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

COMPUTER SCIENCE & ENGINEERING

Department Vision

To achieve leadership in the field of Computer Science & Engineering by strengthening fundamentals and facilitating interdisciplinary sustainable research to meet the ever-growing needs of the society.

Department Mission

- To evolve continually as a centre of excellence in quality education in computers and allied fields.
- To develop state-of-the-art infrastructure and create environment capable for interdisciplinary research and skill enhancement.
- To collaborate with industries and institutions at national and international levels to enhance research in emerging areas.
- To develop professionals having social concern to become leaders in top-notch industries and/or become entrepreneurs with good ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop Graduates capable of applying the principles of mathematics, science, core engineering and Computer Science to solve real-world problems in interdisciplinary domains.
PEO2: To develop the ability among graduates to analyze and understand current pedagogical techniques, industry accepted computing practices and state-of-art technology.
PEO3: To develop graduates who will exhibit cultural awareness, teamwork with professional ethics, effective communication skills and appropriately apply knowledge of societal impacts of computing technology.
PEO4: To prepare graduates with a capability to successfully get employed in the right role and achieve higher career goals or take up higher education in pursuit of lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	**System Analysis and Design -** The student will:
	1. Recognize and understand the dynamic nature of developments in computer architecture, data organization and analytical methods
	2. Learn the applicability of various systems software elements for solving real world design problems.
	3. Identify the various analysis & design methodologies for facilitating development of high quality system software products with focus on performance optimization.
	4. Display good team participation, communication, project management and document skills.
PSO2	**Product Development -** The student will:
	1. Demonstrate knowledge of the ability to write programs and integrate them resulting in state of art hardware/software products in the domains of embedded systems, databases /data analytics, network/web systems and mobile products.
	2. Participate in teams for planning and implementing solutions to cater to business specific requirements displaying good team dynamics and professional ethics.
	3. Employ state of art methodologies for product development and testing / validation with focus on optimization and quality related aspects.

Lead Society: Institute of Electrical and Electronics Engineers

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2016 SCHEME

COMPUTER SCIENCE & ENGINEERING

ABBREVIATIONS

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

INDEX

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

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

FIFTH SEMESTER CREDIT SCHEME

Sl. No.	Course Code	Course Title	BOS	Credit Allocation				Total Credits
				L	T	P	S	
1.	16HSI51	Intellectual Property Rights and Entrepreneurship	HSS	3	0	0	0	3
2.	16CS52	Database Design	CSE	3	0	1	1	5
3.	16CS53	Microcontroller & Embedded Systems	CSE	3	0	1	1	5
4.	16CS54	Software Engineering	CSE	3	0	1	0	4
5.	16CS55	Computer Communication & Networks	CSE	3	1	0	0	4
6.	16CS5AX	Elective A	CSE	3	0	0	1	4
7.	16G5BXX	Elective B	Resp. BoS	4	0	0	0	4
Total number of Credits								**29**
Total Number of Hours / Week				**21**	**02**	**6**	**16****	**-**

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.	16CS62	Compiler Design	CSE	3	0	1	1	5
3.	16CS63	Computer Networks	CSE	3	0	1	1	5
4.	16CS64	Computer Architecture	CSE	3	0	0	0	3
5.	16CS6CX	Elective C	CSE	3	0	0	1	4
6.	16CS6DX	Elective D	CSE	4	0	0	0	4
7.	16G6EXX	Elective E	Resp. BoS	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								**27**
Total Number of Hours / Week				**21**	**00**	**6**	**12****	**-**

** Non-contact hours

V Sem		
GROUP A: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16CS5A1	Artificial Neural Networks
2.	16CS5A2	Probability, Statistics and Queuing Theory
3.	16CS5A3	Artificial Intelligence
4.	16CS5A4	Advanced Algorithms
5.	16CS5A5	Natural Language Processing

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

VI Sem		
GROUP C: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16CS6C1	Mobile Computing
2.	16CS6C2	Web Programming
3.	16CS6C3	Cloud Computing
4.	16CS6C4	Network Programming
GROUP D: PROFESSIONAL CORE ELECTIVES		
1.	16CS6D1	Fuzzy Logic & Intelligent Information Systems
2.	16CS6D2	Data Warehousing& Data mining
3.	16CS6D3	Object Oriented Analysis & Design
4.	16CS6D4	Linux Internals
5.	16CS6D5	Introduction to Optimization Techniques

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

Semester V		
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 Trade marks, Registrable and non- registrable marks. Registration of trade mark; Deceptive similarity; Assignment and transmission; ECO Label, Passing off; Offences and penalties. Infringement of trade mark with Case studies	**04 Hrs**
UNIT-III	
Industrial Design: Introduction, Protection of Industrial Designs, Protection and Requirements for Industrial |Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Case Studies. **Intellectual property and cyberspace:** Emergence of cyber-crime; Grant in software patent and Copyright in software; Software piracy; Data protection in cyberspace	**09 Hrs**
UNIT-IV	
Introduction to Entrepreneurship – Learn how entrepreneurship has changed the world. Identify six entrepreneurial myths and uncover the true facts. Explore E-cells on Campus **Listen to Some Success Stories: -** Global legends Understand how ordinary people become successful global entrepreneurs, their journeys, their challenges, and their success stories. Understand how ordinary people from their own countries have become successful entrepreneurs. **Characteristics of a Successful Entrepreneur** Understand the entrepreneurial journey and learn the concept of different entrepreneurial styles. Identify your own entrepreneurship style based on your personality traits, strengths, and weaknesses. Learn about the 5M Model, each of the five entrepreneurial styles in the model, and how they differ from each other. **Communicate Effectively:** Learn how incorrect assumptions and limiting our opinions about people can negatively impact our communication. Identify the barriers which cause communication breakdown, such as miscommunication and poor listening, and learn how to overcome them. **Communication Best Practices.** Understand the importance of listening in communication and learn to listen actively. Learn a few body language cues such as eye contact and	**08 Hrs**

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

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

Semester V		
DATABASE DESIGN (Theory and Practice)		
Course Code:16CS52		**CIE Marks: 100+50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100+50**
Hours: 36L		**SEE Duration: 3+3 Hrs**
Course Learning Objectives: The students will be able to		
1	Explain how to use the database systems evolved from programming with simple collections of data files.	
2	Describe the major components of relational database, NoSQL database and Elastic Search.	
3	Describe the functionality provided by languages such as SQL.	
4	Give examples of interactions with database systems that are relevant to Computer Science and Engineering.	

UNIT-I	
Introduction to Database Systems -Databases and Database users: Introduction, An example, Characteristics of Database Approach, Actors on the scene, Workers behind the scene. Database System—Concepts and Architecture: Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment. **Data Modeling Using the Entity-Relationship Model-**Using High-Level Conceptual Data Models for Database Design; A Sample Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types;	**8 Hrs**
UNIT-II	
Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues, Using ER- to-Relational Mapping. **Relational Model and Relational Algebra-**Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design**.**	**7 Hrs**
UNIT-III	
SQL Schema Definition, Basic Constraints and Queries-SQL Data Definition, Specifying Constraints in SQL, Schema Change Statements in SQL; Basic Queries in SQL; Insert, Delete and Update Statements in SQL More Complex SQL Retrieval Queries. **Relational Database Design -** Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decompositions; MultivaluedDependencies, Fourth Normal Form and Fifth Normal Form.	**7 Hrs**
UNIT-IV	
NO SQL Database-Introduction to MongoDB: Built for the Internet, MongoDB's key features, Diving into MongoDB Shell. Document-oriented Data: Principles of Schema Design, Designing an E-Commerce data model, Nuts and Bolts: on databases, collections and documents, E-commerce queries, MongoDB's query language. **Elastic Search:**Talking to Elastic Search: Document Oriented, Finding your feet, Life inside Cluster: Scale Horizontally, Coping with Failure, Data-in Data-out: Document Metadata, Indexing a document, Retrieving a document.	**7 Hrs**

UNIT-V	
Transaction Processing Concepts- Introduction to transaction processing, Transaction states and additional operations, Desirable properties of transaction, Schedules of transactions, Characterizing schedules based on Recoverability, Characterizing schedules based on Serializability: Serial, Nonserial and Conflict- Serializable schedules, Testing for Conflict serializability of schedule, Uses of serializability. **Concurrency Control Techniques:** Two phase locking techniques for concurrency control, types of locks and system lock tables, Guaranteeing serializability by two-phase locking, Dealing with Deadlock and starvation, Concurrency control based on timestamp ordering. **Database Recovery Techniques:** Recovery Concepts, Shadow Paging, The ARIES recovery algorithm.	**7 Hrs**

Laboratory Component

PART-A

Open Ended Mini Project should be implemented and shall be carried out in a batch of two students. The students will finalize a topic in consultation with the faculty. The mini project must be carried out in the college only.

The Mini Project tasks would involve:

- Understand the complete domain knowledge of application and derive the complete data requirement specification of the Mini Project
- Design of the project with Integrated database solution (SQL, NOSQL and Elastic Search)
- Normalization of the Relational design up to 3NF (Desirable 5NF).
- Appreciate the importance of security for database systems.
- Documentation and submission of report.

General Guidelines :

- Database management for the project- MySQL, DB2, Oracle, SQL Server, MongoDB server.
- Front End for the project – Java , VC++, C#, Python , Web Interface (HTML, PHP)
- Use database Programming such as Embedded SQL,/Dynamic SQL/SQLJ, PL/SQL

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the needs and concepts of relational database management, non-relational database, transaction processing and related relational database facilities.
CO2.	Apply the knowledge of logical database design principles to real time issues.
CO3.	Analyse and design relational and document-based data model concepts.
CO4.	Develop applications using relational database, NoSQL database and Elastic Search.

Reference Books	
1.	Fundamentals of Database Systems, Elmasri and Navathe, 6th Edition, 2011, Pearson Education, ISBN-13: 978-0136086208.
2.	MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, 2nd Edition, 2015, Manning, ISBN 1617291609, 9781617291609.
3.	Elasticsearch – The Definitive Guide, Clinton Gormley, Zachary Tong, 1st edition, 2015. O'Reilly Media, Inc. ISBN: 978-1-449-35854-9.
4.	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3thEdition, 2003, McGraw-Hill, ISBN : 978-0072465631.

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

High-3 : Medium-2 : Low-1

Semester V		
MICROCONTROLLER & EMBEDDED SYSTEMS (Theory and Practice)		
Course Code: 16CS53		**CIE Marks: 100+50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100+50**
Hours: 36 L		**SEE Duration: 3+3 Hrs**

Course Learning Objectives: The students will be able to	
1	Provide the student with the basic understanding of microcontroller and embedded systems design.
2	Learn the addressing modes, instructions, and assembler directives and develop the flow chart, algorithms to solve problems.
3	Use of subroutines, multi-segments, macros, interrupts, procedures, stacks programs in applications
4	Develop embedded C programs for microcontrollers and run on the simulator, target board and various interfaced hardware devices

UNIT-I	
Introduction to Microcontrollers & Architecture Intel 8051 Microcontroller Introduction, Microprocessor Versus Microcontroller, 8051 Block Diagram, Registers, Flags &PSW, Memory Organization: Program & Data Memory, Stack structure, Addressing Modes, Data transfer Instruction's, Structure of ALP , Working with Keil Software Tools to develop, simulate& debug ALP & embedded C programs ,Assembler Directives. **Case Study: Study the architecture of 8051 variant - NXPs 89V51RD2**	**07 Hrs**
UNIT-II	
Intel 8051 Instruction Set & Assembly Language Programming Study of Instruction set: Arithmetic, Logic, Jump, Loop & Call Instructions, Assembly Language Programming, Procedures, Working & Programming of Timers/Counters**,** Interrupts& ISR Programs, Writing Delay programs using Instructions &Timers. **Case Study: Comparison of Applications built using: Programmed I/O & Interrupt I/O**	**08 Hrs**
UNIT-III	
Intel 8051 Interfacing & Applications Signal/Pin Descriptions, I/O Ports, Interfacing & Programming(using ALP/Embedded C) with LEDs, Switches, Seven segment displays, LCD, Matrix Keypad, Parallel ADC (ADC0804) , DAC (DAC0800), Stepper motor, DC Motor, Programming serial port of 8051, Communication of 8051 with the PC using serial port. **Case Study: Building PC based Embedded System Using 8051 kit & RS-232**	**07 Hrs**
UNIT-IV	
Introduction to Embedded Systems &ARM Processor/Controller Definition, Desirable Features & General Characteristics of embedded systems, Embedded Systems Vs General Computing Systems, Model of an Embedded System, Classification of Embedded Systems. History of the ARM Processor, ARM Architecture, Interrupt vector table, brief overview of ARM Instruction Set & Simple ALP Programs, Current Trends **Case Study: Example of embedded system– RFID** *****	**07 Hrs**
UNIT-V	
ARM7 MCU LPC2148 – Architecture & Peripheral Programming using embedded C The internal architecture of LPC 2148 (a typical and popular ARM7 MCU) – Features of the LPC 214X Family, Peripherals and Programming : GPIO, Timers, PWM ,	**07 Hrs**

UART, SSP units, **Case Study: Building Data Acquisition System using MCB 2140 compatible board**.	

Laboratory Component
1. a) 8051 ALP programs to perform block data transfer and searching operations b) 8051 ALP/Embedded C to Interface Logical Controller and perform: i. Write an ALP to read the status of 8 inputs bits from 8bit switch and display 'FF' if it is even parity otherwise display 00. Also display number of 1's in the input data on the LED outputs, using interface module. ii. Write an ALP to read the status of two 8-bit inputs (X and Y) and display the result X*Y using the interface module iii. Write an ALP to implement BCD Up/Down counters **2.** a) 8051 ALP programs to perform Arithmetic (addn/subn/mult/divn operations) b) 8051 ALP/Embedded C to Interface Seven Segment Display and perform: i. Write a C program to display messages "FIRE" & "HELP" on 4 digit seven segment display alternately with a suitable delay. ii. Write a C program to display the given number on the seven segment display using look up table **3.** a) 8051 ALP programs to perform number conversions, binary to BCD, binary to ASCII b) 8051 ALP/Embedded C to Interface Stepper Motor Module and perform: i. Write an Embedded C program to rotate stepper motor in clockwise direction for "M" steps, anti-clock wise direction for "N" steps ii. Rotate the Stepper Motor, for the given RPM **4.** a) 8051 ALP programs to compute average & maximum/minimum values b) 8051 ALP/Embedded C to Interface DAC Module and perform: i. Write an Embedded C program to generate without rectification / full rectified/ half rectified sine waveform using DAC module ii. Write the program to generate square waveform for the given frequency iii. Generate PWM wave on pin P0.1 to control speed of DC motor. Control the duty cycle by analog input. **5.** a) 8051 ALP programs to perform sorting operations b) 8051 ALP/Embedded C to Interface Keyboard Module and perform: i. Write an Embedded C program to interface 4 X 4 matrix keyboard using lookup table and display the key pressed on the Terminal ii. Interface an LCD Module and display the temperature read from ADC Module.
6. a) To write and simulate ARM assembly language programs for data transfer, arithmetic and logical operations b)Interface Graphics LCD and I2C device to ARM Microcontroller LPC 2148 / 1768 and write the suitable embedded C program Mini Projects : 1. Design & development of PC based Embedded system using 8051 Kit, incorporating application development on both PC & Microcontroller 2. Design & development of LPC 2148/1768 based data acquisition System

Course Outcomes: After completing the course, the students will be able to	
CO1.	Acquire the knowledge of architecture of Microprocessors and Microcontrollers for the different applications.
CO2.	Develop skill in simple program writing for micro controllers for applications in assembly level language and Embedded C.
CO3.	Design system configuration for a given application.
CO4.	Integrate, implement and test the design in applications.

Reference Books	
1.	The 8051 Microcontroller &Embedded Systems (Using Assembly & C), Muhammad Ali Mazidi, Janice Gillispie Mazidi , Rolin D. McKinlay, 2014, Prentice Hall (Pearson), ISBN-13-978-1-292-02657-2.
2.	The 8051 Microcontroller Architecture, Programming &Applications, Kenneth J. AyalaThomson Learning, 2nd Edition, 2006.**ISBN**-0333-92394-4.
3.	Embedded Systems – An integrated approach, Lyla B. Das, 1st Impression 2013, Pearson Education, ISBN- 978-81-317-8766-3.
4.	ARM system developers guide, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, 2004. Morgan Kaufman publishers, ISBN-1558608745,9781558608740
5.	Embedded Systems, Architecture, Programming and Design, Raj Kamal, 2nd Edition-Reprint 2011,Tata McGraw-Hill, ISBN-978-0-07-066764-8.

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

High-3 : Medium-2 : Low-1

Semester V		
SOFTWARE ENGINEERING (Theory)		
Course Code:16CS54		**CIE Marks: 100+50**
Credits: L:T:P:S: 3:0:1:0		**SEE Marks: 100+50**
Hours: 35L		**SEE Duration: 3+3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand software process, process models, activities, stages of software engineering process.
2	Understand requirements engineering process and write the functional and non-function requirements using data flow diagrams, use case diagrams as part of SRS document.
3	Learn the use of appropriate CASE tool for software development
4	Estimate the software development cost and prepare software project plan.
5	Carry out software testing and formal verification and validation of software.

UNIT-I	
Software Processes: Models, process iteration, Process activities. The Rational Unified Process. Computer Aided Software Engineering. **Requirements Analysis & Project Planning:** Requirements Analysis & Specification: Value of a Good SRS, Requirements Process, Requirements Specification, Functional Specification with Use Cases, Other Approaches for Analysis.	**07 Hrs**
UNIT-II	
The Software Problem & Processes: Cost, Schedule & Quality, Scale & Change, Software Processes: Process & Project, Component Software Processes, Software Development Process Models, Project Management Process **Planning a Software Project:** Effort Estimation, Project Schedule & Staffing, Quality Planning, Risk Management Planning, Project Monitoring Plan.	**07 Hrs**
UNIT-III	
Design, Coding: Design: Design Concepts, Function-oriented Design, Object-oriented Design, Detailed Design, Metrics. **Coding:** Programming Principles & Guidelines, Incrementally Developing Code, Managing Evolving Code.	**07 Hrs**
UNIT-IV	
Verification and Validation: Verification and Validation, Planning, Software inspections, Automated static analysis, Verification and formal methods. **Unit Testing and Testing**: Unit Testing, Code Inspection, Metrics Testing Concepts, Testing Process, Black-box Testing, White-box Testing, Metrics. **Critical Systems:** A simple safety-critical system, System dependability. Availability and reliability.	**07 Hrs**
UNIT-V	
Agile methods. Extreme programming, Scrum. **Software Engineering for new paradigms- Cloud** **Impact of Cloud computing on Software Development life cycle**: Limitations and Challenges in Cloud-Based Applications Development- Introduction and Challenges. Impact of Cloud computing on Software Development life cycle.	**07 Hrs**

Software Engineering Lab

Instructions for Lab:

- Students will be grouped in to a batch of two at max.
- Each group will be provided with one case study topic which needs to follow SE principles.
- Students are required to do documentation using rapid tools at the end of each phase.
- Student will have to give report at the end of these phases-
  1. Project Planning and Requirement Specification (use Project Libre tool)
  2. Detailed Design and Architecture (Any design tools)
  3. Implementation (Use IDE recommended)
  4. Testing
- Students are encouraged to use rapid software development tools / CASE Tools for their laboratory question.
- The evaluation of each phase mentioned above will as per the rubrics and will be printed on lab manual.

Following deliverables is to be submitted every week and each carries 10 marks.

Week	Activity	Tools	Deliverables
1	Introduction	-	Problem definition and enlisting various tools
2	Requirements Engineering	Open Source Requirements Management Tool (OSRMT)	SRS
3	Project Management	ProjectLibre/ Ganib/ SureTrack	Work Breakdown Structure, PERT chart, Gantt chart
4	Scheduling Metrics		
5	Risk Management	SimpleRisk	Risk management plan
6	Cost Estimation Metrics	Online tool http://csse.usc.edu/tools/COCOMOII.php	Effort required and Duration of the project
7	Analysis & Design -1	StarUML	Structure chart and Data Flow Diagram
8	Analysis & Design -2		
9	Testing using (JUnit)	JUNIT	Error-free code

Course Outcomes: After completing the course, the students will be able to	
CO1.	Comprehend various software life cycle models and steps of software development process with an inclusive focus on professional ethics, engineering practices and code standards.
CO2.	Apply concepts of Software Project Planning and software Design techniques.
CO3.	Analyze capabilities of various tools to assist in the software development activities.
CO4.	Develop correct and robust software design from requirement gathering to implementation with long software lifetime and that is useful to the society or market.

Reference Books

1. A Concise Introduction to Software Engineering, Pankaj Jalote, Springer, 2008 (Chapters: 1-4, 6-8), ISBN – 13: 978-1-84882-2-108.
2. Software Engineering , Ian Sommerville, 8th Edition, 2013, Pearson Education, ISBN: 9788131762165.
3. Software Engineering-A Practitioners Approach , Roger.S.Pressman, 7th Edition, 2007, Tata McGraw Hill, ISBN: 9780071267823.
4. SWEBOK Book on Software Engineering, IEEE Computer Society, 2014, ISBN-13: 978-0-7695-5166-1.

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.

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); 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**	**1**	**-**	**-**	**1**	**-**	**2**	**-**	**-**	**-**	**2**
CO2	**2**	**1**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO3	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**1**	**2**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**-**	**2**

High-3 : Medium-2 : Low-1

Semester V		
COMPUTER COMMUNICATION AND NETWORKS (Theory)		
Course Code: 16CS55		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 36L+24T		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the functionalities of various elements of the network.
2	Summarize the roles of various layers in the operation of internet.
3	Analyze the design issues involved in various types of communication channels used in computer networks.
4	Illustrate the operation and formats of IEEE LAN standards.

UNIT-I	
Introduction Introduction to Data Communications, Components, Data representation, Data flow, Essential elements of network architecture, Circuit switching and packet switching, Introduction to Networks, Topologies, Categories, Internet. **Network Models and Layered Architecture** Layered tasks, The OSI model, Layers in the OSI model, TCP / IP protocol suite, Addressing, Design Issues for the Layers, Connection-Oriented and Connectionless Services, and Service Primitives.	**07 Hrs**
UNIT-II	
Data and Signals Analog and digital, Periodic analog signals, Digital signals, Transmission impairments, Data rate limits, Performance. **Physical Layer : Digital Transmission** Digital - to -digital conversion, Block coding, Scrambling, Analog - to - digital conversion, Transmission modes.	**07Hrs**
UNIT-III	
Analog Transmission and Bandwidth Utilization Digital - to -analog conversion, Multiplexing: FDM, WDM, Synchronous TDM, Statistical TDM, and Spreading: Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Transmission Media: Guided media, Unguided media. **Data Link Layer : Error Detection and Correction** Introduction, Block coding, Cyclic codes, Checksum.	**08 Hrs**
UNIT-IV	
Data Link Layer : Data Link Control Framing, Flow and Error control, Protocols, Noiseless channels, Noisy channels, HDLC, Point-to-point Protocol - framing, transition phases. **Medium Access Control** Random access - CSMA, CSMA / CD, CSMA / CA, Controlled access - Reservation, Polling, Token passing, Channelization - FDMA, TDMA, CDMA.	**07 Hrs**
UNIT-V	
Local Area Networks Ethernet (802.3) MAC sub layer protocol, Binary exponential back off algorithm, IEEE 802.2 LLC, Wireless LANs, 802.11 stack, 802.11 Physical layer, 802.11 MAC sub layer protocol, 802.11 frame structure, Connecting devices, Backbone networks, Virtual LANs (VLAN), *3G/3.5G standards, LTE/4G architectures, Evolved Packet Core(EPC), Features of 5G.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the basic concepts of computer communication and the switching techniques used in different types of networks.
CO2.	Explore the various types of transmissions through physical media and associated error handling mechanisms.
CO3.	Analyze the operation of network and solve problems relevant to performance of communication links.
CO4.	Investigate the relevance of basic communication protocols in the correct operation of network.

Reference Books	
1.	Data Communications and Networking, Behrouz A Forouzan, 5th Edition; 2013, Tata McGraw-Hill; ISBN – 9781259064753.
2.	Communication Networks, Alberto Leon-Garcia and Indra Widjaja, 2nd Edition; 2011, Tata McGraw-Hill, ISBN 13: 9780072423495.
3.	Computer Networks; Pearson Education, Andrew S Tanenbaum, 5th Edition; 2014, ISBN – 978-81-7758-165-2.
4.	Data and Computer Communications, William Stallings, 8th Edition; 2009, Pearson Education; ISBN-13: 978-0131392052.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester V		
ARTIFICIAL NEURAL NETWORKS (Group A : Professional Core Elective)		
Course Code:16CS5A1		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Perceive the basic concepts of ANN, applications and learning techniques
2	Explain the working of perceptron and multilayer perceptron and related learning algorithms
3	Gain essential knowledge on convolutional neural networks and applications
4	Explore structured probabilistic models for deep learning

UNIT-I	
ARTIFICIAL NEURAL NETWORKS INTRODUCTION AND LEARNING PROCESSES-I: What is a Neural Network? Human Brain, Models of a Neuron, Neural Networks Viewed as DG, Feedback, Network Architectures, Error-correction learning, Memory-based learning, Hebbian Learning, Competitive learning, Boltzmann Learning	**07 Hrs**
UNIT-II	
LEARNING PROCESSES – II AND PERCEPTRON: Learning with a teacher, Learning without a teacher, Learning tasks, Memory and adaptation. Statistical Learning Theory, VC dimension, Probably approximately correct model of learning, Single-Layer Perceptrons: Adaptive filtering problem, Unconstrained optimization techniques: Steepest Descent, Newton's, Gauss-Newton; Linear Least-Squares Filter, LMS algorithm, Learning curves, Learning rate annealing techniques, Perceptron and Convergence theorem.	**08 Hrs**
UNIT-III	
MULTILAYER PERCEPTRON AND GENERALIZATION: BP algorithm, Two passes of computation, Sequential and Batch Modes of training, Stopping Criteria, XOR problem, Heuristics for BP algorithm to perform better, Output representation and Decision rule, Generalization, Universal approximation theorem, Cross-validation	**07 Hrs**
UNIT-IV	
CONVOLUTIONAL NETWORKS: Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the basic convolution function, Structured Outputs, Data types, Efficient Convolution Algorithms, Random or Unsupervised features, The Neuroscientific basis for convolutional networks	**07 Hrs**
UNIT-V	
STRUCTURED PROBABILISTIC MODELS FOR DEEP LEARNING: The challenge of unstructured modelling, Using graphs to describe model structure: Directed, Undirected, Partition function, Energy-based models, Factor graphs; Sampling from graphical models, Advantages of structured modelling, learning about dependencies, Inference and approximate inference, The deep learning approach to structured probabilistic models	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Describe basic concepts of neural network, its applications and various learning models
2	Analyze different Network Architectures, learning tasks, convolutional networks, and deep learning models
3	Investigate and apply neural networks model and learning techniques to solve problems related to society and industry
4	Demonstrate a prototype application developed using any NN tools and APIs

Reference Books	
	Neural Networks – A Comprehensive Foundation, Simon Haykin, 2nd Edition, 2005. PHI, (Units I to III)
	Deep Learning (Adaptive Computation and Machine Learning Series), Ian Good fellow, YoshuaBengio and Aaron Courville, (3 January 2017), MIT Press, ISBN-13: 978-0262035613.
	Introduction to Artificial Neural Networks, Gunjan Goswami, 2012 Edition, S.K. Kataria& Sons; ISBN-13: 978-9350142967.
	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, 2016 Edition, by O'Reilly Publications, ISBN-13: 978-1491925614.

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

High-3 : Medium-2 : Low-1

Semester V		
PROBABILITY, STATISTICS AND QUEUING THEORY (Group A : Professional Core Elective)		
Course Code: 16CS5A2		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the basics of Probability, Statistics and Queuing theory.
2	Evaluate probability bounds, basic statistical measures and demonstrate their significance.
3	Design and perform hypothesis tests and other evaluative tests.
4	Develop probability models for solving real world problems.

UNIT-I	
Introduction of Probability and Random Variables: Axioms of probability, Conditional probability, Baye's theorem, Discrete Random variable and Continuous Random variable,pmf, pdf of some well-known distributions, Moment Generating Functions, Two-dimensional Random variables, Joint pmf and Joint pdf and their properties, Conditional distributions and conditional expectations, Covariance.	**08 Hrs**
UNIT-II	
Probability bounds, Approximations, Poisson process and Hypothesis:Probability inequalities - Markov's inequality, Chernoff bounds, Jensen's inequality, The second moment and the conditional expectation inequality, Chebyshev's inequality, Bienayme's inequality, Schwartz inequality, Cauchy-Schwartz inequality, Counting processes, Definition ofPoisson process, Inter-arrival and waiting time distributions, Tests of Hypothesis.	**07 Hrs**
UNIT-III	
Random Processes: Classification, Methods of description, Special classes, Average values of Random Processes, Analytical representation of Random Process, Autocorrelation function, Cross-correlation function and their properties, Ergodicity, Poisson process, Markov Process, Markov chain.	**07 Hrs**
UNIT-IV	
Queuing Theory: Symbolic Representation of a Queuing Model, Poisson Queue system, Little Law, Types of Stochastic Processes, Birth-Death Process, The M/M/1 Queue, M/M/m Queue, M/M/m/B Queue with Finite Buffers.	**07 Hrs**
UNIT-V	
Random Number Generation: Desired Properties of a Good Generator, Linear-Congruential Generators, Tausworthe Generators, Extended Fibonacci Generators, Combined Generators, Testing Random Number Generators: Chi-Square Test, Kolmogorov-Smirnov.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Identify basic tools of Probability and queuingin the fields where uncertainty and imprecision are involved.
CO2.	Apply random process, sampling theory, stochastic process and queuing models to the field of computer science.
CO3.	Apply probability models using modern tools of probability for synthesizing information to use effectively.
CO4.	Analyze and design probability models for various real world problems involving randomness.

Reference Books	
1.	Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S Trivedi, 2nd Edition, 2008, Eastern Economy Edition, Prentice Hall IndiaISBN: 81-203-0508-6.
2.	Probability, Statistics and Random Processes, T Veerarajan, 3rd Edition, 2008, Tata McGraw Hill Education Private Limited, ISBN:978-0-07-066925-3.
3.	The Art of Computer Systems Performance Analysis, Raj Jain, 1st Edition, 2009, Wiley India Private Limited, ISBN:978-81265-1905-7.
4.	Probability and statistics for Engineers, Miller and Freund's (Richard .A. Johnson, C. B. Gupta), Second impression 2007, Pearson Education, ISBN: 978-0-12-051051-1.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester V		
ARTIFICIAL INTELLIGENCE (Group A : Professional Core Elective)		
Course Code: 16CS5A3		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Know various AI search algorithms like uninformed, informed, heuristic and genetic algorithms.
2	Understand the fundamentals of knowledge representation and different types of AI agents.
3	Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.
4	Know how to build simple knowledge-based systems.

UNIT-I	
Introduction to AI, Definition, History, and Intelligent Agents: How agent should Act, Structure of Agents, Environments.Problem-solving: Problem-solving agents; Example problems; Searching for solution; uninformed search strategies.	**07 Hrs**
UNIT-II	
Informed Search, Exploration, Constraint Satisfaction, Adversial Search: Informed search strategies; Heuristic functions; On-line search agents and unknown environment. Constraint satisfaction problems; Backtracking search for CSPs. Adversial search: Games; Optimal decisions in games; Alpha-Beta pruning.Best-first minimaxsearch.	**08 Hrs**
UNIT-III	
Logical Agents: Knowledge-based agents; Logic; propositional logic Reasoning patterns in propositional logic; Effective propositional inference; Agents based on propositional logic. First-Order Logic, Inference in First-Order Logic –1: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic; Knowledge engineering in first-order logic. Propositional versus first-order inference; Unification and lifting. Inference in First-Order Logic – 2: Forward chaining; backward chaining; Resolution.	**9 Hrs**
UNIT-IV	
Learning AI: Present and Future: Learning: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory. ASHACL: Alternative Shapes Constraint Language.	**05 Hrs**
UNIT-V	
Uncertainty, Probabilistic Reasoning: Uncertainty: Acting under certainty; Inference using full joint distributions; Independence; Bayes' rule and its use. Probabilistic Reasoning: Representing knowledge in an uncertain domain; the semantics of Bayesian networks; efficient representation of conditional distributions; exact inference in Bayesian networks	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and Explore knowledge representation techniques and problem solving strategies to common AI applications.
CO2.	Analyze and find appropriate idealizations for converting real world problems into AI search problems that are formulated using the appropriate search algorithm.
CO3.	Design good evaluation functions for different problem solving strategies.
CO4.	Apply knowledge representation techniques and problem solving strategies to common AI applications.

Reference Books	
1.	Stuart Russel, Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson. 2010,ISBN-13: 978-0137903955.
2.	Elaine Rich, Kevin Knight: Artificial Intelligence, 3rdEdition, Tata McGraw Hill, 2009. ISBN: 9780070087705.
3.	"Hierarchical Adversarial Search Applied to Real-Time Strategy Games", by Marius Stanescu and Nicolas A. Barriga and Michael Buro, Proceedings of the Tenth Annual AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE 2014).
4.	The Neurophysiology of Language Processing Shapes the Evolution of Grammar: Evidence from Case Marking by Balthasar Bickel , AlenaWitzlack-Makarevich, Kamal K. Choudhary, Matthias Schlesewsky, Ina Bornkessel-Schlesewsky, Published: August 2015, http://dx.doi.org/10.1371/journal.pone.0132819

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester V		
ADVANCED ALGORITHMS **(Group A : Professional Core Elective)**		
Course Code: 16CS5A4		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Design and implement `new' algorithms in the real world.
2	Map practical problems to algorithmic problems.
3	Read and understand algorithms published in journals.
4	Develop writing skills to present own algorithms.
5	Collaborate and work together with other people to design new algorithms.

UNIT-I	
Analysis techniques: Growth of functions: Asymptotic notation, Standard notations and common functions, Substitution method for solving recurrences, Recursion tree method for solving recurrences, Master theorem, Amortized analysis, Aggregate, Accounting, and Potential methods	**06 Hrs**
UNIT-II	
String Matching Algorithms: Naïve algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm **Graph Algorithms** Bellman-Ford Algorithm, Shortest paths in a DAG, Johnson's Algorithm for sparse graphs.	**08 Hrs**
UNIT-III	
Advanced Data structures Red-Black tree, Fibonacci heaps, Splay trees, Binomial Queues, skip lists. **Maximum Flow** Flow networks, Ford Fulkerson method and Maximum Bipartite Matching.	**08 Hrs**
UNIT-IV	
Number Theoretic Algorithms Elementary notions, GCD, Modular arithmetic, solving modular linear equations, The Chinese remainder theorem, powers of an element, RSA cryptosystem, primality testing, Integer factorization	**07 Hrs**
UNIT-V	
Polynomials and the FFT Representation of polynomials; DFT and FFT; Efficient implementation of FFT. **Recent Trends** **Approximation algorithms:** A comprehensive survey: artificial bee colony (ABC) algorithm and applications	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the fundamentals of Asymptotic notation, Standard notations, amortized analysis and common functions for given algorithms.
CO2.	Analyse and solve practical problems using different algorithmic techniques.
CO3.	Design robust algorithms using mathematical techniques.
CO4.	Implement advanced techniques for a given problem.

Reference Books	
1.	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 3rd Edition, 2009, MIT Press, ISBN-13: 978-0262033848.
2.	Data Structures and Algorithm Analysis in C++; Mark Allen Weiss, 4th Revised Edition; 2013, Addison-Wesley; ISBN-13**:** 9780132847377.
3.	A comprehensive survey: artificial bee colony (ABC) algorithm and applications, Karaboga, Dervis, 2014, et al. Artificial Intelligence Review 42.1, pp 21-57.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester V		
NATURAL LANGUAGE PROCESSING (Group A : Professional Core Elective)		
Course Code:16CS5A5		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Learn the algorithmic description of the main language levels: morphology, syntax, semantics and pragmatics, as well as the resources of natural language data – corpora.
2	Understand knowledge representation, inference, and relations to artificial intelligence.
3	Explore linguistic phenomena and linguistic features relevant to each NLP task.
4	Apply the learnt methods to new NLP problems.
5	Implement NLP tools like classifiers, translators, pos taggers, stemmers for Indian and other languages.

UNIT-I	
Introduction:Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; The State of the Art and The NearTerm Future; **Regular Expressions and Automata:**Regular Expressions, Finite state automata, Regular languages and FSAs. **Morphology and Finite-State Transducers:**Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing.	**08 Hrs**
UNIT-II	
N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; **Word Classes and Part-of-Speech Tagging**: Part-of-Speech Tagging , Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging; **Context-Free Grammars for English**:Constituency, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase	**08 Hrs**
UNIT-III	
Parsing with Context-Free Grammars:Parsing as search, The Earley Algorithm; **Features and Unification:**Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints; **Lexicalized and Probabilistic Parsing**:Probabilistic Context-Free Grammars, Problems with PCFGs.	**06 Hrs**
UNIT-IV	
Markov Models: Hidden Markov Models, The three fundamental questions for HMMs, HMMs: Implementation, Properties, and Variants **Statistical Alignment and Machine Translation :** Text Alignment, Word Alignment, Statistical Machine Translation	**06 Hrs**
UNIT-V	
Text Categorization : Decision Trees, Maximum Entropy Modeling, Perceptrons, k Nearest Neighbor Classification **Recent Trends :**Matrix factorization techniques for recommender systems.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and Explore the basics of any language representation and model them with formal grammars.
CO2.	Apply experimental methodology for training and evaluating empirical NLP systems.

CO3.	Analyze the linguistic phenomena and linguistic features to each NLP task.
CO4.	Demonstrate the use of modern NLP techniques for processing of texts.

Reference Books	
1.	Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin, 2nd Edition, 2013, Prentice Hall, ISBN: 978-9332518414
2.	Foundations of Statistical Natural Language Processing, Christopher D. Manning, 1st Edition, 1999, MIT Press; ISBN: 978-0262133609
3.	Natural language processing with Python, Bird, Steven, Ewan Klein, and Edward Loper. 1st Edition, 2009, O'Reilly Media, Inc., ISBN: 978-8184047486
4.	Matrix factorization techniques for recommender systems, Koren, Yehuda, 2009, Robert Bell, and Chris Volinsky. IEEE Computer, August, 42(8), pp 30-37.

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

High-3 : Medium-2 : Low-1

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

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

Unit-I	
Biomolecules: Introduction to Biomolecules. Structure, Types and Functions of Carbohydrates, Lipids, Nucleic Acids and Proteins. Genetic code, Codon degeneracy, Genes and Genomes. **Bioinformatics & Biological Databases:** Introduction to Bioinformatics, Goals, Scope, Applications in biological science and medicine. Biological databases – Sequence, structure, Special Databases and applications - Genome, Microarray, Metabolic pathway, motif, and domain databases. Mapping databases – genome wide maps. Chromosome specific human maps.	**09 Hrs**
Unit – II	
Sequence Alignment: Introduction, Types of sequence alignments - Pairwise and Multiple sequence alignment, Alignment algorithms (Needleman & Wunch, Smith & Waterman and Progressive global alignment). Database Similarity Searching- Scoring matrices – BLOSSUM and PAM, Basic Local Alignment Search Tool (BLAST), and FASTA. Next Generation Sequencing – Alignment and Assembly. **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based & Character-Based Methods and Phylogenetic Tree evaluation.	**09 Hrs**
Unit -III	
Predictive methods: Predicting secondary structure of RNA, Protein and Genes – algorithms to predict secondary structure of RNA, Protein and Gene. Prediction of Tertiary structure of Protein, Protein identity and Physical properties of protein. **Molecular Modeling and Drug Designing:** Introduction to Molecular Modeling. Methods of Molecular Modeling and Force Fields used in Molecular Modeling. Drug designing process - deriving Pharmacophore, Receptor Mapping, Estimating Receptor-Ligand interactions and Molecular Docking.	**09 Hrs**
Unit –IV	
Perl: Introduction to Perl, writing and executing a Perl program. Operators, Variables and Special variables. Data Types – Scalar, Array and Associative array. Regular Expressions (REGEX), Components of REGEX - Operators, Metacharacters and Modifiers. Subroutines – types of functions, defining and calling functions in Perl, calling function - call by value and call by reference. Object Oriented Programming in Perl–Class and object, Polymorphism, inheritance and encapsulation. Perl Package – writing and calling package. Perl Module – writing and calling module.	**09 Hrs**
Unit –V	
BioPerl: Introduction to BioPerl, BioPerl Modules, Applications of BioPerl – Sequence retrieval from Database and submission of sequence to online Database, Indexing and accessing local databases, Transforming formats of database record, Sequence alignments BioPerl and Sequence Analysis - Pair wise and Multiple sequence alignment, Restriction mapping. Identifying restriction enzyme sites, acid cleavage sites, searching for genes and	**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, ISBN
4	D. C. Young. Computational Drug Design: A Guide for Computational and Medicinal Chemists,Wiley-Interscience, 1st edition, 2009, ISBN-13: 978-0470126851.

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

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

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

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

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

High-3 : Medium-2 : Low-1

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

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

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

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

Reference Books	
1.	Fuel Cells – Principles and Applications, Viswanathan and M Aulice Scibioh, 1st Edition, 2009, Universities Press, ISBN – 13: 978 1420 060287
2.	Fuel Cell Systems Explained, James Larminie and Andrew Dicks, 2nd Edition, 2003, John Wiley & Sons, ISBN – 978 0470 848579
3.	Fuel Cell Fundamentals, O 'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, 1st Edition, 2006, Wiley, New York, ISBN – 978 0470 258439
4.	Recent Trends in Fuel Cell Science and Technology, Basu. S, 1st Edition, 2007, Springer, ISBN – 978 0387 688152

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

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

CO - PO Mapping

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	1	-	-	-	-	-	-
CO2	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)		
Course Code:16G5B04		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3 Hrs**

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

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

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

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

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

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

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

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

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

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**	**-**	**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)		
Course Code : 16G5B06		**CIE Marks : 100**
Credits : L:T:P:S 4:0:0:0		**SEE Marks : 100**
Hours : 45L		**SEE Duration : 3Hrs**

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester V		
OPTIMIZATION TECHNIQUES **(Group B: Global Elective)**		
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)

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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							
CO5			2			1						1

Low-1 Medium-2 High-3

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

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

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

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember and understand the basic principles of transducers and smart sensors.
CO2:	Apply the knowledge of transducers and sensors to comprehend digital instrumentation systems.
CO3:	Analyze and evaluate the performance of different sensors for various applications.

CO4:	Design and create a system using appropriate sensors for a particular application

Reference Books	
1	Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, 18th Edition, 2008, Dhanpat Rai and Sons, ISBN: 81-7700-016-0.
2	Sensor systems: Fundamentals and applications, Clarence W.de Silva, 2016 Edition, CRC Press, ISBN: 9781498716246.
3	Transducers and Instrumentation, D.V.S. Murthy, 2nd Edition 2008, PHI Publication, ISBN: 978-81-203-3569-1.
4	Introduction to Measurement and Instrumentation, Arun K. Ghosh, 3rd Edition, 2009, PHI, ISBN: 978-81-203-3858-6.

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

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

SEE for 100 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)		
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, 4th Edition, 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)

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

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

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	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)**		
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,	**10 Hrs**

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.	

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)

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**	**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)		
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.

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

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

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

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	---	1	1	---	---	---	1	---	---	---
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)		
Course Code:16G5B12		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours: 44L		**SEE Duration:** 3Hrs

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

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

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

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

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

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

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

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

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

High-3: Medium-2: Low-1

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

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

Unit-I	
Introduction to Aircraft : History of aviation, International Standard atmosphere, Atmosphere and its properties, Temperature, pressure and altitude relationships, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions, Introduction to Unconventional and Autonomous Air vehicles.	**08 Hrs**
Unit – II	
Basics of Aerodynamics : Bernoulli's theorem, Aerodynamic forces and moments on an Airfoil, Lift and drag, Types of drag, Centre of pressure and its significance, Aerodynamic centre, Aerodynamic Coefficients, Wing Planform Geometry, Airfoil nomenclature, Basic characteristics of airfoils, NACA nomenclature, Simple problems on lift and drag.	**08 Hrs**
Unit -III	
Aircraft Propulsion : Introduction, Classification of powerplants, Piston Engine: Types of reciprocating engines, Principle of operation of turbojet, turboprop and turbofan engines, Introduction to ramjets and scramjets, Comparative merits and demerits of different types Engines.	**07 Hrs**

Unit -IV	
Introduction to Space Flight : History of space flight, Evolution of Indian Space Technology, The upper atmosphere, Introduction to basic orbital mechanics, some basic concepts, Kepler's Laws of planetary motion, Orbit equation, Space vehicle trajectories**.** **Rocket Propulsion :** Principles of operation of rocket engines, Classification of Rockets, Types of rockets.	**08 Hrs**
Unit -V	
Aerospace Structures and Materials : Introduction, General types of construction, Monocoque, Semi-Monocoque and Geodesic structures, Typical wing and fuselage structure; Metallic and non-metallic materials for aircraft application. Use of aluminum alloy, titanium, stainless steel and composite materials, Low temperature and high temperature materials.	**07 Hrs**

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

Reference Books	
1	John D. Anderson, Introduction to Flight, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Sutton G.P., Rocket Propulsion Elements, 8th Edition, 2011, John Wiley, New York, ISBN:1118174208, 9781118174203.
3	Yahya, S.M, Fundamentals of Compressible Flow, 5th Edition, 2016, New Age International, ISBN: 8122440223
4	T.H.G Megson, Aircraft structural Analysis, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4

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

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

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

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

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

High-3 : Medium-2 : Low-1

SEMESTER VI 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 & Neharika Vohra, 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, 5th Edition, 2009, TMH Pub. 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		
COMPILER DESIGN (Theory& Practice)		
Course Code: 16CS62		**CIE Marks: 100+50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100+50**
Hours: 33 L		**SEE Duration: 3+3Hrs**

Course Learning Objectives: The students will be able to	
1	Learn basic skill for constructing the compiler which gives the good insight into the algorithms, which have wider applications.
2	Gain Knowledge of different forms of language translators and machine architecture that shapes compilers.
3	Construct lexical analyser and the parsing methods that are typically used in compilers
4	Know about the principle ideas in syntax directed definitions and translations to generate intermediate code for the typical programming languages.
5	Understand about the run time environment, code generation and code optimization.

UNIT-I	
Introduction to Compiling and Lexical Analysis Introduction, Language Processors, The structure of Compiler, Evolution of programming Languages, Application of compiler technology, Programming Language Basics, Lexical Analysis- The Role of Lexical Analyzer, Input Buffering, Specifications of Tokens, Recognition of Tokens	**06 Hrs**
UNIT-II	
Syntax Analysis Introduction, Context-free Grammars, Writing a Grammar, Top-down Parsing, Bottom-up Parsing, and Introduction to LR Parsing: Simple LR, Most powerful LR parsers (Excluding efficient construction and compaction of parsing tables), Using ambiguous grammars, Parser Generators.	**08 Hrs**
UNIT-III	
Syntax-Directed Translation Syntax-Directed Definitions, Evaluation orders for SDD, Application of Syntax Directed Translation, Syntax directed translation schemes. **Run-time Environments:** Storage Organization, Stack Allocation of Space, Access to Nonlocal data on the Stack, Heap Management, Introduction to Garbage Collection	**06 Hrs**
UNIT-IV	
Intermediate Code Generation Variants of Syntax trees, Three address code, Types and Declaration, Translation of Expression, Control flow, Back patching, Switch statements, Procedure calls, Type Checking.	**06 Hrs**
UNIT-V	
Code Generation & Machine Independent Optimization Issues in the design of Code Generator, The Target Language, Address in the target Code, Basic Blocks and Flow graphs, Optimization of Basic blocks, A Simple Code Generator, Peephole Optimization	**07 Hrs**

Laboratory Component
Student should be able to design compiler by incorporating following features: 1 Familiarity with compiled codes (assembly language) of RISC and CISC machines. 2 Writing a scanner, writing predictive parser for a small language.(A Source code will be given to the students to write the scanner and predictive parser). 3 Small experiment with scanner (lex/flex) and parser (yacc/byson) generator (such as translation of regular expression to NFA or the construction or parse tree), 4 Writing scanner-parse specification for a small language.(A source code will be given to students to write the scanner-parser specification.) 5 Translation of the language to an intermediate form (e.g. three-address code), 6 Generation of target code (in assembly language). 7 Code improvement.

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the logic and fundamental concepts of compiler design using different data structures and techniques.
CO2.	Apply various rules for designing and generating code for compiler design.
CO3.	Analyse different optimization methods on intermediate code to generate efficient compiler.
CO4.	Implement and demonstrate in-depth knowledge of various technologies related to principles, techniques and tools for designing compiler.

Reference Books	
1.	Compilers- Principles, Techniques and Tools, Alfred V Aho, Monica S.Lam, Ravi Sethi, Jeffrey D Ullman, 2nd Edition, 2014, Pearson Education; ISBN – 10-1-292-02434-8, ISBN – 13- 978-1-292-02434-9.
2.	Compiler Construction Principles & Practice, Kenneth C Louden, 1st Edition 2009, Cengage Learning, ISBN – 0534939724.
3.	Modern Compiler Implementation in C, Andrew W Apple, 1st Edition; 2004, Cambridge University, ISBN 10: 0521607655 ISBN 13: 9780521607650.
4.	Crafting a Compiler with C, Charles N. Fischer, Richard J. leBlanc, Jr., 1st Edition, United States (28 October 2009), Pearson Education, ISBN-13:978-0136067054 ISBN-10: 0136067050.

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

High-3 : Medium-2 : Low-1

Semester VI	
COMPUTER NETWORKS (Theory& Practice)	
Course Code: 16CS63	**CIE Marks: 100+50**
Credits: L:T:P:S: 3:0:1:1	**SEE Marks: 100+50**
Hours: 33L	**SEE Duration: 3+3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the design aspects in computer networks.
2	Gain the knowledge of routing, internetworking and congestion control.
3	Explore networks layer, transport layer and application layer protocols.
4	Comprehend the importance of network security.

UNIT-I	
Network layer - 1 **Network layer design issues,** Store and Forward packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual Circuit and Datagram Subnets; **Routing algorithms**: Shortest Path Routing, Flooding, Distance Vector Routing, Link state Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing; **Congestion Control Algorithms,** General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control; Quality Of Service: Requirements, Techniques for Achieving Good Quality of Service; Integrated Services, Differentiated Services, *RSVP*	**07 Hrs**
UNIT-II	
Network layer - 2 : Internetworking: How networks differ, How networks can be connected, Connectionless Internetworking, Tunnelling, Internetwork Routing, Fragmentation,The Network Layer in the Internet : The IP Protocol, IP Addresses, Internet Control Protocols, IPv6.	**07 Hrs**
UNIT-III	
Transport Layer : The Transport Service: Services provided to the Upper Layers, Transport Service Primitives; Elements of Transport Protocols: Addressing, Connection Establishment, Connection Release, Flow Control and Buffering. The Internet Transport Protocols(UDP): Introduction to UDP; The Internet Transport Protocols(TCP): Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Transmission Policy, TCP Congestion Control.	**07 Hrs**
UNIT-IV	
Application Layer – 1: Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in Internet, DNS- The Internet's Directory Service, Socket Programming: Creating Network Applications, Network Management: SNMP.	**06 Hrs**
UNIT-V	
Security in Network: What Is Network Security? Principles of Cryptography, Message Integrity and Digital Signatures, End-Point Authentication, Securing E-Mail, Network-Layer Security. **Introduction to Working of SDN:** Fundamental Characteristics of SDN, SDN Operation, SDN Applications.	**06 Hrs**

Laboratory Component

PART - A: EXPERIMENTS

1. Implement a client and server communication using sockets programming.
2. Write a program to implement routing protocol for a simple topology of routers.
3. Write a program to implement error detection algorithm.
4. Write a program to illustrate error correction concept.
5. Write a program to implement congestion control algorithm.
6. Implement a simple multicast routing mechanism.
7. Write a program to encrypt and decrypt the data.
8. Write a program to demonstrate key exchange between sender and receiver.

Note : The above experiments shall be conducted using C / C++ on Linux Operating System.

PART – B: SIMULATION

Qualnet Experiments

1. Setup a simple PPP network with 3 nodes n1, n2 and n3. Provide a) half duplex b) full duplex communication between three nodes. Apply the FTP, Telnet applications between nodes. Vary the bandwidth, queue size and observe the packet drop probability.
2. Setup an IEEE 802.3 network with a) hub b) switch c) Hierarchy of switch. Apply the FTP, Telnet applications between nodes. Vary the number of nodes. Vary the bandwidth, queue size and observe the packet drop probability.
3. Setup a wireless sensor networks with atleast two device co-coordinators and nodes. Provide Constant Bit Rate (CBR), Variable Bit Rate (VBR) application between several nodes. Increase the number of co-coordinators and nodes in the same area and observe the performance at physical and MAC layers.
4. Setup an IEEE 802.11 network with atleast two access points. Apply the CBR, VBR applications between devices belonging to same access points and different access points. Provide roaming of any device. Vary the number of access points and devices. Find out the delay in MAC layer, packet drop probability.

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the functionalities and services provided by layer 3 and above.
CO2.	Analyse different protocols used to implement internetworking.
CO3.	Design of efficient networking protocols.
CO4.	Implement routing, congestion control and applications layer protocols.

Reference Books	
1.	Computer Networks; Pearson Education, Andrew S Tanenbaum, 5th Edition, 2013, ISBN-13: 978-0-13-212695-3.
2.	Computer Networking, A Top-Down Approach, James Kurose and Keith Ross, 6th Edition, 2013, ISBN-13: 978-0-13-285620-1.
3.	Software Defined Networks A Comprehensive Approach , Paul Goransson, Chuck Black, Elsevier, 2014.
4.	Computer Networks - A Systems Approach, Larry L Peterson and Bruce S Davie, Elsevier; 5th Edition; 2011, ISBN – 978-0123850591.

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

High-3 : Medium-2 : Low-1

Semester VI	
COMPUTER ARCHITECTURE (Theory)	
Course Code: 16CS64	**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0	**SEE Marks: 100**
Hours: 33L	**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the design aspects in computer architecture.
2	Explore the recent trends in computer architecture.
3	Appreciate the importance of pipelining and Instruction level parallelism.
4	Know the memory types, hierarchy, design and its performance.
5	Understand shared memory architectures.

UNIT-I	
Fundamentals of computer design: Introduction, Trends in Technology; Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance attributes; Quantitative Principles of computer design **Pipelining:**Introduction, pipeline hazards,pipeline implementation and its challenges.	**07 Hrs**
UNIT-II	
Review of memory hierarchy and Design: Introduction, Cache performance, Ten advanced Optimizations of cache performance,memory technology and optimizations, Protection: virtual memory and virtual machines. Memory hierarchies in the ARM Cortex-A8 and intel Core i7.	**07 Hrs**
UNIT-III	
Instruction level parallelism: Concepts and challenges, basic compiler techniques for exposing ILP, reducing branch costs with prediction, overcoming data hazards with dynamic scheduling, hardware based speculation.	**06 Hrs**
UNIT-IV	
Exploiting Instruction level parallelism: Multiple issues and static scheduling. Exploring ILP using dynamic scheduling, multiple issue and speculation, Advanced techniques for instruction delivery and speculation-Increasing instruction fetch bandwidth; Implementation issues and extensions of speculation, studies of the limitations of ILP, Parallelism in ARM Cortex-A8 and intel Core i7.	**06 Hrs**
UNIT-V	
Thread Level Parallelism: Introduction, Centralized Shared-Memory architecture, Performance of symmetric shared memory multiprocessors. **Programming with OpenMP:**Introduction Parallel programming, OpenMP directives, Parallel Control Structures, Communication and Data Environments, Synchronization, Parallelizing a Simple Loops, usage of work sharing constructs, Controlling Data Sharing.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the principles of computer design and its performance.
CO2.	Identify and relate the performance aspects in computer architecture.
CO3.	Analyze the design aspects of MIPs architecture with respect to memory and Parallelism.
CO4.	Compare and summarize the design aspects of different architectures.

Reference Books	
1.	Computer Architecture: A Quantitative Approach, John L Hennessy, David A Patterson, Elsevier, 5th Edition; 2011, ISBN:9780123838728.
2.	Parallel Programming with OpenMP, Rohit Chandra, 2001. ISBN 1-55860-671-8
3.	Advanced Computer Architecture Parallelism, Scalability, Programmability, Kai Hwang, Naresh Jotwani, 2nd Edition, 2010, McGraw-Hill, ISBN 10: 0070702101 / ISBN 13: 9780070702103.
4.	Advanced Computer Architectures: A Design Space Approach, DezsoSima, Terence Fountain, Peter Karsuk, 2005, Pearson Education, ISBN-10: 0201422913, ISBN-13: 978-0201422917.

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

High-3 : Medium-2 : Low-1

Semester VI		
MOBILE COMPUTING **(Group C : Professional Core Elective)**		
Course Code:16CS6C1		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Learn the basic concept of mobile computing.
2	Understand and explore the GSM and similar Architecture of mobile computing.
3	Explore intricacies of GPRS and Voice over IP.
4	Provide recent trends and development in mobile computing.

UNIT-I	
Mobile Computing: An Overview: Mobile computing, Mobile computing function, Mobile computing architecture, Mobile System Networks ,Data dissemination, Mobility Management.	**07 Hrs**
UNIT-II	
GSM and Similar architecture: GSM-services and system architecture, GSM entities, Call routing in GSM, Calling, Handover, CDMA: Introduction, CDMA Vs GSM.	**07 Hrs**
UNIT-III	
General Packet Radio Service(GPRS): GPRS and Packet data network, GPRS network architecture, GPRS network operation, Data services in GPRS ,Application for GPRs, Limitation of GPRS, Enhanced data rates for GSM Evolution(EDGE).	**07 Hrs**
UNIT-IV	
Voice over Internet Protocol and Convergence: Voice over IP,H.32 framework for voice over IP, Session initiation protocol(SIP), Comparison between H.323 and SIP ,Convergence technologies, Call routing, Voice over IP application, Mobile VoIP.	**08Hrs**
UNIT-V	
Emerging Technologies: Bluetooth, Radio Frequency Identification (RFID), Wireless broadband(WIMAX),mobile IP, Internet protocol version 6(IPV6),3G,4G,LTE.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the basic and fundamental principle of Mobile Computing.
CO2.	Identify the significance of Voice over IP.
CO3.	Analyze the design aspects of mobile architecture with respect to different technologies.
CO4.	Synthesis the different emerging technologies of mobile computing.

Reference Books	
1.	Mobile Computing , Ashok K Talukder, Hasan Ahmad, Roopa R Yavagal, 2nd Edition; 2014, McGraw Hill Education(India) private Limited , ISBN-13:978-07-014457-6/ISBN-10:0-07-14457-5.
2.	Mobile computing, Raj Kamal, 1st Edition, 2008, Oxford University Press, ISBN-13:978-19-568677-7/ISBN-10:0-19-568677-2 2001.

3.	Internet of Things (IoT) Security: Current Status, Challenges and Prospective Measures, Rwan Mahmoud, Tasneem Yousuf, Fadi Aloul, Imran Zualkernan, The 10th International Conference for Internet Technology and Secured Transactions (ICITST-2015).
4.	The Evolution to 4G Cellular Systems: Architecture and Key Features of LTE-Advanced Networks, Ghassan A. Abed, Mahamod Ismail, Kasmiran Jumari, IRACST – International Journal of Computer Networks and Wireless Communications (IJCNWC), ISSN: 2250-3501 Vol. 2, No. 1, 2012.

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

High-3 : Medium-2 : Low-1

Semester VI		
WEB PROGRAMMING (Group C : Professional Core Elective)		
Course Code:16CS6C2		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 34L		**SEE Duration: 3Hrs**

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, PHP, XML, AngularJS to design web pages.
4	Design and develop GUIs which are quick, easy and well-presented using different techniques such as CSS, JavaScripts, XML and AngularJS.

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.	**06 Hrs**
UNIT-II	
CSS (Cascading Style Sheets): 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;	**07Hrs**
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.	**06Hrs**

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. **AngularJS:** Introducing AngularJS:MVC, AngularJS Benefits, Philosophy; Basic AngularJS Directives and Controllers: AngularJS Modules, Creating our first controller, Working with and Displaying Arrays, Working with ng-repeat.	**08Hrs**

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 JavaScripts, PHP, XML and AngularJS to design the web pages.
CO4.	Develop web based applications using PHP, XML and AngularJS.

Reference Books	
1.	Programming the World Wide Web – Robert W. Sebesta, 7th Edition, 2013, Pearson Education, ISBN-13:978-0132665810.
2.	AngularJS Up & Running- Shyam Seshadri, Brad Green, 1st Edition, 2014, O'Reilly, ISBN:978-1491901946.
3.	Web Programming Building Internet Applications – Chris Bates, 3rd Edition, 2006, Wiley India, ISBN *:* 978-81-265-1290-4.
4.	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
5.	The Complete Reference to HTML and XHTML- Thomas A Powell, 4th Edition, 2003, Tata McGraw Hill, ISBN: 978-0-07-222942-4.

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

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

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

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

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

Low-1 Medium-2 High-3

Semester VI		
CLOUD COMPUTING **(Group C : Professional Core Elective)**		
Course Code: 16CS6C3		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Explore cloud computing models and infrastructure for larger networks.
2	Identify policies, mechanisms and scheduling for resource management, virtualization, and optimization of networks.
3	Compare multiple approaches to cloud system design and solve real world problems.
4	Illustrate storage concept and self-organizing capability for different cloud systems.

UNIT-I	
Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Eras of Computing, Parallel vs. Distributed Computing, Elements of Parallel Computing.	**07 Hrs**
UNIT-II	
Virtualization and Cloud Architecture Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples, Xen, VMware, Microsoft Hyper-V, Cloud Reference Model and Architecture, Infrastructure as a Service, Platform as a Service, Software as a Service, Types of Clouds, Economics of the Cloud, Open Challenges in Clouds.	**07Hrs**
UNIT-III	
Data-Intensive Computing: What is data-intensive computing? Characterising data-intensive computations, Challenges ahead, Historical perspective, Technologies for data-intensive computing – Storage systems, Programming platforms - MapReduce. **Public Cloud Infrastructures:** Amazon Web Services - Compute, Storage, and Communication Services; Google AppEngine – Architecture, Application Life-Cycle, Cost Model; and Microsoft Azure.	**07 Hrs**
UNIT-IV	
Cloud Applications - ECG Data Analysis on Cloud, Protein Structure Prediction, Satellite Image Processing; Business and Consumer Applications – CRM, Social Networks, Media Applications, and Multiplayer Online Gaming. **Advanced Topics in Cloud Computing**, Energy efficiency in clouds, Energy-efficient and green cloud computing architecture, Market-based management of clouds, Market-oriented cloud computing, A reference model for MOCC,3 Technologies and initiatives supporting MOCC, Observations	**07 Hrs**
UNIT-V	
Cloud Security: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor.	**07Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Explore the basic concepts of cloud computing, cloud infrastructure, cloud models, cloud services, distributed computing, and other related concepts.
CO2.	Understand Virtualization, and working of some of industrially popular Virtualization technologies.
CO3.	Apply MapReduce programming model to solve some data-intensive computing applications over public or private cloud platforms.
CO4.	Analysing the security risks in cloud from different perspectives and study some of the available solutions.

Reference Books	
1.	Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi, 2013, McGraw Hill, New Delhi, India, ISBN-13: 978-1-25-902995-0. (Units 1 – 4)
2.	Cloud Computing Theory and Practice, Dan C Marinescu, 1st Edition, 2013, Elsevier (MK), ISBN: 9780124046276. (Unit – 5)
3.	Distributed Computing and Cloud Computing, from parallel processing to internet of things, Kai Hwang, GeofferyC.Fox, Jack J Dongarra, 1st Edition, 2012, Elsevier(MK), ISBN: 978-0-12-385880-1.
4.	Cloud Computing Implementation, Management and Security,John W Rittinghouse, James F Ransome, 1st Edition, 2013, CRC Press, ISBN: 978-1-4398-0680-7.

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

High-3 : Medium-2 : Low-1

Semester VI		
NETWORK PROGRAMMING (Group C : Professional Core Elective)		
Course Code:16CS6C4		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Introduce students to programming fundamentals and TCP/IP socket programming.
2	The students will be able to develop simple client/server applications using TCP and UDP sockets.
3	The basic knowledge of DNS and daemon process are provided to utilize and develop applications.
4	The knowledge of IPV4 & IPV6 interoperability with respect to network applications.
5	Broadcasting, Unix domain protocols are introduced to the students.
6	Signal and Thread concepts with echo server/client example with introduction to synchronization of threads.

UNIT-I	
The Transport Layer and Introduction to sockets Introduction to TCP, UDP and SCTP, The big picture, Difference between UDP, TCP, SCTP, TCP connection establishment and termination, TIME_WAIT state, TCP port numbers and concurrent servers, Buffer sizes and limitation. Socket address structure, value-result arguments, byte ordering functions, byte manipulation functions, inet_aton, inet_addr and inet_ntoa functions, inet_pton and inet_ntop functions,	**06 Hrs**
UNIT-II	
TCP client/server socket function, connect function, bind, listen, accept, fork, exec functions, concurrent servers, close function, getsockname and getpeername functions, TCP Echo server – main – str_echo ,TCP Echo client - main – str_echo, Normal startup, normal termination. **UDP client/server and Name server** socket options introduction, getsockopt and setsockopt functions. recvfrom and sendto functions, UDP Echo server & UDP Echo client, lost datagrams, DNS, Gethostbyname function, gethostbyaddr function, getservbyname and getservbyport functions, getaddrinfo function, gai_strerror function, freeaddrinfo function, getaddrinfo function: example, host_serv function**.**	**08 Hrs**
UNIT-III	
IPV4 and IPV6 Interoperability, Daemon process Introduction to IPv4 and IPv6, IPv4 client- IPv6 server, IPv6 client - IPv4 server, IPv6address – Testing Macros, Source code portability. Introduction to daemon processes, syslogd Deamon, syslog function, daemon_init function, inetd Daemon, daemon_inetd function**.** **Signal driven I/O** Introduction, Signal-driven I/O for sockets, UDP Echo server using SIGIO.	**08 Hrs**
UNIT-IV	
Broadcasting Introduction to Broadcasting, Broadcast address, Unicast Vs Broadcast, dg_client function using broadcasting. **Multicasting** Multicast addresses, Multicasting versus broadcasting on a LAN, Multicasting on a WAN, Source-specific multicast.	**07 Hrs**

UNIT-V	
Introduction to Pthreads and Synchronization Basic thread functions, str_cli function using threads, TCP Echo server using threads, Thread specific data. Mutexes: Mutual Exclusion, Condition variables. **Recent Topics** Frenetic: A network programming language.	**06 Hrs**

Practice programs:

1. Design and implement TCP concurrent chat server and client using multiplexing system call "select".
2. Design a TCP concurrent server to echo given set of sentences using poll functions.
3. Write C client/server program for signal handling and handling zombie processes.

Experiential Learning:

1. Design and implement a protocol following its RFC. (FTP, HTTP, SMTP etc.)
2. Design and implement a broadcast application. (DNS, DHCP, NTP etc.)
3. Design and develop a packet capturing tool using library like libpcap and display the statistics.

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the TCP and UDP protocols in detail.
CO2.	Apply socket APIs and concepts to realize client-server solutions to robust real-world applications
CO3.	Analyse Protocol interoperability and application
CO4.	Design and Implement specific network programming modules using specific APIs and structures

Reference Books	
1.	UNIX Network Programming – The sockets networking API Vol. 1, W.Richard Stevens, Bill Fenner, Andrew M. Rudoff, 3rd edition, 2010, PHI, ISBN: 978-0131411555.
2.	, Internetworking with TCP/IP, Vol. I, Comer, StevensSixth Edition, 2015, PHI, ISBN: 978-0136085300.
3.	Computer Networking: A Top-Down Approach, J. F. Kurose and K. W. Ross, 6th Edition, 2013, Addison-Wesley Publishing, ISBN: 978-0132856201.
4.	Frenetic: A network programming language, Foster, Nate, et al. ACM Sigplan Notices. Vol. 46. No. 9. ACM, 2011.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester VI	
FUZZY LOGIC & INTELLIGENT INFORMATION SYSTEMS (Group D : Professional Core Elective)	
Course Code:16CS6D1	**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	Gain knowledge of fundamental concepts in Fuzzy Logic and Intelligent Systems.
2	Illustrate fuzzy sets and fuzzy logic as mathematical models.
3	Focus on problems related to various engineering, mathematics, and science disciplines.
4	Use fuzzy logic based techniques for various applications.

UNIT-I	
Introduction The case for Imprecision, The Utility and Limitations of Fuzzy Systems, Fuzzy sets and membership, Chance verses fuzziness, Sets as points in hyper cubes. Fuzzy Sets - Fuzzy set operations, Properties of Fuzzy Sets, Alternative fuzzy set operations, membership value assignments-intution, inference and rank ordering methods, Features of the Membership Function,transformations. **Fuzzy Relations** Fuzzy Cartesian product, Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations and Composition of fuzzy relation, Fuzzy Tolerance and equivalence Relations. Value Assignments - Cosine Amplitude, Max-min Method, Other Similarity methods.	**09 Hrs**
UNIT-II	
Fuzzification, and Defuzzification Fuzzification, defuzzification to crisp sets, Lambda-cuts for fuzzy relations, Defuzzification to Scalars. **Intutionistic fuzzy sets and other forms** Intuitionistic fuzzy sets, Intuitionistic fuzzy set operations, properties of Intuitionistic fuzzy sets, Intuitionistic fuzzy relations, Operations on Intuitionist Fuzzy Relations, Properties of IntuitionistFuzzy Relations, Interval valued fuzzy sets, Type-2 fuzzy sets.	**08 Hrs**
UNIT-III	
Fuzzy Logic and Fuzzy Systems Deductive Inferences. Fuzzy Logic, approximate reasoning, other forms of the Implication Operation ,Fuzzy Systems: Fuzzy if-then rules, types, fuzzy rule based models for function approximation, Mamdani Model, TSK Model. **Fuzzy Arithmetic and Extention Principle** Extention principle, Crisp Function, Mapping and Relations, Function of fuzzy sets-Extentionprinciple , fuzzy transform, practical considerations, fuzzy arithmetic, internal analysis in arithmetic, Approximate of extension.	**08 Hrs**
UNIT-IV	
Fuzzy Classification and Pattern Recognition Classification of Equivalence relations, Crisp Relationsand Fuzzy Relations, Cluster Analysis, Cluster Validity, c-means clustering, Hard c-means, Fuzzy c-means algorithm , cluster validity, Knowledge based pattern recognition, Hybrid pattern based recognition, applications in Medical Image Segmentation: case study of hybrid fuzzy system for MRI segmentation.	**09Hrs**

UNIT-V	
Fuzzy Logic and Artificial Intelligence AI, Neural Network, genetic Algorithms, Fuzzy logic in frame based representation, FL in expert systems, Intelligent Agents, FL in Intelligent systems. Fuzzy Logic in Database and Information Systems. Fuzzy information, FL in database systems, fuzzy relation data models and its operations, Design theory for fuzzy relational databases.	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Explore and Understand basic concepts of all types of fuzzy sets and relations, fuzzy logic extension principle in the field of computer science and Engineering.
CO2.	Analyse the tools of all types of fuzzy sets in different areas of intelligent information systems where uncertainty and imprecision are involved.
CO3.	Design fuzzy systems and solve complex problems using various fuzzy techniques.
CO4.	Create application by utilizing cloud platforms Apply fuzzy systems and solve complex problems using various fuzzy techniques.

Reference Books	
1.	Timothy J. Ross, "Fuzzy logic with engineering applications" John Wiley; 2nd Edition; 2007, ISBN: 13 978-81-265-1337-6.
2.	John Yen, Reza Langari, "Fuzzy Logic Intelligence, Control and Information", 1st edition, 9th Impression, 2012, Pearson, ISBN: 978-81-317-0534-6.
3	George J. Klir, Bo Yuan "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall; 1st Edition; 2008, ISBN: 81-203-0695-3.
4	Research Papers on Intuitionistic Fuzzy Logic and Interval Valued Fuzzy Logic.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester VI	
DATA WAREHOUSING AND DATA MINING **(Group D : Professional Core Elective)**	
Course Code: 16CS6D2	**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0	**SEE Marks: 100**
Hours: 44 L	**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the functionality of the various data warehousing and data mining components.
2	Describe and utilize a range of techniques for designing data warehousing and data mining systems for real -world applications.
3	Provide comprehensive analysis of the organization, related to business, its requirements and any trends which requires access of historical data.
4	Find the hidden interesting patterns in data.
5	Analyze the historical data, identify the problems, and choose the relevant algorithms to apply.

UNIT-I	
Data Warehouse : Introduction to Data Warehouse, Differences between Operational Database Systems and Data Warehouses , A Separate Data Warehouse, Data Warehousing : A Multitier Architecture Data Warehouse Modelling: Data Cube and OLAP; Data Cube : A Multidimensional Data Model, Stars, Snowflakes, and Fact Constellations: Schemas for multidimensional Data Models, Dimensions: The Role of Concept Hierarchies, Typical OLAP Operations **Introduction to Data Mining** Introduction to Data Mining, Importance of Data mining, kinds of data and patterns to be mined, technologies used, Data Objects and Attribute Types, Data Preprocessing: Data cleaning, Data Integration, Data Reduction, Data Transformation and discretization	**09 Hrs**
UNIT-II	
Classification Basic concepts of classification, Decision Tree Induction, Bayesian Classification, Rule based Classification, Model Evaluation and selection, Techniques to improve classification accuracy	**09 Hrs**
UNIT-III	
Classification: Advanced Methods Bayesian Belief Network, Classification by Backpropagation, Support Vector Machines, Multi class classification, semi supervised classification.	**09 Hrs**
UNIT-IV	
Association Analysis Basic Concepts, Apriori algorithm, Generating association rules from frequent itemsets, improving the efficiency of Apriori, Pattern growth approach for Mining frequent itemsets, Mining Frequent itemsets using vertical data format, Mining closed and max itemsets.	**09 Hrs**
UNIT-V	
Data mining trends and research frontiers Mining sequential data, time series, Symbolic sequences, Biological sequences, mining graphs and networks, Data mining applications, Data mining and society, *Bayesian Deep Learning.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and Explore Data Warehousing and Data Mining concepts and Techniques.
CO2.	Exemplify the strengths and weakness of various Data Warehouse and data mining techniques for pattern discovery.
CO3.	Analyze the implementation of Data Mining Techniques using any a open source analytical tools.
CO4.	Identify and apply an efficient Data Mining Algorithm on historical data for knowledge discovery.

Reference Books	
1.	Data Mining – Concepts and Techniques, Jiawei Han and Micheline Kamber, Jian Pei, 3rd Edition, 2012, Morgan Kaufmann, ISBN 978-0-12-381479-1.
2.	Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, 2007, Pearson Education, ISBN 978-81-317-1472-0.
3.	Insight into Data Mining, Theory & Practice, K. P. Soman, Shyam Diwakar, V. Ajay, 2006, PHI, ISBN: 978-81-203-2897-6.
4.	* Hao Wang and Dit-Yan Yeung, Senior Member, IEEE, Towards Bayesian Deep Learning: A Framework and Some Existing Methods, IEEE TRANSACTIONS on Knowledge And Data Engineering, Vol. 28, No. 12, December 2016,pp3395-3408.

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

High-3 : Medium-2 : Low-1

Semester VI	
OBJECT ORIENTED ANALYSIS AND DESIGN (Group D : Professional Core Elective)	
Course Code: 16C6D3	**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	Specify, Design, Build and Understand Complex systems.
2	Acquire knowledge of notations and process of object-oriented analysis and design.
3	Demonstrate design concepts through Unified Modeling Language (UML).
4	Visualize, Specify, Construct and Document the artifacts of software-intensive system.

UNIT-I	
Complexity The Structure of Complex Systems, The Inherent Complexity of Software, The Five Attributes of a Complex System, Organized and disorganized Complexity, Bringing Order to Chaos, On Designing Complex Systems. **Classes and Objects** The Nature of an Object, Relationships among Objects, The Nature of a Class, Relationships among Classes**,** The Interplay of Classes and Objects, On building quality classes and objects.	**08 Hrs**
UNIT-II	
Classification The Importance of Proper Classification, Identifying Classes and Objects. **Notation** The Unified Modelling Language, Package diagrams, Component Diagrams, Deployment Diagrams, Use Case Diagrams.	**10 Hrs**
UNIT-III	
Notation Activity Diagrams, Class Diagrams, Sequence Diagrams, Interaction Overview Diagrams, Composite Structure Diagrams, State Machine Diagrams, Timing Diagrams, Object Diagrams, Communication Diagrams.	**10 Hrs**
UNIT-IV	
Process First Principles-Traits of successful projects, Towards a Rational Development Process, The Macro Process: The Software Development Lifecycle, The Macro Process Content Dimension-Disciplines, The Micro Process: The Analysis and Design Process-overview, Levels of Abstraction, Activities, Products, The Micro Process and Levels of Abstarction.	**08 Hrs**
UNIT-V	
Pragmatics Management and Planning, Staffing, Release Management, Reuse. **Case Study** Control System: Traffic Management: Inception, Elaboration, Construction, Post-Transition. *Large scale object-oriented software-development in a banking environment, Open Issues in Object-Oriented Programming, Research on Improving the Quality of the Object Oriented System, Security for Object-Oriented Systems.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Explore the concepts of object model.
CO2.	Apply basic and advanced structural and behavioural UML modelling to solve software-intensive problems.
CO3.	Model the object oriented analysis and design aspect through Unified Modelling Language (UML).
CO4.	Analyze the requirements of the problem and design solutions to complex problems using UML notations.

Reference Books	
1.	Grady Booch, Robert A Maksimchuk, Michael W Engle, Bobbi J Young, Jim Conallen, KelliaHoustan, Object Oriented Analysis and Design with Applications, Addison Wesley, 3rd Edition, 2013, ISBN 978-81-317-2287-93.
2.	Grady Booch, James Rumbaugh, Ivar Jacobson , The Unified Modeling Language User Guide, Addison Wesley Professional, 2nd Edition, 2005, ISBN: 0-321-26797-4.
3.	Ali Bahrami, Object Oriented Systems Development using the Unified Modelling Language, McGraw Hill, Second Reprint 2008, ISBN:978-0-07-026512-7.
*	IEEE/ACM and other refereed journals, white papers, and manuals.

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

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

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

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

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

High-3 : Medium-2 : Low-1

Semester VI		
LINUX INTERNALS **(Group D : Professional Core Elective)**		
Course Code: 16CS6D4		**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	Reinforce the kernel level features of Linux operating system.
2	Develop and implement the system calls.
3	Gain knowledge about memory management techniques of the Linux OS.
4	Present an adequate programming environment in Linux OS.

UNIT-I	
Introduction to the Linux Kernel History of Unix, Along Came Linus: Introduction to Linux, Overview of Operating Systems and Kernels, Linux Versus Classic Unix Kernels, Linux Kernel Versions, The Linux Kernel Development Community. **Process Management** The Process, Process Descriptor and the Task Structure, Process Creation, The Linux Implementation of Threads, Process Termination.	**08 Hrs**
UNIT-II	
Process Scheduling Multitasking, Linux's Process Scheduler, Policy, The Linux Scheduling Algorithm, The Linux Scheduling Implementation, Process Selection, Preemption and Context Switching, Real-Time Scheduling Policies, Scheduler-Related System Calls. **System Calls** Communicating with the Kernel, APIs, POSIX, and the C Library, Syscalls, System Call Handler, System Call Implementation, System Call Context.	**10 Hrs**
UNIT-III	
Interrupts and Interrupt Handlers Interrupts, Interrupt Handlers, Top Halves Versus Bottom Halves, Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Implementing Interrupt Handlers, /proc/interrupts, Interrupt Control. **Bottom Halves and Deferring work** Bottom Halves, A World of Bottom Halves, Softirqs, Tasklets, Work Queues, Which Bottom Half Should I Use?, Locking Between the Bottom Halves, Disabling Bottom Halves.	**08 Hrs**
UNIT-IV	
Memory Management Pages, Zones, Getting Pages, kmalloc() , vmalloc() , Slab Layer, Statically Allocating on the Stack, High Memory Mappings, Per-CPU Allocations, The New percpu Interface,Reasons for Using Per-CPU Data, Picking an Allocation Method.**The virtual File System**Common Filesystem Interface, Filesystem Abstraction Layer, Unix Filesystems, VFS.	**10 Hrs**
UNIT-V	
An Introduction to Kernel Synchronization Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability. **Kernel Synchronization Methods** Atomic Operations, Spin Locks, Reader-Writer Spin Locks, Semaphores, Reader-Writer Semaphores, Mutexes , Completion Variables, BKL: The Big Kernel Lock. **Recent Trends** kvm: the Linux virtual machine monitor.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and Explore the fundamental concepts of Unix, high-level structure and development environments.
CO2.	Illustrate the use of data structures and system calls within the Linux kernel.
CO3.	Integrate the operating system concepts with relevant design issues associated with Linux kernel.
CO4.	Develop applications using Linux Processes and Interrupt handling techniques.

Reference Books	
1.	Robert Love; Linux Kernel Development; Pearson Education; 3rd Edition; 2010, ISBN-8131758182.
2.	M. Beck et.al ; Linux Kernel Programming; Pearson Education; 3rd Edition; 2002, ISBN-110-201-71975-4.
3.	Daniel Bovet ; Understanding the Linux Kernel, O'Reilly, 1st Edition, 2000, ISBN-10: 0596000022.
4.	Michael kerrish; Linux Programming Interface; 1st Edition, 2010, ISBN-10159327220
5	Kivity, Avi, et al. "kvm: the Linux virtual machine monitor." Proceedings of the Linux symposium. Vol. 1. 2007.

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**	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**1**
CO2	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**2**	**_**	**1**	**1**
CO3	**1**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**2**	**_**	**1**	**1**
CO4	**1**	**3**	**3**	**2**	**1**	**2**	**1**	**1**	**2**	**_**	**1**	**1**

High-3 : Medium-2 : Low-1

Semester VI		
INTRODUCTION TO OPTIMIZATION TECHNIQUES (Group D : Professional Core Elective)		
Course Code: 16CS6D5		**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	To understand the concepts of optimization techniques.
2	To learn the modelling 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. **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.	**09 Hrs**
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	
Project Management Using Network Analysis: Network construction, determination of critical path and duration, floats. PERT- Estimation of project duration, variance. CPM - Elements of crashing, least cost project scheduling.	**09 Hrs**
UNIT-V	
Metaheuristics: The nature of Metaheuristics, Tabu Search, Simulated Annealing, Genetic Algorithms. Nature-inspired metaheuristics : Research Papers on evolutionary algorithms, ant colony optimization and particle swarm optimization.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1.	Understand and explore the various optimization models and their areas of application.
CO2.	Apply the process of formulating and solving problems using optimization methods.
CO3.	Analyze models for real life problems using optimization techniques.
CO4.	Develop solutions through optimization techniques.

Reference Books	
1.	Taha H A, Operation Research an Introduction, PHI, 8th Edition, 2009, ISBN: 0130488089.
2.	Philips, Ravindran and Solberg - Principles of Operations Research – Theory and Practice, John Wiley & Sons (Asia) Pte Ltd, 2nd Edition, 2000, ISBN 13: 978-81-265-1256-0.
3.	Hiller, Liberman, Nag, Basu, Introduction to Operation Research, Tata McGraw Hill 9th Edition, 2012, ISBN 13: 978-0-07-133346-7.
4.	J K Sharma, Operations Research Theory and Application, Pearson Education Pvt Ltd, 4th Edition, 2009, 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**	**2**	**1**	**-**	**1**	**-**	**2**	**1**	**1**	**1**	**2**
CO2	**2**	**1**	**2**	**1**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**1**
CO3	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**
CO4	**1**	**2**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**2**	**1**	**2**

High-3 : Medium-2 : Low-1

Semester VI		
BIOINSPIRED ENGINEERING (Group E: Global Elective)		
Course Code: 16G6E01		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36L		**SEE Duration: 3Hrs**

Course Learning Objectives:	
1	To familiarize engineering students with basic biological concepts
2	Utilize the similarities noted in nature for a particular problem to bring inspiration to the designer.
3	Explain applications such as smart structures, self-healing materials, and robotics relative to their bio logical analogs
4	To gain an understanding that the design principles from nature can be translated into novel devices and structures and an appreciation for how biological systems can be engineered by human design

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

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember and explain the fundamentals of Biology
CO2:	Describe the basic principles of design in biological systems.
CO3:	Differentiate biological phenomena to support inspiration for visual and conceptual design problems
CO4:	Create engineered solutions to customer needs utilizing a variety of bio-inspiration techniques.

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

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

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

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

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

High-3 : Medium-2 : Low-1

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

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

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

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

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

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

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

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

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

Semester VI		
SOLID WASTE MANAGEMENT (Group E: Global Elective)		
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	
1	Understand the existing solid waste management system and to identify their drawbacks.
2	Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste.

3	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.
4	Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment & Forest.

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 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	-	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-1 Medium-2 High-3

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

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

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

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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)		
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	**07 Hrs**

Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), 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)		
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	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	1	2	2	1	1	2	-	1
CO2	3	2	2	3	3	-	1	-	-	-	2	1
CO3	3	2	2	3	2	2	-	1	-	-	1	2
CO4	3	3	3	3	2	3	2		1	-	-	1

High-3: Medium-2: Low-1

Semester VI		
PROJECT MANAGEMENT **(Group E: Global Elective)**		
Course Code : 16G6E07		**CIE Marks : 100**
Credits : L: T: P: S:3:0:0:0		**SEE Marks : 100**
Hours : 33L		**SEE Duration : 03 Hrs**

Course Learning Objectives: The students will be able to	
1.	To understand the principles and components of project management.
2.	To appreciate the integrated approach to managing projects.
3.	To explain the processes of managing project cost and project procurements.

Unit – I	
Introduction: What is project, what is project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.	**06 Hrs**
UNIT – II	
Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle. **Project Integration Management:** Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.	**08 Hrs**
UNIT – III	
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Project Time Management:** Plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule, control schedule.	**07 Hrs**
UNIT – IV	
Project Cost management: Project Cost management, estimate cost, determine budget, control costs. **Project Quality management:** Plan quality management, perform quality assurance, control quality.	**06 Hrs**
UNIT – V	
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Procurement Management:** Project Procurement Management, conduct procurements, control procurements, close procurement.	**06 Hrs**

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

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

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

UNIT-I	
Graphical Programming Environment: Basic of Virtual Instrumentation, Conventional and Graphical Programming. Introduction to LabVIEW, Components of LabVIEW and Labels. **Fundamentals:** Data Types, Tool Pallets, Arranging Objects, Color Coding, Code Debugging, Context Help, Creating Sub-VIs Boolean, Mechanical action- switch, and latch actions, String data types, enum, ring, Dynamics.	**06 Hrs**
UNIT-II	
Fundamentals of Virtual Instrumentation Programming: For Loop, While Loop, shift registers, stack shift register, feedback node, and tunnel. **Timing function**: Timing VI, elapsed time, wait function. Case structures, formula node, Sequence structures, Arrays and clusters, visual display types- graphs, charts, XY graph. Local and Global variables.	**09 Hrs**
UNIT-III	
Error Handling- error and warning, default error node, error node cluster, automatic and manual error handling. **String Handling:** Introduction, String Functions, LabVIEW String Formats. **File Input/ Output:** Introduction, File Formats, File I/O Functions and file Path functions. **Design patterns:** Producer/consumer, event handler, derived design pattern, Queued message handler, Producer/consumer (events), Producer/consumer (state machine).	**08 Hrs**
UNIT-IV	
Data Acquisition: Introduction to data acquisition, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O, counters, NI-DAQmx tasks. **DAQ Hardware configuration:** Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants. **Interfacing Instruments: GPIB and RS232:** Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, RS232C/RS485 Interfacing, and VISA.	**06 Hrs**
UNIT-V	
Advanced Topics In LabVIEW: Use of analysis tools and application of VI: Fourier transforms Power spectrum, Correlation methods, windowing & filtering. Inter-Process Communication, Notifier, Semaphore, Data Sockets. **Simulation of systems using VI:** Development of Control system, Image acquisition and processing.	**06 Hrs**

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

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

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

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**	**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)		
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)

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

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

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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)		
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, Upena Dalal, 1st Edition , 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
2	Wireless and Mobile Networks Concepts and Protocols, Dr. sunil Kumar s Manvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4.

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

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

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

SEE for 100 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
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 (Global Elective)		
Course Code:16G6E12		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 35L		**SEE Duration: 3Hrs**

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

Unit-I	
Partial Differential Equations of first order: Introduction to formation of partial differential equations, Cauchy problem, Orthogonal surfaces, First order non-linear partial differential equations-Charpit's method, Classification and canonical forms of partial differential equations.	**07 Hrs**
Unit – II	
Elliptic Differential Equations: Derivation of Laplace and Poisson equation, Separation of variable method, 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**

High-3: Medium-2: Low-1

Semester VI		
GLOBAL ELECTIVE-E		
AIRCRAFT SYSTEMS (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 :	
1	Categorise the various systems required for designing a complete airplane
2	Comprehend the complexities involved during development of flight vehicles.
3	Explain the role and importance of each systems for designing a safe and efficient flight vehicle
4	Demonstrate the different integration techniques involved in the design of an air vehicle

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

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

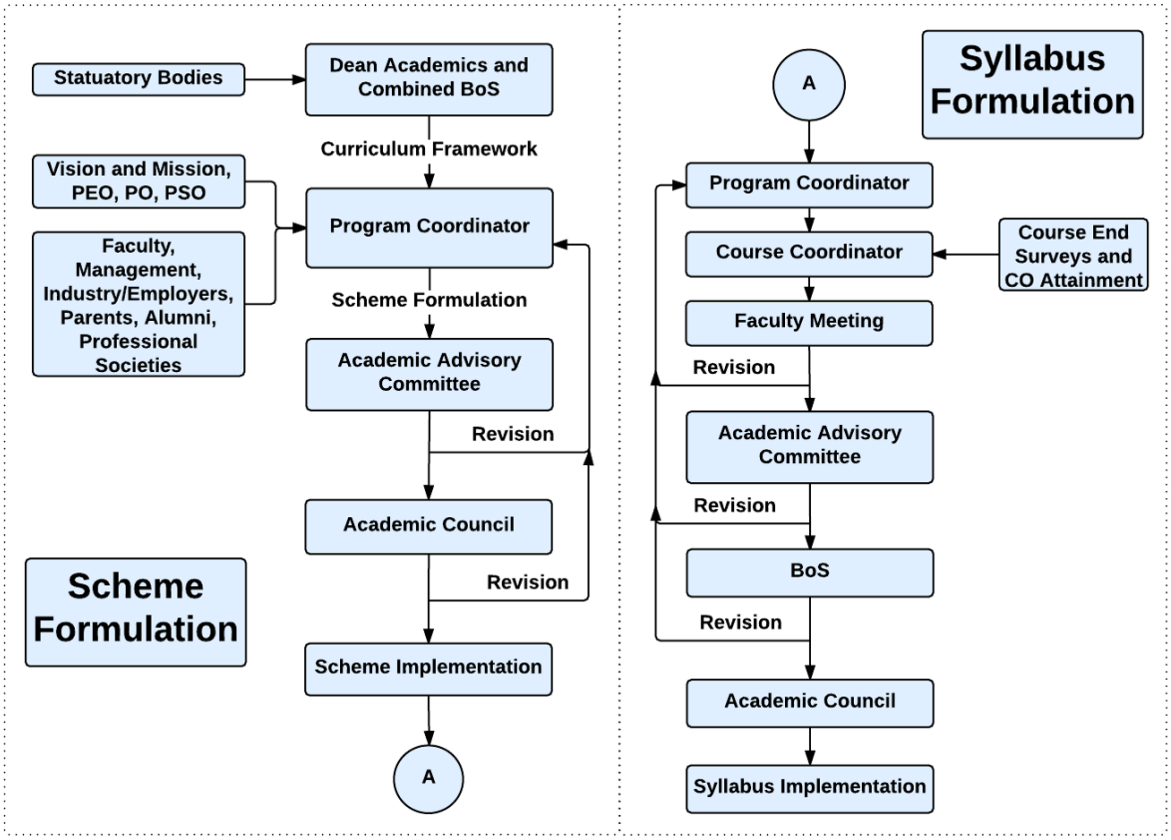
Phase	Activity	Weightage
I	Test 1 is conducted in V Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit-1, Unit-2 and Unit -3.A for 18 hours of training sessions.	50%
II	Test 2 is conducted in VI Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive answers)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

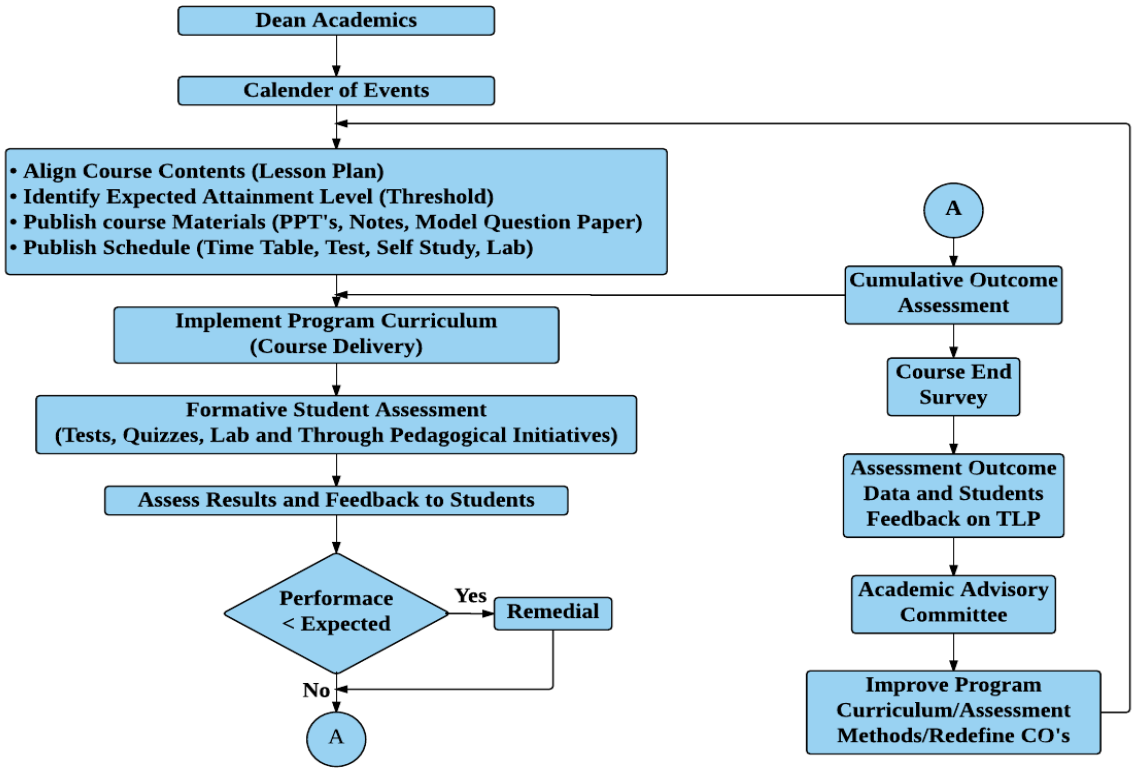
CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	---	___	---	----	1	----	1	1	1	2	1
CO2	1	2	2	---	---	---	----	1	2	1	2	1
CO3	---	---	3	---	---	1	---	2	1	2	1	---
CO4	---	---	___	---	----	1	3	1	1	1	1	---

Low-1 Medium-2 High-3

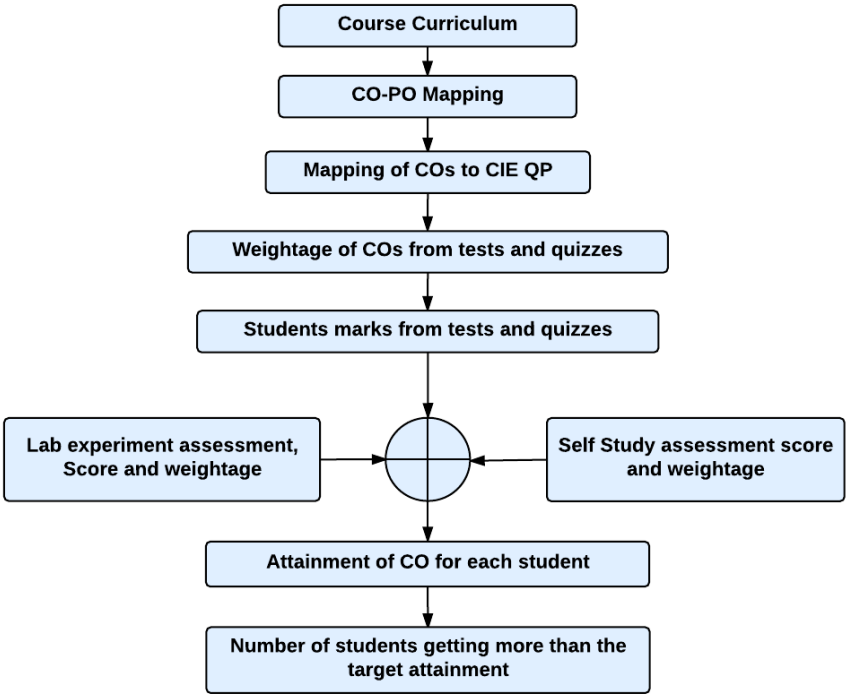
Curriculum Design Process



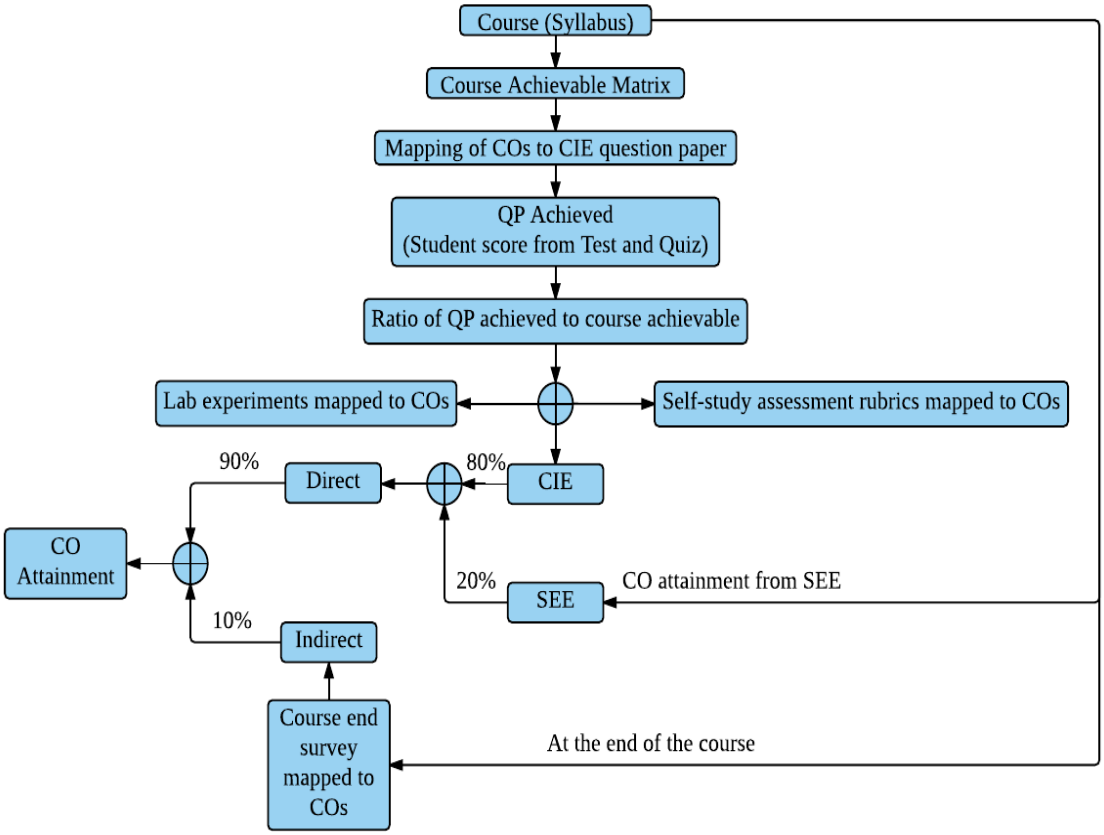
Academic Planning and Implementation


Dean Academics
Calender of Events
• Align Course Contents (Lesson Plan)
• Identify Expected Attainment Level (Threshold)
• Publish course Materials (PPT's, Notes, Model Question Paper)
• Publish Schedule (Time Table, Test, Self Study, Lab)
Implement Program Curriculum (Course Delivery)
Formative Student Assessment (Tests, Quizzes, Lab and Through Pedagogical Initiatives)
Assess Results and Feedback to Students
Performace < Expected
Yes
Remedial
No
A
A
Cumulative Outcome Assessment
Course End Survey
Assessment Outcome Data and Students Feedback on TLP
Academic Advisory Committee
Improve Program Curriculum/Assessment Methods/Redefine CO's

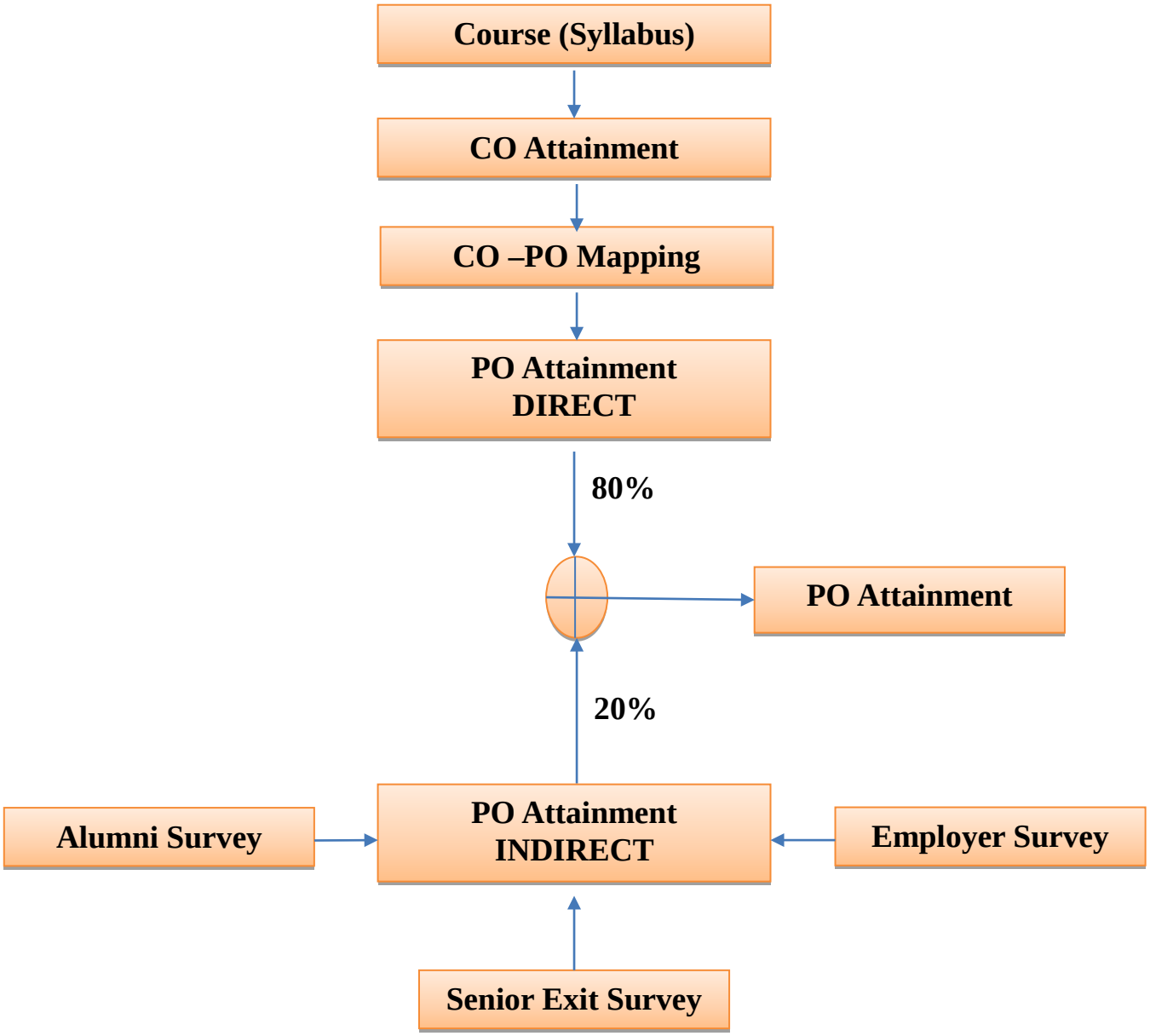
PROCESS FOR COURSE OUTCOME ATTAINMENT



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.