Vehicle Performance, EV Powertrain Component Sizing, Series Hybrid Vehicle, Parallel Hybrid Vehicle, Wheel Slip Dynamics. **Plug-in Hybrid Electric Vehicles:** Introduction to PHEVs, PHEV Architectures, Equivalent Electric Range of Blended PHEVs, Fuel Economy of PHEVs, Power Management of PHEVs, Component Sizing of EREVs, Component Sizing of Blended PHEVs, Vehicle-to-Grid Technology.	**10 Hrs**
UNIT-III	
Power Electronics in HEVs: Power electronics including switching, AC-DC, DC-AC conversion, electronic devices and circuits used for control and distribution of electric power, Thermal Management of HEV Power Electronics. **Batteries, Ultracapacitors, Fuel Cells, and Controls:** Introduction, Different batteries for EV, Battery Characterization, Comparison of Different Energy Storage Technologies for HEVs, Battery Charging Control, Charge Management of Storage Devices, Flywheel Energy Storage System, Hydraulic Energy Storage System, Fuel Cells and Hybrid Fuel Cell Energy Storage System and Battery Management System.	**10 Hrs**
UNIT-IV	
Electric Machines and Drives in HEVs: Introduction, BLDC motors, Induction Motor Drives, Permanent Magnet Motor Drives, Switched Reluctance Motors, Doubly Salient Permanent Magnet Machines, Design and Sizing of Traction Motors, Thermal Analysis and Modelling of Traction Motors. **(only functional treatment to be given**)	**10Hrs**
UNIT-V	
Integration of Subsystems: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems. **Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.	**08Hrs**

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

1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2	Evaluate the performance of electrical machines and power electronics converters in HEVs.
3	Analyse the different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
4	Design and evaluate the sizing of subsystem components and Energy Management strategies in HEVs.
Reference Books:	
1.	Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives, Mi Chris, Masrur A.and Gao D.W. Wiley Publisher, 1st Edition, 2011,*ISBN*:0-824-77653-5
2.	Ali, Modern Electric, Hybrid electric and Fuel Cell Vehicles, Ehsani Mehrdad, Gao Yimin, E. Gay Sebastien, Emadi CRC Press, 1st Edition, 2005, ISBN: *0-8493-3154-4.*
3.	Modern Electric Vehicle Technology, Chan, C.C.,Chau, K.T. Oxford University Press, 2001, ISBN 0 19 850416 0.
4.	Hybrid Electric Vehicles: Energy Management Strategies, Simona Onori, Lorenzo Serrao, Giorgio Rizzoni, *ISBN*: 978-1-4471-6779-2.

Continuous Internal Evaluation (CIE); Theory (100 Marks):
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**2**	**2**	**1**	**1**	**3**	**1**	**-**	**1**	**-**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**-**	**3**	**-**	**2**	**1**	**2**	**1**
CO3	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**-**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**1**	**3**

High-3 : Medium-2 : Low-1

V Semester

Course Outcomes: After going through this course the student will be able to	
CO1	Understand the various optimization models and their areas of application.
CO2	Explain the process of formulating and solving problems using optimization methods.
CO3	Develop models for real life problems using optimization techniques.
CO4	Analyze solutions obtained through optimization techniques.
CO5	Create designs for engineering systems using optimization approaches.

Reference Books:	
1.	Operation Research An Introduction, Taha H A, 8th Edition, 2009, PHI, ISBN: 0130488089.
2.	Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg, 2nd Edition, 2000, John Wiley & Sons (Asia) Pte Ltd, ISBN 13: 978-81-265-1256-0
3.	Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 9th Edition, 2012,Tata McGraw Hill, ISBN 13: 978-0-07-133346-7
4.	Operations Research Theory and Application, J K Sharma, 4th Edition, 2009, Pearson Education Pvt Ltd, ISBN 13: 978-0-23-063885-3.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

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CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2											
CO2	2	2		1	1							
CO3							1	1				
CO4	2		3		1							
CO5			2			1						1

Low-1 Medium-2 High-3

V Semester		
SENSORS & APPLICATIONS **(Group B: Global Elective)**		
Course Code:16G5B08		**CIE Marks:** 100
Credits/Week: L:T:P:S:4:0:0:0		**SEE Marks:** 100
Hours:44L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Impart the principles and working modes of various types of Resistive, Inductive, Capacitive, Piezoelectric and Special transducers.
2	Give an idea about the applications of various transducers and selection criteria of a transducer for a particular application.
3	Give an insight into the static and dynamic characteristics of different orders of instruments.
4	Describe different data conversion techniques and their applications.

UNIT-I	
Introduction: Definition of a transducer, Block Diagram, Active and Passive Transducers, Advantages of Electrical transducers. **Resistive Transducers:** Potentiometers: Characteristics, Loading effect, and problems. **Strain gauge:** Theory, Types, applications and problems. **Thermistor, RTD:** Theory, Applications and Problems.	**09 Hrs**
UNIT-II	
Thermocouple: Measurement of thermocouple output, compensating circuits, lead compensation, advantages and disadvantages of thermocouple. **LVDT:** Characteristics, Practical applications and problems. **Capacitive Transducers:** Capacitive transducers using change in area of plates, distance between plates and change of dielectric constants, Applications of Capacitive Transducers and problems.	**10 Hrs**
UNIT-III	
Piezo-electric Transducers: Principles of operation, expression for output voltage, Piezo-electric materials, equivalent circuit, loading effect, and Problems. **Special Transducers:** Hall effect transducers, Thin film sensors, and smart transducers: Principles and applications, Introduction to MEMS Sensors and Nano Sensors, Schematic of the design of sensor, applications.	**10 Hrs**
UNIT-IV	
Chemical sensors: pH value sensor, dissolved oxygen sensor, oxidation-reduction potential sensor. **Light sensors**: Photo resistor, Photodiode, Phototransistor, Photo-FET, Charge coupled device. **Tactile sensors:** Construction and operation, types.	**08 Hrs**
UNIT-V	
Data Converters: Introduction to Data Acquisition System, types of DAC, Binary Weighted DAC, R-2R ladder DAC, DAC-0800, Types of ADC, Single Slope ADC and Dual-slope integrated type ADC, Flash ADC, 8-bit ADC-0808, Programmable Gain Amplifier.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember and understand the basic principles of transducers and smart sensors.
CO2:	Apply the knowledge of transducers and sensors to comprehend digital instrumentation systems.

CO3:	Analyze and evaluate the performance of different sensors for various applications.
CO4:	Design and create a system using appropriate sensors for a particular application
Reference Books	
1	Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, 18th Edition, 2008, Dhanpat Rai and Sons, ISBN: 81-7700-016-0.
2	Sensor systems: Fundamentals and applications,Clarence W.de Silva, 2016 Edition, CRC Press, ISBN: 9781498716246.
3	Transducers and Instrumentation, D.V.S. Murthy, 2nd Edition 2008, PHI Publication, ISBN: 978-81-203-3569-1.
4	Introduction to Measurement and Instrumentation, Arun K. Ghosh, 3rd Edition, 2009, PHI, ISBN: 978-81-203-3858-6.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**3**	**-**	**1**

Low-1 Medium-2 High-3

V Semester		
INTRODUCTION TO MANAGEMENT INFORMATION SYSTEMS (Group B: Global Elective)		
Course Code: 16G5B09		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours :45L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	To understand the basic principles and working of information technology.
2	Describe the role of information technology and information systems in business.
3	To contrast and compare how internet and other information technologies support business processes.
4	To give an overall perspective of the importance of application of internet technologies in business administration.

UNIT I	
Information Systems in Global Business Today: The role of information systems in business today, Perspectives on information systems, Contemporary approaches to information systems, Hands-on MIS projects. **Global E-Business and Collaboration** : Business process and information systems, Types of business information systems, Systems for collaboration and team work, The information systems function in business. A Case study on E business.	**09 Hrs**
UNIT II	
Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues, **Ethical and Social issues in Information Systems**: Understanding ethical and Social issues related to Information Systems, Ethics in an information society, The moral dimensions of information society. A Case study on business planning.	**09 Hrs**
UNIT III	
IT Infrastructure and Emerging Technologies :IT infrastructure, Infrastructure components, Contemporary hardware platform trends, Contemporary software platform trends, Management issues**. Securing Information Systems**: System vulnerability and abuse, Business value of security and control, Establishing framework for security and control, Technology and tools for protecting information resources. A case study on cybercrime.	**09 Hrs**
UNIT IV	
Achieving Operational Excellence and Customer Intimacy: Enterprise systems, Supply Chain Management (SCM) systems, Customer relationship management (CRM) systems, Enterprise application. **E-commerce: Digital Markets Digital Goods**: E-commerce and the internet, E-commerce-business and technology, The mobile digital platform and mobile E-commerce, Building and E-commerce web site. A Case study on ERP.	**09 Hrs**
UNIT V	
Managing Knowledge: The knowledge management landscape, Enterprise-wide knowledge management system, Knowledge work systems, Intelligent techniques. **Enhancing Decision Making**: Decision making and information systems, Business intelligence in the enterprise. Business intelligence constituencies. **Building Information Systems**: Systems as planned organizational change, Overview of systems development.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and apply the fundamental concepts of information systems.
CO2:	Develop the knowledge about management of information systems.
CO3:	Interpret and recommend the use information technology to solve business problems.
CO4:	Apply a framework and process for aligning organization's IT objectives with business strategy.
Reference Books	
1	Management Information System, Managing the Digital Firm, Kenneth C. Laudon and Jane P. Laudon, 14th Global Edition, 2016, Pearson Education, ISBN:9781292094007
2	Management Information Systems, James A. O' Brien, George M. Marakas, 10th Edition, 2011, Global McGraw Hill, ISBN: 978-0072823110
3	Information Systems The Foundation of E-Business, Steven Alter, 4thEdition, 2002, Pearson Education, ISBN:978-0130617736
4	W.S. Jawadekar, Management Information Systems, Tata McGraw Hill, 2006, ISBN: 9780070616349

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	1	-	-	-	1	-	-	1	-
CO2	1	2	-	1	-	-	-	1	-	-	1	-
CO3	-	-	3	2	2	-	-	1	-	1	1	-
CO4	-	-	2	1	-	-	-	1	-	1	1	-

Low-1 Medium-2 High-3

V Semester		
INDUSTRIAL AUTOMATION (Theory)		
Course Code:16GB510		**CIE Marks: 100**
Credits: L:T:P:S : 4:0:0:0		**SEE Marks: 100**
Hours: 44L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students should be able to:	
1	Identify types of actuators, sensors and switching devices for industrial automation
2	Explain operation and controls of Hydraulic and Pneumatic systems
3	Understand fundamentals of CNC, PLC and Industrial robots
4	Define switching elements and sensors which are interfaced in an automation system
5	Describe functions of Industrial switching elements and Inspection technologies for automation
6	Select sensors to automatically detect motion of actuators
7	Develop manual part programs for CNC and Ladder logic for PLC
8	Develop suitable industrial automation systems using all the above concepts

UNIT-I	
Automation in Production Systems: Manufacturing support systems, Automation principles and strategies, Levels of Automation, Production Concepts and Mathematical models, Numericals **Automated Production Lines:** Fundamentals, Applications, Analysis with no storage, Analysis with storage buffer, Numericals	**08 Hrs**
UNIT-II	
Switching theory and Industrial switching elements Binary elements, binary variables, Basic logic gates, Theorems of switching algebra, Algebraic simplification of binary function, Karnough maps, Logic circuit design, problems. Electromechanical relays, Moving part logic elements, Fluidic elements, Timers, Comparisons between switching elements, Numericals **Industrial Detection Sensors and Actuators:** Introduction, Limit switches, Reed switches, Photoelectric sensors- methods of detection, Hall effect sensors, Inductive proximity sensors, Capacitive proximity sensors, Pneumatic back pressure sensors, Absolute encoder, Incremental encoder, Pressure switches and temperature switches; their working principles and applications, Brushless DC motors, Stepper motors and Servo motors	**08 Hrs**
UNIT-III	
Hydraulic Control circuits Components, Symbolic representations, Control of Single and Double Acting Cylinder, Regenerative Circuit application, Pump unloading circuit, Double Pump Hydraulic System, speed control circuits, accumulator circuits **Pneumatic Control circuits** Components, Symbolic representations as per ISO 5599, Indirect control of double acting cylinders, memory control circuit, cascading design, automatic return motion, quick exhaust valve circuit, and cyclic operation of a cylinder, pressure sequence valve and time delay valve circuits.	**10 Hrs**
UNIT-IV	
Introduction to CNC Numerical control, components of CNC, classification, coordinate systems, motion control strategies, interpolation, programming concepts **Industrial Robotics** Components of Robots, base types, classification of robots, end of arm tooling, robot precision of movement, programming, justifying the use of a robot, simple numerical	**08 Hrs**

UNIT-V	
Programmable logic control systems Difference between relay and PLC circuits, PLC construction, principles of operation, latching, ladder diagrams, programming instructions, types of timers, forms of counters, writing simple ladder diagrams from narrative description and Boolean logic. **Programming exercises on PLC with Allen Bradley controller** Programming exercises on motor control in two directions, traffic control, annunciator flasher, cyclic movement of cylinder, can counting, conveyor belt control, alarm system, sequential process, and continuous filling operation on a conveyor.	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Illustrate applications of sensors actuators, switching elements and inspection technologies in industrial automation
2	Build circuit diagrams for fluid power automation, Ladder diagrams for PLC and identify its application areas
3	Evaluate CNC programs for 2D complex profiles performed on machining and turning centres interfaced with Robots
4	Develop suitable industrial automated system integrating all of the above advanced automation concepts

Reference Books	
1.	Industrial automation - Circuit design and components, David W. Pessen, 1st Edition, 2011, Wiley India, ISBN –13–978–8126529889
2.	Pneumatic Controls,Joji P, 1st Edition, Wiley India, ISBN – 978–81–265–1542–4
3.	Fluid Power with Applications,Anthony Esposito, 7th Edition, 2013, ISBN – 13; 978– 9332518544
4.	Automation, Production systems and Computer Integrated Manufacturing,Mikell P. Groover, 3rd Edition, 2014, ISBN – 978–81–203–3418–2

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**				**2**	**1**	**2**	**1**			**1**	**2**
CO2	**1**		**2**	**3**	**2**	**2**	**2**			**2**		
CO3		**1**		**2**	**1**					**2**		
CO4			**3**	**2**	**2**	**1**		**2**	**2**	**3**	**2**	**2**

Low-1 Medium-2 High-3

V Semester		
TELECOMMUNICATION SYSTEMS (Group B: Global Elective)		
Course Code:16G5B11		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 46L		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Represent schematic of communication system and identify its components.
2	Classify satellite orbits and sub-systems for communication.
3	Analyze different telecommunication services, systems and principles.
4	Explain the role of optical communication system and its components.
5	Describe the features of wireless technologies and standards.

UNIT-I	
Introduction to Electronic Communication: The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications. **The Fundamentals of Electronics**: Gain, Attenuation, and Decibels.	**09 Hrs**
UNIT-II	
Modulation Schemes: Analog Modulation: AM, FM and PM- brief review. **Digital Modulation:** PCM, Line Codes, ASK, FSK, PSK, and QAM. **Wideband Modulation:** Spread spectrum, FHSS, DSSS. **Multiplexing and Multiple Access Techniques:** Frequency division multiplexing, Time division multiplexing **Multiple Access**: FDMA, TDMA, CDMA, Duplexing.	**10 Hrs**
UNIT-III	
Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.	**09 Hrs**
UNIT-IV	
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	**09 Hrs**
UNIT-V	
Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse. Advanced Mobile Phone System (AMPS) **Digital Cell Phone Systems:** 2G, 2.5G, 3G and 4G cell phone systems, Advanced Cell Phones. **Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, WiMAX and Wireless Metropolitan-Area Networks.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the basics of communication systems.
CO2	Analyze the importance of modulation and multiple access schemes for communication systems.
CO3	Compare different telecommunication generations, wired and wireless communication.
CO4	Justify the use of different components and sub-system in advanced communication systems.

Reference Books	
1.	Principles of Electronic Communication Systems, Louis E. Frenzel, 3rd Edition, 2008, Tata McGraw Hill, ISBN: 978-0-07-310704-2.
2.	Electronic Communication Systems, Roy Blake, 2nd Edition, 2002, Thomson/Delamar, ISBN: 978-81-315-0307-2.
3.	Electronic Communication Systems, George Kennedy, 3rd Edition, 2008, Tata McGraw Hill ISBN: 0-02-800592-9.

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Semester End Evaluation (SEE); Theory (100 Marks)

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CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	---	1	1	---	---	---	1	---	---	---
CO2	2	1	---	1	1	---	---	---	1	---	---	---
CO3	2	1	---	1	1	---	---	---	2	---	---	---
CO4	1	1	---	1	1	1	---	---	1	---	---	---

Low-1 Medium-2 High-3

V Semester		
COMPUTATIONAL ADVANCED NUMERICAL METHODS (Group B: Global Elective)		
Course Code:16G5B12		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours: 44L		**SEE Duration:** 3Hrs

Course Learning Objectives:	
1	Adequate exposure to learn alternative methods and analyze mathematical problems to determine the suitable numerical techniques.
2	Use the concepts of interpolation, eigen value problem techniques for mathematical problems arising in various fields.
3	Solve initial value and boundary value problems which have great significance in engineering practice using ordinary differential equations.
4	Demonstrate elementary programming language, implementation of algorithms and computer programs to solve mathematical problems.

Unit-I	
Algebraic and Transcendental equations: Roots of equations in engineering practice, Polynomials and roots of equations, Fixed point iterative method, Aitken's process, Muller's method, Chebychev method.	**08 Hrs**
Unit – II	
Interpolation: Introduction to finite differences, Finite differences of a polynomial, Divided differences and Newton's divided difference interpolation formula, Hermite interpolation, Spline interpolation–linear, quadratic and cubic spline interpolation.	**08 Hrs**
Unit -III	
Ordinary Differential Equations: Solution of second order initial value problems–Runge-Kutta method, Milne's method, Boundary value problems (BVP's)–Shooting method, Finite difference method for linear and nonlinear problems, Rayleigh-Ritz method.	**09 Hrs**
Unit –IV	
Eigen value problems: Eigen values and Eigen vectors, Power method, Inverse Power method, Bounds on Eigen values, Greschgorin circle theorem, Jacobi method for symmetric matrices, Givens method.	**09 Hrs**
Unit –V	
Computational Techniques: Algorithms and Matlab programs for Fixed point iterative method, Aitken's–process, Muller's method, Chebychev method, Newton's divided difference method, Hermite interpolation, Spline interpolation, Power method, Inverse Power method, Runge-Kutta method, Milne's method, Shooting method, Rayleigh-Ritz method, Jacobi method and Givens method.	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and interpret the fundamental concepts of polynomial equations, Interpolation, Eigen value problems, Differential equations and corresponding computational techniques.
CO2:	Apply the knowledge and skills of computational techniques to solve algebraic and transcendental equations, Ordinary differential equations and eigen value problems.
CO3:	Analyze the physical problem and use appropriate method to solve roots of equations, Interpolating the polynomial, Initial and boundary value problems, Eigen value problems numerically using computational techniques.
CO4:	Distinguish the overall mathematical knowledge gained to demonstrate and analyze the problems of finding the roots of equations, Interpolation, Differential equations, Eigen value

	problems arising in engineering practice.
Reference Books	
1	Numerical methods for scientific and engineering computation, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers, 6th Edition, 2012, ISBN-13: 978-81-224-2001-2.
2	Numerical Analysis, Richard L. Burden and J. Douglas Faires, Cengage Learning, 9th Edition, 2012, ISBN-13: 978-81-315-1654-6.
3	Introductory Methods of Numerical Analysis, S. S. Sastry, PHI Learning Private Ltd., 4th Edition, 2011, ISBN: 978-81-203-2761-0.
4	Numerical Methods for Engineers, Steven C Chapra, Raymond P Canale, Tata Mcgraw Hill, 5th Edition, 2011, ISBN-10: 0-07-063416-5.

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

High-3: Medium-2: Low-1

V Semester		
BASICS OF AEROSPACE ENGINEERING **(Group B: Global Elective)**		
Course Code:16GE5B13		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours: 44L		**SEE Duration:** 3Hours

Course Learning Objectives: To enable the students to:	
1	Understand the history and basic principles of aviation
2	Demonstrate and explain foundation of flight, aircraft structures, material, aircraft propulsion
3	Comprehend the importance of all the systems and subsystems incorporated on a air vehicle
4	Appraise the significance of all the subsystems in achieving a successful flight

Unit-I	
Introduction to Aircraft : History of aviation, International Standard atmosphere, Atmosphere and its properties, Temperature, pressure and altitude relationships, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions, Introduction to Unconventional and Autonomous Air vehicles.	**08 Hrs**
Unit – II	
Basics of Aerodynamics : Bernoulli's theorem, Aerodynamic forces and moments on an Airfoil, Lift and drag, Types of drag, Centre of pressure and its significance, Aerodynamic centre, Aerodynamic Coefficients, Wing Planform Geometry, Airfoil nomenclature, Basic characteristics of airfoils, NACA nomenclature, Simple problems on lift and drag.	**08 Hrs**
Unit -III	
Aircraft Propulsion : Introduction, Classification of powerplants, Piston Engine: Types of reciprocating engines, Principle of operation of turbojet, turboprop and turbofan engines, Introduction to ramjets and scramjets, Comparative merits and demerits of different types Engines.	**07 Hrs**
Unit -IV	
Introduction to Space Flight : History of space flight, Evolution of Indian Space Technology, The upper atmosphere, Introduction to basic orbital mechanics, some basic concepts, Kepler's Laws of planetary motion, Orbit equation, Space vehicle trajectories**.** **Rocket Propulsion :**Principles of operation of rocket engines, Classification of Rockets, Types of rockets.	**08 Hrs**
Unit -V	
Aerospace Structures and Materials : Introduction, General types of construction, Monocoque, Semi-Monocoque and Geodesic structures, Typical wing and fuselage structure; Metallic and non-metallic materials for aircraft application. Use of aluminum alloy, titanium, stainless steel and composite materials, Low temperature and high temperature materials.	**07 Hrs**

Course Outcomes: At the end of this course the student will be able to :	
1	Appreciate and apply the basic principles of aviation
2	Apply the concepts of fundaments of flight, basics of aircraft structures, aircraft propulsion and aircraft materials during the development of an aircraft
3	Comprehend the complexities involved during development of flight vehicles.
4	Evaluate and criticize the design strategy involved in the development of airplanes

Reference Books	
1	John D. Anderson, Introduction to Flight, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.

2	Sutton G.P., Rocket Propulsion Elements, 8th Edition, 2011, John Wiley, New York, ISBN:1118174208, 9781118174203.
3	Yahya, S.M, Fundamentals of Compressible Flow, 5th Edition, 2016, New Age International, ISBN: 8122440223
4	T.H.G Megson,Aircraft structural Analysis, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**				**1**
CO2	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**1**				**1**
CO3	**1**		**3**	**3**								**1**
CO4	**2**	**2**	**3**	**3**		**2**	**2**	**2**				**1**

High-3 : Medium-2 : Low-1

VI SEMESTER		
INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP (Theory) (Common to BT, CHE, CV,E&I, IEM, ME)		
Course Code:16HSI61		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 36L		**SEE Duration:** 03Hrs
Course Learning Objectives: The students will be able to		
1	To build awareness on the various forms of IPR and to build the perspectives on the concepts and to develop the linkages in technology innovation and IPR.	
2	To equip students on the need to protect their own intellectual works and develop ethical standards governing ethical works.	
3	To motivate towards entrepreneurial careers and build strong foundations skills to enable starting, building and growing a viable as well as sustainable venture.	
4	Develop an entrepreneurial outlook and mind set along with critical skills and knowledge to manage risks associated with entrepreneurs.	
UNIT-I		
Introduction: Types of Intellectual Property, WIPO, WTO, TRIPS. **Patents:** Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; Biotechnology patents, protection of traditional knowledge, Infringement of patents and remedy, Case studies **Trade Secrets:** Definition, Significance, Tools to protect Trade secrets in India.		**07 Hrs**
UNIT-II		
Trade Marks: Concept, function and different kinds and forms of Trade marks, Registrable and non- registrable marks. Registration of trade mark; Deceptive similarity; Assignment and transmission; ECO Label, Passing off; Offences and penalties. Infringement of trade mark with Case studies		**04 Hrs**
UNIT-III		
Industrial Design: Introduction, Protection of Industrial Designs, Protection and Requirements for Industrial |Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Case Studies. **Intellectual property and cyberspace:** Emergence of cyber-crime; Grant in software patent and Copyright in software; Software piracy; Data protection in cyberspace		**09 Hrs**
UNIT-IV		
Introduction to Entrepreneurship – Learn how entrepreneurship has changed the world. Identify six entrepreneurial myths and uncover the true facts. Explore E-cells on Campus **Listen to Some Success Stories:** - Global legends Understand how ordinary people become successful global entrepreneurs, their journeys, their challenges, and their success stories. Understand how ordinary people from their own countries have become successful entrepreneurs. **Characteristics of a Successful Entrepreneur** Understand the entrepreneurial journey and learn the concept of different entrepreneurial styles. Identify your own entrepreneurship style based on your personality traits, strengths, and weaknesses. Learn about the 5M Model, each of the five entrepreneurial styles in the model, and how they differ from each other. **Communicate Effectively:** Learn how incorrect assumptions and limiting our opinions about people can negatively impact our communication. Identify the barriers which cause communication breakdown, such as miscommunication and poor listening, and learn how to overcome them. **Communication Best Practices.** Understand the importance of listening in communication and learn to listen actively. Learn a few body language cues such as eye contact and		**08 Hrs**

handshakes to strengthen communication. (Practical Application)	
UNIT-V	
Design Thinking for Customer Delight: - Understand Design Thinking as a problem-solving process. Describe the principles of Design Thinking. Describe the Design Thinking process. **Sales Skills to Become an Effective Entrepreneur:** - Understand what is customer focus and how all selling effort should be customer-centric. Use the skills/techniques of personal selling, Show and Tell, and Elevator Pitch to sell effectively. **Managing Risks and Learning from Failures:** - Identify risk-taking and resilience traits. Understand that risk-taking is a positive trait. Learn to cultivate risk-taking traits. (Practical Application) Appreciate the role of failure on the road to success, and understand when to give up. Learn about some entrepreneurs/risk-takers. (Practical Application). **Are You Ready to be an Entrepreneur:** - Let's ask "WHY" Give participants a real picture of the benefits and challenges of being an entrepreneur. Identify the reasons why people want to become entrepreneurs. Help participants identify why they would want to become entrepreneurs.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the applicable source, scope and limitations of Intellectual Property within the purview of engineering domain.
CO2:	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.
CO3:	Enable the students to have a direct experience of venture creation through a facilitated learning environment.
CO4:	It allows students to learn and apply the latest methodology, frameworks and tools that entrepreneurs use to succeed in real life.

Reference Books	
1.	Law Relating to Intellectual Property, Wadehra B L,5th Edition, 2012, Universal Law Pub Co. Ltd.-Delhi, ISBN: 9789350350300
2.	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.
3.	Intellectual Property and the Internet, Rodney Ryder, 2002, Lexis Nexis U.K., ISBN: 8180380025, 9788180380020.
4.	Entrepreneurship, Rajeev Roy, 1st Edition, 2012, Oxford University Press, New Delhi, ISBN: 9780198072638.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**1**	**2**	**-**	**3**
CO2	**1**				**3**	**3**	**3**	**3**	**1**	**2**	**-**	**3**
CO3	**-**	**3**	**2**	**-**	**-**	**2**	**2**	**3**	**3**	**3**	**3**	**3**
CO4	**-**	**3**	**2**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Low-1 Medium-2 High-3

VI Semester		
VIRTUAL INSTRUMENTATION & DATA ACQUISITION (Theory and Practice)		
Course Code:16EI62		**CIE Marks:** 100+50
Credits/Week: L:T:P:S: 3:0:1:1		**SEE Marks:** 100+50
Hours:36L		**SEE Duration:** 03Hrs+03Hrs

Course Learning Objectives: The students will be able to	
1	Understand the difference between conventional and graphical programming, basic data acquisition concepts
2	Differentiate the real time and virtual instrument
3	Develop ability for programming in LabVIEW using various data structures and program structures
4	Analyze the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.

UNIT-I	
Graphical Programming Environment: Basic of Virtual Instrumentation, Conventional and Graphical Programming. Introduction to LabVIEW, Components of LabVIEW and Labels. **Fundamentals:** Data Types, Tool Pallets, Arranging Objects, Color Coding, Code Debugging, Context Help, Creating Sub-VIs Boolean, Mechanical action- switch, and latch actions, String data types, enum, ring, Dynamics.	**05 Hrs**
UNIT-II	
Fundamentals of Virtual Instrumentation Programming: For Loop, While Loop, shift registers, stack shift register, feedback node, and tunnel. **Timing function**: Timing VI, elapsed time, wait function Case structures, formula node, Sequence structures, Arrays and clusters, visual display types- graphs, charts, XY graph. Local and Global variables.	**09 Hrs**
UNIT-III	
Error Handling- error and warning, default error node, error node cluster, automatic and manual error handling. **String Handling:** Introduction, String Functions, LabVIEW String Formats. **File Input/ Output:** Introduction, File Formats, File I/O Functions and file Path functions. **Design patterns:** Producer/consumer, event handler, derived design pattern, Queued message handler, Producer/consumer (events), Producer/consumer (state machine).	**08 Hrs**
UNIT-IV	
Data Acquisition: Introduction to data acquisition, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O, counters, NI-DAQmx tasks. **DAQ Hardware configuration:** Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants, Instrument Assistants **Interfacing Instruments: GPIB and RS232 :** Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, RS232C/RS485 Interfacing, VISA **Case Studies:** Real time application using myRIO and myDAQ.	**07 Hrs**
UNIT-V	
Advanced Topics In LabVIEW: Use of analysis tools and application of VI: Fourier transforms Power spectrum, Correlation methods, windowing & filtering. Inter-Process Communication, Notifier, Semaphore, Data Sockets, VI server **Advanced data transfer mechanism:** Synchronous dynamic VI, re-entrant VI Simulation of systems using VI: Development of Control system, Image acquisition and processing.	**07 Hrs**

Lab 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. Data acquisition from different sensors, Processing collected data and analyzing parameters and storing the results.
6. To perform the control system design.
7. Acquisition and processing of a biomedical signal and processing.
8. Programming using Image Processing concept.
9. Application using myRIO.
10. Application using myDAQ.

Course Outcomes: After completing the course, the students 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.

Reference Books	
1	Virtual instrumentation Using LabVIEW, Jovitha Jerome, 4th Edition, 2010, PHI Learning Pvt. Ltd., ISBN: 978-812034035.
2	Virtual Instrumentation Using LabVIEW, Sanjay Gupta & Joseph John, 2nd Edition, New Delhi, 2010,Tata McGraw Hill Publisher Ltd., ISBN : 978-0070700284
3	LabVIEW for Everyone: Graphical Programming made easy and fun, Jeffrey Travis, Jim Kring, 3rd Edition, 2006, Prentice Hall, ISBN: 978-0131856721
4	Data Acquisition using LabVIEW, Behzad Ehsani, 1st Edition, 2017, Packt Publishing, ISBN:978-1782172161

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks
CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total CIE for theory is 100.

Laboratory- 50 Marks
The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.
Semester End Evaluation (SEE): Total marks: 100+50=150

Theory – 100 Marks

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO2	**1**	**1**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO3	**1**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO4	**2**	**1**	**1**	**2**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**2**

Low-1 Medium-2 High-3

VI Semester		
AUTOMATIC PROCESS CONTROL AND MODELLING TECHNIQUES (Theory and Practice)		
Course Code: 16EI63		**CIE Marks:**100+50
Credits/Week: L:T:P:S: 3:0:1:1		**SEE Marks:**100+50
Hours: 35L		**SEE Duration:** 03Hrs+03Hrs
Course Learning Objectives: The students will be able to:		
1	Understand the concepts and applications of basic & advanced Automatic Process Control Systems.	
2	Design and predict the performance of various Analog and Digital Electronic PID controllers.	
3	Analyze Control loop Tuning and Learn the language of ISA symbols and create P&ID flow Diagrams.	
4	Develop the various Process Models and apply the Mathematical representations for Analysis.	

UNIT-I	
Introduction to Process control: Introduction, Process control systems, Process-Control Block Diagram, control system evaluation, Stability, Steady State Regulation, Transient Regulation, Evaluation Criteria, Damped Response, Cyclic Response, Quarter Amplitude Criterion. **Analog & Digital Processing:** Data representation, On/Off Control, Analog Control, Digital Control, Supervisory Control, Direct Digital control, Smart Sensor, Networked Control Systems, PLC for On/Off Control application, Analog Data Representation, Definitions, Process Control Drawings, Problems.	**05 Hrs**
UNIT-II	
Controller principles: Introduction, Process Characteristics, Process Equation, Process Load, Process Lag, Process Regulation, Control System Parameters, Error, Variable Range, Control Parameter Range, Control Lag, Dead Time, Cycling. **Controller Modes:** Continuous Controller Modes, Mathematical Analysis of Two-Position Controller Mode, P, I, & D Controller Modes, Direct & Reverse Action, Mathematical Analysis of Two-Mode & Three-Mode Composite Controllers, Applications & Problems on Predicting Controller Outputs.	**10 Hrs**
UNIT-III	
Analog controllers: Introduction, General features of an Actual Controller, Electronic controllers, Error Detector, Design of an On/Off Controller, Design of Single-Mode, Two-Position and Three-Position Controller Modes. **Digital controllers:** Introduction, Digital Electronic Methods, Computers in Process Controls, Data Logging, DAS, Supervisory Control, Controller Software, Controller Modes, P, I, D, and PID Digital Controller Modes, Computer Controller Examples.	**10 Hrs**
UNIT-IV	
Control loop characteristics: Introduction, Control system configurations, Single Variable, Independent Single Variable, Interactive Single Variable, Compound Variable, Cascade Control, Multi-Variable Control systems, Analog Control, Supervisory & Direct Digital Control. **Process loop tuning methods:** Open-Loop Transient Response Method and Ziegler-Nichols Closed-Loop Method for P, PI, & PID control Modes, Frequency Response Methods for P, I, & D Modes, P&ID Symbols, Introduction, Connecting Lines, General Instruments or Functions, Actuators & Process Elements, P&ID for a Chemical Process, ISA Flow Diagrams.	**05 Hrs**
UNIT-V	
Process Control Modelling: Process model, Physical model and control models, Process Modelling, Uses of Process Models, Types of Process Models, Frequency-domain Modelling, Time-domain Modelling, Examples, Mathematical Modelling of a room heating system.	**05 Hrs**

Modelling Procedure: General steps of Modelling procedure, Goals Definition, Information preparation, Model formulation, Solution determination, Results Analysis, Model Validation.	

Lab Experiments:

PID Automatic Controller Experiments:

1. Tuning and Testing the Performance of Flow control loop.
2. Tuning and Testing the Performance of Temperature control loop.
3. Tuning and Testing the Performance of Level control loop.
4. Tuning and Testing the Performance of Pressure control loop.
5. Tuning and Testing the Performance of Multi-Process control loops.

Virtual Instrumentation Based Process Control Experiments:

6. Simulation experiment on V.I. for temperature indication and annunciation .
7. Simulate level measurement and indication of emergency shutdown feature using LabVIEW.
8. LabVIEW based Data Acquisition System design and realization for Multiple Parameter (temperatures) measurements using NI-DAQ.

µC - based Experiments:

9. µC-based Thermocouple Temperature Indicator – Programming, & Calibration using Look-Up Table technique.
10. µC-based RTD Temperature Indicator – Programming, & Calibration using Look up Table technique.
11. µC-based Thermistor Temperature Indicator – Programming, & Calibration using Look up Table Technique.
12. µC-based Strain Indicator – Programming, & Calibration using Look up Table Technique.

Advanced Process Control Demo Experiments using Universal Process Control Trainer:

13. Design and demonstrate the ratio controller to control the ratio of two liquids to be mixed with the given ratio using UPCT.
14. Configure and realize a cascade multi-variable control loop with level & flow control loops using UPCT.

Course Outcomes: After completing the course, the students will be able to:	
CO1:	Understand the basic concepts and develop schematics & block diagrams for various industrial process control systems.
CO2:	Apply the techniques of control loop tuning & learn the art of reading P&ID Symbols and create ISA Flow Diagrams..
CO3:	Analyze & Design electronic analog P, I, D, PI, PD, PID controllers and write the algorithms for their digital implementation
CO4:	Develop solutions for real time problems.

Reference Books	
1	Process Control Instrumentation Technology, Curtis D. Johnson, 7th Edition, 2012, ISBN 81-7758-410-3.
2	Process Control – Concepts, Dynamics and Applications, S. K. Singh, 2009, Prentice hall of India, ISBN-978-81-203-3678-0.
3	Instrument Engineers Handbook, Process Measurement: Volume-1,Process Control,Volume-2, Bela G. Liptak, 3rd Edition, 2010, Chilton Book Company/ Rad-nor, ISBN-81-7956-540-8.
4	Instrumentation, Kirk & Rimboi, 2nd Edition, 2010, PHI, ISBN 81-7758-410-5.

Continuous Internal Evaluation (CIE): Total marks: 100+50=150

Theory – 100 Marks

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total CIE for theory is 100.

Laboratory- 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE): Total marks: 100+50=150

Theory – 100 Marks

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**2**	**3**	**3**	**3**	**1**	**1**	**-**	**2**	**3**	**1**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**2**	**3**	**2**	**3**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**2**	**3**	**1**	**2**
CO4	**2**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**-**	**3**

Low-1 Medium-2 High-3

VI Semester

COMMUNICATION SYSTEMS (Theory)		
Course Code:16EI64		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:1:0:0		**SEE Marks:** 100
Hours: 35L+24T		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Understand the fundamentals concepts of communication system concepts.
2	Study generation and detection of AM, DSB modulation and de modulation techniques.
3	Study generation and detection of VSB and SSB modulation and de modulation techniques.
4	Understand fundamentals of digital modulation techniques.
5	Study the generation of ASK, FSK generation techniques.

UNIT-I	
Introduction to Communication systems: 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. Block diagram of communication system, Need for modulation, Types of modulation.	**07 Hrs**
UNIT-II	
Analog Communication **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. Demodulation of AM waves: Square law detector, Envelope detector. **DSB Modulation:** Double side band suppressed carrier modulation, time domain and frequency domain description. Time domain and Frequency domain description of SSB modulated waves, Generation of SSB waves, Demodulation of SSB waves.	**07 Hrs**
UNIT-III	
Modulation Techniques **VSB Modulation:** Time domain and frequency domain description of VSB modulated waves, Generation of VSB Modulated wave. **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, Frequency translation and FDM.	**07 Hrs**
UNIT-IV	
Digital Communication: Channel Capacity Theorem, model of digital communication systems, sampling theorem, Reconstruction of message process from its samples, TDM, Pulse code modulation, differential Pulse code modulation, delta modulation, applications.	**07 Hrs**
UNIT-V	
Digital modulation techniques: Binary modulation techniques, ASK, FSK generation and detection of modulated waves.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand fundamentals of analog and digital communication systems.
CO2:	Apply the fundamental concepts of communication for modulation and demodulation techniques.
CO3:	Evaluate the performance of different modulation techniques.
CO4:	Create a modulation system using the pros and cons of different modulation techniques.

Reference Books

1	Electronic Communication Systems, Roy Blake, 2nd Edition, 2006, Delmar Cengage Learning, ISBN: 978-8131503072.
2	Electronic Communication Systems, George Kennedy, 5th Edition, 2011, TATA McGraw-Hill, ISBN: 978-0071077828.
3	Communication systems, Simon Haykin, 3rd Edition, 2007, Willey Publishers, ISBN: 978-8126513666.
4	Digital and analog communication, Leon W. Couch, 8th Edition, 2013, Pearson publishers, ISBN: 9789332518582, 9332518580.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO2	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**2**
CO3	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**1**
CO4	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**

Low-1 Medium-2 High-3

VI Semester		
COMPUTER COMMUNICATION NETWORKS **(Group C:Professional Core Elective)**		
Course Code:16EI6C1		**CIE Marks:** 100
Credits/Week: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand the various layers of OSI and TCP/IP communication models.
2	Apply the appropriate concepts of data rate of channels; decide on cables based on bandwidth requirements.
3	Analyze the different networking algorithms.
4	Evaluate the hardware and software components of networking.

UNIT-I	
Introduction: Data Communications, Networks, Topologies, Protocols and Standards, Layered tasks, OSI model, Layers in the OSI model, TCP/IP protocol suite, Addressing, Telephone Networks, Dial up Modem, DSL, Cable TV for Data transmission.	**06 Hrs**
UNIT-II	
The Physical Layer: Guided media, Transmission impairments, Data rate limits, Performance, Multiplexing, FDM, WDM and TDM, Circuit switching, Packet switching. **Data Link Layer Error Detection and Correction:** Introduction, Block coding, Cyclic codes, Cyclic Redundancy Check, Checksum, Framing, Protocol: Noiseless channel, Noisy channel	**09 Hrs**
UNIT-III	
Multiple Access: Random Access-ALOHA, CSMA, Controlled Access. **Wired LANs**: Ethernet-Standard Ethernet, Fast Ethernet and Gigabit Ethernet. **Wireless LAN**: IEEE 802.11frame format, Bluetooth architecture, Connecting Devices. Passive Hubs, Repeaters, Active Hubs, Bridges, Routers, Gateways, Back bone Networks, Virtual LANs, Communication between Switches.	**09 Hrs**
UNIT-IV	
Routing Algorithms: Optimality principle, Shortest path routing, Flooding, Distance vector routing, Link state routing, and Hierarchical routing. **Network Layer:** IPv4 addresses, address space, notation, Classful addressing, Structure of IPv6, address space.	**06 Hrs**
UNIT-V	
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.	**05 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of computer communication networks and their securities.
CO2:	Apply the various networking protocols for different networking scenarios.
CO3:	Analyze the different networking algorithms and their usage.
CO4:	Develop simulation models for networking topologies.

Reference Books

1	Data Communications and Networking, Behrouz A Forouzan, 5th Edition, 2012, McGraw-Hill, ISBN: 9781259064753.
2	Computer Networks, Andrews S. Tanenbaum, 5th Edition, 2014, Pearson Publication, ISBN: 978-93-325-1874-2.
3	Data and Computer Communications, W.Stallings, 10th Edition, 2014, Pearson Education, ISBN: 978-0024542526.
4	Introduction to Data Communications and Networking, Wayne Tomasi, 1st Edition, 2011, Pearson Education, ISBN: 978-81- 31709306.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-		-	-	-	-		-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	1	1	2	-	1	-	-	-	1	1	-	
CO4	1	-	1	-	2	-	-	-	2	2	-	2

Low-1 Medium-2 High-3

VI Semester		
ADVANCED SIGNAL PROCESSING **(Group C:Professional Core Elective)**		
Course Code:16EI6C2		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:1		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Study the parametric methods for power spectrum estimation.
2	Study adaptive filtering techniques using LMS algorithm and to study the applications of adaptive filtering.
3	Study multirate signal processing fundamentals.
4	Study the analysis of speech signals & also to introduce the student to wavelet transforms.

UNIT-I	
Parametric methods for power spectrum estimation: Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters – unconstrained least-squares method for the AR Model parameters – sequential estimation methods for the AR Model parameters – selection of AR Model order.	**07 Hrs**
UNIT-II	
Speech signal processing: Digital models for speech signal: Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal: - Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.	**07 Hrs**
UNIT-III	
Wavelet transforms: Fourier Transform: Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet.	**07 Hrs**
UNIT-IV	
Multirate signal processing: Decimation by a factor D – Interpolation by a factor I – Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures – Polyphase filter structure.	**07 Hrs**
UNIT-V	
Adaptive Signal Processing: FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand different algorithms for different signal processing applications.
CO2:	Apply different algorithms for practical applications.
CO3:	Analyze the algorithms and concepts of signal processing.
CO4:	Develop algorithms for real time signal processing applications.

Reference Books	
1	Digital Signal Processing, Principles, Algorithms and Applications, John G.Proakis, Dimitris

	G.Manobakis, 4th Edition, 2007, PHI, ISBN-13:978-8131710005.
2	Statistical Digital Signal Processing and Modelling, Monson H. Hayes, 2002, Wiley, ISBN-13: 978-047159314.
3	Digital Processing of Speech Signals, L.R.Rabiner and R.W.Schafer, 2005, Pearson Education, ISBN-13: 978-0132136037.
4	Modern Digital Signal Processing, Roberto Crist, 1st edition, 2004. Cengage Learning, ISBN-13: 978-0534400958.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**
CO2	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**
CO3	**1**	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**
CO4	**-**	**2**	**1**	**1**	**2**	**2**	**-**	**-**	**1**	**2**	**-**	**1**

Low-1 Medium-2 High-3

VI Semester		
LASERS INSTRUMENTATION AND APPLICATION **(Group C:Professional Core Elective)**		
Course Code:16EI6C3		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:1		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand the fundamentals of LASERs and fiber optics.
2	Apply and interpret the industrial importance of LASERs and fiber optical instruments.
3	Analyze the working of various optical sensors.
4	Design and evaluate applications involving fiber optics and optical sensors.

UNIT-I	
Laser Fundamentals : Principles of LASERs, Fundamental characteristics of Lasers– laser modes – resonator configuration – Q-switching and mode locking. Safety with LASERs.	**06 Hrs**
UNIT-II	
Laser types: Three level and four level lasers- liquid lasers, semiconductor lasers. Principle, Construction and working of Ruby, Nd-YAG, He-Ne, Carbon dioxide, Argon lasers. **Lasers applications:** Measurement of distance: Reversible Counting, refractive Index Correction, Surface topography and optical Component testing, beam modulation telemetry, pulse echo techniques, Laser Doppler Velocimetry, Laser Spectroscopy: Molecular Beam Spectroscopy, Saturation Spectroscopy.	**09 Hrs**
UNIT-III	
Optical Fibers and Optical Sensors Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses – dispersion – optical fiber measurement – optical sources – optical detectors. **Noncommunication applications of Fibers:** Fiber optic sensors– Multimode passive Optical fiber sensors, Multimode active Optical fiber sensors, Single mode fiber sensors. **Light Guiding fibers:** Coherent bundles.	**09 Hrs**
UNIT-IV	
Biomedical Application of Lasers **Cardiovascular Applications of lasers:** Angioplasty, Vascular Anastomoses-Laser welding in Cardiovascular system, Transmyocardial Laser revascularization (TMLR). **Lasers in Photodynamic Therapy:** PHOTOFRIN PDT in the treatment of Ocular cancer, Cutaneous and subcutaneous Tumors, Plastic surgery, gynaecology and oncology.	**06 Hrs**
UNIT-V	
Industrial Application of Lasers **Materials processing Applications**: Surface Hardening, Semiconductor processing. Laser welding: Micro welding, Deep Penetrating welding, Laser assisted machining, Laser cutting, Micro Machining, Drilling Scribing and Marking.	**05 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic fundamentals of LASER and Fiber optics
CO2:	Apply LASER as source in designing various Optoelectronic applications
CO3:	Analyze various optic sensor applications with LASER light.
CO4:	Develop a design solution in applications using LASERs and fiber optics.

Reference Books	
1	Lasers Principles and Applications, J Wilson, JFB Hawkes, 1991, Prentice Hall International Series in Optoelectronics, ISBN-13: 978-0135236970, ISBN-10: 0135236975.
2	Masers and Lasers, Mario Bertolotti, 2nd Edition, 2016. CRC press, ISBN: 9781482217773.
3	An Introduction to LASERS-Theory and applications, M.N Avadhanulu, 2001,S. Chand Company Ltd. ISBN :9788121920711
4	Industrial applications of lasers, John F Read, 2nd Edition, 1997, Academic Press, ISBN: 9780125839617.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**-**	**1**	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**2**	**-**	**-**

Low-1 Medium-2 High-3

VI Semester		
JAVA PROGRAMMING **(Group C:Professional Core Elective)**		
Course Code:16EI6C4		**CIE Marks:** 100
Credits/Week: L:T:P:S:3:0:0:1		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Demonstrate knowledge of basic features of the Java programming language.
2	Exercise ability to use the Java programming language to create a simple application.
3	Create class definitions and declare variables of class type in the Java programming language.
4	Describe exceptions that can be recognized and handled by the Java programming language.
5	Design and create GUIs using the Java programming language.

UNIT-I	
Introduction to Java: Describe Internet role, advantages and, environment setup of Java. Basics of Java, Background/History of Java, Java and the Internet, Advantages of Java, Java Virtual Machine & Byte Code, Java Environment Setup, Java Program Structure, Differentiate between POP and OOP. Basics of OOP: Abstraction, Inheritance, Encapsulation, Classes, subclasses and super classes, Polymorphism and Overloading, message communication. Data types, Literals: Types of Literals, Operators, Control Statements: If, switch, do-while, while, for, enhanced for loop, Nested Loop, break, continue, return statements, Conversion and Casting, Scope of variables & default values of variables declared Wrapper classes Comment, Syntax Garbage Collection.	**07 Hrs**
UNIT-II	
Object Oriented Programming Concepts: Defining classes, fields and methods, creating objects, accessing rules, this keyword, static keyword, method overloading, and final keyword, Constructors: Default constructors, Parameterized constructors, copy constructors, passing object as a parameter, constructor overloading. **Inheritance:** Basics of Inheritance, Types of inheritance: single, multiple, multilevel, hierarchical and hybrid inheritance, concepts of method overriding, extending class, super class, subclass, dynamic method dispatch & Object class.	**07 Hrs**
UNIT-III	
Packages & Interfaces: Creating package, importing package, access rules for packages, class hiding rules in a package. Defining interface, inheritance on interfaces, implementing interface, multiple inheritance using interface, Abstract class and final class. **Exception Handling:** Types of errors, exceptions, try, catch statement, multiple catch blocks, throw and throws keywords, finally clause, uses of exceptions, user defined exceptions.	**07 Hrs**
UNIT-IV	
Multithreading: Fundamentals: Thread Life Cycle, Ways of creating threads, creating multiple threads, is Alive (), join (), Thread Synchronization, Thread priorities, Interthread communication, Methods for suspending, resuming and stopping threads.	**07 Hrs**
UNIT-V	
File Handling: Stream classes, class hierarchy, useful I/O classes, creation of text file, reading and writing text files. **String Handling**: String and String Buffer class, String constructors, Data conversion using value Of (), to String () methods, Methods for String Comparison, Searching string and modifying string.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand various concept of Java using object oriented programming language.
CO2:	Apply multithreading concept to solve real world industrial applications.
CO3:	Analyze the basic structure of Database and recognize the different views of the database.
CO4:	Design functional and aesthetic displays on the computer screen using Java classes and interact with users, and to understand the event-based GUI handling principles.

Reference Books	
1	Java The Complete Reference, Herbert Schildt, 9th Edition, 2017, Tata McGraw Hill, ISBN: 978-9339212094.
2	J2EE The Complete Reference, Jim Keogh, 1st Edition, 2017, Tata McGraw Hill, ISBN: 978-0070529120.
3	The J2EE Tutorial, Stephanie Bodoff , 2nd Edition, 2002, Addison Wesley, ISBN: 978-0201791686
4	Introduction to JAVA Programming, Daniel Liang, 6th Edition, 2011, Pearson Education, ISBN: 978-8131725825.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**-**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO2	**1**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO3	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**-**	**2**

Low-1 Medium-2 High-3

VI Semester		
ANALYTICAL INSTRUMENTATION **(Group D:Professional Core Elective)**		
Course Code:16EI6D1		**CIE Marks:**100
Credits/Week: L:T:P:S:4:0:0:0		**SEE Marks:**100
Hours:46L		**SEE Duration:** 3 Hrs
Course Learning Objectives: The students will be able to		
1	Describe the principle and operation of different types of spectroscopy.	
2	Explain the principle, working and instrumentation of Chromatography, Mass spectrometry and automated chemical analysis systems.	
3	Analyze the performance of different analytical instruments for a particular analysis.	
4	Carry out further study should they be interested to work in the field.	

UNIT-I	
Introduction: Types of analytical methods, Instruments for analysis, Electromagnetic radiation, its properties and interaction with matter. Elements of an analytical instrument, Intelligent analytical instrumentation systems, PC based analytical instruments. **Colorimeters and Spectrophotometers (Visible-Ultraviolet):** Visible spectroscopy: Theory of spectrophotometry and colorimetry, Deviations from Beers law. Colorimeters/Photometers: Single beam, Double beam, Multichannel Photometers. Spectrophotometers: Single beam null type, Double beam ratio recording, Microprocessor based and High Performance Spectrophotometers.	**10 Hrs**
UNIT-II	
Infrared spectrophotometers: Introduction, range of infrared radiation, Instrumentation, Single beam and Double beam spectrophotometers, Fourier transform Infrared Spectroscopy. **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 Spectroscopy:** Theory, Instrumentation, Spectrographs, Applications of Emission Spectroscopy, Advantages and Disadvantages of Emission spectroscopy.	**10 Hrs**
UNIT-III	
X-ray spectroscopy: Introduction to X-ray absorption, General theory, Instrumentation, Non-dispersive instruments, X-ray diffraction and its applications. **Nuclear Magnetic Resonance spectroscopy:** Introduction, Principle, Instrumentation, Types, Applications and Limitations of NMR. **Radiochemical Instruments:** Fundamentals, Radiation detectors, Liquid scintillation counters, Pulse-Height analyzer, Gamma Spectrometry.	**10 Hrs**
UNIT-IV	
Gas chromatography: Introduction, Gas chromatography, Instrumentation, Types of columns and detectors, Applications of Gas chromatography. **Raman Spectrometer:** The Raman effect, Raman Spectrometer, PC based Raman Spectrometer.	**08 Hrs**
UNIT-V	
Mass spectrometry: Theory of mass spectrometry, Instrumentation: Ion sources, Inlet systems, mass analyzers: single beam, double beam, quadrapole and time of flight, applications. **Automated chemical analysis systems:** Benefits of automation, types of automatic analysis systems, automated biochemical analysis system, Lab-on–chip technology for	**08 Hrs**

automated analysis.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic principles of different types of spectroscopies.
CO2:	Apply the basic concepts to realize the theoretical design for analytical instruments.
CO3:	Analyse and evaluate the performance of different analytical instruments for a particular application.
CO4:	Create an analytical instrument using appropriate sources and detectors for a particular problem.

Reference Books	
1	Instrumental Methods of Chemical Analysis, Gurdeep R. Chatwal, Sham K. Anand, 6th Edition, 2015, Himalaya Publishing house, ISBN-13:9789351420880.
2	Handbook of Analytical Instruments, Dr. R S Khandpur, Second Edition, 2007, Tata McGraw-Hill Education, ISBN: 9780071331494.
3	Principles of Instrumentation Analysis, Douglas A Skoog, F. James Holler, Stanley R. Crouch, 6th revised Edition, 2013, Thomson Brooks, ISBN-13: 978-0495125709.
4	Instrumental Methods of Chemical Analysis, Galen W Ewing, 5th revised Edition, 2013, Mc-Graw Hill, ISBN-13: 978-0070198579.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**2**	**2**	**-**	**1**
CO2	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**1**
CO3	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**2**
CO4	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**2**	**-**	**2**

Low-1 Medium-2 High-3

VI Semester		
AUTOMOTIVE ELECTRONICS (Group D:Professional Core Elective)		
Course Code:16EI6D2		**CIE Marks:** 100
Credits/Week: L:T:P:S:4:0:0:0		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 3 Hrs

Course Learning Objectives: The students will be able to	
1	Understand the fundamentals of Automotive electronics and its evolution and trends.
2	Understand sensors and sensor monitoring mechanisms aligned to automotive systems.
3	Get an overview about electronic engine and vehicle motion control.
4	Understand, design and model various automotive control systems using Model based development technique.

UNIT-I	
Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System. **Air/Fuel Systems:** Fuel Handling, Air Intake System, Air/ Fuel Management.	**09 Hrs**
UNIT-II	
Sensors I: Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor.	**09 Hrs**
UNIT-III	
Sensors II: Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor. Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator.	**09 Hrs**
UNIT-IV	
Electronic Engine Control: Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control. **Vehicle Motion Control:** Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension.	**09 Hrs**
UNIT-V	
Automotive Control Systems and Model Based Development: Automotive Control System & Model Based Development: Control system approach in Automotive Electronics, Analog and digital control methods, modelling of linear systems, System responses, Modelling of Automotive Systems with simple examples. **Model based Development**: Introduction to Simulink tool boxes, Model-Based Design for a small system, Motor Model, Generator Model, Controller Model.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand fundamentals of automotive system.

CO2:	Analyse different sensors and other engine parameters necessary in making a complete automotive system.
CO3:	Evaluate electronic engineering methodologies and techniques related to automotive systems.
CO4:	Develop/simulate automotive subsystem using modern numerical analysis and simulation.

Reference Books	
1	Understanding Automotive Electronics, William B. Ribbens, 8th Edition, 2017, SAMS/Elsevier Publishing, ISBN: 9780128104354
2	Automotive Electronics Systems and Components, Robert Bosch Gambh, 5th Edition, 2007, John Wiley & Sons Ltd., ISBN 978-3-658-01784-2.
3	Automobile Electrical and Electronics System, Tom Denton, 3rd Edition, 2004, Elsevier Publications, ISBN: 0 7506 62190.
4	Automotive Electronics Handbook, Ronald K Jurge, 1995,2nd Edition, 1999, McGraw-Hill, ISBN-978-0070344532

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**-**	**1**
CO2	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**
CO3	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO4	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**1**

Low-1 Medium-2 High-3

VI Semester		
APPLICATION SPECIFIC INTEGRATED CIRCUITS (ASIC) **(Group D:Professional Core Elective)**		
Course Code: 16EI6D3		**CIE Marks:** 100
Credits/Week: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours:45L		**SEE Duration:**3 Hrs

Course Learning Objectives: The students will be able to	
1	Understanding the ASIC custom and semicustom design flow.
2	Describe about ASIC library design.
3	Impart ideas about floor planning and placement.
4	Analyze basic design concepts of Routing.

UNIT-I	
Introduction: Full Custom with ASIC, Semicustom ASICS, Standard Cell based ASIC, Gate array based ASIC, Channelled gate array, Channelless gate array, structured get array, Programmable logic device, FPGA design flow, ASIC cell libraries.	**09 Hrs**
UNIT-II	
ASIC Library Design: Logical effort: practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum number of stages, library cell design.	**09 Hrs**
UNIT-III	
Low-level Design Entry: Schematic Entry: Hierarchical design. The cell library, Names, Schematic Icons & Symbols, Nets, schematic entry for ASIC'S, vectored instances and buses, edit in place attributes, Net list, screener, Back annotation connections.	**09 Hrs**
UNIT-IV	
ASIC Construction Floor Planning and placement: Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning, placement algorithms, iterative placement improvement, Time has driven placement methods.	**09 Hrs**
UNIT-V	
Physical Design: Global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the full custom and semicustom design flow.
CO2:	Apply the concept to design standard cell library.
CO3:	Analyse and evaluate the different design techniques and physical design algorithms to achieve effective power, area and timing.
CO4:	Design a complex system using different design flow.

Reference Books	
1	Application Specific Integrated Circuits, Michael John Sebastin Smith, 2008, Pearson Education, ISBN: 0201500221
2	Analog VLSI Design-NMOS and CMOS, Malcolm R. Haskard, Lan. C. May, 1998, Prentice Hall,ISBN-10: 0130326402
3	VLSI Circuits and Systems in Silicon, Andrew Brown, 2001, McGraw Hill, ISBN-10: 0077072219.
4	Application Specific Integrated Circuit (ASIC) Technology, Norman G. Einspruch and Norman Einspruch,2012, Academic Press, ISBN-13: 978-0124315211

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**

Low-1 Medium-2 High-3

VI Semester		
AIRCRAFT INSTRUMENTATION **(Group D:Professional Core Elective)**		
Course Code:16EI6D4		**CIE Marks:** 100
Credits/Week: L:T:P:S:4:0:0:0		**SEE Marks:** 100
Hours:45L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Understand qualitative and quantitative displays of an aircraft.
2	Gain knowledge on air data instruments and how they are incorporated in an aircraft.
3	Develop the knowledge of safety aspects of an aircraft such as warning systems.
4	Learn more about gyroscope and its related flight instruments. Give better view of engine instruments and ways to improve its efficiency.

UNIT-I	
Introduction: Instrument Displays-Qualitative and quantitative displays, Director displays, instruments grouping- T grouping. **Integrated Display Systems:** head-up displays **Air Data Instruments**: Standard Atmosphere (ISA), basic air data system, pitot-static probe, heating circuit element, Mach/air speed indicator	**09 Hrs**
UNIT-II	
Vertical Air Speed Indicators: Instantaneous Vertical Airspeed indicator, Mach warning system, altitude alert system **Direct Reading Compasses:** Terrestrial magnetism, Compass construction, aircraft magnetism, components of magnetism.	**09 Hrs**
UNIT-III	
Gyroscopic Flight Instruments: The gyroscope and its properties, determining direction of precession, limitations of gyroscope, gyro horizon, direction indicator, Turn and Bank indicator.	**09 Hrs**
UNIT-IV	
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.	**09 Hrs**
UNIT-V	
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.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the scope and extent of avionics and identify the different types of instrument grouping categories and the indicators in each category.
CO2:	Appreciate the need for measurement in Aircraft Instrumentation.
CO3:	Analyze different instrumentation and its applications.
CO4:	Interpret the Case Studies with the theory learnt and hence develop a system concept

	operational in latest aircraft instrumentation.

Reference Books	
1	Aircraft instruments and Integrated systems, E H J Pallet, 2nd Edition, 1992, Pitman and Sons Longman Publishers, ISBN: 582086272.
2	Aircraft Instruments, C.A. Williams, 2nd Edition, 2007, Galgotia Publications New Delhi, ISBN: 817598080X, 9788175980808.
3	Aircraft Propulsion, Bhaskar Roy, 1st Edition 2011, Elsevier publications, New Delhi, ISBN: 9788131214213.
4	Aircraft Instrumentation and Systems, S. Nagabhushana & L.K. Sudha, 2010, I.K Publishing House, New Delhi, Pvt. Ltd, Hardback ISBN: 9789380578354.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	**1**	-	**1**	-	-	-	-	-	-	-	-
CO2	**1**	**1**	**2**	**1**	-	-	-	-	-	-	-	-
CO3	**2**	**1**	**2**	**1**	-	-	-	-	-	-	-	-
CO4	**2**	**1**	**2**	**1**	-	-	-	-	-	-	-	-

Low-1 Medium-2 High-3

VI Semester		
BIOINSPIRED ENGINEERING **(Group E: Global Elective)**		
Course Code:16G6E01		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**
Course Learning Objectives:		
1	To familiarize engineering students with basic biological concepts	
2	Utilize the similarities noted in nature for a particular problem to bring inspiration to the designer.	
3	Explain applications such as smart structures, self-healing materials, and robotics relative to their bio logical analogs	
4	To gain an understanding that the design principles from nature can be translated into novel devices and structures and an appreciation for how biological systems can be engineered by human design	

UNIT-I	
Introduction to Biology: Biomolecules-Proteins, carbohydrates, lipids and Nucleic acids. Cell types- Microbial, plant, animal.Organ system- Circulatory, digestive, respiratory, excretory and nervous system. Sense organs. Plant process- Photosynthesis.	**06 Hrs**
UNIT – II	
Introduction to Biomimetics: Wealth of invention in nature as inspiration for human innovation: Mimicking and inspiration of nature- synthetic life. Nature as a model for structure and tools: Biological clock, honey comb as strong light weight structure. Materials and processes in biology- Spider web, honey bee as a multi-material producer, fluorescent materials in fire flies. Bird and insect as source of inspiring flight. Robotics as beneficiary for biomimetic technologies.	**08 Hrs**
UNIT -III	
Biological materials in Engineering mechanisms: Introduction, Comparison of biological and synthetic materials: Silk processing and assembly by insects and spiders- High performance fibers from nature, Seashells- High performance organic and inorganic composites from nature. Shark skin- Biological approaches to efficient swimming via control of fluid dynamics, Muscles- Efficient biological conversion from chemical to mechanical engineering.	**08 Hrs**
UNIT –IV	
Biological inspired process and products: Artificial neural networks, genetic algorithms, medical devices. Biosensors. Plant as Bioinspirations: Energy efficiency, Biomimetic super hydrophobic surfaces- lotus leaf effect. Bionic leaf and Photovoltaic cells.	**08 Hrs**
UNIT –V	
Implants in Practice: Artificial Support and replacement of human organs-Introduction, Artificial kidney, liver, blood, lung, heart, skin and pancreas. Total joint replacements- Visual prosthesis -artificial eye. Sense and sensors: Artificial tongue and nose,Biomimetic echolation. Limitations of organ replacement systems.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember and explain the fundamentals of Biology

CO2:	Describe the basic principles of design in biological systems.
CO3:	Differentiate biological phenomena to support inspiration for visual and conceptual design problems
CO4:	Create engineered solutions to customer needs utilizing a variety of bio-inspiration techniques.

Reference Books	
1	Jenkins, C.H. Bioinspired Engineering, NY: Momentum press, 2012 ISBN: 97816066502259
2	C.C.Chatterjee, Human Physiology Volume 1 (11th Edition), 2016, ISBN 10: 8123928726 / ISBN 13: 9788123928722
3	Yoseph Bar-Cohen, Biomimetics: Biologically Inspired technologies, 2005, CRC press, ISBN: 9780849331633
4	Donald Voet,Charlotte W. Pratt. Principles of Biochemistry: International Student Version. Wiley John and Sons, 2012. ISBN:1118092449.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**
CO4	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**

High-3 : Medium-2 : Low-1

VI Semester		
GREEN TECHNOLOGY **(Group E: Global Elective)**		
Course Code: 16G6E02		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 36L		**SEE Duration:** 3Hrs

Course Learning Objectives:	
1	Learn the tools of green technology
2	Know various forms of renewable energy
3	Study the environmental consequences of energy conversation
4	Understand energy audits and residential energy audit
5	Understand the application of green technology in various industries

Unit-I	
Current Practices and Future Sustainability: Need for green technology, fundamentals of energy and its impact on society and the environment, the mechanics, advantages and disadvantages of renewable energy sources, energy conservation and audits, zero waste technology, life cycle assessment, extended product responsibility, concept of atom economy, tools of Green technology **Cleaner Production:** Promoting cleaner production, benefits and obstacles of cleaner production, cleaner production technologies.	**07 Hrs**
Unit – II	
Solar Radiation and Its Measurement: Solar constant, solar radiation at the earth's surface, solar radiation geometry, solar radiation measurements **Applications of Solar Energy**: Introduction, solar water heating, space-heating (or solar heating of buildings), space cooling (or solar cooling of building), solar thermal electric conversion, agriculture and industrial process heat, solar distillation, solar pumping, solar cooking **Geothermal Energy:** Resource identification and development, geothermal power generation systems, geothermal power plants case studies and environmental impact assessment.	**08 Hrs**
Unit -III	
Energy From Biomass (Bio-Energy): Introduction, biomass conversion technologies, wet Processes, dry Processes, biogas generation, factors affecting biodigestion, types of biogas plants (KVIC model & Janata model), selection of site for biogas plant **Bio Energy (Thermal Conversion):** Methods for obtaining energy from biomass, thermal gasification of biomass, classification of biomass gasifiers, chemistry of the gasification process, applications of the gasifiers.	**07 Hrs**
Unit –IV	
Wind Energy: Introduction, basic components of WECS (Wind Energy Conversion system), classification of WEC systems, types of wind machines (Wind Energy Collectors), horizontal-axial machines and vertical axis machines. **Ocean Thermal Energy**: OTEC-Introduction, ocean thermal electric conversion (OTEC), methods of ocean thermal electric power generation, open cycle OTEC system, the closed or Anderson, OTEC cycle, Hybrid cycle **Energy from Tides**: Basic principles of tidal power, components of tidal power plants, operation methods of utilization of tidal energy, advantages and limitations of tidal power generation	**07 Hrs**

Unit –V	
Hydrogen, Hydrogen Energy: Introduction, methods of hydrogen production (principles only), storage transportation, utilization of hydrogen gas, hydrogen as alternative fuel for motor vehicle, safety and management, hydrogen technology development in India **Application of Green Technology:** Electronic waste management, bioprocesses, green composite materials, green construction technology **Sustainability of industrial waste management:** Case studies on cement industry, iron and steel industry, petroleum sectors, marble and granite industry, sugar industry	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Recall the fundamentals of various forms of energy
CO2:	Explain the principles of various forms of renewable energy
CO3:	Apply the concept of zero waste, atom economy for waste management
CO4:	Create a waste management plan incorporating tools of green technology in various industries

Reference Books	
1	Non-Conventional Energy Sources, G.D.Rai, 5th Edition, 2016, Khanna Publications, ISBN: 8174090738
2	Renewable Energy-Power for a Sustainable Future, Edited by Godfrey Boyle, 3rd Edition, 2012, Oxford University Press, ISBN: 9780199545339
3	Energy Systems and Sustainability: Power for a Sustainable Future, Godfrey Boyle, Bob Everett, and Janet Ramage, 2nd Edition, 2012, Oxford University Press, ISBN: 0199593744
4	Renewable Energy resources , John Twidell and Tony Weir, 3rd Edition, 2015, Routledge publishers, ISBN:0415584388

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

VI Semester		
SOLID WASTE MANAGEMENT (Theory)		
Course Code:16G6E03		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**
Course Learning Objectives: The students will be able to		
1	Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks.	
2	Understand various waste management statutory rules.	
3	Analyze different elements of solid waste management, design and develop recycling options for biodegradable waste by composting.	
4	Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.	

UNIT-I	
Introduction: Land Pollution. Scope and importance of solid waste management. Present solid waste disposal methods. Merits and demerits of open dumping, feeding to hogs, incineration, pyrolysis, composting, sanitary landfill. Definition and functional elements of solid waste management. **Sources**: Sources of Solid waste, types of solid waste, composition of municipal solid waste, generation rate, Numerical Problems. **Collection and transportation of municipal solid waste:** Collection of solid waste-services and systems, Municipal Solid waste (Management and Handling) 2000 rules with 2016 amendments. Site visit to collection system.	**08 Hrs**
UNIT-II	
Composting Aerobic and anaerobic composting - process description, process microbiology, Vermicomposting, Site visit to compost plant, Numerical problems. **Sanitary land filling**: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.	**08 Hrs**
UNIT-III	
Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, hazardous waste (Management and handling) rules 2008 with amendments. Site visit to hazardous landfill site	**06 Hrs**
UNIT-IV	
Bio medical waste management: Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Bio medical waste (Management and Handling) rules 1998 with amendments. Site visit to hospital to see the collection and transportation system and visit to biomedical waste incineration plant.	**06 Hrs**
UNIT-V	
E-waste management: Definition, Components, Materials used in manufacturing electronic goods, Recycling and recovery integrated approach. E- waste (management and handling) rules 2011.Site visit to e- waste processing facility. **Plastic waste management:** Manufacturing of plastic with norms. Plastic waste management. Plastic manufacture, sale & usage rules 2009 with amendments.	**06 Hrs**

	Course Outcomes: After completing the course, the students will be able to
1.	Understand the existing solid waste management system and to identify their drawbacks.
2.	Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste.
3.	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.
4.	Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment & Forest.

	Reference Books
1.	Integrated Solid Waste Management : Engineering principles and management issues George Tchobanoglous, Hilary Theisen , Samuel A Vigil, published by M/c Graw hill Education . Indian edition 2014. ISBN – 13: 978- 9339205249, ISBN-10 : 9339205243
2.	Environmental Engineering, Howard S Peavy, Donald R Rowe and George Tchobanoglous, Tata Mcgraw Hill Publishing Co ltd., 2013, ISBN-13 9789351340263.
3.	Electronic waste management, R.E. Hester, Roy M Harrison,, Cambridge, UK, RSC Publication, 2009, ISBN 9780854041121
4.	Municipal Solid waste (Management & Handling Rules) 2000. Ministry of Environment & Forest Notification, New Delhi, 25th Sept 2000 and 2016 amendments.
5.	Hazardous waste (management, handling) rules 2008.Ministry of Environment and Forest Notification, New Delhi, 25th February 2009.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	1	-	-	-	-	-	-
CO2	2	1	-	-	1	1	-	-	-	-	-	-
CO3	2	2	1	-	2	1	1	-	-	-	-	1
CO4	2	2	1	-	3	2	2	-	-	-	1	1

Low-1 Medium-2 High-3

VI Semester		
INTRODUCTION TO WEB PROGRAMMING (Group E : Global Elective)		
Course Code:16G6E04		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the basic concepts used in web programming.
2	Learn the definitions and syntax of different web technologies.
3	Utilize the concepts of JavaScripts, XML and PHP.
4	Design and develop web pages which are quick, easy and well-presented using different techniques such as CSS,XML and JavaScripts.

UNIT-I	
Introduction to Web Concepts Fundamentals of Web, HTML 5 - Core HTML attributes, headings, paragraphs and breaks, divisions and centering, quotations, preformatted text, lists, horizontal rules, block-level elements, text-level elements.XHTML – 1: Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox. XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links.XHTML (continued): Lists, Tables, Forms, Frames.	**07 Hrs**
UNIT-II	
Cascading Style Sheets (CSS): Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **The Basics of JavaScript:** Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements	**09 Hrs**
UNIT-III	
JavaScript (continued): Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts. **JavaScript and HTML Documents:** The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object; DOM tree traversal and modification.	**09 Hrs**
UNIT-IV	
Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging	**06 Hrs**

and dropping elements. **Introduction to PHP:** Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling; Files; Cookies; Session Tracking.	

UNIT-V	
XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT Style sheets; XML processors; Web services.	**05 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore internet related concepts that are vital for web development.
CO2.	Apply HTML tags for designing static web pages and forms using Cascading Style Sheet.
CO3.	Utilize the concepts of XML, JavaScripts along with XHTML for developing web pages.
CO4.	Design and develop web based applications using JavaScripts, CSS, XHTML, PHP and XML.

Reference Books	
1.	Programming the World Wide Web – Robert W. Sebesta, 7th Edition, 2013,Pearson Education, ISBN-13:978-0132665810
2.	Web Programming Building Internet Applications , Chris Bates, 3rd Edition, , 2006, Wiley India, ISBN : 978-81-265-1290-4
3.	Internet & World Wide Web How to H program , M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition,2004, Pearson Education / PHI, ISBN-10: 0-130-89550-4
4.	Thomas A Powell, The Complete Reference to HTML and XHTML, 4th Edition, 2003, Tata McGraw Hill publisher. ISBN: 978-0- 07-222942- 4.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**-**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**-**	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO4	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

Low-1 Medium-2 High-3

VI Semester			
AUTOMOTIVE ELECTRONICS (Group E: Global Elective)			
Course Code: 16G6E05			**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0			**SEE Marks:** 100
Hours:36L			**SEE Duration:** 3Hrs
Course Learning Objectives: The students will be able to			
1	Understand the application of principles of sensing technology in automotive field		
2	Apply control systems in the automotive domain		
3	Understand automotive specific communication protocols / techniques		
4	Analyze fault tolerant real time embedded systems		

UNIT-I	
Power Train Engineering and Fundamentals of Automotive: Fundamentals of Petrol, diesel and gas engines, electric motors and control systems. Basic Automotive System, System Components, Evolution of Electronics in Automotive. Alternators and charging, battery technology, Ignition systems. Working principles of various electronic components and accessories used in Automotive. Developments in existing engine forms and alternatives. Hybrid designs (solar power, electric/gasoline, LPG, CNG, fuel cells). Basic Transmission systems.	**08 Hrs**
UNIT-II	
Sensor Technologies in Automotive: In-vehicle sensors: Working principles, Characteristics, limitations and use within the automotive context of the following: Temperature sensing e g. coolant, air intake. Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. manifold, exhaust differential, tyre. Distance sensing e.g. anti-Collision, Velocity sensing e.g. speedometer, anti-skid. Torque sensing e.g. automatic transmission. Vibration sensing e.g. Airbags. flow sensing and measurement e.g. fuel injection. Interfacing principles: Operation, topologies and limitations of all sensors covered in the above to in-vehicle processing or communications nodes. Use of Actuators: Types, working principle, Characteristics, limitations and use within the automotive context of each type.	**07 Hrs**
UNIT-III	
Automotive Control Systems: Control system approach in Automotive: Analog and Digital control methods, stability augmentation, control augmentation. Transmission control, System components and functions. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control. Special Control Schemes: Vehicle braking fundamentals, Antilock systems. Variable assist steering and steering control. Controls for Lighting. Wipers, Air conditioning /heating. Remote keyless Entry and Anti-theft System, Emission Course-system control. Control techniques used in hybrid system. Electronic Engine control: Motion equations, modeling of linear and non-linear systems, numerical methods, system responses Objective of Electronic Engine control. Spark Ignition and Compression Ignition Engines and their electronic controls. Engine management testing: Engine management system strategies and implementation. Simulation and implementation methods. Methods of improving engine performance and efficiency. Model Based Development (MBD) Technology. AUTOSAR: Objectives and Architecture.	**07 Hrs**
UNIT-IV	
Automotive Communication Systems: Communication interface with ECU's: Interfacing techniques and interfacing with infotainment gadgets. Relevance of internet protocols, such as TCP/IP for automotive applications. Wireless LANs standards, such as Bluetooth, IEEE802.11x. Communication protocols for automotive applications. Automotive Buses: Use of various buses such as CAN, LIN, Flex Ray. Recent trends in automotive buses (Such as OBDI1. MOST, IE, IELI.I, D2B and DSI). Application of Telematics in Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an	**07 Hrs**

automotive environment. Vehicle to Vehicle Communication Higher End Technology: Comparative Study and applications of ARM Cortex-Ascries/M-scries. ARM 9 and ARM11.	
UNIT-V	
Diagnostics and Safety in Automotive: Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments, Self-Diagnostic system. Fault finding and corrective measures. Electronic transmission checks and Diagnosis, Diagnostic procedures and sequence. On board and off board diagnostics in Automotive. Safety in Automotive: Safety norms and standards. Passenger comfort and security systems. Future trends in Automotive Electronics.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Acquire the knowledge of automotive domain fundamentals and need of electronics in Automotive systems
CO2:	Apply various sensors and actuators for Automotive applications
CO3:	Analyze different control systems and communication interfaces used in automotive systems.
CO4:	Evaluate the performance of telematics Diagnostics and safety norms in Automotive Systems.

Reference Books	
1.	Understanding Automotive Electronics, Williams. B. Ribbens, 6th Edition, 2003, Elsevier science, Newness publication, ISBN-9780080481494.
2.	Automotive Electronics Handbook, Robert Bosch, 2004, John Wiley and Sons,
3.	Automotive Embedded Systems Handbook, Nicolas Navet, F Simonot-Lion, Industrial Information Technology Series, CRC press.
4.	Automotive Control Systems Engine, Driveline and vehicle, Uwekiencke and lars Nielsen, Springer, 2nd Edition, 2005, ISBN 0-387-95368X

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**1**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**1**
CO3	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**2**	**-**	**1**	**1**
CO4	**3**	**1**	**2**	**1**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**

Low-1 Medium-2 High-3

VI Semester		
INDUSTRIAL ELECTRONICS (Group E: Global Elective)		
Course Code:16G6E06		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 36L		**SEE Duration:** 3Hrs
Course Learning Objectives: The students will be able to		
1	Explain the working of the devices used in power electronic circuits in industrial applications	
2	Analysing and designing power electronic circuits which handle the electrical energy efficiently and economically and Identify the typical practical problems with industrial exposure acquired	
3	Use basic concepts of design and working of electronic circuits for conversion and control of electrical energy.	
4	Apply the knowledge to work as part of teams on multidisciplinary projects and to discuss industrial problems with regard to application of Power Electronics.	

Unit-I	
Power semi-conductor Devices and static characteristics: Construction, working & characteristics of MOSFET, SCR, IGBT. Comparison of Power BJT, MOSFET, SCR, IGBT. Turn on methods of Power BJT, MOSFET and IGBT. Design of R, R-C, and UJT (pulse train) Gate triggering methods of SCR.	**08 Hrs**
Unit-II	
Thyristor Dynamic characteristics, Specifications and Protection: Gate characteristics of SCR, Dynamic characteristics of SCR. Design of Snubber circuit for SCR, Line Commutation and Forced Commutation circuits with design, Gate protection & overvoltage protection of SCR.	**07 Hrs**
Unit-III	
Converters: Single Phase Controlled Convertor- Full wave Half and Fully controlled line commutated bridge converters, Derivation of average load voltage and current. Three phase converters –Six pulse converters- with R load- Active inputs to the convertors with and without Freewheeling diode, Derivation of average load voltage and current. **Converter applications:** Industrial Applications of Half and Fully controlled converters to DC drives (Control of DC drives)	**06 Hrs**
Unit-IV	
Choppers – Step down, Step up Chopper, Step up/Down Chopper, Time ratio control and Current limit control strategies –Derivation of load voltage and currents with R, RL of Step down, Step up Chopper, Step up/Down Chopper – load voltage expression. Application of choppers to subway cars, Industrial drives ,battery operated vehicles.	**07 Hrs**
Unit-V	
Classification of Choppers and Applications: Type A, Type B, Type C, Type D, Type E choppers and their industrial Applications, AC Chopper –phase control type. Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter, bridge inverter(single phase) – Voltage control techniques for inverters Pulse width	**08 Hrs**

modulation techniques. – UPS-online, offline (Principle of operation only	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the comprehensive working of different devices and their applications.
CO2:	Analyze the application of skills in controlling and conversion of electrical energy.
CO3:	Evaluate and distinguish the performance of converters and inverters.
CO4:	Ability to implement their knowledge and skills in design of applications.

Reference Books	
1.	Power Electronics, M. D. Singh & K. B. Kanchandhani, Tata Mc Graw – Hill Publishing company, ISBN : 978-0-07-058389-4, 2008
2.	Power Electronics : Circuits, Devices and Applications,M. H. Rashid, Prentice Hall of India, 2nd Edition, ISBN : 0131228153, 9780131228153, 2004
3.	Power Electronics, P.C. Sen, Tata McGraw-Hill Publishing, ISBN: 978-0-07-462400-5, 2008.
4	Power ElectronicsP S Bimbra P.S Bimbra ,Khanna Publication ,ISBN:978-7409-279-3,5th Edition.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	2	1	1	2	0	1
CO2	3	2	2	3	3	0	1	0	0	0	2	1
CO3	3	2	2	3	2	2	0	1	0	0	1	2
CO4	3	3	3	3	2	3	2	0	1	0	0	1

High-3: Medium-2: Low-1

VI Semester		
PROJECT MANAGEMENT **(Group E: Global Elective)**		
Course Code : 16G6E07		**CIE Marks : 100**
Credits : L: T: P: S:3:0:0:0		**SEE Marks : 100**
Hours : 33L		**SEE Duration : 03 Hrs**
Course Learning Objectives: The students will be able to		
1.	To understand the principles and components of project management.	
2.	To appreciate the integrated approach to managing projects.	
3.	To explain the processes of managing project cost and project procurements.	
Unit – I		
Introduction: What is project, what is project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.		**06 Hrs**
UNIT – II		
Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle. **Project Integration Management:** Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.		**08 Hrs**
UNIT – III		
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Project Time Management:** Plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule, control schedule.		**07 Hrs**
UNIT – IV		
Project Cost management: Project Cost management, estimate cost, determine budget, control costs. **Project Quality management:** Plan quality management, perform quality assurance, control quality.		**06 Hrs**
UNIT – V		
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Procurement Management:** Project Procurement Management, conduct procurements, control procurements, close procurement.		**06 Hrs**

Course Outcomes: After going through this course the student will be able to	
CO1	Understand the concepts, tools and techniques for managing large projects.
CO2	Explain various sub processes in the project management frameworks.
CO3	Analyze and evaluate risks in large and complex project environments.
CO4	Develop project plans for various types of organizations.

Reference Books:
1. A Guide to the Project Management Body of Knowledge(PMBOK Guide), Project Management Institute, 5th Edition, 2013, ISBN: 978-1-935589-67-9
2. Project Planning Analysis Selection Financing Implementation & Review, Prasanna Chandra, 7th Edition, 2010, Tata McGraw Hill Publication, ISBN 0-07-007793-2.
3. Project Management A System approach to Planning Scheduling & Controlling, Harold Kerzner, 10th Edition, 2009, CBS Publishers and Distributors, ISBN 047027806.
4. Strategic Project Management Made Simple: Practical Tools for Leaders and Teams, Terry Schmidt, 1st Edition, 2009, John Wiley & Sons, ISBN: 978-0470411582

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**											
CO2	**2**	**2**		**1**	**1**							
CO3							**1**	**1**				
CO4	**2**		**3**		**1**							

Low-1 Medium-2 High-3

VI Semester		
VIRTUAL INSTRUMENTATION **(Group E: Global Elective)**		
Course Code:16G6E08		**CIE Marks:** 100
Credits/Week: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours:35L		**SEE Duration:** 3Hrs

Course Learning Objectives: The students will be able to	
1	Understand the difference between conventional and graphical programming, basic data acquisition concepts.
2	Differentiate the real time and virtual instrument.
3	Develop ability for programming in LabVIEW using various data structures and program structures.
4	Analyze the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.

UNIT-I	
Graphical Programming Environment: Basic of Virtual Instrumentation, Conventional and Graphical Programming. Introduction to LabVIEW, Components of LabVIEW and Labels. **Fundamentals:** Data Types, Tool Pallets, Arranging Objects, Color Coding, Code Debugging, Context Help, Creating Sub-VIs Boolean, Mechanical action- switch, and latch actions, String data types, enum, ring, Dynamics.	**06 Hrs**
UNIT-II	
Fundamentals of Virtual Instrumentation Programming: For Loop, While Loop, shift registers, stack shift register, feedback node, and tunnel. **Timing function**: Timing VI, elapsed time, wait function. Case structures, formula node, Sequence structures, Arrays and clusters, visual display types- graphs, charts, XY graph. Local and Global variables.	**09 Hrs**
UNIT-III	
Error Handling- error and warning, default error node, error node cluster, automatic and manual error handling. **String Handling:** Introduction, String Functions, LabVIEW String Formats. **File Input/ Output:** Introduction, File Formats, File I/O Functions and file Path functions. **Design patterns:** Producer/consumer, event handler, derived design pattern, Queued message handler, Producer/consumer (events), Producer/consumer (state machine).	**08 Hrs**
UNIT-IV	
Data Acquisition: Introduction to data acquisition, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O, counters, NI-DAQmx tasks. **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, and VISA.	**06 Hrs**

UNIT-V	
Advanced Topics In LabVIEW: Use of analysis tools and application of VI: Fourier transforms Power spectrum, Correlation methods, windowing & filtering. Inter-Process Communication, Notifier, Semaphore, Data Sockets. **Simulation of systems using VI:** Development of Control system, Image acquisition and processing.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember and Understand the fundamentals of Virtual Instrumentation and data Acquisition.
CO2:	Apply the theoretical concepts to realize practical systems.
CO3:	Analyze and evaluate the performance of Virtual Instrumentation Systems.
CO4:	Create a VI system to solve real time problems using data acquisition.

Reference Books	
1	Virtual instrumentation Using LabVIEW, Jovitha Jerome, 4th Edition, 2010, PHI Learning Pvt. Ltd., ISBN: 978-812034035.
2	Virtual Instrumentation Using LabVIEW, Sanjay Gupta & Joseph John, 2nd Edition, New Delhi, 2010,Tata McGraw Hill Publisher Ltd., ISBN: 978-0070700284
3	LabVIEW for Everyone: Graphical Programming made easy and fun,Jeffrey Travis, Jim Kring, 3rd Edition, 2006, Prentice Hall,ISBN: 978-0131856721.
4	Data Acquisition using LabVIEW,Behzad Ehsani, 1st Edition,2017, Packt Publishing, ISBN: 978-1782172161.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO MAPPING												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**1**	**1**	**2**	-	-	-	**2**	**2**	-	**1**
CO2	**1**	**1**	**1**	**1**	**2**	-	-	-	**2**	**2**	-	**1**
CO3	**1**	-	**1**	**1**	**2**	-	-	-	**2**	**2**	-	**1**
CO4	**2**	**1**	**1**	**2**	**3**	-	-	-	**2**	**2**	-	**2**

Low-1 Medium-2 High-3

VI Semester		
INTRODUCTION TO MOBILE APPLICATION DEVELOPMENT (Group E: Global Elective)		
Course Code: 16G6E09		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours : 36L		**SEE Duration: 3Hrs**
Course Learning Objectives: The students will be able to		
1	Learn Android application development platform for mobile devices and use it.	
2	Understand mobile application architecture and its components.	
3	Define Android specific programming concepts such as activities, intents, fragments, services, broadcast receivers and content providers.	
4	Describe sensors like motion sensors, environmental sensors, and positional sensors; most commonly embedded in Android devices along with their application programming interface.	
UNIT I		
Overview of Software platforms and Development: Mobile OS: Android development platform and tools, Programming language, Emulator, SDK and Development Environments **Creating Applications and Activities:** Introducing the Application Manifest File; Creating Applications and Activities; Architecture Patterns (MVC); Android Application Lifecycle.		**07 Hrs**
UNIT II		
User Interface Design: Fundamental Android UI Design; Introducing Layouts; Introducing Fragments. **Intents and Broadcasts**: Introducing Intents; Creating Intent Filters and Broadcast Receivers.		**07 Hrs**
UNIT III		
Database and Content Providers: Introducing Android Databases; Introducing SQLite; Content Values and Cursors; Working with SQLite Databases; Creating Content Providers; Using Content Providers; Case Study: Native Android Content Providers.		**07 Hrs**
UNIT IV		
Location Based Services, Telephony and SMS: Using Location-Based Services; Using the Emulator with Location-Based Services; Selecting a Location Provider; Using Proximity Alerts; Using the Geocoder; Example: Map-based activity; Hardware Support for Telephony; Using Telephony; Introducing SMS and MMS.		**08 Hrs**
UNIT V		
Hardware Support and Devices (AUDIO, VIDEO, AND USING THE CAMERA): Using Sensors and the Sensor Manager; Monitoring a Device's Movement and Orientation; Introducing the Environmental Sensors; Playing Audio and Video; Using Audio Effects; Using the Camera; Recording Video		**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Assess the basic framework and usage of SDK to build GUI and apply advanced

	technologies in developing Android mobile applications.
CO2:	Differentiate techniques for persisting user data, such as shared preferences, traditional file systems (internal and external storage), and SQLite database
CO3:	Articulate the communication programming features and capabilities of Android platforms.
CO4:	Design and create innovative, sophisticated mobile applications using Android platform.

Reference Books	
1.	Professional Android 4 Application Development, Reto Meier, WROX Press, 2012, Wiley Publishing, ISBN: 9781118102275
2.	Android Application Development: Programming with the Google SDK, John Lombardo, Blake Meike, Rick Rogers and Zigurd Mednieks, 2009, O'Reilly Media, Inc. ISBN: 9788184047332
3.	Hello Android, Introducing Google's Mobile Development Platform, Ed Burnette, 3rd Edition, Pragmatic Programmers, LLC.ISBN: 9781934356562
4.	Android Studio Development Essentials - Android 6, Neil Smyth, 2015, Createspace Independent Publishing Platform, ISBN: 9781519722089

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Self-Study(S). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self-study is 20. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	-	3	-	-	-	-	-	-	2
CO2	3	3	3	-	3	1	-	-	-	2	-	2
CO3	-	3	3	-	3	2	-	-	-	2	1	3
CO4	3	3	3	2	3	2	2	2	2	2	1	3

Low-1 Medium-2 High-3

VI Semester		
AUTOMOTIVE ENGINEERING (Group E: Global Elective)		
Course Code:	16G6E10	**CIE Marks: 100**
Credits: L:T:P:S	**3:0:0:0**	**SEE Marks: 100**
Hours:	**36L**	**SEE Duration: 3Hrs**
Course Learning Objectives: The students will be able to		
1	Identify the different sub-systems in automobiles.	
2	Describe the functions of each of the sub-systems and its effect.	
3	Discuss fuel injection, transmission, braking, steering, suspension, air intake and exhaust systems.	
4	Explain the importance of selection of suitable sub-system for a given performance requirement.	

UNIT-I	
Automobile Engines Classifications of Internal Combustion Engines based on no. of cylinders, Arrangement of cylinders, Type of fuel and no. of strokes**.** Engine construction and nomenclature. Thermodynamic principles of Otto and Diesel cycle. Operation in a 4 stroke engine. Direct and indirect injection. Combustion stages in engines. Fuels: Gasoline, Diesel, LPG and Natural Gas For automotive applications. Fuel properties- Octane number and Cetane number. Pollutants and Emission norms- Regulated pollutants and its effects, Regulations as per emission norms.	**06 Hrs**
UNIT-II	
Engine Auxiliary Systems: AirIntake and Exhaust System- Working principle ofAir filters, Intake manifold, Turbocharger, Intercooler, Exhaust manifold, Catalytic convertor, Exhaust Gas Recirculation system, Muffler. Cooling system- Components, working principle, Coolant. Lubrication system- Components, Properties of lubricating oil, Viscosity numbers. Fuel system- Working principle of Fuel Injection Pump, Injector, Nozzle, Fuel filter. Working of ignition system, Battery, Immobilizer.	**08 Hrs**
UNIT-III	
Transmission: Clutch- Classification and working, Gear box- Classification, Working of sliding mesh and Synchromesh transmission, Automatic transmission. Propeller shaft, Differential assembly and rear axle- Working. Wheels and Tyres- Wheel alignment and balancing classification of tyres, Radial, Tubeless.	**08 Hrs**
UNIT-IV	
Vehicular Auxiliary Systems: Suspension- Front and rear suspension working, Types of springs. Brake- Classification and Components - Disc and drum brakes, Hydraulic, parking brake, Front and rear wheel brakes. Antilock Braking Systems. Steering- components and operation of power steering.	**06 Hrs**

Vehicle frame and body classification- Hatchback, Sedan, SUV. Safety systems- Passive safety systems, Active safety systems- Principle of Electronic Stability Program, Air bags, Crash testing methods.	
UNIT-V	
Demonstrations of Automobile Systems: Engine performance measurement in terms of Brake power, Emission measurement and principle, Drawing Valve Timing Diagram for multi-cylinder engine, Production and properties of biodiesel.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Describe the different types of automotive systems. (L1- L2)
2	Construct the Valve Timing Diagram for multi-cylinder engines. (L3)
3	Detect the automotive exhaust pollutants using gas analyzer. (L4)
4	Evaluate the performance of engines by determining Brake Power. (L6)

Reference Books	
1.	Automotive Engineering Fundamentals, Richard Stone and Jeffrey K. Ball, 2004 , SAE International, ISBN: 0768009871
2.	Bosch Automotive Handbook, Robert Bosch, 9th Edition, 2004, ISBN: 9780768081527.
3.	Automotive Engineering e-Mega Reference,David Crolla, Butterworth-Heinemann, 1stEdition, 2009, ISBN: 9781856175784.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**		**1**			**2**		**2**			**1**
CO2		**2**										
CO3		**2**	**1**			**2**		**1**			**2**	**1**
CO4	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	

Low-1 Medium-2 High-3

VI Semester		
MOBILE NETWORK SYSTEMS AND STANDARDS (GROUP E: GLOBAL ELECTIVE)		
Course Code: 16G6E11		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 34L		**SEE Duration: 03Hrs**
Course Learning Objectives: The students will be able to		
1	Understand land mobile concepts, radio link design and cellular network.	
2	Compare the standards of WPAN, WLAN and WMAN.	
3	Analyze WPAN, WLAN and WMAN standards and their architecture.	
4	Design and demonstrate wireless networks for various applications.	

UNIT-I	
Cellular Wireless Networks: Principles of cellular Networks, cellular system components and Operations, channel assignment, Attributes of CDMA in cellular system.	**06 Hrs**
UNIT-II	
Second generation Cellular Networks: GSM architecture, IS-95, GPRS, EDGE.	**08 Hrs**
UNIT-III	
Third generation cellular systems: WCDMA, IMT 2000 and LTE, Convergence in the network.	**06 Hrs**
UNIT-IV	
Wireless Personal Area Networks: Network architecture, components, Applications, Zigbee, Bluetooth. **Wireless Local Area networks:** Network Architecture, Standards, Applications.	**08 Hrs**
UNIT-V	
Wireless Metropolitan Area Networks: IEEE 802.16 standards, advantages, WMAN Network architecture, Protocols, Applications.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the architectures and characteristics of different mobile networks. (L1- L2)
CO2	Apply the Network standards to a suitable application (L3)
CO3	Analyze the operation of various network technologies and standards (L4)
CO4	Evaluate the performance of various network technologies (L5)

Reference Books	
1	Wireless Communication, UpenaDalal, 1st Edition , 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
2	Wireless and Mobile Networks Concepts and Protocols, Dr.sunil Kumar s Manvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition,

	Pearson, ISBN 97881-317-3186-4.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	---	2	---	---	2	---	2	---	1
CO2	3	3	2	---	2	---	---	2	---	2	---	1
CO3	3	3	3	---	2	---	---	2	---	2	---	2
CO4	3	3	3	---	3	---	---	2	---	2	---	2

Low-1 Medium-2 High-3

VI Semester		
PARTIAL DIFFERENTIAL EQUATIONS **(Group E: Global Elective)**		
Course Code:16G6E12		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 35L		**SEE Duration:** 3Hrs

Course Learning Objectives:	
1	Adequate exposure to learn basics of partial differential equations and analyze mathematical problems to determine the suitable analytical technique.
2	Use analytical techniques and finite element technique for the solution of elliptic, parabolic and hyperbolic differential equations.
3	Solve initial value and boundary value problems which have great significance in engineering practice using partial differential equations.
4	Identify and explain the basics of partial differential equations and use the same to analyze the behavior of the system.

Unit-I	
Partial Differential Equations of first order: Introduction to formation of partial differential equations, Cauchy problem, Orthogonal surfaces, First order non-linear partial differential equations-Charpit's method, Classification and canonical forms of partial differential equations.	**07 Hrs**
Unit – II	
Elliptic Differential Equations: Derivation of Laplace and Poisson equation, Separation of variable method, Direchlet problem, Neumann problem, Solution of Laplace equation in cylindrical and spherical coordinates.	**07 Hrs**
Unit -III	
Parabolic Differential Equations: Formation and solution of Diffusion equation, Dirac-Delta function, Separation of variable method, Solution of Diffusion equation in cylindrical and spherical coordinates.	**07 Hrs**
Unit –IV	
Hyperbolic Differential Equations: Formation and solution of one dimensional wave equation, D'Alembert's solution, vibrating string, Forced vibration, Periodic solution of one dimensional wave equation in cylindrical and spherical coordinates, Vibration of Circular membrane.	**07 Hrs**
Unit –V	
Numerical solutions of Partial Differential Equations: Finite difference method for Elliptic, Parabolic and Hyperbolic partial differential equations, Introduction to the finite element method-simple problems.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and interpret the fundamental concepts of formation and solution of parabolic, hyperbolic and elliptic differential equations using analytical and numerical methods.

CO2:	Apply the knowledge and skills of analytical and numerical methods to solve the parabolic, hyperbolic and elliptic differential equations arising in the field of science and engineering.
CO3:	Analyze the physical problem to establish mathematical model and use appropriate method to solve and optimize the solution using the appropriate governing equations.
CO4:	Distinguish the overall mathematical knowledge to demonstrate and analyze the solution of parabolic, hyperbolic and elliptic differential equations arising in practical situations.

Reference Books	
1	Partial Differential Equations, K. Sankara Rao, Prentice-hall of India, 3rd Edition, 2012, ISBN: 978-81-203-3217-1.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley, 10th Edition, 2016, ISBN: 978-81-265-5423-2.
3	Numerical methods for scientific and engineering computation, M K Jain, S. R. K. Iyengar, R. K. Jain, New Age International Publishers, 6th Edition, 2012, ISBN-13: 978-81-224-2001-2.
4	An Introduction to the finite element method, J. N. Reddy, McGraw Hill, 3rd Edition, 2005, ISBN 13: 9780072466850.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

High-3: Medium-2: Low-1

VI Semester		
AIRCRAFT SYSTEMS **(Group E: Global Elective)**		
Course Code:16GE6B13		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 36L		**SEE Duration:** 3Hrs

Course Learning Objectives: To enable the students to:	
1	List the various systems involved in the design of an aircraft
2	Demonstrate the technical attributes of all the subsystems of an aircraft
3	Explain the significance of each systems and its subsystems for developing an airplane
4	Demonstrate the integration of the systems with the airplane

Unit-I	
Flight Control Systems : Primary and secondary flight controls, Flight control linkage system, Conventional Systems, Power assisted and fully powered flight controls.	**07 Hrs**
Unit – II	
Aircraft Hydraulic & Pneumatic Systems : Components of a typicalHydraulic system, Working or hydraulic system, Power packs, Hydraulic actuators. Pneumatic system and components, Use of bleed air, Landing gear and braking, Shock absorbers-Retraction mechanism.	**08 Hrs**
Unit -III	
Aircraft Fuel Systems : Characteristics of aircraft fuel system, Fuel system and its components, Gravity feed and pressure feed fuel systems, Fuel pumps-classification, Fuel control unit.	**07 Hrs**

Unit -IV	
Environmental Control Systems : Air-conditioning system, vapour cycle system, de-icing and anti-icing system, Fire detection- warning and suppression. Crew escape aids. **Engine Systems :**Engine starting sequence, Starting and Ignition systems, Engine oils and a typical lubricating system.	**07 Hrs**
Unit -V	
Aircraft Instruments : Instruments displays, panels & layouts, Instrumentation grouping, Navigation instruments, Radio instruments, Hydraulic and Engine instruments. **Air Data Instruments :** Basic air data system and probes, Mach meter, Air speed indicator, Vertical speed indicator, Barometric pressure sensing, Altimeter, Air data alerting system- angle of attack sensing, stall warning, Mach warning, altitude alerting system.	**07 Hrs**

Course Outcomes: At the end of this course the student will be able to :	
1	Categorise the various systems required for designing a complete airplane
2	Comprehend the complexities involved during development of flight vehicles.

3	Explain the role and importance of each systems for designing a safe and efficient flight vehicle
4	Demonstrate the different integration techniques involved in the design of an air vehicle

Reference Books	
1	John D. Anderson, Introduction to Flight, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Moir, I. and Seabridge, A.,Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, 3rdEdition, 2008, Wiley Publications, ISBN- 978-0470059968

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment. A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for assignment is 10. The total marks of CIE are 100.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for each course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**				**1**
CO2	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**				**1**
CO3	**2**	**2**	**3**	**3**	**1**							**2**
CO4	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**2**				**1**

High-3 : Medium-2 : Low-1

VI Semester		
PROFESSIONAL PRACTICE – III **EMPLOYABILITY SKILLS AND PROFESSIONAL DEVELOPMENT OF ENGINEERS**		
Course Code:16HS68		**CIE Marks:** 50
Credits: L:T:P:S: 0:0:1:0		**SEE Marks:** NA
Hours: 18 Hrs		**CIE Duration:** 02Hrs

Course Learning Objectives: The students will be able to	
1	Improve qualitative and quantitative problem solving skills.
2	Apply critical and logical thinking process to specific problems.
3	Ability to verbally compare and contrast words and arrive at relationships between concepts, based on verbal reasoning.
4	Applying good mind maps that help in communicating ideas as well as in technical documentation

V Semester	
UNIT-I	
Aptitude Test Preparation- Importance of Aptitude tests, Key Components, Quantitative **Aptitude** – Problem Solving, Data Sufficiency, Data Analysis - Number Systems, Math Vocabulary, fraction decimals, digit places etc. **Reasoning and Logical Aptitude** - Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Analytical Reasoning, Critical Reasoning.	06 Hrs
UNIT-II	
Verbal Analogies - What are Analogies, How to Solve Verbal Analogies & developing Higher Vocabulary, Grammar, Comprehension and Application, Written Ability. Non-Verbal Reasoning, Brain Teasers. Creativity Aptitude. **Group Discussion**- Theory &Evaluation : Understanding why and how is the group discussion conducted, The techniques of group discussion, Discuss the FAQs of group discussion, body language during GD.	**06 Hrs**
UNIT-III.A	
Resume Writing- Writing Resume, how to write effective resume, Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts.	**06 Hrs**
VI Semester	
UNIT-III.B	
Technical Documentation - Introduction to technical writing- Emphasis on language difference between general and technical writing, Contents in a technical document, Report design overview & format Headings, list & special notes, Writing processes, Translating technical information, Power revision techniques, Patterns & elements of sentences, Common grammar, usage & punctuation problems.	**06 Hrs**
UNIT-IV	
Interview Skills -a) Personal Interviews , b) Group Interviews , c) Mock Interviews - Questions asked & how to handle them, Body language in interview, Etiquette, Dress code in interview, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on stress interviews, technical interviews, General HR interviews	**06 Hrs**

etc.	
UNIT-V	
Interpersonal Relations - Optimal Co-existence, Cultural Sensitivity, Gender sensitivity Adapting to the Corporate Culture- Capability & Maturity Model, Decision Making Analysis, Brain Storm. Adapting to the Corporate Culture.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Inculcate employability skill to suit the industry requirement.
CO2:	Analyze problems using quantitative and reasoning skills
CO3:	Exhibit verbal aptitude skills with appropriate comprehension and application.
CO4:	Focus on Personal Strengths and Competent to face interviews and answer
Reference Books	
1.	The 7 Habits of Highly Effective People, Stephen R Covey Free Press, 2004 Edition, ISBN: 0743272455
2.	How to win friends and influence people, Dale Carnegie General Press, 1st Edition, 2016, ISBN: 9789380914787
3.	Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan 2012 Edition, McGraw-Hill Publication ISBN: 9780071772204
4.	Aptimithra: Best Aptitude Book ,Ethnus,2014 Edition, Tata McGraw Hill ISBN: 9781259058738

Scheme of Continuous Internal Examination (CIE)
Evaluation of CIE will be carried out in TWO Phases.

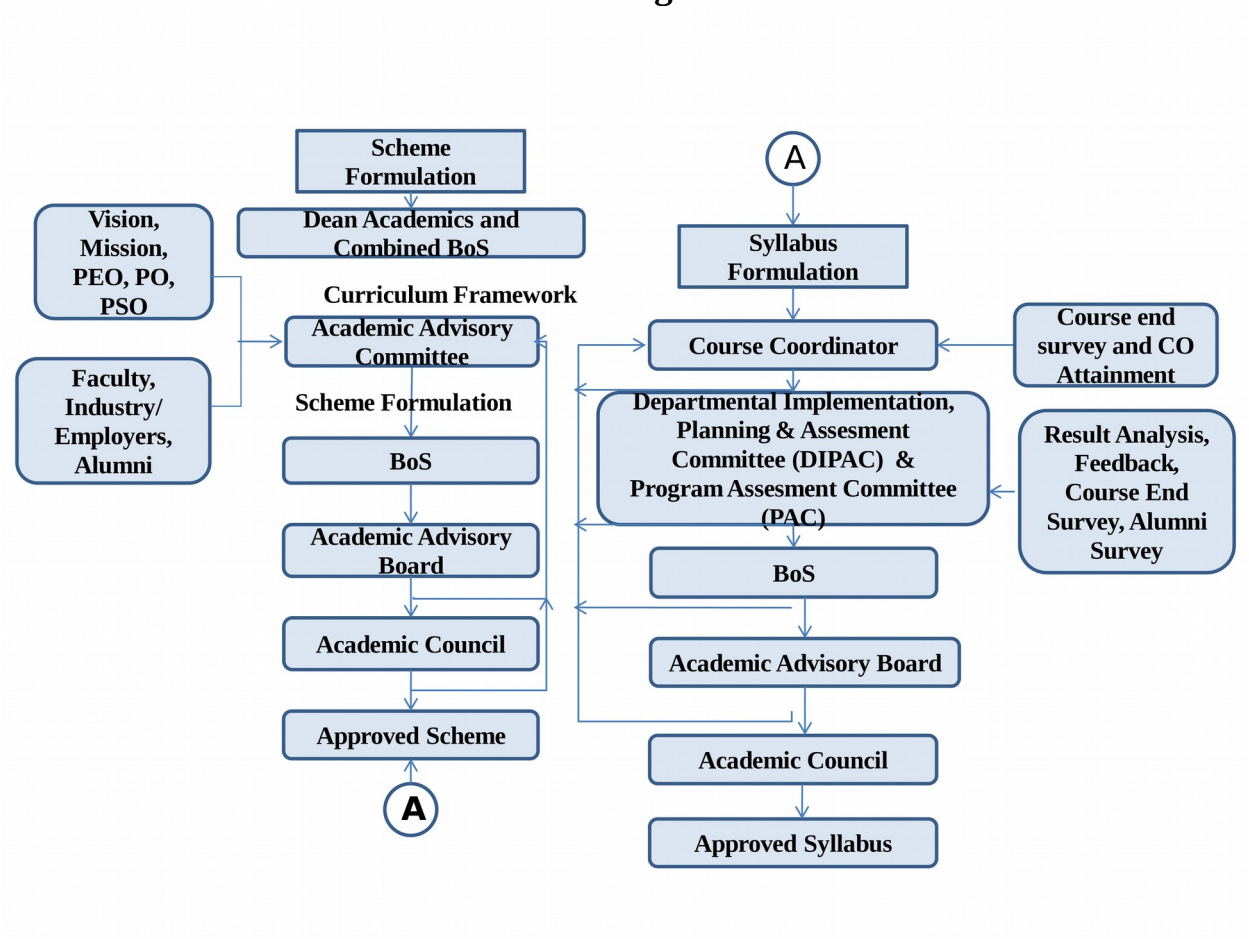
Phase	Activity	Weightage
I	Test 1 is conducted in V Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit-1, Unit-2 and Unit -3.A for 18 hours of training sessions.	50%
II	Test 2 is conducted in VI Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit -3B, Unit - 4 and Unit-5 for 18 hours of training sessions.	50%
	At the end of the VI sem Marks of Test 1 and Test 2 is consolidated for 50 marks (Average of Test1 and Test 2 (T1+T2/2). The grading is provided by the Coe. The final CIE marks is scrutinized by the committee comprising of HSS- Chairman, Training Co-ordinator, respective department Staff Placement co-ordinator before submitting to CoE.	

SEE: NA

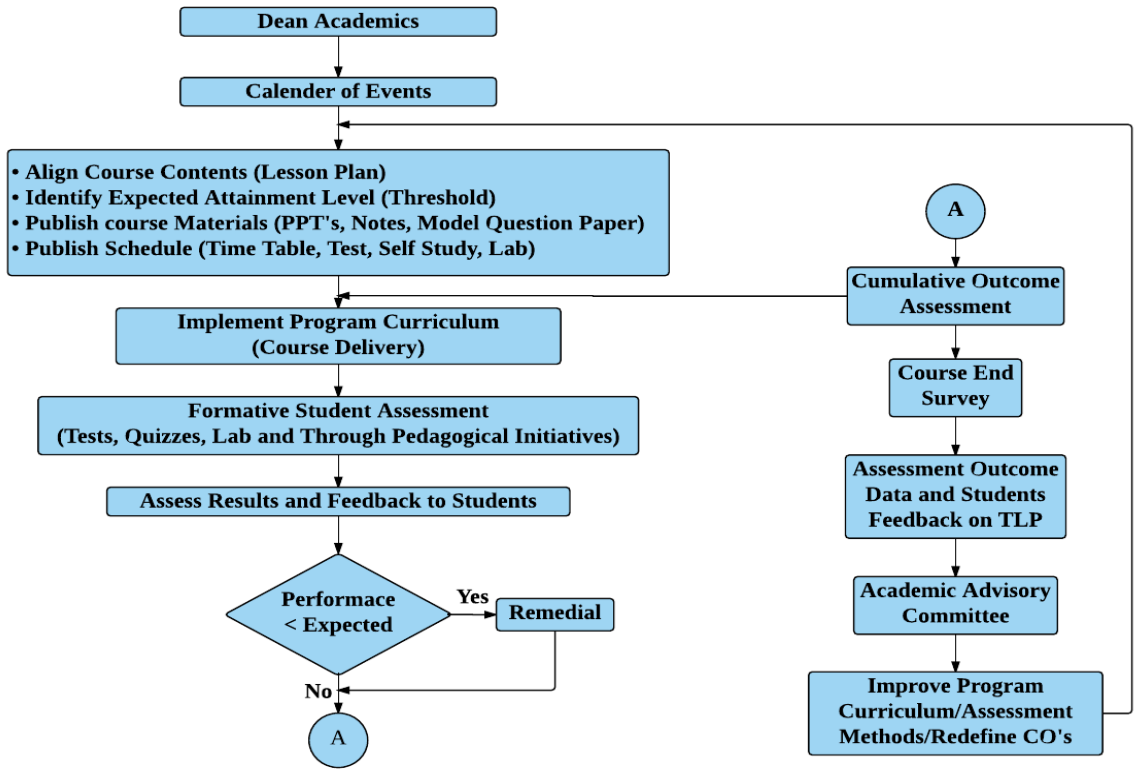
CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	---	___	---	----	1	----	1	1	1	2	1
CO2	1	2	2	---	---	---	----	1	2	1	2	1
CO3	---	---	3	---	---	1	---	2	1	2	1	---
CO4	---	---	___	---	----	1	3	1	1	1	1	---

Low-1 Medium-2 High-3

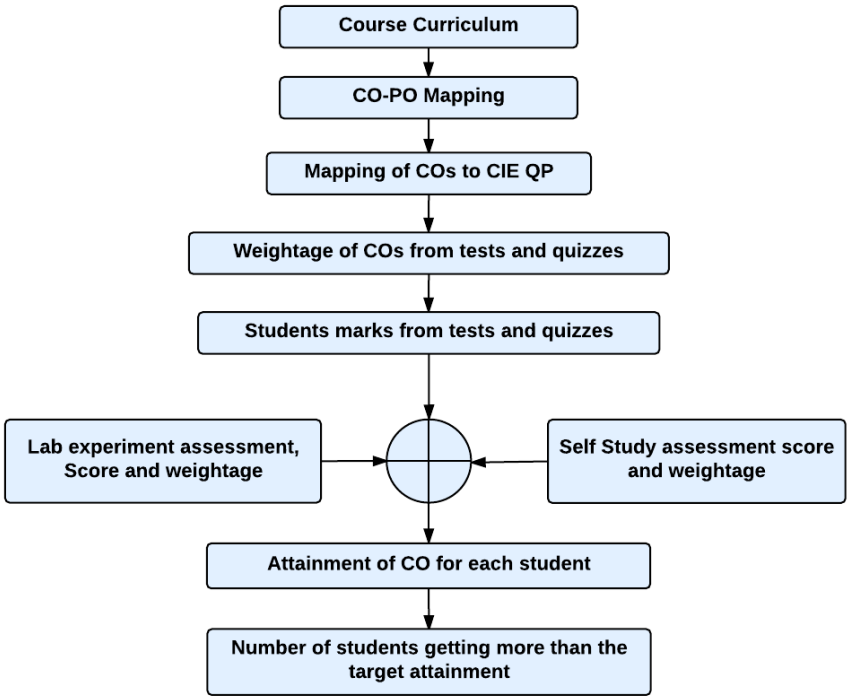
Curriculum Design Process



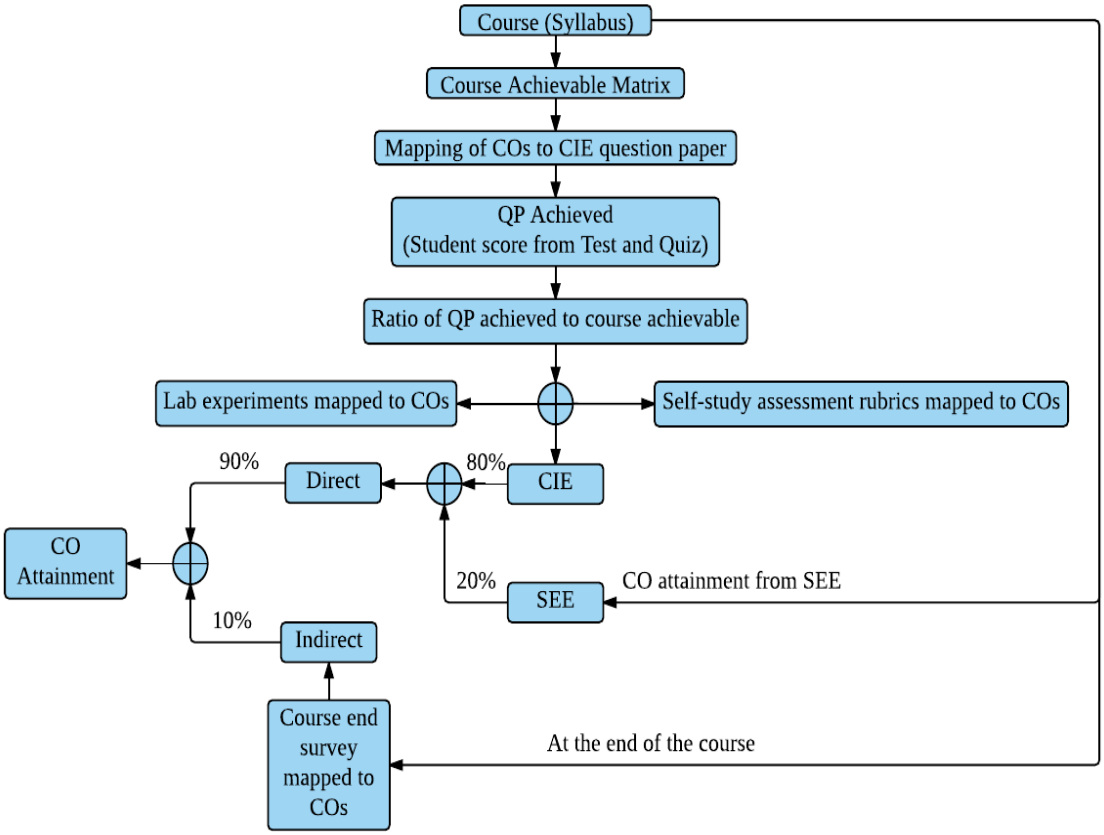
Academic Planning and Implementation



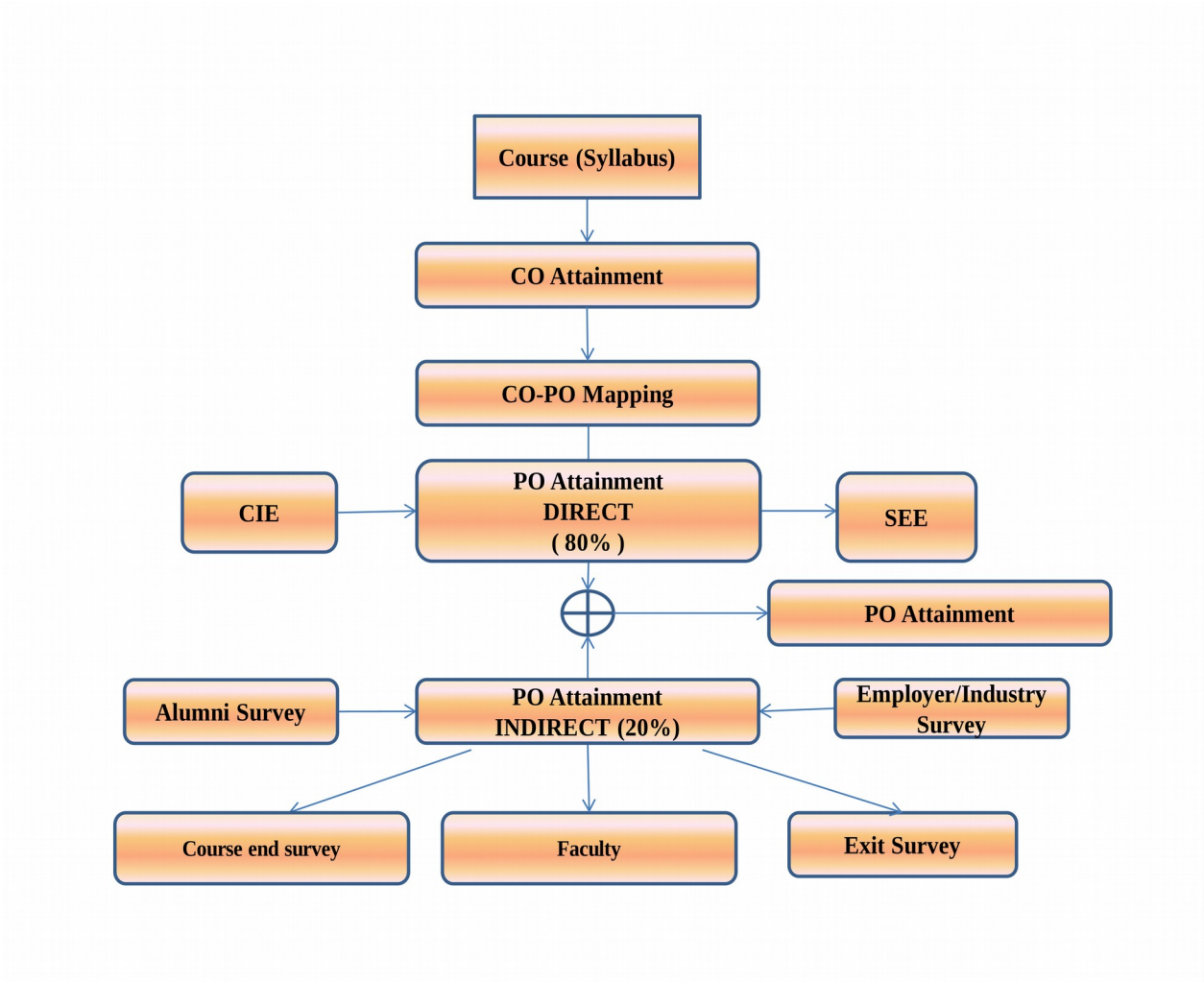
PROCESS FOR COURSE OUTCOME ATTAINMENT



Final CO Attainment Process



Program Outcome Attainment Process



Guidelines for Fixing Targets

- The target may be fixed based on last 3 years' average attainment

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet t h e specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **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.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. **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.

7. **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.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with t h e 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.

11. **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.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.