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

TELECOMMUNICATION ENGINEERING

Department Vision

Imparting quality education in Electronics and Telecommunication Engineering through focus on fundamentals, research and innovation for sustainable development

Department Mission

- Provide comprehensive education that prepares students to contribute effectively to the profession and society in the field of Telecommunication.
- Create state-of-the–art infrastructure to integrate a culture of research with a focus on Telecommunication Engineering Education
- Encourage students to be innovators to meet local and global needs with ethical practice
- Create an environment for faculty to carry out research and contribute in their field of specialization, leading to Center of Excellence with focus on affordable innovation.
- Establish a strong and wide base linkage with industries, R&D organization and academic Institutions.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO	Description
PEO1	Acquire appropriate knowledge of the fundamentals of basic sciences, mathematics, engineering sciences, Electronics & Telecommunication engineering so as to adapt to rapidly changing technology
PEO2	Think critically to analyze, evaluate, design and solve complex technical and managerial problems through research and innovation.
PEO3	Function and communicate effectively demonstrating team spirit, ethics, respectful and professional behavior.
PEO4	To face challenges through lifelong learning for global acceptance.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Analyze, design and implement emerging Telecommunications systems using devices, sub-systems, propagation models, networking of Wireless and Wire line communication systems.
PSO2	Exhibit Technical skills necessary to choose careers in the design, installation, testing, management and operation of Telecommunication systems.

Lead Society: Institute of Electrical and Electronics Engineers (IEEE)

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2016 SCHEME

TELECOMMUNICATION 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.	**TE**	Telecommunication Engineering
13.	**PHY**	Engineering Physics
14.	**SEE**	Semester End Examination
15.	**MAT**	Engineering Mathematics
16.	**PCE**	Professional Core Elective
17.	**GE**	Global Elective

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

DEPARTMENT OF TELECOMMUNICATION ENGINEERING

FIFTH SEMESTER CREDIT SCHEME								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				L	**T**	**P**	**S**	
1.	16HSI51	IPR & Entrepreneurship	HSS	3	0	0	0	3
2.	16TE52	Digital Signal Processing	TE	3	0	1	1	5
3.	16TE53	Digital Communication	TE	3	0	1	1	5
4.	16TE54	Telecom Switching System	TE	3	0	0	0	3
5.	16TE55	Microwave Engineering	TE	3	1	0	0	4
6.	16TE5AX	Elective A (PCE)	TE	3	1	0	0	4
7.	16G5BXX	Elective B (GE)	TE	3	0	0	1	4
Total number of Credits								**28**
Total Number of Hours / Week				**21**	**4**	**4**	**12****	**29**

SIXTH SEMESTER CREDIT SCHEME								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				L	**T**	**P**	**S**	
1.	16HEM61	Foundations of Management & Economics	HSS	2	0	0	0	2
2.	16TE62	Computer Communication Networks	TE	4	0	1	0	5
3.	16TE63	Information Theory& Coding	TE	3	1	0	0	4
4.	16TE64	Radiating Systems	TE	3	0	1	1	5
5.	16TE6CX	Elective C (PCE)	TE	3	1	0	0	4
6.	16TE6DX	Elective D (PCE)	TE	3	0	0	1	4
7.	16G6XX	Elective E (GE)	TE	3	0	0	0	3
8.	16HS68	Professional Practice-III (Employability Skills and Professional Development of Engineers)	HSS	0	0	1	0	1
Total number of Credits								**28**
Total Number of Hours / Week				**21**	**4**	**6**	**8****	**30**

** Non-contact hours

V Sem		
GROUP A: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16TE5A1	Digital Design and Verification using Verilog
2.	16TE5A2	Control Systems
3.	16TE5A3	Video Engineering
4.	16TE5A4	Computer Organization and Architecture

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.	16TE6C1	CMOS Circuit Design
2.	16TE6C2	ARM Processor
3.	16TE6C3	Multimedia Communication
4.	16TE6C4	Operating Systems
GROUP D: PROFESSIONAL CORE ELECTIVES		
1.	16TE6D1	Microwave Integrated Circuits
2.	16TE6D2	Digital Signal Processor Architecture
3.	16TE6D3	Cryptography and Network Security
4.	16TE6D4	JAVA

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	Applied Partial Differential Equations	3
13.	AE	16G6E13	Aircraft Systems	3
14.	HSS	16G6E14	Employability Skills and Professional Development of Engineers	1

V SEMESTER		
INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP (Theory) (Common to AE, CSE, ECE, EEE, ISE, TE)		
Course Code:16HSI51		**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 Trademarks, 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 handshakes to strengthen communication. (Practical Application).	**08 Hrs**

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

Semester: V		
DIGITAL SIGNAL PROCESSING (Theory & Practice)		
Course Code: 16TE52		**CIE Marks: 100+50**
Credits: 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	Analyze the time domain and frequency domain representations of discrete-time signals	
2	Apply efficient method for calculating the DFT & IDFT.	
3	Design & implement FIR & IIR filters.	
4	Perform Frequency transformations in Analog and Digital domains.	
5	Define the various structures for discrete-time systems.	

UNIT-I	
Discrete Fourier Transform: Discrete Fourier Transform (DFT), DFT as a linear Transformation and Relationship of DFT to other transform. **Properties of DFT**: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and circular convolution, additional DFT properties. **Linear filtering methods based on the DFT:** Use of DFT in linear filtering, Filtering of long data sequences.	**08 Hrs**
UNIT-II	
Frequency Analysis of Signals using DFT. **Efficient computation of DFT: FFT Algorithms:** Direct computation of DFT, Divide and conquer approach to computation of DFT, Radix-2 FFT Algorithms for the computation of DFT and Inverse DFT. **Discrete Cosine Transform (DCT):** Forward DCT, Inverse DCT, Relationships between DFT and DCT, Energy Compaction property of DCT.	**07 Hrs**
UNIT-III	
Analog Filters: Characteristics of commonly used Analog Filters –Butterworth and Chebyshev Type-1 filters. **Design of Digital IIR Filter from Analog Filters:** IIR Filter design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation. **Frequency Transformations**: Frequency transformation in the Analog Domain, Frequency transformation in the Digital Domain.	**08 Hrs**
UNIT-IV	
Design of Digital Filters: Causality and its Implications, Characteristics of practical Frequency Selective Filters. **Design of FIR Filters**: Symmetric and anti-symmetric FIR Filters, Design of Linear phase FIR Filters using Windows, Design of Linear phase FIR filters by frequency Sampling method, Design of FIR Differentiators and Hilbert Transformers.	**07 Hrs**
UNIT-V	
Structures for the realization of the discrete time systems: **Structures for FIR systems**: Direct form structure, Cascade form structures, frequency Sampling structures, lattice Structure. **Structure for IIR systems:** Direct form structures, Signal Flow Graphs and Transposed Structures, Cascade Form Structures, Parallel- Form.	**06 Hrs**

Laboratory Experiments
Part – A Simulation using MATLAB/SCILAB tool. 1. Computation of DFT, IDFT 2. Computation of Circular and Linear Convolution, and Correlation. 3. Computation of Response of digital systems 4. Design and simulation of digital filters. **Part – B** Simulation using DSP hardware. 1. Implementation of various operations: DFT, IDFT, Convolution and Correlation. 2. Design and implementation of various digital filters

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze signals and perform various signal processing operations, using DFT.
CO2	Explain and implement the FFT algorithms for efficient computation of the DFT.
CO3	Design, implement and present various digital filters for the required specifications
CO4	Evaluate the digital signal processing systems using simulation tool and DSP processors.

Reference Books	
1	Digital Signal Processing, Proakis G, Dimitris G. Manolakis, 4th Edition, 2007, PHI, ISBN: 81-317-1000-9.
2	Fundamentals of Digital Signal Processing, Lonnie C. Ludeman, 2013, John Wiley & Sons, ISBN: 978-81-265-2222-4.
3	Digital Signal Processing, Monson H.Hayes, 2nd Edition, 2011, Schaum's Outline Series, ISBN: 0071635092
4	Discrete Time Signal Processing, Alan .V. Oppemheim, 2nd Edition, 2002, PHI, ISBN: 81-7808-244-6.

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	---	3	2	---	---	---	---	---	---	1
CO2	3	2	---	---	2	---	---	---	---	---	---	1
CO3	3	3	2	2	3	---	---	---	2	2	1	2
CO4	3	3	3	2	3	---	---	---	2	2	1	2

Low-1 Medium-2 High-3

Semester: V		
DIGITAL COMMUNICATION (Theory & Practice)		
Course Code: 16TE53		**CIE Marks: 100+50**
Credits: 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	Explain the principles of Digital communication Systems.
2	Compare different modulation techniques and its application.
3	Analyze various spread spectrum concepts and their applications
4	Design sub systems with software/hardware and analyze their performances.

UNIT-I	
Base-band shaping for Data Transmission: Discrete PAM signals, power spectra of discrete PAM signals(Derivation of power spectra for NRZ,RZ only), ISI, Nyquist criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems for data transmission, Adaptive Equalization for data transmission.	**08 Hrs**
UNIT-II	
Detection Concepts: Model of Digital communication System, Gram-Schmidt Orthogonalization procedure, Geometric Interpretation of Signals, Response of Bank correlators to Noisy Input, Detection of known signals in noise, Probability of Error, Correlation Receiver, Matched Filter Receiver.	**06 Hrs**
UNIT-III	
Digital Modulation Techniques-I: Digital Modulation Formats, Coherent Binary Modulation Techniques, Coherent Quadrature – Modulation Techniques, Non-coherent detection Techniques, Comparison of various modulation techniques, M-ary Modulation Techniques - QAM Modulation.	**08 Hrs**
UNIT-IV	
Digital Modulation Techniques- II: Power Spectra, Bandwidth Efficiency, Effect of ISI, Bit versus Symbol Error Probabilities, Synchronization, Applications - Digital radio and voice grade modem. **Multi Carrier Modulation:** Multi- Channel Radio, Discrete Multi Tone data Transmission system, OFDM.	**08 Hrs**
UNIT-V	
Spread Spectrum Modulation: Pseudonoise sequences, Notion of Spread Spectrum, PN sequences, DSS Coherent Binary PSK, Signal-Space Dimensionality and Processing Gain, Probability of Error, Frequency-Hop spread spectrum, Applications.	**06 Hrs**

Laboratory Experiments

Part A

The students are expected to simulate the following circuits/systems using Lab VIEW.

1. Time Division Multiplexing.
2. ASK, FSK, BPSK, DPSK & QPSK generation and detection, BER analysis.
3. Quadrature Amplitude modulation – generation and detection, BER analysis
4. Spread Spectrum systems –DSSS and FHSS

Part B

The students are expected to implement the following circuits on hardware.

1. Time Division Multiplexing.
2. Generation and Detection of ASK, FSK and BPSK signals.
3. Generation and Detection of Quadrature Phase Shift Keying & Differential Phase shift keying
4. Spread Spectrum –FHSS generation and Detection

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain basic principles of baseband Pulse Shaping, digital modulation techniques and wide band modulation techniques.
CO2	Analyze the behaviour of communication systems with and without noise.
CO3	Design various modulation and demodulation circuits and wide band modulation techniques.
CO4	Implement, Demonstrate and Evaluate the performance parameters of different digital communication circuits.

Reference Books	
1	Digital communication, Simon Haykin, 1988, Reprint 2009, John Wiley, ISBN: 9788126508242.
2	Communication Systems, Simon Haykin, 4th Edition, 2006, John Wiley and Sons, ISBN: 9788126509041.
3	Lab VIEW Digital Signal Processing and Digital Communications, Cory L.Cork, 2005, Tata McGraw Hill, ISBN: 007060141.

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	2	---	---	---	---	---	---	2	---	---
CO2	2	3	3	2	3	---	---	---	---	2	---	3
CO3	2	3	3	2	3	---	---	---	1	---	---	3
CO4	---	3	3	3	---	---	---	---	---	---	---	3

Low-1 Medium-2 High-3

Semester: V		
TELECOM SWITCHING SYSTEM (Theory)		
Course Code: 16TE54		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Define the importance of switching over wired and wireless channels.
2	Understand the signaling principles in telecommunication networks.
3	Explain switching, signaling, traffic and standards in telecommunication networks.
4	Analyze how a telecommunication network handles traffic.

UNIT-I	
Evolution of Switching Systems telecommunication switching: Introduction, message switching, circuit switching, register-translator, senders, distribution frames, cross bar systems, need of trunking, electronic switching, reed-electronic systems, digital systems.	**07 Hrs**
UNIT-II	
Time-division switching: Introduction, Space and time switching, Time-division switching networks, Grades of service of time-division switching networks, Non-blocking networks, Synchronization.	**07 Hrs**
UNIT-III	
Switching networks: Single-stage networks, Principle of gradings, Design of progressive grading, Types of grading, Traffic capacity of gradings, Applications of gradings, link systems. Grades of service of link systems, application of graph theory to link systems, stick-sense non blocking networks, sectionalized switching networks.	**07 Hrs**
UNIT-IV	
Telecommunication traffic: Introduction, the unit of traffic, congestion, traffic measurement, a mathematical model, Lost-call systems, queuing systems, simulation.	**07 Hrs**
UNIT-V	
Signalling: Introduction, Customer line Signalling, Audio-frequency junctions and trunk circuits, FDM Carrier systems, PCM Signalling, Inter-register Signalling, Common-channel signalling principles, CCIT Signalling system No:6, CCIT Signalling system No:7, Digital customer line signalling.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the concepts of switching in wired and wireless communication.
CO2	Identify the classes of switching and grading analysis for a given switching network.
CO3	Analyze the importance of telecommunication services.
CO4	Design telecommunication networks for switching, signaling and traffic standards.

Reference Books	
1	Telecommunications, switching traffic and networks, J.E.Flood, 2005, Pearson education Ltd, ISBN: 1844860140.
2	John, C.Bellamy-"Digital Telephony"-Wiley series, 3rd Edition, 2002. ISBN: 9814126357.
3	Thiagarajan Viswanathan-"Telecommunication switching systems and networks"-Prentice Hall, 2004, ISBN: 1587202166.

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	--	--	--	--	--	---	---	---	---
CO2	---	3	2	--	--	--	--	1	2	1	---	2
CO3	---	3	2	--	--	--	--	--	--	1	--	2
CO4	--	3	3	--	--	--	--	1	2	2	--	2

Low-1 Medium-2 High-3

Semester: V		
MICROWAVE ENGINEERING (Theory)		
Course Code: 16TE55		**CIE Marks: 100**
Credits: 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	Use the concept of Electromagnetic field theory and network analysis to analyze microwave transmission line and Waveguides.
2	Design an impedance matching circuit at microwave frequency using transmission lines.
3	Analyze the characteristics of Microwave passive devices, active devices and vacuum tube devices.
4	Measure various network parameters used to analyze microwave networks.

UNIT-I	
Introduction to Microwaves: Properties, Frequency bands, Application of Microwaves in Domestic, Industrial and Medical fields, Microwave Hazards. **Transmission Line Theory:** The Lumped- Element Circuit Model for a Transmission Line- Wave Propagation on a Transmission Line, The Lossless Line, The Terminated Lossless Transmission Line- Special Cases of Lossless Terminated Lines, The Slotted Line, The Quarter Wave Transformer – The Impedance Viewpoint, Generator and Load Mismatches- Load Matched to Line, Generator matched to Load Line, Conjugate Matching, Lossy Transmission Lines- The Low Loss Line, The Distortionless Line, The Terminated Lossy Line.	**08 Hrs**
UNIT-II	
High Frequency Lines and Waveguides: Rectangular Waveguide-TE modes, TM modes for unloaded rectangular waveguides from Maxwell's equations, Attenuation as function of frequency, Excitation of Waveguides – Aperture Coupling (Qualitative Discussion), Coaxial Line – TEM modes, Higher order modes, Microstrip - Formulas for Effective Dielectric Constant, Characteristic Impedance and Attenuation.	**07 Hrs**
UNIT-III	
Basic Smith chart &Impedance Matching and Tuning: Smith Chart – Construction, Basic Smith Chart Operations ,Smith chart types-Impedance and Admittance Chart Single Stub Tuning- Shunt Stubs, Series Stubs, Double Stub Tuning- only Smith Chart Solution.	**07 Hrs**
UNIT-IV	
Microwave Network Analysis & Passive Devices: Review of S parameters and their properties. **Passive Devices:** Attenuators, Basic Properties of power Magic Tee junctions, Ferrite Isolators, Ferrite Phase Circulators.	**07 Hrs**
UNIT-V	
Active RF Components: Microwave Diode characteristics-Schottky Diodes and Detectors, PIN diodes, Gunn diode-Modes and construction, RF Transistor construction and characteristics – FETs, BJTs, Microwave Integrated Circuits-Hybrid Microwave Integrated Circuits, Monolithic Microwave Integrated Circuits. **Microwave Vacuum Tube Devices:** Reflex Klystrons, Travelling Wave Tubes and Cylindrical Magnetrons–Construction, Operation (Only Qualitative Discussion).	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Define the circuit parameters for design of microwave subsystems using active and passive devices.
CO2	Identify and design the transmission line for a given application.
CO3	Apply Smith Chart for microwave network/circuit analysis.
CO4	Compute microwave network/circuit parameters and Evaluate their performances.

Reference Books	
1	Microwave Engineering, David M Pozar, 3rd Edition, 2011, John Wiley, ISBN-978-81-265-1049-8.
2	Microwave Engineering, Annapurna Das, Sisir K das, 2nd Edition, Reprint 2011, Tata McGraw-Hill, ISBN -13:978-0-07-066738-9/10: -0-07-066738-1.
3	Microwave devices and circuits, Samuel .Y.Liao, 3rd Edition, 2000, PHI, ISBN-81-203-0699-6.

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	---	---	---	---	---	---	---	---	---	---	---	2
CO2	3	3	2	---	---	---	---	---	---	---	---	3
CO3	3	2	2	2	1	---	---	---	---	---	1	3
CO4	3	3	2	---	1	---	---	---	---	---	1	3

Low-1 Medium-2 High-3

Semester: V		
DIGITAL DESIGN AND VERIFICATION USING VERILOG (GROUP A: PROFESSIONAL CORE ELECTIVE) (Theory)		
Course Code: 16TE5A1		**CIE Marks: 100**
Credits: 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 design flow and hierarchical modeling concepts
2	Develop Verilog modules in various modeling techniques
3	Identify types of delay models and timing checks
4	Classify different Verification techniques and perform logic synthesis.

UNIT-I	
Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-based design flow in HDLs. **Hierarchical Modeling Concepts:** Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. **Basic Concepts, Modules and Ports.**	**07 Hrs**
UNIT-II	
Introduction to Modeling styles, **Gate-Level Modeling:** Gate types, Examples, Gate delays, Examples. **Dataflow Modeling:** Continuous assignments, Delays, Operator types, Examples **Behavioral Modeling:** Structured procedures, initial and always statements, Blocking and non blocking assignments, Timing controls, Conditional statements, Multi-way branching.	**07 Hrs**
UNIT-III	
Behavioral Modeling: Loops, Sequential and parallel blocks, Generate blocks. **Tasks and Functions:** Differences between tasks and functions, Tasks, Functions. **Useful Modeling Techniques:** Procedural continuous assignments, Overriding parameters, Conditional Compilation and Execution, Time scales. **Delays and Timing:** Delay models: Distributed, Lumped and Pin-to-pin delays, Path delay modeling, Timing checks, Delay back-annotation.	**08 Hrs**
UNIT-IV	
Switch-Level Modeling: Switch-modeling elements, Delay specification on switches. Examples: CMOS gates, Latch, Multiplexer. **Logic Synthesis with Verilog HDL:** Introduction to logic synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow.	**07 Hrs**
UNIT-V	
Functional and Timing verification of Gate-level netlist, Modeling tips: Verilog coding style, Design partitioning and constraint specification. **Verification Techniques:** Traditional verification flow, architectural modeling, Functional verification, Simulation, Analysis, Coverage, Assertion checking, Formal verification, Semi-formal verification, Equivalence checking.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Define modeling concepts, modules, operators and data types in Verilog.
CO2	Identify various types of delay models, timing checks and modeling techniques.
CO3	Classify different verification techniques and analyze design flow using Logic synthesis.
CO4	Develop Verilog HDL codes in various modeling styles to model digital circuits.

Reference Books	
1	Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar, 2nd Edition, 2003, Prentice Hall PTR, ISBN: 0-13-044911-3.
2	Verilog HDL Primer, J Bhasker, 1st Edition, 2008, BS Publications, ISBN-13: 978-8178001425.
3	Verilog Hardware Description Language, Thomas & Moorby, 5th Edition, 2014, Springer ISBN-13: 978-1475775891.

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

Low-1 Medium-2 High-3

Semester: V		
CONTROL SYSTEMS **(GROUP A: PROFESSIONAL CORE ELECTIVE)** **(Theory)**		
Course Code: 16TE5A2		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 37L+24T		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Learn the fundamental concepts of control systems & stabilized Control systems using Classical Methods.
2	Analyze the time response and frequency response of control systems using Conventional Approach.
3	Perform stability analysis of control systems.
4	Design stabilized control systems using Classical Methods.

UNIT-I	
Introduction and Modeling of Systems: The control system, open loop and closed loop control systems. Mathematical models of electrical circuits. **Transfer functions:** Block diagram reduction Technique, Signal Flow Graphs, Mason's gain formula (No derivation).	**07 Hrs**
UNIT-II	
Time Response of feedback control systems: Standard test signals, Unit step response of First and second order systems, Time response specifications (No derivations for the time specifications) of second order systems, steady – state errors and error constants.	**07 Hrs**
UNIT-III	
Stability analysis: Concepts of stability, Necessary conditions for stability, Routh-stability criterion, Relative stability analysis. **Root–Locus Techniques:** Introduction, The root locus concepts, Construction of root loci.	**07 Hrs**
UNIT-IV	
Stability in the frequency domain: Mathematical preliminaries, Nyquist stability criterion (Inverse polar plots excluded). Assessment of relative stability using Nyquist criterion. **Frequency domain analysis**: Introduction, Correlation between time and frequency response, Bode plots.	**09 Hrs**
UNIT-V	
Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations loss Concept of Controllability and observability, Pole placement by state Feedback.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Model the Feedback Control Systems in Integro-Differential Equations and generalize using Block Diagram and Signal flow graph methods.
CO2	Analyze the first and second order system for stability due to various input test signals.
CO3	Describe the stability of the control systems by Classical frequency analysis Methods.
CO4	Evaluate the Dynamic behaviour of Control System using State Space Models.

Reference Books	
1	Control system Engineering, I J Nagrath and M Gopal, 5th Edition, 2012, New Age International (P) Ltd., ISBN: 81-224-1192-4.
2	Feedback and Control System, Joseph J Distefano III et al., 2nd Edition, 2007, Schaum's Outlines, TMH, ISBN-13: 978-0071635127.
3	Automatic Control Systems, Benjamin Kuo, Farid Golnaagi, 8th Edition, 2009, Wiley Publication, ISBN-13: 978-0470048962.

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	---	1	2	---	---	---	---	---	---	---	---
CO2	3	---	1	2	---	---	---	---	---	---	---	---
CO3	3	2	2	1	2	---	---	---	---	---	---	---
CO4	3	2	3	2	2	---	---	---	---	---	---	---

Low-1 Medium-2 High-3

Semester: V		
VIDEO ENGINEERING **(GROUP A: PROFESSIONAL CORE ELECTIVE)** **(Theory)**		
Course Code: 16TE5A3		**CIE Marks: 100**
Credits: 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	Describe the scanning principles used in television.
2	Analyze the video broadcasting standards.
3	Represent pictures in optical and analogous electrical representation using appropriate standards.
4	Analyze different video compression and transmission standards.

UNIT-I	
Picture and scanning Principle: Picture characteristics (Monochrome and Color), scanning types, resolution and bandwidth, various standards. Need of synchronization, building composite video signals for monochrome, gamma correction, characteristics of Human eye, trichromatic coloring , color triangle, conversion of color picture to primary colors, compatibility, Bandwidth requirement, Color difference signals, Generation of luminance and chrominance in NTSC, PAL and SECAM. Differential Phase error and Weighting factor, Encoders and Decoders. Building Composite Video in each system. Standard definition of composite video parameters.	**08 Hrs**
UNIT-II	
Pickup and Display devices: Pickup Tubes, MOS and CCDs Working Principle of each and their important Characteristics, Comparison of different devices. Video- Display Tubes, LCD and Plasma.	**07 Hrs**
UNIT-III	
Television Application of Video: Mixing of various video and audio sources. Broadcast Television, Modulation and Bandwidth requirement. Transmitting system (NTSC, PAL, SECAM) corresponding Receiving Systems, HDTV & CCTV system.	**07 Hrs**
UNIT-IV	
Digitizing Video: Advantages of Digital Video, Comparison of analog and digital video. Definition of Pixel, Pixel Arrays, Different standards used. Sampling of video, Bandwidth requirement. Sampling luma and chroma. Standards adopted. compression, Compression strategies. Macro Blocks, Sampling Composite and Component digital signals, I,B,P frames. Quantization, motion compensation, Synchronization, Encoding process in H.261, H.263 and MPEG 1 ATSC and HDTV, HD SDI, Interleaving in HD SDI.	**07 Hrs**
UNIT-V	
Digital recording, Direct to Home TV (Principles and Technology), IPTV.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the characteristics of picture and scanning principles.
CO2	Analyze composite video signals and receiver front end.
CO3	Analyze bandwidth requirement, modulation techniques, processing for video broadcasting.
CO4	Apply the DVB standards for the design of video system blocks.

Reference Books	
1	Television and Video Engineering, Dhake A.M., 1995, TMH, ISBN-13:978-0-07-460105-1.
2	Video Demystified, Keith Jack, 4th Edition, 2007, Elsevier, ISBN: 0-7506-7822-4.
3	The Art of Digital Video, John Watkinson, 4th Edition, 2008, Focal press, ISBN-0-240-51586-2.

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	2	---	1
CO2	---	2	---	1	2	---	---	---	---	2	1	2
CO3	2	1	2	2	2	---	---	---	---	---	---	2
CO4	2	2	3	---	1	---	---	2	---	---	1	---

Low-1 Medium-2 High-3

Semester: V		
COMPUTER ORGANIZATION AND ARCHITECTURE (GROUP A: PROFESSIONAL CORE ELECTIVE) (Theory)		
Course Code: 16TE5A4		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 38L+24T		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the functions of major components and their organization in a computer.
2	Analyze the various processors, Memory and bus architectures.
3	Analyze the algorithms for computational units.
4	Choose an architecture and associated components for a given application.

UNIT-I	
Basic Structures of Computers, Machine Instructions and Programs: Review of basic Operational concepts - Bus structures, Performance , Processor clock, Basic Performance equation, Pipelining & Superscalar operation, Multiprocessor & Multicomputer, General features if CISC & RISC, Big – endian Little –endian assignments, Assembler Directives, Stacks & Queues : Subroutines : Subroutine Nesting.	**07 Hrs**
UNIT-II	
Input/ Output Organization: Accessing I/O devices, Interrupts, Interrupt Hardware, Enabling & Disabling Interrupt, Handling Multiple devices, Controlling Device Requests, Exceptions, Direct Memory Access, Bus Arbitration, Buses - Synchronous Bus, Asynchronous Bus.	**08 Hrs**
UNIT-III	
The Memory System: Review of Memory classification, characteristics and basic organization of memory chips. Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Organization of Larger Memories, Memory System Considerations, Rambus memory; Cache Memories - Mapping functions, Performance considerations, Interleaving, Hit Rate & Miss Penalty, Virtual Memories - Address Translation.	**08 Hrs**
UNIT-IV	
Arithmetic unit: Implementation of Addition & Subtraction of Signed Numbers: Design of fast adders-Carry-Look ahead Addition; Multiplication of positive numbers - Signed–Operand Multiplication, Booth Algorithm, Fast Multiplication, Bit-pair Recoding of Multipliers; Integer division , Floating – Point Numbers & Operations.	**08 Hrs**
UNIT-V	
Advanced Processor Architecture: Introduction to Advanced Architecture ARM, SHARC, Tiger SHARC, DSP, Architecture of DSP, Processor and memory organizations, instruction level parallelism.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the basic architecture and operational concepts involved in computer system design.
CO2	Identify the memory and bus structure requirements for a given system design.
CO3	Design Memory of a computer & ALU by applying fast computation algorithms.
CO4	Choose the appropriate processor for a particular application.

Reference Books	
1	Computer organization, Carl Hamacher, Z Vranesic& S Zaky, 5th Edition, 5th Reprint 2012, Tata McGraw- Hill, ISBN 10: 1259005275.
2	Computer System Architecture, Morris Mano, 3rd Edition, 1992, PHI, ISBN: 978-0131755635.
3	Embedded Systems Architecture Programming and Design, Raj Kamal, 5th Reprint, 2005, Tata McGraw Hill, ISBN-10: 933290149X.

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

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CO1	1	1	1	---	---	---	---	1	---	2	---	1
CO2	2	2	2	---	---	---	---	1	---	2	---	1
CO3	3	3	3	---	---	---	---	1	---	2	---	2
CO4	3	3	3	---	---	---	---	1	---	2	---	3

Low-1 Medium-2 High-3

Semester: V		
BIOINFORMATICS **(Group B: Global Elective)** **(Theory)**		
Course Code:16G5B01		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours:04		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
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	**09 Hrs**

other structures on genomic DNA, Parsing BLAST and FASTA results. BioPerl and 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., 4th edition, 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.
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)

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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	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	-	-

Low-1 Medium-2 High-3

Semester: V		
FUEL CELL TECHNOLOGY **(Group B: Global Elective)** **(Theory)**		
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.	**09 Hrs**
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.	**09 Hrs**
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.	**09 Hrs**
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.	**09 Hrs**
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	
CO1	Understand the fundamentals and characteristics of fuel cells
CO2	Apply chemical engineering principles to distinguish fuel cells from conventional energy systems
CO3	Analyze the performance of fuel cells using different characterization techniques
CO4	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)

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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												
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	2	-	-	-	-	-	1	-	1	-	-	-
CO 2	2	-	2	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	3	-	2	-	-	-
CO 4	-	2	2	-	-	-	2	-	3	-	-	2

High-3 : Medium-2 : Low-1

Semester: V		
GEOINFORMATICS **(Group B: Global Elective)** **(Theory)**		
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

Semester: V		
GRAPH THEORY **(Group B : Global Elective)** **(Theory)**		
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)

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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	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

Semester: V		
ARTIFICIAL NEURAL NETWORKS & DEEP LEARNING **(Group B: Global Elective)** **(Theory)**		
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

Semester: V		
HYBRID ELECTRIC VEHICLES **(Group B: Global Elective)** **(Theory)**		
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):

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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	**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

Low-1 Medium-2 High-3

V Semester		
OPTIMIZATION TECHNIQUES **(Group B: Global Elective)** **(Theory)**		
Course Code : 16G5B07		**CIE Marks : 100**
Credits : L: T: P: S:4:0:0:0		**SEE Marks : 100**
Hours : 44L		**SEE Duration : 03 Hrs**

Course Learning Objectives: The students will be able to	
1.	To understand the concepts behind optimization techniques.
2.	To explain the modeling frameworks for solving problems using optimization techniques.
3.	To design and develop optimization models for real life situations.
4.	To analyze solutions obtained using optimization methods.
5.	To compare models developed using various techniques for optimization.

UNIT – I	
Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR.	**09 Hrs**
Linear Programming: Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel. **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables.	
UNIT – II	
Duality and Sensitivity Analysis: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Primal-Dual relationships, Economic interpretation of duality, Post optimal analysis - changes affecting feasibility and optimality, Revised simplex method.	**09 Hrs**
UNIT – III	
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	**08 Hrs**
UNIT – IV	
Queuing Theory: Queuing system and their characteristics, The M/M/I Queuing system, Steady state performance analyzing of M/M/1 queuing models. Introduction to M/M/C and M/Ek/1 queuing models **Game Theory**: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance.	**09Hrs**
UNIT – V	**09 Hrs**
Markov chains: Definition, Absolute and n-step transition probabilities, Classification of the states, Steady state probabilities and mean return times of ergodic chains, First passage times, Absorbing states. Applications in weather prediction and inventory management. Over view of OR software's used in practice.	

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)

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							
CO5			2			1						1

Low-1 Medium-2 High-3

V Semester		
SENSORS & APPLICATIONS **(Group B: Global Elective)** **(Theory)**		
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 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	1	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	2	2	-	-	-	-	-	-
CO3	1	2	2	-	1	1	-	-	-	-	-	2
CO4	-	-	-	-	1	1	-	-	-	3	-	1

Low-1 Medium-2 High-3

Semester: V		
INTRODUCTION TO MANAGEMENT INFORMATION SYSTEMS **(Group B: Global Elective)** **(Theory)**		
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

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	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

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

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 numericals	**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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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	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

Semester: V		
TELECOMMUNICATION SYSTEMS **(Group B: Global Elective)** **(Theory)**		
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

Semester: V		
COMPUTATIONAL ADVANCED NUMERICAL METHODS **(Group B: Global Elective)** **(Theory)**		
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: The students will be able to	
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.

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	-	-	-	-	-	-	-	2
CO2	3	2	1	-	-	-	-	-	-	-	-	2
CO3	2	3	2	2	-	-	-	-	-	-	-	1
CO4	3	3	1	2	1	-	-	-	-	-	-	3

Low-1 Medium-2 High-3

Semester: V		
BASICS OF AEROSPACE ENGINEERING **(Group B: Global Elective)** **(Theory)**		
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	
CO1	Appreciate and apply the basic principles of aviation
CO2	Apply the concepts of fundaments of flight, basics of aircraft structures, aircraft propulsion and aircraft materials during the development of an aircraft
CO3	Comprehend the complexities involved during development of flight vehicles.
CO4	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 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	2	2	3	2	1	1	1				1
CO3	1		3	3								1
CO4	2	2	3	3		2	2	2				1

Low-1 Medium-2 High-3

VI SEMESTER FOUNDATIONS OF MANAGEMENT AND ECONOMICS (Theory) (Common to AE, CSE, ECE, EEE, ISE, TE)		
Course Code:16HEM61		**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

Semester: VI		
COMPUTER COMMUNICATION NETWORKS (Theory & Practice)		
Course Code: 16TE62		**CIE Marks: 100+50**
Credits: L:T:P:S: 4:0:1:0		**SEE Marks: 100+50**
Hours: 45L		**SEE Duration: 03Hrs+03Hrs**
Course Learning Objectives: The students will be able to		
1	Explain the concepts of networks and how communication takes place between computers and networks using OSI reference model and TCP/IP model.	
2	Apply fundamentals of Digital Communications and switching systems.	
3	Analyze flow control, congestion control and QOS of the network for reliable data transfer.	
4	Implement and Evaluate various protocols at Link, Network, Transport layer and Application	

UNIT-I	
Introduction: Overview Of The Internet: Networks, Switching, The Internet, Accessing the Internet, Hardware and Software. Protocol Layering: Scenarios, TCP/IP Protocol Suite, The OSI Model. **Physical layer & transmission media :** Data And Signals: Analog and Digital, Transmission Impairment, Data Rate Limits, Performance. Bandwidth Utilization, Multiplexing. Transmission Media**:** Guided Media, Unguided Media.	**09 Hrs**
UNIT-II	
Data-Link Layer: Wired Networks: Introduction, Nodes and Links, Two Types of Links, Two Sublayers. Data Link Control (DLC): Framing, Flow and Error Control, Error Detection and Correction, Two DLC Protocols. Multiple Access Protocols: Random Access, Controlled Access, Channelization, Link Layer Addressing. Wired LANs: Ethernet Protocol IEEE project 802, Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, Virtual LANs.	**09 Hrs**
UNIT-III	
Network Layer: Introduction: Network-Layer Services, Packet Switching, Network-Layer Performance, Network-Layer Congestion. **Network-Layer Protocols:** IPv4 Datagram Format, IPv4 Addresses, Forwarding of IP Packets, ICMPv4. Unicast Routing: General Idea, Routing Algorithms, Unicast Routing Protocols.	**09 Hrs**
UNIT-IV	
Transport Layer: Introduction: Transport-Layer Services. **Transport-Layer Protocols:** Simple Protocol, Stop-and-Wait Protocol, Go-Back-NProtocol (GBN), Selective-Repeat Protocol, Bidirectional Protocols: Piggybacking, Internet Transport-Layer Protocols. **User Datagram Protocol (UDP):** User Datagram, UDP Services, UDP Applications. **Transmission Control Protocol (TCP):**TCP Services , TCP Features, Segment, A TCP Connection , State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers , Options.	**09 Hrs**
UNIT-V	
Application Layer: Introduction: Providing Services, Application-Layer Paradigms. **Client-Server Paradigm:** Application Programming Interface, Using Services of the transport layer. **Standard Client-Server Applications:** World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Secure Shell (SSH) , Domain Name System (DNS). **Peer-To-Peer Paradigm:** P2P Networks, Distributed Hash Table (DHT).	**09 Hrs**

LABORATORY EXPERIMENTS	
Part- A **Experiments Using Routers and Switches:** Configuration of Cisco router, Cisco switch, IP static routing and RIP using Cisco router, and VLAN using Cisco switch. **Part- B** **Experiments Using Qualnet:** Experiments on FTP, Telnet, IEEE 802.3 and IEEE 802.11. **Part-C** **Programs based on implementation of various algorithm using C/C++.** 1. Program for error detecting code using CRC-CCITT (16-bits). 2. Shortest Path algorithm to find suitable path for transmission. 3. Spanning Tree algorithm to find loop less path. 4. Implement a client and server communication using sockets programming. 5. Message queues of FIFOs as IPC Channel.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the functions of different layers in the network models.
CO2	Analyze various protocols and algorithms in the network model.
CO3	Design and Implement protocols and algorithms for computer networks.
CO4	Evaluate the performance parameters of networks models.

Reference Books	
1	Computer Networks - A Top-Down Approach, Behrouz A. Forouzan, Firouz Mosharraf, , Special Indian Edition, 2012, McGraw Hill Publishers, ISBN-13: 978-1-25-900156-7.
2	Computer networks, Andrew S. Tanenbaum, 5th Edition, Prentice Hall, ISBN-13: 978-0-13-212695-3.
3	Computer Networking A Top-Down Approach featuring the Internet, James F. Kurose, Keith W. Ross, 3rd edition, Pearson Education.

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

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 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	1	2	2	2	---	---	---	---	---	---	---	---
CO2	2	2	2	2	2	2	---	---	2	---	---	---
CO3	2	3	3	3	2	2	---	---	2	---	---	---
CO4	3	3	3	3	2	2	---	---	2	---	---	---

Low-1 Medium-2 High-3

Semester: VI		
INFORMATION THEORY & CODING (Theory)		
Course Code: 16TE63		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 38L+24T		**SEE Duration: 03Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the need for Source coding and Channel coding in Communication systems.	
2	Apply the Shannon's theorem for the performance analysis.	
3	Analyze various Error control coding techniques.	

UNIT-I	
Definitions of probability, Joint and conditional probabilities, Total probability and Bayes theorems, Independent Events.Measure of Information, Units of Information, Discrete memory less source(DMS) and Entropy, Logarithmic inequalities, Properties of Entropy, Information Rate, Extension of a zero memory source, Sources with finite memory – Markov sources, Extension of a Markov Source.	**08 Hrs**
UNIT-II	
Source Encoding: Source coding Theorem, Huffman coding, Discrete memory less channels, Mutual Information, Channel Capacity, Channel coding theorem, Differential Entropy and mutual Information for continuous ensembles, Channel Capacity theorem.	**08 Hrs**
UNIT-III	
Error Control Coding: Rationale for Coding, Types of Codes, Discrete memory less channel. **Linear Block codes**: Repetition codes, Syndrome decoding, Minimum distance considerations, Hamming Codes. **Cyclic Codes:** Generator Polynomial, Generator Matrix, Encoder, Syndrome calculation, Cyclic Redundancy Check (CRC) codes, Maximum Length codes, Bose-Chaudhury- Hocquenghem (BCH) Codes, Reed-Solomon Codes.	**08 Hrs**
UNIT-IV	
Convolution Codes: Convolution Encoding – Time domain approach, Transform Domain Approach, State, Tree and Trellis diagrams.	**07 Hrs**
UNIT-V	
Decoding of Convolution Codes using Viterbi algorithm.Distance Properties of Convolution codes, Sequential Decoding of Convolution Codes, Trellis Codes, Applications of Error-control Coding, Turbo Codes.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the importance of source coding and channel coding in digital communication.
CO2	Apply various source coding techniques to reduce redundancy.
CO3	Analyze and develop various channel coding schemes.
CO4	Design the convolution coding and decoding schemes.

Reference Books	
1	Digital & Analog communication systems, K Sam Shanmugam, Reprint 2008, John Wiley & Sons, ISBN: 978-81-265-0914-0.
2	Digital Communications, Simon Haykin, 2009, John Wiley, ISBN: 9788126508242.
3	Communication Systems, Simon Haykin, 4th Edition, 2006, John Wiley, ISBN: 9788126509041.
4	Analog and Digital Communications, H.P. Hsu, 2nd Edition, 2006, Tata McGraw Hill, ISBN: 0071402284 / 9780071402286.

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	---	--
CO2	2	2	2	2	2	---	---	---	---	--	--	2
CO3	2	2	3	2	2	---	---	---	---	1	---	2
CO4	3	2	3	2	3	---	---	---	---	1	--	2

Low-1 Medium-2 High-3

Semester: VI		
RADIATING SYSTEMS (Theory & Practice)		
Course Code: 16TE64		**CIE Marks: 100+50**
Credits: 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	Learn the fundamental concepts of antenna design.
2	Analyze and Design the antenna for various applications.
3	Employ concept of Beam forming in Smart antenna design.
4	Characterize the waveguide and micro strip components and evaluate their

UNIT-I	
Antenna Basics: Basic antenna parameters, Radiation patterns, Radiation Intensity, Beam area, Beam Efficiency, Directivity and Gain, Aperture antennas, Fields from oscillating electric Dipole with mathematical derivations, Antenna field zones, Power theorem & its applications, Radiation intensity, Power patterns, Examples of Power patterns. Electric dipole-fields of short dipole, radiation resistance of short and half wave dipole.	**07 Hrs**
UNIT-II	
Antenna arrays: Field patterns, Phase patterns of Point sources, Arrays of two isotropic point sources, Arrays of Non-isotropic sources, Pattern multiplication and synthesis, Array of n-isotropic point sources with equal amplitude and spacing, Broadside, End fire arrays & Extended end-fire arrays, dipole arrays with parasitic elements, Yagi-Uda array.	**07 Hrs**
UNIT-III	
Types of Antennas: Microwave antennas- Rectangular Horn antenna and its radiation characteristics, Parabolic antenna-General properties, Paraboloidal reflector, Feed methods for parabolic reflectors. Broadband antennas- Helical antenna geometry and its modes, Practical considerations for the monofilar Axial-mode Helical antenna. Broadband basics, Rumsey's Principle, Log-Periodic Antenna.	**07 Hrs**
UNIT-IV	
Smart Antennas : Smart Antenna Configurations, Switch Beam Antennas, Adaptive antenna approach , Space Division multiple access, Architectures of smart antennas, Benefits and drawbacks , Basic Principles, Mutual Coupling Effects, Antennas for terrestrial mobile communication systems(Base station Antennas).	**07 Hrs**
UNIT-V	
Microstrip Antenna: Introduction, Advantages and Limitations, Rectangular Microstrip antennas, feeding methods, Characteristics of Microstrip Antennas, Impact of Different parameters on Characteristics, brief method of analysis - Transmission line model, Printed Antennas for handheld applications.	**07 Hrs**

LABORATORY EXPERIMENTS

Students are expected to implement the following circuits on Microwave Benches

1. Characterization of Reflex Klystron, Gunn diode sources.
2. Characterization of Directional Coupler, Tee junctions, Circulator and Isolator.
3. Horn antenna, Parabolic Dish, Micro strip antennas.
4. Microstrip Passive components.

The students are expected to simulate the following Antennas using RF CAD tools

1. Radiation characteristics of Dipole antenna.
2. N- isotropic point source array.
3. Rectangular Microstrip Patch antenna.

Course Outcomes: After completing the course, the students will be able to	
CO1	Define the performance parameters for Antennas.
CO2	Identify antennas for different frequency applications
CO3	Analyze array antenna for different patterns.
CO4	Design and implement Antennas for required radiation characteristics

Reference Books	
1	Antennas, John D. Kraus & Ronald J. Marhefka, 4th Edition, 2011, Mc Graw Hill, ISBN -0-07-060185-2.
2	Antenna Theory, Constantine A Balanis, 2nd Edition, 2005, John Wiley & Sons, ISBN – 9971-51-233-5.
3	Introduction to Smart Antennas, Constantine A Balanis , Bannides, 2007, ISBN: 1598291769

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	---	---	---	---	---	---	---	1
CO2	2	2	1	1	---	---	---	---	---	---	---	1
CO3	2	2	2	2	2	---	---	---	---	---	---	1
CO4	2	2	2	2	2	---	---	---	---	---	---	1

Low-1 Medium-2 High-3

Semester: VI		
CMOS CIRCUIT DESIGN (GROUP C: PROFESSIONAL CORE ELECTIVES) (Theory)		
Course Code: 16TE6C1		**CIE Marks: 100**
Credits: 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	Define the structure of MOS transistors and explain geometrical effects of a MOSFET.
2	Draw stick diagram and corresponding layout for a given digital circuit.
3	Analyze design steps involved in digital design and explain the need for low power in IC design.
4	Evaluate the circuit reliability and signal integrity issues in DSM IC design.

UNIT-I	
Review of MOS transistor: MOSFET operations, MOS current equation. **Physical and geometrical effects on the behavior of the MOS transistor:** Back-bias effect, Zero field mobility, Carrier mobility degradation, Channel length modulation, Punch through, Hot carrier effects, and Weak inversion behavior.	**07 Hrs**
UNIT-II	
CMOS circuits: Electrical design of CMOS circuits: CMOS inverter, Dissipation of a CMOS inverter, CMOS Buffer design, Noise margins, Digital CMOS circuits: pass transistor logic, Static CMOS circuits, Clocked static CMOS circuits, Dynamic CMOS circuits, Choosing a CMOS implementation, Clocking strategies.	**08 Hrs**
UNIT-III	
Fabrication: Basic fabrication operations, nMOS process steps. **CMOS Fabrication:** n-well, p-well and twin-tub. **VLSI Layout:** MOS layer, Stick diagrams, Layout design rules, Layout diagrams for Boolean equations.	**07 Hrs**
UNIT-IV	
VLSI and ASICs: Introduction, Abstraction levels for VLSI, Digital VLSI design. **Low power IC design:** Sources of CMOS power consumption, Technology options for low power, Design options for low power (excluding topics from capacitance reduction).	**07 Hrs**
UNIT-V	
Circuit Reliability: Introduction, Design for Reliability: Introduction, Latch-up in CMOS circuits, ESD and its protection Electro-migration, Hot-carrier degradation. **Signal Integrity:** Introduction, Clock distribution and critical timing issues, Clock generation and synchronization in different domains on a chip, Testing, Yield.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamentals of semiconductor physics in MOS transistors.
CO2	Analyze VLSI fabrication flow involved in IC design and create layouts for Boolean functions.
CO3	Justify the need for low power, circuit reliability and signal integrity in IC design.
CO4	Design digital circuits for Boolean functions and realize them in variants of CMOS logic.

Reference Books	
1	Deep-Submicron CMOS ICs, Harry Veendrick, 2nd Edition, 2000, Kluwer academic publishers, ISBN: 9044001116.
2	Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2003, PHI, ISBN: 8120309863.
3	CMOS Digital Integrated Circuits: Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, 3rd Edition, Tata McGraw-Hill, ISBN: 0070530777, 2003.

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	1	2	---	---	---	---	---	---	---
CO2	---	1	---	1	3	---	---	---	---	---	---	---
CO3	2	1	1	2	3	---	---	---	---	---	---	---
CO4	1	1	1	2	3	---	---	---	---	---	---	---

Low-1 Medium-2 High-3

Semester: VI		
ARM PROCESSOR **(GROUP C: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6C2		**CIE Marks: 100**
Credits: 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	Describe basic architecture and operations of arm processors.	
2	Explain Thumb instruction set for programming.	
3	Design an embedded system using ARM processor.	
4	Analyze the working principles of the cross compilers.	

UNIT-I	
ARM embedded systems: ARM Architecture. **ARM processor fundamentals:** Registers current program status register, pipeline, exceptions, interrupts and vector table, core extensions, Architecture revisions, ARM processor families.	**08 Hrs**
UNIT-II	
Cache: The memory Hierarchy & Cache Memory, Cache architecture, discussions on latest applications of ARM. **Introduction to ARM instruction set:** Data processing instructions, Branch Instructions, Load Store Instructions, Software Interrupt Instruction, Program status Register Instructions.	**08 Hrs**
UNIT-III	
Introduction to ARM instruction set: Loading Constants, ARMv5E Extensions, and Conditional Execution. Basic Programming. **Introduction to the THUMB Instruction set:** Thumb register Usage, ARM-Thumb Interworking, other branch instructions, Data Processing Instructions, Single register Load – store Instructions.	**07 Hrs**
UNIT-IV	
Introduction to the THUMB Instruction set: Multiple register Load Store Instruction, Stack Instructions, Basic Programming. **Interrupts & Exception Handling:** Exception Handling, Interrupts, Interrupt handling schemes.	**06 Hrs**
UNIT-V	
Embedded firmware Design and Development: Embedded firmware design approaches, Embedded firmware Design languages.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the basic design principles of ARM processor based system.
CO2	Identify the different attributes for designing ARM processor based application.
CO3	Analyze the execution of Thumb instructions.
CO4	Design ARM based embedded system.

Reference Books	
1	ARM system developer's guide, Andrew N. Sloss, 2008, Elsevier, ISBN: 9781558608740.
2	Introduction to Embedded systems, Shibu KV, 9th Reprint, 2013, McGraw Hill, ISBN: 8186308792.
3	ARM Assembly Language – Fundamentals and Techniques, William Hohl, 2009, CRC Press, ISBN: 9781439806104.
4	ARM Assembly Language An Introduction, J.R. Gibson, 2010, CENGAGE Learning, ISBN: 9788131513606.

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	---	---	1	1	1	---	---	1	---
CO2	3	2	2	---	---	1	1	1	---	---	1	---
CO3	2	1	1	---	---	---	---	---	---	---	---	---
CO4	3	3	3	1	2	1	---	1	---	---	---	1

Low-1 Medium-2 High-3

Semester: VI		
MULTI MEDIA COMMUNICATION **(GROUP C: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6C3		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 38L+24T		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Describe data compression algorithms for multimedia communication.
2	Analyze lossless compression techniques for digital data.
3	Use quantizers and transform coding for data compression.
4	Apply multimedia system standards for different applications.
5	Explain multimedia networks and their applications.

UNIT-I	
Multimedia Communications: Multimedia information representation, multimedia networks, multimedia applications, Qos-Network QoS and application QoS.	**07 Hrs**
UNIT-II	
Multimedia Information Representation: Digitization principles, Text formats – Unformatted, formatted and hypertext, Images- Graphics, Documents; Audio and Video.	**07 Hrs**
UNIT-III	
Text and Image Compression: Compression principles, Text compression- Huffman coding, Arithmetic Coding,LZ, LZW coding; Image compression- GIF, TIFF, Digitized documents and pictures, JPEG.	**08 Hrs**
UNIT-IV	
Audio and Video Compression: Audio compression - DPCM, Adaptive DPCM, Adaptive and Linear predictive coding, CELP, MPEG and Dolby audio coders. **Video compression** - video compression principles; Standards - H.261, H.263, MPEG, MPEG-1, MPEG-2, MPEG-4.	**08 Hrs**
UNIT-V	
Multimedia Entertainment Networks: Cable TV networks – HFC networks, Satellite TV networks – broadcast television principles, digital television, services, Terrestrial television networks principles, digital television and interactive services, High speed PSTN access technologies –ADSL, VDSL.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze different multimedia data for processing.
CO2	Apply Sampling, Quantization and transform coding for data compression.
CO3	Describe multimedia system standards such as JPEG & MPEG.
CO4	Describe the functioning of Cable TV, satellite TV, digital TV and High speed access technologies.

Reference Books	
1	Multimedia Communications, Fred Halsall, 2008, Pearson Education, ISBN: 1405814292.
2	Fundamentals of Multimedia, Li and Drew, 2006, PHI, ISBN: 9788120328174.
3	Multimedia Communication Systems, K.R. Rao, Zoran S.Bojkovic, D.A.Milovanovic, 2009, PHI, ISBN: 8120321456.

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	3	2	---	---	---	---	---	---	2
CO2	3	2	2	1	2	---	---	---	---	---	---	---
CO3	1	1	2	2	2	2	---	---	2	---	---	---
CO4	1	2	1	1	---	3	2	---	3	1	1	2

Low-1 Medium-2 High-3

Semester: VI		
OPERATING SYSTEMS **(GROUP C: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6C4		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 38L+24T		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Define fundamental principles of operating system design and kernel implementation. Interpret the concepts of memory hierarchy and caching and how they affect performance.
2	Analyze resource management in Operating System.
3	Evaluate and identify the algorithms for resource management.
4	Implement operating system algorithms using any high level language.

UNIT-I	
Introduction: Operating Systems, Goals of an OS, Operations of OS, Resource Allocation and Related Functions, User Interface related functions, Classes of OS Multiprogramming Systems, Time Sharing System, Real-Time Operating System. **Structure of Operating System:** Operation of an OS, Structure of the supervisor, Virtual Machine OS, Kernel Based OS, Microkernel Based OS.	**07 Hrs**
UNIT-II	
Processes: Process concept, Process Scheduling, Operations on processes, cooperating process, Inter process communication, Multithreading Models, Threading Issues. **CPU Scheduling:** Basic concepts, scheduling criteria, scheduling algorithms, multi-processor scheduling, thread scheduling.	**07 Hrs**
UNIT-III	
Process Synchronization: The critical selection problem, Peterson's solutions, Synchronization Hardware, Semaphores. **Deadlocks:** System models, Deadlocks Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from deadlock.	**08 Hrs**
UNIT-IV	
Memory management: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation. **Virtual Memory:** Demand Paging, Copy-on-write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, and Allocation Kernel Memory.	**08 Hrs**
UNIT-V	
File Systems: File concept, Access methods, Protection, File-system structure, File-system Implementation, Directory Implementation and Allocation Methods. **Case Studies**: Windows Overview, Thread Management, Scheduling Management, Memory Management, I/Os, File System.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and interpret various functions, goals and resource management in operating system.
CO2	Describe and Implement key parameters to improve the Process Scheduling, Memory Management and I/O file system.
CO3	Apply the knowledge learnt to support the system in terms of best performance using resources.
CO4	Compare and analyze the functionality of different operating system like windows using case study.

Reference Books	
1	Operating System Concepts, A Sliberschatz and P B Galvin, 7th Edition, Reprint 2011, Addison Wesley, ISBN: 978-81-265-0962-1.
2	Operating Systems –A Concept Based Approach, D. M. Dhamdhere, 5th Edition, Reprint 2005, TMH, ISBN: 0-07-061194-7.
3	Operating Systems Internals and Design Principles, William Stallings, 7th Edition, 2012, Pearson Prentice Hall, ISBN: 978-0132309981.
4	Operating Systems, Design and Implementation, Andrew S. Tanenbaum, 2006, Pearson Education, ISBN: 978-0131429383.

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	2	1	1	---	---	---	---	---	---	---
CO2	2	3	2	1	1	---	---	---	---	---	---	---
CO3	2	3	2	1	1	---	---	---	---	---	---	---
CO4	1	2	2	2	2	---	---	---	1	---	---	---

Low-1 Medium-2 High-3

Semester: VI		
MICROWAVE INTEGRATED CIRCUITS **(GROUP D: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6D1		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 34L		**SEE Duration: 03Hrs**
Course Learning Objectives: The students will be able to		
1	Recognize the effects of miniaturization of microwave devices.	
2	Analyze the design issues of RFICs.	
3	Identify Passive Circuit Elements in RF systems.	
4	Design RF active subsystems on RFICs.	

UNIT-I	
Introduction: Lower Frequency Analog Design and Microwave Design Versus Radio Frequency Integrated Circuit Design, Types of MICs - HMICs, MMICs. **Issues in RFIC design, noise, linearity:** Introduction, Noise, thermal Noise, Noise figure, The noise figure of an Amplifier circuits and components in series, Linearity and Distortion in RF circuits, Third-order and second order Intercepts point, the 1-db compression point, Broadband measures of linearity.	**06 Hrs**
UNIT-II	
Impedance Matching: Introduction, review of smith chart, impedance matching using LC networks, bandwidth and Q factor of matching networks. **The use and design of passive circuit elements in IC technologies:** Introduction, sheet resistance and the skin effect, parasitic capacitance & inductance, Applications of On-chip spiral inductors and transformers, On chip Transmission lines.	**07 Hrs**
UNIT-III	
LNA Design: Common-Emitter Amplifier, Noise in Amplifiers, Input-Referred Noise Model of the Bipolar Transistor, Noise Figure of the Common-Emitter Amplifier, Input Matching of LNAs for Low Noise, Relationship Between Noise Figure and Bias Current, Linearity in Amplifiers - Exponential Nonlinearity in the Bipolar Transistor, Nonlinearity in the Output Impedance of the Bipolar Transistor, High- Frequency Nonlinearity in the Bipolar Transistor.	**07 Hrs**
UNIT-IV	
Mixers: Mixing with Nonlinearity, Basic Mixer Operation, Controlled Transconductance Mixer, Double-Balanced Mixer, Mixer Noise, Linearity, Improving Isolation, Image Rejection. **Voltage-Controlled Oscillators :** The LC Resonator, Configuration of the amplifier as Colpitts oscillator, Analysis of an Oscillator as a Feedback System, Negative Resistance Generated by the Amplifier, The Effect of Parasitics on the Frequency of Oscillation, Large-Signal Nonlinearity in the Transistor, Phase Noise.	**07 Hrs**
UNIT-V	
Power Amplifiers: Power Capability, Efficiency Calculations, Matching Considerations, Classification of Power Amplifiers, Amplifier Classes for RF Integrated Circuits, AC Load Line, Matching to Achieve Desired Power, Transistor Saturation, Current Limits, Power Combining, Thermal Runaway—Ballasting, Breakdown Voltage, Effects of Nonlinearity.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain design concepts and performance parameters in RFICs.
CO2	Identify different Passive Circuit Elements on RF ICs.
CO3	Analyze the characteristics of RF subsystems.
CO4	Design various RF subsystems for RF transceivers.

Reference Books	
1	Radio Frequency Integrated Circuit Design, John Rogers, Calvin Plett, , 2003, Artech house, ISBN-13- 978-1580535021(UNIT-I & II).
2	Radio Frequency and Microwave Electronics, Mathew M. Radmanesh, Prentice Hall Communications Engineering and Emerging Technologies Series, 2001, ISBN-9780130279583 (UNIT-III, IV & V).
3	Microwave amplifiers-Analysis and Design, Gulliermo Gonzalez, 2nd edition, 1997, Prentice Hall- Technology & Engineering, ISBN-13: 978-0132543354.

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	2	2	2	2	---	---	---	---	1	---	1
CO2	2	2	2	2	2	---	---	---	---	1	---	2
CO3	3	3	2	2	2	---	---	---	---	1	---	2
CO4	3	3	3	2	3	---	---	---	---	1	---	2

Low-1 Medium-2 High-3

Semester: VI		
DIGITAL SIGNAL PROCESSOR ARCHITECTURE (GROUP D: PROFESSIONAL CORE ELECTIVES) (Theory)		
Course Code: 16TE6D2		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 38L		**SEE Duration: 03Hrs**
Course Learning Objectives: The students will be able to		
1	Describe the architectural features of DSP processor.	
2	Analyze various addressing modes of TMS320C54xx DSP processor	
3	Compare the architectural features of different fixed point DSPs.	
4	Interface Memory and Parallel I/O Peripherals and CODEC to Programmable DSP Device	
5	Develop different applications on TMS320C54xx DSP processo	
6	Write the simple programs to implement different DSP algorithms	

UNIT-I	
Introduction to Digital Signal Processing: Introduction, A Digital Signal-Processing System, Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation. **Architectures for Programmable Digital Signal-Processing Devices :** Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability an Program Execution, Speed Issues, Features for External Interfacing .	**07 Hrs**
UNIT-II	
Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS320C54xx Digital Signal Processors, Data Addressing Modes of TMS320C54xx Processors, Memory Space of TMS320C54xx Processors, Program Control, TMS320C54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54xx Processors, Pipeline Operation of TMS320C54xx Processors.	**08 Hrs**
UNIT-III	
Implementations of Basic DSP Algorithms and FFT algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, Adaptive filters.An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit-Reversed Index Generation, FFT Implementation on the TMS320C54xx, Computation of the Signal Spectrum.	**08 Hrs**
UNIT-IV	
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access. **Interfacing Serial Converters to a Programmable DSP Device:** Introduction, Synchronous Serial Interface, A multi-channel Buffered Serial Port (McBSP), A CODEC Interface Circuit.	**08 Hrs**
UNIT-V	
Applications: DSP system, DSP based Biotelemetry Receiver, Speech processing Systems, Image Processing Systems. **Overview of Floating Point Processors:** Architectural features of C67X processor.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain basic requirements and features of programmable DSP devices.
CO2	Describe the importance of McBSP, CODEC interfaces and DSP applications.
CO3	Analyze and develop simple programs to implement different DSP algorithms.
CO4	Design interfaces for digital signal processors with memory and I/O peripherals.

Reference Books	
1.	Digital Signal Processing, Avatar Singh and S Srinivasan, 2004, Thomson Learning ISBN: 9788131500347.
2.	Digital Signal Processors, B Venkataramani and M Bhaskar, 2nd Edition, 2011, TMH ISBN: 0072393912.
3.	Digital Signal Processing – A Practical approach, E.C.Ifeachor and B.W.Jervis, 2nd Edition, 2002, Pearson Education, ISBN: 0201596199.

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	2	2	2	2	---	---	---	---	1	1
CO2	2	2	2	1	1	---	---	---	---	---	1	1
CO3	3	3	3	2	3	2	---	---	---	---	2	2
CO4	3	2	3	3	3	2	---	---	---	---	2	2

Low-1 Medium-2 High-3

Semester: VI		
CRYPTOGRAPHY AND NETWORK SECURITY **(GROUP D: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6D3		**CIE Marks: 100**
Credits: 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	Define the fundamentals of Security and cryptography for data transmission.	
2	Explain the principles of cryptography and encryption	
3	Analyze modern stenographic techniques and differentiate between stenography and cryptography	
4	Explain IRM features and describe DRM systems and technologies	
5	Identify the necessity of data security in various industries.	

UNIT-I	
Introduction: Introduction to encryption, Importance of prime numbers, Types of encryption, How encryption is used. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques. **Block Ciphers and Data Encryption Standards (DES):** Block Cipher Principles, The Data Encryption Standard, The Strength of DES.	**07 Hrs**
UNIT-II	
Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Key management, Diffie-Hellman key exchange. **Message Authentication and Hash Functions:** Authentication Functions, Message Authentication Codes (MAC), Hash Functions, Security of MAC and Hash Functions.	**08 Hrs**
UNIT-III	
Authentication Applications: Kerberos, X-509 Authentication Service, Public-Key Infrastructure. **Electronic Mail security:** Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64 conversion.	**07 Hrs**
UNIT-IV	
Steganography: Introduction to Steganography, Modern Techniques Steganography, Comparison between steganography and cryptography, Stenographic Techniques, Detecting steganography, Stegoanalysis, uses of Steganography. **Information Rights Management:** Introduction to IRM, Features, Naming conventions of IRM. **Digital Right Management**: Introduction to DRM, Environment For DRM Systems, Evaluation Criteria for DRM Systems, Common DRM techniques, DRM technologies.	**07 Hrs**
UNIT-V	
Encryption and Data Security in Industries: Data encryption (local and Cloud) in Banking and Financial Transactions, Data encryption Methods used in Secure Auto teller Machines, Role of encryption in Mobile industry, Importance of Email Encryption in Health Care Industry.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamental concepts, issues, principles and theories of cryptography and Encryption for data transmission.
CO2	Apply contemporary theories, process and tools in the development and evaluation of solutions to product design
CO3	Analyze cryptographic and stegnographic techniques, and differentiate between them.
CO4	Design solutions to securely communicate in the appropriate form with the clients.

Reference Books	
1	Cryptography and Network Security, Williams Stallings, 2003, Pearson Education/PHI, ISBN: 0-13-111502-2.
2	Network Security, Perlman - Kaufman Spenciner, 2002, Pearson Education/PHI, ISBN: 9971–51–345–5.
3	Cryptography & Network Security, Atul Kahate, 2003, TMH, ISBN-81-203-2186-3.
4	Investigator's Guide to Steganography, Gregory Kipper,

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	2	2	---	---	1	---	---	2	---	---	---
CO2	3	3	2	2	2	1	---	---	2	---	---	---
CO3	3	3	3	2	2	1	---	---	2	---	---	---
CO4	3	3	3	2	2	1	---	---	2	---	---	---

Low-1 Medium-2 High-3

Semester: VI		
JAVA **(GROUP D: PROFESSIONAL CORE ELECTIVES)** **(Theory)**		
Course Code: 16TE6D4		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 03Hrs**

Course Learning Objectives: The students will be able to	
1	Map the concepts learnt in object oriented programming by considering suitable use-cases and implement same using the programming constructs specified in Java.
2	Build awareness of basic programming constructs and methods in Java and implement simple programs on it.
3	Introduce utilities and advanced programming concepts in Java to cater the demand of full-fledged application.
4	Develop a project that will apply concepts in to workable code.

UNIT-I	
Java Programming Fundamentals: Java Language introduction, Java features, why Java is important to internet, Hello World (simple java programs), Lexical Issues, Java class Libraries, Variables, Data Types- the primitive Types, Type conversion and Casting, Arrays. Operators, Flow Control-Branching, Looping.	**07 Hrs**
UNIT-II	
Introducing classes: Class fundamentals, declaring objects**,** Classes-Object References, Instance Variables, The new operator, The Dot (.) Operator, introducing methods, Method Declaration, Method Calling, Constructors, Method Overloading. **Inheritance:** Inheritance basics, Method Overriding, uses of super, Dynamic Method Dispatch, Abstract classes, Enumerations, Type wrappers.	**07 Hrs**
UNIT-III	
Packages and Interfaces: Packages, Access protection, Importing packages and Interfaces. **Excepton handling:** Excepton types, uncaught exceptions, java's built-in exceptions. **Multithreaded programming:** The java thread model, Thread life cycle, main thread, creation of threads using implementing runnable and extending thread, creating multiple threads, Thread priorities, synchronization, Inter thread communication, suspending, resuming, and stopping threads.	**07 Hrs**
UNIT-IV	
Introduction to Java GUI **Applets:** Applet Basics, Architecture, Applet Lifecycle, repaint (), update, HTML APPLET Tags, passing parameters to Applets. **AWT:** AWT classes, Window fundamentals. **Swings:** Introduction to Swings, JApplet, JFrame and JComponent, Icons & labels, Handling Threading issues, Text Fields, Buttons.	**07 Hrs**
UNIT-V	
Servlets: servlet Lifecycle, The Concept of JDBC; JDBC Driver Types; JDBC Packages; Database Connection; Associating the JDBC/ODBC Bridge with the Database. J2ME basics, J2ME overview and J2ME Architecture.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals concepts and its applications of JAVA such as Exceptions, Applets, AWT, Swings, JDBC, JSP.
CO2	Apply the concepts of classes, instances & Inner classes in Java, inheritance, exceptions and threading concepts in programming.
CO3	Create applications using the concepts of Applets, Swings, and Servlets.
CO4	Design and implement applications using Java allied technologies.

Reference Books	
1	The Complete Reference – Java, Herbert Schildt, 7th Edition, TMH Publications, ISBN-10: 0071808558.
2	The Complete Reference -J2EE, Jim Keogh, TMH publications, ISBN-10, 0070529124.
3	The Complete Reference J2ME, Jim Keogh, 2006, Tata McGraw Hill, ISBN: 9780070534155.

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	2	2	1	---	---	1	---	---	---	1
CO2	3	3	3	2	2	---	---	1	---	---	---	1
CO3	3	3	3	1	1	---	---	1	---	---	---	1
CO4	3	3	3	2	1	---	---	1	---	---	---	1

Low-1 Medium-2 High-3

Semester: VI		
BIOINSPIRED ENGINEERING **(Group E: Global Elective)** **(Theory)**		
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)

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	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

Low-1 Medium-2 High-3

Semester: VI		
GREEN TECHNOLOGY **(Group E: Global Elective)** **(Theory)**		
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, e.xtended 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)

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.

Semester: VI		
SOLID WASTE MANAGEMENT **(Group E: Global Elective)** **(Theory)**		
Course Code:16GE6E03		**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	
CO1	Understand the existing solid waste management system and to identify their drawbacks.
CO2	Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste.
CO3	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.
CO4	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.

Text 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.

Reference Books	
1	Municipal Solid waste (Management & Handling Rules) 2000. Ministry of Environment & Forest Notification, New Delhi, 25th Sept 2000 and 2016 amendments.
2	Hazardous waste (management, handling) rules 2008.Ministry of Environment and Forest Notification, New Delhi, 25th February 2009.
3	Biomedical waste (Management & Handling) rules, 1998. Ministry of Environment and Forest Notification, New Delhi, 20thJuly 1998, and amendment.
4	E- waste (management and handling) rules 2011.Ministry of Environment and Forest Notification, New Delhi, 12th May 2011.
5	The Plastic Manufacture, Sale and usage Rules2009. Ministry of Environment and Forest Notification, New Delhi, amendment on February 4, 2011.

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	2	-	3	1	2	2	2	-	-	-	2
CO2	2	3	1	2	1	2	2	2	1	-	-	2
CO3	2	1	-	2	1	1	2	2	-	-	-	-
CO4	3	-	1	1	-	2	2	2	-	-	-	1

Low-1Medium-2 High-3

Semester :VI		
INTRODUCTION TO WEB PROGRAMMING **(Group E : Global Elective)** **(Theory)**		
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 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.	**06 Hrs**
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)

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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	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

Semester: VI		
AUTOMOTIVE ELECTRONICS **(Group E: Global Elective)** **(Theory)**		
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),	**07 Hrs**

for use in an 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

SEMESTER – VI		
INDUSTRIAL ELECTRONICS **(Group E: Global Elective)** **(Theory)**		
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 modulation techniques. – UPS-online, offline (Principle of operation only.	**08 Hrs**

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 Electronics, P 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 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	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	2	1	2	2	1	1	2	0	1	3	2	2
CO2	3	2	2	3	3	0	1	0	0	0	2	1	3	2	2
CO3	3	2	2	3	2	2	0	1	0	0	1	2	3	2	2
CO4	3	3	3	3	2	3	2	0	1	0	0	1	3	3	3

Low-1 Medium-2 High-3

VI Semester		
PROJECT MANAGEMENT **(Group E: Global Elective)** **(Theory)**		
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)

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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											
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)** **(Theory)**		
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)

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	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

Semester: VI		
INTRODUCTION TO MOBILE APPLICATION DEVELOPMENT **(Group E: Global Elective)** **(Theory)**		
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 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	-	-	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

Semester: VI		
AUTOMOTIVE ENGINEERING **(Group E: Global Elective)** **(Theory)**		
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. 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.	**06 Hrs**
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, 1st Edition , 2009 , ISBN: 9781856175784.

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	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

Semester: VI		
MOBILE NETWORK SYSTEMS AND STANDARDS (GROUP E: GLOBAL ELECTIVE) (Theory)		
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)

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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	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

Semester: VI		
APPLIED PARTIAL DIFFERENTIAL EQUATIONS (GROUP E: GLOBAL ELECTIVE) (Theory)		
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, Dirichlet 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

Low-1 Medium-2 High-3

Semester: VI		
AIRCRAFT SYSTEMS **(Group E: Global Elective)** **(Theory)**		
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 typical Hydraulic 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	
CO1	Categorise the various systems required for designing a complete airplane.
CO2	Comprehend the complexities involved during development of flight vehicles.
CO3	Explain the role and importance of each systems for designing a safe and efficient flight vehicle.
CO4	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, 3rd Edition, 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 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	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

V/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: 02 Hrs**

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 Aptitud** - 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 etc.	**06 Hrs**
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.

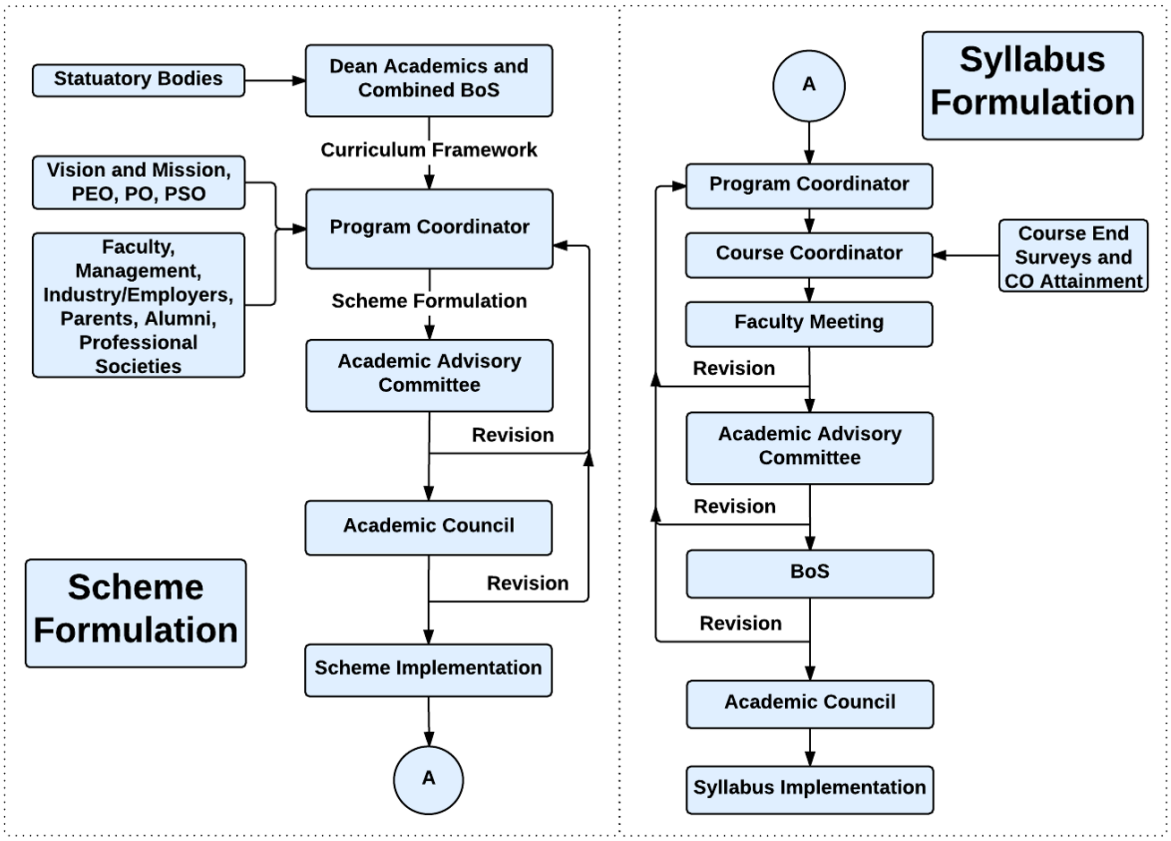
Phase	**Activity**	**Weightage**
I	Test 1 is conducted in V Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit-1, Unit-2 and Unit -3.A for 18 hours of training sessions.	50%
II	Test 2 is conducted in VI Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive 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

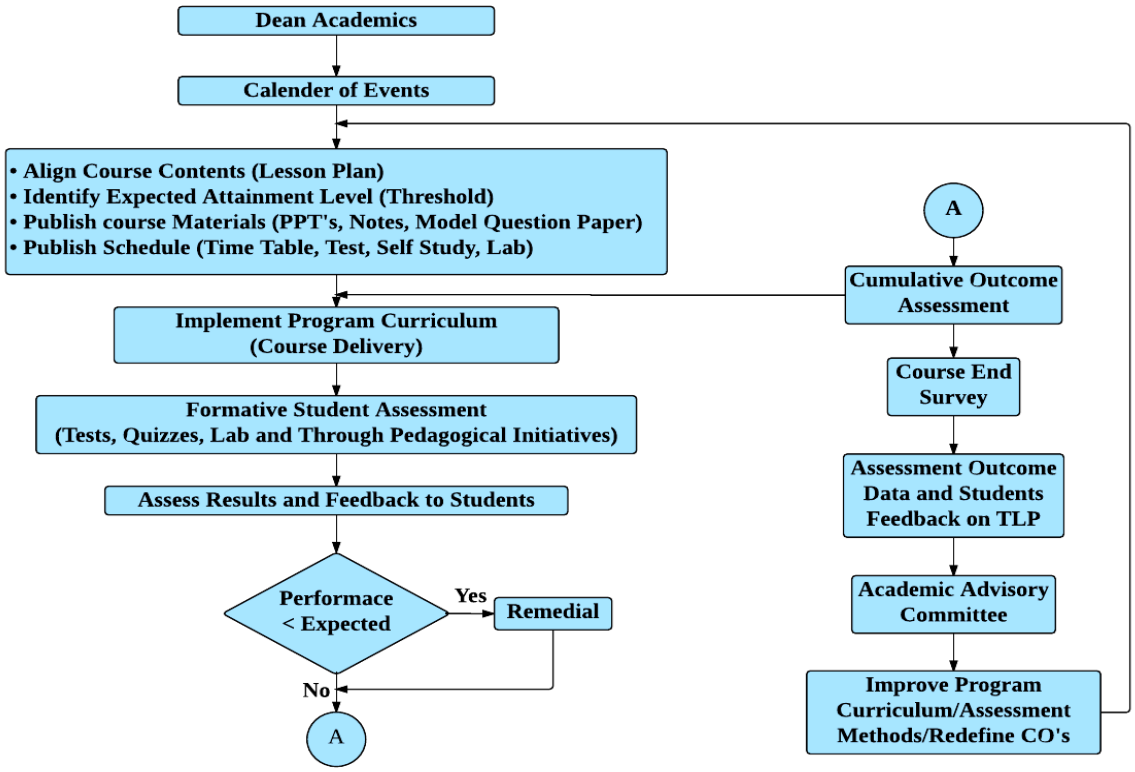
CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	---	___	---	----	1	----	1	1	1	2	1
CO2	1	2	2	---	---	---	----	1	2	1	2	1
CO3	---	---	3	---	---	1	---	2	1	2	1	---
CO4	---	---	___	---	----	1	3	1	1	1	1	---

Low-1 Medium-2 High-3

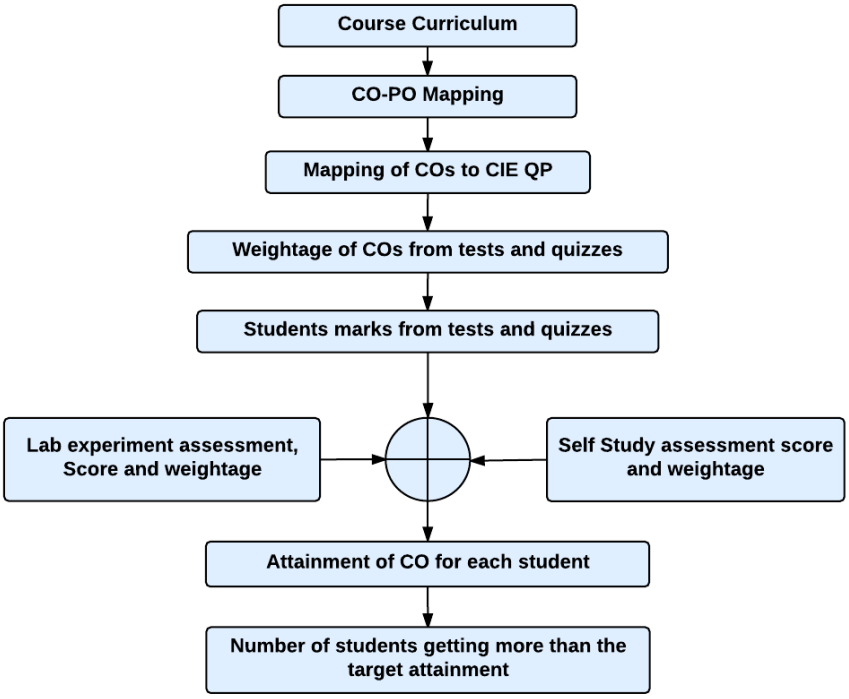
Curriculum Design Process



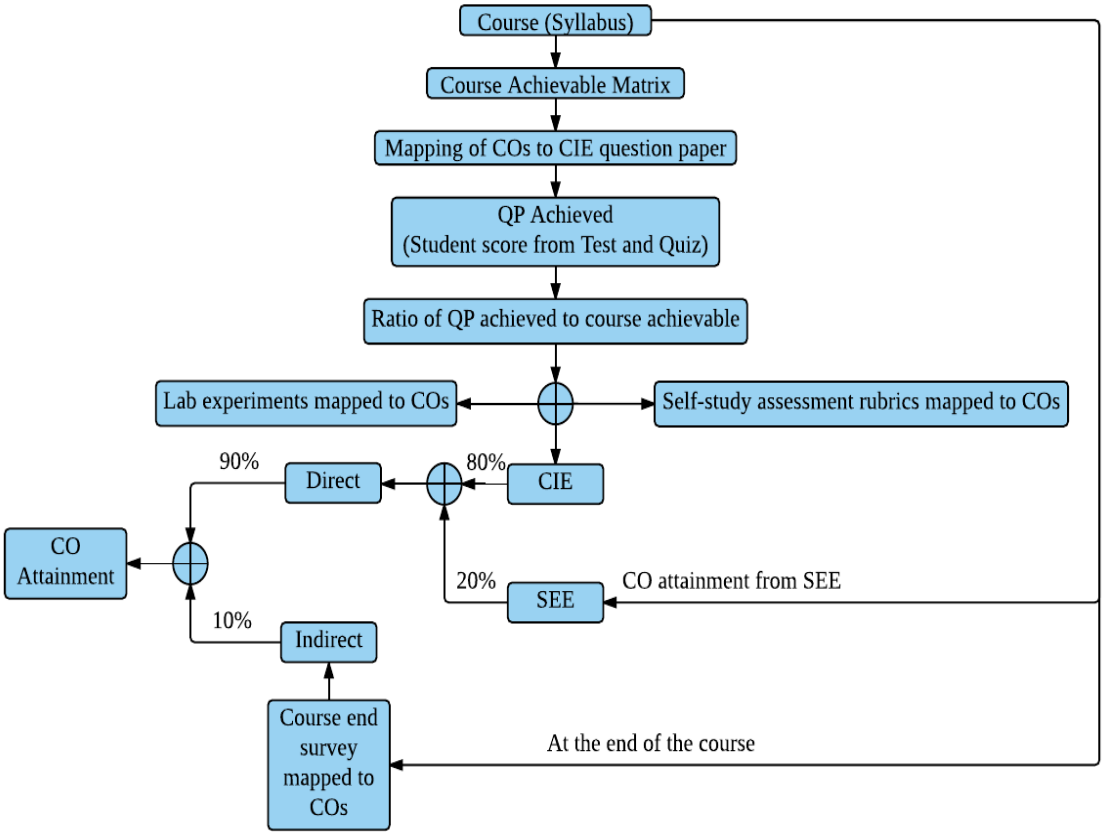
Academic Planning and Implementation



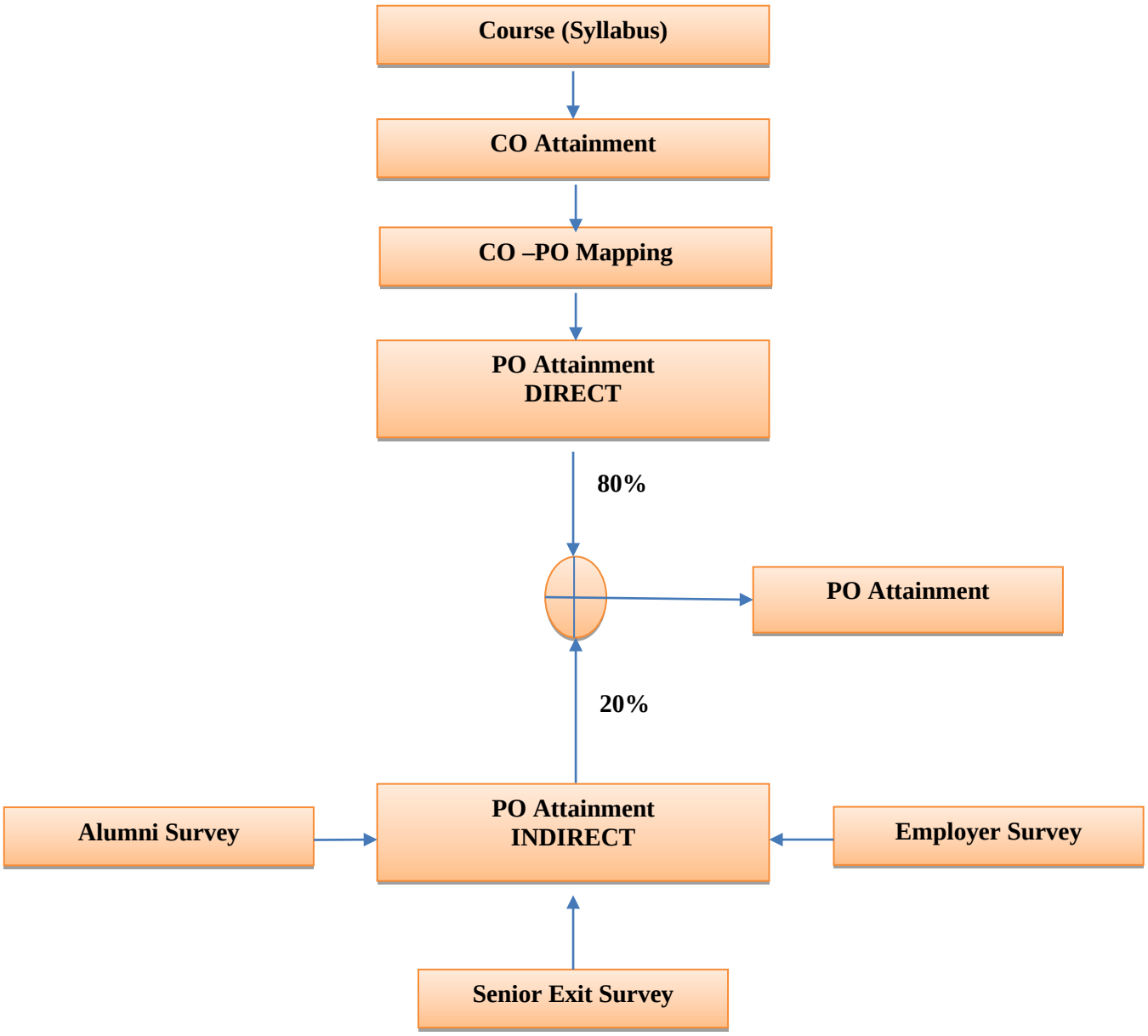
Process for Course Outcome Attainment



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.