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

INFORMATION SCIENCE & ENGINEERING

Department Vision

To be the hub for innovation in Information Science & Engineering through Teaching, Research, Development and Consultancy; thus make the department a well-known resource centre in advanced, sustainable and inclusive technology.

Department Mission

ISE1: To enable students to become responsible professionals, strong in fundamentals of information science and engineering through experiential learning.

ISE2: To bring research and entrepreneurship into class rooms by continuous design of innovative solutions through research publications and dynamic development oriented curriculum.

ISE3: To facilitate continuous interaction with the outside world through student internship, faculty consultancy, workshops, faculty development programmes, industry collaboration and association with the professional societies.

ISE4: To create a new generation of entrepreneurial problem solvers for a sustainable future through green technology with an emphasis on ethical practices, inclusive societal concerns and environment.

ISE5: To promote team work through inter-disciplinary projects, co-curricular and social activities**.**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide adaptive and agile skills in Information Science and Engineering needed for professional excellence / higher studies /Employment, in rapidly changing scenarios.

PEO2: To provide students a strong foundation in basic sciences and its applications to technology.

PEO3: To train students in core areas of Information science and Engineering, enabling them to analyze, design and create products and solutions for the real world problems, in the context of changing technical, financial, managerial and legal issues.

PEO4: To inculcate leadership, professional ethics, effective communication, team spirit, multi-disciplinary approach in students and an ability to relate Information Engineering issues to social and environmental context.

PEO5: To motivate students to develop passion for lifelong learning, innovation, career growth and professional achievement.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Recognize and appreciate the principles of theoretical foundations, data organization, data communication, security and data analytical methods in the evolving technology
PSO2	Learn the applicability of various system software for the development of quality products in solving real-world problems with a focus on performance optimization
PSO3	Demonstrate the ability of team work, professional ethics, communication and documentation skills in designing and implementation of software products using the SDLC principles

Lead Society:

Program Criteria

All programs seeking accreditation from the Computing Accreditation Commission of ABET must demonstrate that they satisfy all of the specific Program Criteria implied by the program title.

PROGRAM CRITERIA FOR COMPUTER SCIENCE AND SIMILARLY NAMED COMPUTING PROGRAMS

Lead Society: CSAB

Computer Science	1. Coverage of fundamentals of algorithms, data structures, software design, concepts of programming languages and computer organization and architecture.[CS] 2. An exposure to a variety of programming languages and systems.[CS] 3. Proficiency in at least one higher-level language. [CS] 4. Advanced course work that builds on the fundamental course work to provide depth. [CS]
Information Technology	1. The core information technologies of human computer interaction, information management, programming, networking, web systems and technologies. [IT] 2. information assurance and security.[IT] 3. System administration and maintenance[IT]. 4. system integration and architecture. [IT]

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2016 SCHEME

INFORMATION 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

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R V COLLEGE OF ENGINEERNG, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENT OF INFORMATION 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.	16IS52	Theory of Computation	ISE	3	0	0	0	3
3.	16IS53	Computer Networks	ISE	3	1	0	0	4
4.	16IS54	Introduction to Parallel Programming	ISE	3	0	1	1	5
5.	16IS55	System Software	ISE	3	0	1	1	5
6.	16IS5AX	Elective A (PE)	ISE	3	0	0	1	4
7.	16GB5XX	Elective B (GE)	Respective BOS	4	0	0	0	4
Total number of Credits				22	1	2	3	28
Total Number of Hours / Week								

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.	16IS62	Web Programming	ISE	3	0	0	0	3
3.	16IS63	Software Engineering and Testing	ISE	3	0	1	1	5
4.	16IS64	Database Management System	ISE	3	0	1	1	5
5.	16IS6CX	Elective C (PE)	ISE	3	0	0	1	4
6.	16IS6DX	Elective D (PE)	ISE	4	0	0	0	4
7.	16GE6XX	Elective E(GE)	Respective BOS	3	0	0	0	3
8.	16HSE68	Professional Practice-III (Employability Skills and Professional Development of Engineers)	HSS	0	0	1	0	1
Total number of Credits				22	0	2	3	27
Total Number of Hours / Week								

V Sem		
GROUP A: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16IS5A1	Natural Language Processing with Python
2.	16IS5A2	Management Information System
3.	16IS5A3	Information theory and Coding
4.	16IS5A4	JAVA and J2EE
5.	16IS5A5	Advanced Algorithm
VI Sem		
GROUP C: PROFESSIONAL CORE ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16IS6C1	Information Security
2.	16IS6C2	System Simulation and Modelling
3.	16IS6C3	Supply Chain Management
4.	16IS6C4	Mobile Application Development
GROUP D: PROFESSIONAL CORE ELECTIVES		
1.	16IS6D1	Machine Learning and Pattern Recognition
2.	16IS6D2	Wireless Sensor Networks
3.	16IS6D3	Fuzzy Logic and Genetic Algorithm
4.	16IS6D4	Advanced Compiler Design
5.	16IS6D5	Computer System Performance Analysis

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	Geo Informatics	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

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

V SEMESTER		
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:** 3Hrs

Course Learning Objectives: The students will be able to	
1	To build awareness on the various forms of IPR and to build the perspectives on the concepts and to develop the linkages in technology innovation and IPR.
2	To equip students on the need to protect their own intellectual works and develop ethical standards governing ethical works.
3	To motivate towards entrepreneurial careers and build strong foundations skills to enable starting, building and growing a viable as well as sustainable venture.
4	Develop an entrepreneurial outlook and mind set along with critical skills and knowledge to manage risks associated with entrepreneurs.

Unit-I	
Introduction: Types of Intellectual Property, WIPO, WTO, TRIPS. **Patents:** Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; Biotechnology patents, protection of traditional knowledge, Infringement of patents and remedy, Case studies **Trade Secrets:** Definition, Significance, Tools to protect Trade secrets in India.	**07 Hrs**
Unit – II	
Trade Marks: Concept, function and different kinds and forms of Trademarks, Registrable and non- registrable marks. Registration of trade mark; Deceptive similarity; Assignment and transmission; ECO Label, Passing off; Offences and penalties. Infringement of trade mark with Case studies	**04 Hrs**
Unit -III	
Industrial Design: Introduction, Protection of Industrial Designs, Protection and Requirements for Industrial |Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Case Studies. **Intellectual property and cyberspace:** Emergence of cyber-crime; Grant in software patent and Copyright in software; Software piracy; Data protection in cyberspace	**09 Hrs**

Unit –IV	
Introduction to Entrepreneurship – Learn how entrepreneurship has changed the world. Identify six entrepreneurial myths and uncover the true facts. Explore E-cells on Campus **Listen to Some Success Stories: -** Global legends Understand how ordinary people become successful global entrepreneurs, their journeys, their challenges, and their success stories. Understand how ordinary people from their own countries have become successful entrepreneurs. **Characteristics of a Successful Entrepreneur** Understand the entrepreneurial journey and learn the concept of different entrepreneurial styles. Identify your own entrepreneurship style based on your personality traits, strengths, and weaknesses. Learn about the 5M Model, each of the five entrepreneurial styles in the model, and how they differ from each other. **Communicate Effectively:** Learn how incorrect assumptions and limiting our opinions about people can negatively impact our communication. Identify the barriers which cause communication breakdown, such as miscommunication and poor listening, and learn how to overcome them. **Communication Best Practices.** Understand the importance of listening in communication and learn to listen actively. Learn a few body language cues such as eye contact and handshakes to strengthen communication. (Practical Application)	**08 Hrs**

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

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

THEORY OF COMPUTATION (Theory)		
Course Code: 16IS52		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 36L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Understand various Computing models like Finite Automata, Pushdown Automata, and Turing Machine and their limitations.
2	Identify different formal languages and their equivalence to different computing models.
3	Relate language representations like- grammars and regular expressions and their equivalence with different languages.
4	Determine the decidability and intractability of computational problems

Unit-I	
Regular Languages: NFA and €-NFA, Regular Languages, Regular Expressions, Equivalence of NFA and DFA and regular expressions, Non-regular languages - Pumping Lemma, Closure and Decision properties of Regular Languages, Problems on Pumping Lemma.	**07 Hrs**
Unit – II	
Context-Free Languages and Grammars: Introduction to Grammar– Types of Grammar – Regular and Context Free Grammars (CFG) – Derivations and Derivation trees / Parse trees –Equivalence of regular grammar and Finite automata - Context Free Languages (CFL)– Ambiguity in grammars - Simplification of CFG – Left factoring, Elimination of Left recursion, Removal of Null productions and Unit productions and Useless symbols – Chomsky Normal Form (CNF) – Problems related to CNF.	**07 Hrs**
Unit -III	
Pushdown Automata: Introduction to Pushdown Automata – Definitions, Moves and Instantaneous descriptions – Languages of a Pushdown Automata, Deterministic pushdown automata (DPDA) – Equivalence of Pushdown automata and CFG - pumping lemma for CFL – Closure and Decision properties of CFL, problems based on pumping Lemma.	**08 Hrs**
Unit –IV	
Turing Machines: Definitions of Turing machines – Models – Computable languages and functions –Techniques for Turing machine construction – Multi head and Multi tape Turing Machines - The Halting problem – Partial Solvability – Problems about Turing machine- Chomskian hierarchy of languages.	**07 Hrs**
Unit –V	
Unsolvable Problems and Computable Functions: Unsolvable Problems and Computable Functions – Primitive recursive functions – Recursive and recursively enumerable languages – Universal Turing machine. **Measuring and Classifying Complexity:** Tractable and Intractable problems- Tractable and possibly intractable problems - P and NP completeness - Polynomial time reductions.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Design Finite State Machine, Pushdown Automata, and Turing Machine.
CO2:	Establish limitations and equivalence of different computing models.
CO3:	Create and simplify the grammars for different formal languages.
CO4:	Explain the Decidability or Undecidability of various problems and identify such problems.

Reference Books	
1	Introduction to Automata Theory, Languages and Computations, Hopcroft J.E., Motwani R. and Ullman J.D, 3rd Edition, 2008, Pearson Education, ISBN: 9788131720479
2	Introduction to Languages and the Theory of Computation, John C Martin, 3rd Edition, 2007, Tata McGraw Hill Publishing Company, New Delhi, ISBN 13: 9780070660489
3	Introduction of the Theory and Computation, Micheal Sipser, Thomson Brokecole, 1997, ISBN:978-0-557-24979-4
4	An Introduction To Formal Languages & Automata, Peter Linz, 6th Edition, 2007, Narosa Publishing House, ISBN:978-1-4496-1552-9

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

High-3 : Medium-2 : Low-1

COMPUTER NETWORKS (Theory)		
Course Code: 16IS53		**CIE Marks:** 100
Credits: L:T:P:S: 3:1:0:0		**SEE Marks:** 100
Hours: 36L+24T		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Identify the relationship between OSI layers of the computer networks
2	Understand the layer services and principles of various layers
3	Apply the protocols and services prescribed for the physical, data link, network and transport layers to real world case studies
4	Comprehend the technology behind various applications for the internet.

Unit-I	
Introduction: Uses of Computer Networks: Business Applications, Home applications, Mobile Users, Social issues, network hardware: Personal Area Networks, Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, network software: Protocol Hierarchies, Design issues for the layers, Connection Oriented Vs Connectionless Service, Service Primitives, Relationship services to Protocols Reference Models: The OSI Reference Model, The TCP/IP Reference Model **The Physical Layer :** Guided Transmission Media: Magnetic Media, Twisted Pair, Coaxial Cable, Power lines, Fiber Optics , Wireless Transmission: Electromagnetic spectrum, Radio transmission, microwave transmission, Infrared transmission, light transmission The Mobile Telephone System: 1G: Analog Voice,2G: Digital Voice,3G: Digital Voice and Data	**09 Hrs**
Unit – II	
The Data Link Layer: Data Link Layer Design Issues: Framing, error control, flow control, Error Detection And Correction: Error Correcting codes, Error detecting codes, Elementary Data Link Protocols: Utopian Simplex protocol, Stop and wait(error free channel & noisy channel), Sliding Window Protocols: One bit sliding window, Go back N, Selective Repeat.	**09 Hrs**
Unit -III	
The Network Layer : Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality Of Service, Internetworking, The Network Layer In The Internet: IPV4, IP addresses, IP version, Internet Control Protocols, OSPF, BGP, Internet Multicasting, Mobile IP	**09 Hrs**
Unit –IV	
The Transport Layer: The Transport Service, Elements Of Transport Protocols: Connection Establishment and Release, Error and Flow Control Multiplexing and Crash recovery, Congestion Control, The Internet Transport Protocols: UDP, RPC, RTP, TCP.	**09 Hrs**
Unit –V	
The Application Layer: DNS—The Domain Name System, Electronic Mail, World Wide Web, Streaming Audio And Video.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Differentiate between various models and devices used in networking.
CO2:	Comprehend the concepts of various protocols at different layers of OSI model.
CO3:	Discriminate routing algorithms and their applications.
CO4:	Understand data delivery over networks through applications.

Reference Books	
1	Computer Networks, Andrew S Tannenbaum, David J Wetherall, 5th Edition, Pearson Publications, ISBN-13: 978-0-13-212695-3
2	Computer Networking -A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, 6th Edition, 2012, Pearson Education, ISBN: 0132856204, 9780132856201
3	Computer Networks, A Top Down Approach, Behrouz A. Forouzan, Special Indian Edition Tata McGraw Hill, 2012, ISBN-13: 978-1-25-900156-7
4	Data and Computer Communication, William Stallings, 10th Edition, 2010, Pearson Education, ISBN-10: 0131392050, ISBN-13: 978-0-13-212695-3.

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

High-3 : Medium-2 : Low-1

INTRODUCTION TO PARALLEL PROGRAMMING (Theory & Practice)		
Course Code: 16IS54		**CIE Marks:** 100 + 50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100 + 50
Hours: 35L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Review the trends in computers and parallelism in computer architecture
2	Demonstrate the basic ideas of vector processing, multiprocessing and parallel operations with case studies
3	Focus on performance of different processor architectures
4	Exposure to basics of various parallel programming paradigms

Unit-I	
Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques	**07 Hrs**
UNIT-II	
Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models, Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, the Effect of Granularity on Performance.	**07 Hrs**
Unit -III	
Programming Using the Message Passing Paradigm: Principles of Message Passing Programming, Building Blocks, MPI, Topologies and Embedding, Overlapping Communication with computation, Collective Communication and computation operations, Groups and Communicators.	**07 Hrs**
Unit –IV	
Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API, Thread Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, OpenMP: a Standard for Directive Based Parallel Programming.	**07 Hrs**
Unit –V	
GPU Programming using CUDA: Heterogeneous Computing, Hello World from GPU, Introducing the CUDA Programming Model, Organizing Parallel Threads, Managing Devices, CUDA Memory Model.	**07 Hrs**
LABORATORY EXPERIMENTS	
Students are supposed to execute the programs on computationally intensive algorithms like compression, decompression, encoding, decoding, encryption and decryptions. A list of programs that is suggestive but not exhaustive is given below. 1. Write a program that computes the sum of all the elements in an array A and finds the largest number in an array A. Parallelize the loop required to find the largest element and sum of all the elements. 2. Write a program using OpenMP to convert a color image to black and white image. (a)Demonstrate the performance of different scheduling techniques for varying chunk values. (b)Analyze the scheduling patterns by assigning a single color value for an image for each thread. 3. Write a program using OpenMP to generate the prime factors of given prime numbers. (Prime factorization, which is the key to cracking RSA algorithms). Calculate Time Elapsed.	

4. Write a program that computes a simple matrix-matrix multiplication using OpenMP. 5. Write a program using MPI to send different amount of data from each processor to the root processor. Use MPI_Gather to tell the root how much data is going to be sent. 6. Write a C program which counts the number of primes between 1 and N, using MPI for parallel execution. 7. Write a C program which demonstrates one way to generate the same sequence of random numbers for both sequential execution and parallel execution under MPI. 8. Write a program using MPI to implement the Hill cipher, an encryption algorithm based on matrices and cipher text.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply the fundamentals of high performance computing concepts on known case studies.
CO2:	Analyze the performance of different CPU architectures.
CO3:	Design and apply parallel computing constructs for different applications.
CO4:	Demonstrate high performance computing concepts using various parallel programming paradigms.

Reference Books	
1	Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, VipinKumar, 2nd Edition, 2013, Pearson Education, ISBN 13: 9788131708071
2	Professional CUDA C Programming, John Cheng, Max Grossman, Ty McKercher, 1st Edition, 2014, Wiley Publishers, ISBN: 978-1-118-73932-7
3	CUDA by Example-An Introduction to General-Purpose GPU Programming, Jason Sanders, Edward Kandrot, 2010 Edition, Publisher -Addison-Wesley Professional, ISBN-978-0-13-138768-3
4	Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, Naresh Jotwani, 2nd Edition, 2010, McGraw-Hill, ISBN- 13: 978-0-07-053070-6

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

High-3 : Medium-2 : Low-1

SYSTEM SOFTWARE (Theory & Practice)		
Course Code: 16IS55		**CIE Marks:** 100 + 50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100 + 50
Hours: 36L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Differentiate between the system software and application software
2	Identify the relationship between machine architecture and system software
3	Understand the techniques involved in development of system software
4	Apply design techniques for enhancing the features of system software

Unit-I	
System Software: Introduction: What is System Software? Goals of System Software, System Programs and Systems Programming, The Wonderland of System Software: Compiler and Interpreter, Programs related to compilers, Translation Process (Front End), Tiny Language **Scanning:** The Scanning Process, Lex and its application to generate scanner automatically, Scanner for TINY Language.	**06 Hrs**
UNIT-II	
Parsing: Parsing Process, Syntax of TINY Language, Top-down Parsing : First and Follow Sets, LL(1) Parser, Bottom-Up Parsing : DFA of LR(0) Items, SLR(1) Parser, DFA of LR(1) Items, LR(1) Parser, LALR Parser, Error recovery in Bottom-Up Parsing	**09 Hrs**
Unit -III	
Instructional Computer (SIC) Machine Architecture, SIC/XE Machine Architecture, SIC programming examples **Assemblers-1:** Basic Assembler Function - A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler Features - Instruction Formats & Addressing Modes, Program Relocation. Machine Independent Assembler Features – Literals, Symbol-Definition Statements, Expression	**09 Hrs**
Unit –IV	
Assemblers-2: Program Blocks, Control Sections and Program Linking, Implementation example - MASM Assembler **Loaders and Linkers – 1:** Basic Loader Functions - Design of an Absolute Loader, A Simple Bootstrap Loader, Machine-Dependent Loader Features – Relocation, Program Linking, Algorithm and Data Structures for a Linking Loader	**06 Hrs**
Unit –V	
Loaders and Linkers – 2: Machine-Independent Loader Features - Automatic Library Search, Loader Options, Loader Design Options - Linkage Editor, Dynamic Linkage, Bootstrap Loaders, Implementation Example - MS-DOS Linker. **Other System Software :** Text Editors, Interactive Debugging Systems	**06 Hrs**
LABORATORY EXPERIMENTS	
PART-A 1. Develop a program to create a symbol table which stores the symbol name, symbol value and symbol address given the sample SIC program with the starting address 2. Develop a program to evaluate the format of given SIC program instruction and extract the op-code of the given instruction if the instruction conforms to the SIC Machine Instruction Format 3. Develop a program to validate and evaluate a given arithmetic expression 4. Develop a program to identify and list the keywords used in a 'C' program	

5. Develop a program to evaluate the syntax of 'for' looping construct in 'C' programming language

PART-B

Groups with a maximum of TWO students in each are formed. Each group is assigned a project that implements any of the system software or its module that is complex enough, by lab-in charge. A list that is suggestive but not exhaustive is given below.

1. Implement a 2-pass Assembler for and SIC program
2. Implement a Text Editor
3. Implement a simple Lexical Analyzer for 'C' or 'C++' language
4. Implement a Single pass assembler for an SIC program
5. Implement a simple Parser for 'C' language
6. Implement a Shell
7. Implement an IDE for Lex &Yacc
8. Implement a Programming Language with Kannada keywords
9. Implement a translator to generate instructions in 'C' language for operations specified through sentences in English grammar
10. Simulate a loader in 'C' language
11. Simulate a linker in 'C' language
12. Generate a control flow graph through software testing techniques
13. Implement an IDE to view contents of registers for each assembly instruction execution
14. Implement a translator which converts 'C' language statements into assembly level language

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyze the working of essential system software
CO2:	Design system software features which are dependent as well as independent of underlying hardware
CO3:	Apply the concepts learnt for improving the design of system software
CO4:	Develop System Software to make user interaction level, simple and effortless

Reference Books	
1	System Software - An Introduction to Systems Programming, Leland L Beck, 3rd Edition, 1996, Pearson Publications, ISBN: 978-0201423006
2	Compiler Construction – Principles and Practice, Kenneth C Louden, 1997 Edition, PWS Publishing Company, ISBN: 978-0534939724
3	Compilers, Alfred V. Aho, Monica S. Lam, Jeffrey D. Ullman, Ravi Sethi, 2nd Edition, 2006 , Addison Wesley Publications, ISBN: 978-0321486813
4	System Programming, D M Dhamdhere, 2011 Edition, Tata McGraw Hill Publications, ISBN: 9780071333115

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 three tests are conducted for 50 marks each and the sum of the marks secured from three tests is reduced to 50. Self-study is evaluated for 20 marks. 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. Evaluation includes phases of mini project

implementation. Student performance in laboratory for 40 marks is evaluated based on programs, project synopsis submission, project progress, project demonstration and project report review. At the end of the semester a test is conducted for 10 marks which is evaluated based on program execution, project demonstration, project viva and project report submission. 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

Project demonstration, implementation of suggested modifications on project and project viva is evaluated for 30 marks. Program Write-up, program execution and Viva related to program will be evaluated for 20 marks. Total SEE for laboratory is 50 marks.

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

High-3 : Medium-2 : Low-1

NATURAL LANGUAGE PROCESSING WITH PYTHON (Group A: Professional Core Elective) (Theory)		
Course Code: 16IS5A1		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Demonstrate sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2	Train and evaluate empirical NLP systems
3	Manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods
4	Design, implement, and analyze NLP algorithms

Unit-I	
Overview and Language Modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications -Information Retrieval. Language Modeling: Various Grammar- based Language Models - Statistical Language Model **Accessing Text Corpora** Accessing Text Corpora, Conditional Frequency Distributions	**09 Hrs**
Unit – II	
Processing Raw Text : Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text ,Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings	**09 Hrs**
Unit -III	
Categorizing and Tagging Words : Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word **Learning to Classify Text :** Supervised Classification, Further Examples of Supervised Classification, Evaluation, Decision Trees, Naive Bayes Classifiers**,** Markov Models, Hidden Markov Models	**09 Hrs**
Unit –IV	
Extracting Information from the text : Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Term weighting, Inverse document frequency, Residual inverse document frequency **Analyzing Sentence Structure :** Some Grammatical Dilemmas, What's the Use of Syntax?, Context-Free Grammar, Parsing with Context-Free Grammar, Dependencies and Dependency Grammar, Grammar Development.	**09 Hrs**
Unit –V	
Analyzing the Meaning of words and Sentences : The semantics of English sentences, Representing Meaning, Semantic Analysis, Lexical semantics, Word-sense disambiguation, Supervised – Dictionary based and Unsupervised Approaches, Compositional semantics, Semantic Role Labelling and Semantic Parsing **Applications:** Machine translation, Text summarization, Word-sense disambiguation, phrase-based translation, sentiment analysis, document classification	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the approaches to syntax and semantics in Natural Language Processing, the various types of language processors, the elements of formal language theory, the types of grammar, and the computational morphology.
CO2:	Understand the basic parsing technique for context-free grammars, the data structures and algorithms for parsing, and the approaches to ambiguity resolution.
CO3:	Apply the fundamental algorithms and techniques in the area of Natural Language Processing.

CO4:	Comprehend and compare different natural language models.

Reference Books	
1	Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, OUP India, 2008, ISBN : 9780195692327
2	Natural Language Processing with Python, Steven Bird, Ewan Klein, Edward Loper, 2009, Publisher: O'Reilly Media, ISBN : 9780596516499
3	Natural Language Processing and Text Mining, Anne Kao and Stephen R. Poteet (Eds), Springer, 2007, ISBN : 9781846281754
4	Natural Language Understanding, James Allen, 2nd Edition, 1995, Benjamin / Cummings Publishing company, ISBN : 9788131708958

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.

SEE Evaluation Procedure

1. SEE will be conducted as Lab evaluation combining 40 marks for Theory and 60 marks for Lab programs.
2. Lab program evaluation:
    a. External examiner will be called for the lab program evaluation.
    b. Students are required to answer 3 questions (no choice) each of 20 marks.
    c. Program execution is considered for Lab programs evaluation.
    d. Students are allowed to use text books for execution of lab programs (Open Book exam)
    e. Students will appear for exam (10-12) in a batch.
3. Theory evaluation:
    a. Students are required to answer 5 questions (no choice) each carrying 8 marks, which would cover all the units. Questions need to be answered within the first 1 hour duration of the commencement of exam.
    b. This is closed book exam
4. Students are not allowed to use internet during the exam (including the lab evaluation session)

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

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

High-3 : Medium-2 : Low-1

MANAGEMENT INFORMATION SYSTEMS (Group A: Professional Core Elective) (Theory)		
Course Code: 16IS5A2		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Understand the basic principles and working of information technology.
2	Describe the role of information technology and information systems in business.
3	Contrast and compare how internet and other information technologies support business processes.
4	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 cyber crime.	**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 of 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, Global 10th Edition, 2011, McGraw Hill, ISBN: 978-0072823110
3	Information Systems The Foundation of E-Business, Steven Alter, 4th Edition, 2002, Pearson Education, ISBN:978-0130617736
4	Management Information Systems, W.S. Jawadekar, 2006, Tata McGraw Hill, ISBN: 9780070616349

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

High-3 : Medium-2 : Low-1

INFORMATION THEORY AND CODING (Group A: Professional Core Elective) (Theory)		
Course Code: 16IS5A3		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Interpret the basics of Information theory and channel capacity theorem
2	Apply knowledge of error control coding techniques on communication systems
3	Design; implement an error free communication of text audio, speech image and video.
4	Formulate and solve problems creatively using block and convolutional coding.

Unit-I	
Information Theory: Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shann onlimit.	**08 Hrs**
Unit – II	
Source Coding: Text, Audio And Speech: Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding	**09 Hrs**
Unit -III	
Source Coding: Image And Video : Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard	**10 Hrs**
Unit –IV	
Error Control Coding: Block Codes: Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC.	**09 Hrs**
Unit –V	
Error Control Coding: Convolutional Codes: Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and design the various components of a source coding in communication system.
CO2:	Apply various error controlling coding techniques for error free communication in networks.
CO3:	Analyze the block coding challenges and Design an efficient communication networks.
CO4:	Build an efficient communication system using the convolutional coding techniques.

Reference Books	
1	Information Theory, Coding and Cryptography, R Bose, 2nd Edition, 2013, TMH ,ISBN : 9788126536801
2	Multimedia Communications: Applications, Networks, Protocols and Standards, Fred Halsall, 2012, Pearson Education Asia, ISBN: 0-13-035548-8
3	Introduction to Data Compression, K Sayood, 3rd Edition, 2012, Elsevier, ISBN: 9780124157965
4	Introduction to Error Control Codes, S Gravano, 2010, Oxford University Press, ISBN 13: 9780198562313

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

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

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

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

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

High-3 : Medium-2 : Low-1

JAVA AND J2EE (Group A: Professional Core Elective) (Theory)		
Course Code: 16IS5A4		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Understand fundamentals of object-oriented programming in Java
2	Design console based, and web based enterprise applications
3	Use the Java SDK environment to create, debug and run standalone, multi-tier and enterprise level applications
4	Integrate Servlets, JSPs and Databases in J2EE application

Unit-I	
Core Language Elements: Features; Java basics: identifiers, variables, data types, operators, control structures, arrays, jagged arrays, command line arguments; **Java Core Features:** Object oriented programming: classes, objects, inheritance, method overriding and hiding, interface, abstract class, polymorphism, inner class, wrapper classes; Boxing; Packages	**09 Hrs**
Unit – II	
Java Advanced Concepts: Exception handling; Multithreaded Programming; Utility classes; I/O files in Java; Event handling.	**09 Hrs**
Unit -III	
Java Enterprise Concepts - I: **Servlets:** Introduction; Servlet life cycle; Deployment and web.xml; Servlet chaining; Session management; Cookies. **Java Server Pages:** Architecture, Life cycle, JSP tags, Expressions, JSP with database, Implicit objects	**09 Hrs**
Unit –IV	
Java Enterprise Concepts - II: Introduction to J2EE, Tomcat; **JDBC**: Introduction, Types of drivers, Basic Steps of JDBC, Creating and Executing SQL statement, The Result Set Object, Working with Databases.	**09 Hrs**
Unit –V	
Java Enterprise Concepts - III: **Struts:** Struts architecture; Struts classes; Action mapping; Struts flow; Combining Struts and tiles.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic concepts of Java Standard Edition and the Enterprise Edition.
CO2:	Create, debug and run Java standalone applications and access database through Java programs.
CO3:	Design and build maintainable web applications by creating dynamic web pages with Servlets and JavaServer Pages.
CO4:	Apply advanced enterprise concepts like tags, cookies, Struts for quick enterprise application development.

Reference Books	
1	Java 7 The Complete Reference, Herbert Schildt, 8th Edition, 2011, McGraw-Hill Osborne Media , ISBN: 9780071606301
2	Java Server Programming Java EE7 J2EE 1.7, Kogent learning solution, 2015, Dreamtech Press, ISBN-13: 9789351194170
3	Java How to Program, H.M Deitel and P.J. Deitel, 10th Edition, Pearson Education ISBN: 9780133807806
4	Thinking in Java, Bruce Eckel, 4th Edition, 2006, Pearson Education, ISBN: 0131872486

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

High-3 : Medium-2 : Low-1

ADVANCED ALGORITHM (Group A: Professional Core Elective) (Theory)		
Course Code: 16IS5A5		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Hours: 45L		**SEE Duration:** 03Hrs

Course Learning Objectives:	
1	Be able to apply amortized analysis on data structures.
2	Understand the implementation and complexity analysis of fundamental algorithms such as RSA, primality testing and max flow
3	Have an idea of applications of algorithms in a variety of areas, including string matching, game-theory
4	Determine the most suitable algorithm for any given task and then apply it to the problem.

Unit-I	
Analysis Techniques: Insertion sort, Analyzing algorithms, Designing Algorithms, Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.	**09 Hrs**
Unit – II	
Graph Algorithms: Representations of graphs, Bellman - Ford Algorithm; Single source shortest paths in a DAG; Dijkstra's algorithm, Johnson's Algorithm for sparse graphs; Flow networks and Ford- Fulkerson method; Maximum bipartite matching. Balanced search trees, Binary Search Trees, Red Black Trees, Fibonacci Heaps	**09 Hrs**
Unit -III	
String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm, Boyer-Moore algorithm. **Computational Geometry:** Line-segment properties, Determining whether any pair of segments intersects, Finding the convex hull, Finding the closest pair of points	**09 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, Strassen's algorithm for matrix multiplication.	**09 Hrs**
Unit –V	
NP-Completeness and Approximation Algorithms: Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems, Approximation Algorithms – Approximation Ratio, The vertex-cover problem, The travelling salesman problem	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the techniques of proof by contradiction, mathematical induction and recurrence relation, and apply them to prove the correctness and to analyze the running time of algorithms.
CO2:	Apply the techniques to derive algorithmic solutions for new problems
CO3:	Implement learned algorithm design techniques and data structures to solve problems
CO4:	Efficiently implement both basic as well as advanced data structures

Reference Books	
1	Introduction to algorithms, Thomas H., Leiserson, Charles E., Rivest, Ronald L. and Clifford Stein, 3rd Edition, 2009, MIT Press
2	The Design and Analysis of Computer Algorithms, Alfred V. Aho,John E. Hopcroft, J.D.Ullman, Addison-Wesley
3	Computer Algorithms, Horowitz E, Sahani S, Rajasekharan S, 2001, Galgotia Publications, ISBN:9780716783169
4	Data structures and Algorithm analysis in C++, Mark Allen Weiss, 2003, Pearson Education, ISBN:032144146

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

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:** 03Hrs

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

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

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:** 03Hrs

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	
CO1:	Understand the fundamentals and characteristics of fuel cells
CO2:	Apply chemical engineering principles to distinguish fuel cells from conventional energy systems
CO3:	Analyze the performance of fuel cells using different characterization techniques
CO4:	Evaluate the possibility of integrating fuel cell systems with conventional energy systems

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

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

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

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

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

CO - PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
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:** 03 Hrs

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	
CO1:	Understand the principle of Remote Sensing (RS) and Geographical Information Systems (GIS) data acquisition and its applications.
CO2:	Apply RS and GIS technologies in various fields of engineering and social needs.
CO3:	Analyze and evaluate the information obtained by applying RS and GIS technologies.
CO4:	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:** 03 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:** 03 Hrs

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 :** 03 Hrs

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	
CO1:	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
CO2:	Evaluate the performance of electrical machines and power electronics converters in HEVs.
CO3:	Analyse the different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
CO4:	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	3	1	-	1	-	2
CO2	3	3	2	2	3	-	3	-	2	1	2	1
CO3	2	3	2	2	2	2	3	1	1	1	-	1
CO4	3	3	3	3	3	1	3	3	3	3	1	3

High-3 : Medium-2 : Low-1

V Semester		
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	
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.	**09 Hrs**

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

V Semester		
SENSORS & APPLICATIONS (Group B: Global Elective)		
Course Code:16G5B08		**CIE Marks:** 100
Credits/Week: L:T:P:S:4:0:0:0		**SEE Marks:** 100
Hours:44L		**SEE Duration:** 03Hrs

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:** 03 Hrs

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)

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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												
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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:** 03 Hrs

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

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

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	
CO1:	Illustrate applications of sensors actuators, switching elements and inspection technologies in industrial automation
CO2:	Build circuit diagrams for fluid power automation, Ladder diagrams for PLC and identify its application areas
CO3:	Evaluate CNC programs for 2D complex profiles performed on machining and turning centres interfaced with Robots
CO4:	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

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

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

Low-1 Medium-2 High-3

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

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)

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

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

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

VI SEMESTER		
FOUNDATIONS OF MANAGEMENT & ECONOMICS (Theory) (Common to BT, CHE, CV, E&I, IEM, ME)		
Course Code: 16HEM61		**CIE Marks:** 50
Credits: L:T:P:S: 2:0:0:0		**SEE Marks:** 50
Hours: 23L		**SEE Duration:** 02 Hrs

Course Learning Objectives:	
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

WEB PROGRAMMING (Theory)		
Course Code: 16IS62		**CIE Marks:** 100
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:** 100
Hours: 35L		**SEE Duration: 0**3 Hrs

Course Learning Objectives:	
1	Understand the key concepts of Web programming.
2	Comprehend the concepts of web services , SOAP & WSDL
3	Analyze the techniques involved in creating web applications.
4	Implement web applications using XML & PHP.

Unit-I	
HTML and XHTML: Introduction, editing XHTML, w3c XHTML validation service, headers, linking, images, special characters, unsorted lists, nested and ordered lists, XHTML tables, XHTML forms, internal linking, meta elements. Style Sheets: Inline styles, embedded style sheets, conflicting styles, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu, User style sheets.	**07 Hrs**
Unit – II	
Java Script: Introduction, Program modules in javascript, function definitions, scope rules, global functions, recursion, arrays, references and reference parameters, passing arrays to functions, sorting arrays, searching arrays, multi-dimensional arrays, math object, string object, date object, Boolean and number object, document object, window object, using cookies, using JSON to represent objects. **Document Object Model:** Introduction, Modeling a document, DOM Nodes and Trees, Traversing and modifying a DOM tree, DOM Collections, dynamic styles, summary of DOM objects and Collections, registering event handlers, onload, onmousemove, the event object, this, onmouseover, onmouseout, onfocus, onblur, onsubmit, onreset, event bubbling, more events.	**07 Hrs**
Unit -III	
XML : Mark-up languages, XML, Uses of XML. WELL-FORMED XML: Parsing XML, Tags, text, elements, attributes, comments and empty elements. XML Declaration, Processing Instructions, Errors in XML. XML NAMESPACES: Need for namespaces, How XML namespaces work, URIs, When to use namespace. VALIDATION: Document type definitions (DTD), Sharing vocabularies, Anatomy of DTD, Developing DTDs, DTD Limitations. XML SCHEMAS: Benefit of XML schemas, Elements of XML Schema Definition, Creating a Schema from multiple documents.	**07 Hrs**
Unit –IV	
HTML 5: Detecting HTML 5 features – Canvas, video, local storage, web workers, offline applications, geo-location, placeholders, input types. What does it all mean – doctype, root, headers, articles, dates and times, navigation and footers. Let's call it drawing surface Simple shapes, canvas, Paths, texts, gradients and images. The past, present and future of local storage for web applications, A Form of madness – place holders, autofocus fields, email, web addresses, numbers as spinboxes and sliders, date and color pickers, search boxes.	**07 Hrs**
Unit –V	
PHP & MySQL : PHP Installation, Configuration of Apache Web Server and basic PHP syntax.PHP input/output.PHP If...Else, Loops.PHP Functions writing and calling. Basic difference between Get/Post. Handling user requests through Get/Post. E-mailing and file uploading through PHP. PHP Date, PHP Include. How can you maintain user states on server. PHP Cookies, PHP Sessions. Basic overview of different DBMS. MySQL Introduction, Installation, configuration and its administration Basic queries Execution like select/update/insert/delete. PHP database connectivity with MySQL ,PHP Errors and Exceptions	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define and understand protocols used in Web development.
CO2:	Analyze various Client/Server approaches involved in Web design.
CO3:	Design web applications by adopting Mark-up languages & accepted standards.
CO4:	Justify and explain relevant alternatives for design recommendations of web applications.

Reference Books	
1	Programming the World Wide Web, Robert W. Sebesta , 8th Edition, 2015, University of Colorado, Colorado Springs, ISBN 9780321303325
2	Internet & World Wide Web How To Program, P Deitel, HmDeital, Tr Nieto, 1st Edition, 2012, Pearson Education Limited Publications, ISBN 9788131701126.
3	Beginning Xml, Andrew Watt, Jeff Rafter, David Hunter, 4th Edition, 2011, Wiley India, ISBN: 9788126513031
4	Professional Web 2.0 Programming, Erik Bruchez, Danny Ayers, Eric Van Der Vlist, 1st Edition, 2014, Wiley India Pvt. Ltd, ISBN: 9788126510665

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

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

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

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

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

Low-1 Medium-2 High-3

SOFTWARE ENGINEERING AND TESTING (Theory & Practice)		
Course Code:16IS63		**CIE Marks:** 100 + 50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100 + 50
Hours: 35L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	Describe software engineering principles and activities involved in building large software programs.
2	Identify ethical and professional issues and explain why they are of concern to software engineers.
3	Perform the process of requirements gathering, requirements classification, requirements specification and requirements validation.
4	Outline software quality standards and practices involved.

Unit-I	
Introduction: From an art form to an Engineering Discipline, Software Development Projects, Exploratory style of software development, Emergence of software engineering, Notable changes in software development Practices, Computer Systems Engineering. Software Evolution: Evolution processes, Program evolution dynamics, Software maintenance, Legacy system management. The Software Life Cycle Models, A few Basic Concepts, The Waterfall Model and its extensions, Rapid Application Development, Agile development models, Spiral Model, Comparison of different lifecycle models.	**07 Hrs**
Unit – II	
Software Project Management: Software Project Management Complexities, Responsibilities of a software project Manager, Project Planning, Metrics for project size estimation, Project estimation techniques, Empirical estimation techniques, COCOMO, Halstead's Software Science, Staffing level estimation, Scheduling, Organization and Team Structures, Staffing, Risk Management, Software Configuration Management. ISO9000, SEI Capability Maturity Model, Other Important Quality Standards, Six Sigma.	**07 Hrs**
Unit –III	
Requirements Gathering and Analysis, Software Requirements Specification, Formal System Specification, Axiomatic specification, Algebraic Specification, Executable Specification. **Dependability and Security**: Socio Technical Systems, Dependability and Security. **System Modelling:** Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering.	**07 Hrs**
Unit –IV	
Software Design: Characteristics of software design; Cohesion and coupling; Layered arrangement of modules; Function-oriented and object-oriented design approach. **User Interface Design**: Characteristics of Good User Interface, Basic Concepts, Types of User Interfaces, Fundamentals of Component based GUI Development, A User Interface Design Methodology	**07 Hrs**
Unit –V	
Software Quality Management Software Reliability; Statistical Testing, Software Quality, Software Quality Management System, Coding and Testing, Coding, Code Review, Software Documentation, Testing, Unit Testing, Black Box Testing, White Box Testing, Debugging, Program Analysis Tools, Integration Testing, Testing OO Programs, System Testing, General Issues associated with Testing.	**07 Hrs**
LABORATORY COMPONENT	
1. Considering the following case studies, a) Identify the requirements and prepare the SRS document (as per IEEE format) from Problem Statements.	

b) Design Models using following UML diagrams for the case studies given below (Tool: Star UML/Enterprise Architect) c) Use of any Open Source Test Tool like Selenium or equivalent as determined by the course co-ordinator Structural Diagrams • Class diagram • Object diagram • Component diagram • Deployment diagram **Behavioral Diagrams** • Use case diagram • Sequence diagram • Collaboration diagram • State chart diagram • Activity diagram List of Case Studies 1. Library Management System 2. Hospital Management System 3. Online reservation Management System 4. Airport check-in and security screening System 5. Restaurant business System 6. Bank ATM System 7. Ticket vending machine 8. Student marks Analysing System	
2. Design and execute test cases and test suites for the following applications. a) A Web Application (Website) Using Selenium IDE. b) Design the test cases for following programs using Equivalence class Partitioning (weak normal and strong normal), Boundary value analysis test cases and robustness Software Testing techniques. Use a Bug Repository tool (like Bugzilla) to log the bugs while testing the programs. • Nextdate program • Triangle program	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic concepts of Software Engineering.
CO2:	Apply the concepts of Software Engineering in an organizational context.
CO3:	Analyze the Software Engineering Methodologies.
CO4:	Compare and Evaluate best Software Engineering practices for building software system.

Reference Books	
1	Fundamentals of Software Engineering, Rajib Mall, 2015, Prentice-Hall Of India Pvt. Ltd., ISBN: 9788120348981
2	Software Engineering, Ian Sommerville, 9th Edition, 2007, Person Education,. ISBN: 9789332518858
3	Software Testing -A Craftsman's Approach, Paul C. Jorgensen, 4th Edition, 2013, Auerbach Publications, ISBN: 9781138628076
4	Software Testing Principles and Practices, Srinivasan Desikan, Gopalaswamy Ramesh, Pearson, 2014. ISBN: 9788177581218

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

Low-1 Medium-2 High-3

DATABASE MANAGEMENT SYSTEMS (Theory & Practice)		
Course Code:16IS64		**CIE Marks:** 100 + 50
Credits: L:T:P:S: 3:0:1:1		**SEE Marks:** 100 + 50
Hours: 35L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	List and explain the fundamental concepts of a relational database system.
2	Analyze database requirements and determine the entities involved in the system and their relationship to one another.
3	Develop the logical design of the database using data modeling concepts such as entity-relationship diagrams.
4	Create a relational database using a relational database package and manipulate a database using SQL.
5	Assess the quality and ease of use of data modeling and diagramming tools.

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, Advantages of using the DBMS Approach, Database System—Concepts and Architecture: Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client/Server Architectures for DBMSs, Classification of Database Management Systems. **Entity-Relationship Model** Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues, Enhanced Entity Relationship(EER) Modeling, Subclasses, Superclasses, and Inheritance, Specialization and Generalization ,Constraints and Characteristics of Specialization and Generalization Hierarchies. Modeling of UNION types using categories, A sample UNIVERSITY EER schema, Design Choices and Formal Definitions.	**07 Hrs**
Unit – II	
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 Using ER- to-Relational Mapping, Mapping EER Model Constructs to Relations **Relational Database Design** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Multivalued Dependencies and Fourth Normal Form; Join Dependencies and Fifth Normal Form	**07 Hrs**
Unit -III	
Sql-99: Schema Definition, Basic Constraints and Queries SQL Data Definition, Specifying Basic Constraints in SQL, Schema Change Statements in SQL; Basic Queries in SQL; More Complex SQL Queries; Insert, Delete and Update Statements in SQL; **Query Processing and Optimization:** Translating SQL queries into Relational Algebra, Algorithm for external Sorting, Algorithm for SELECT and JOIN operations, Algorithm for project and Set Operations, Implementing Aggregate Operations and OUTER JOINs, Combining Operations using Pipelining, Using Heuristics in Query Optimization, Using selectivity and cost estimation in query optimization.	**07 Hrs**
Unit –IV	
Overview of Transaction Management The ACID property, Transaction and schedules,	**07 Hrs**

Concurrent Execution of Transactions, Lock based Concurrency control, performance of locking, Transaction support in SQL, Introduction to crash recovery. **Concurrency Control** 2PL, Serializability, recoverability, Introduction to Lock management , Lock conversions, Dealing with Deadlocks, Specialized Locking Techniques, Concurrency control without Locking. **Crash Recovery** Introduction to ARIES, the LOG, Other recovery related structures, The Write-Ahead Log protocol, check pointing, Recovery from a system Crash, media recovery, other approaches and interaction with concurrency control.	
Unit –V	
NOSQL Databases: Introduction to NOSQL Systems , The CAP Theorem , Document-Based NOSQL Systems and MongoDB , NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems , NOSQL Graph Databases and Neo4j.	**07 Hrs**
LABORATORY COMPONENTS	
Contents A 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 • 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 for the project- MySQL, DB2, Oracle, SQL Server etc • Front End for the project – Visual Basic, C++, C#, Web Interface (HTML, PhP) **Typical Mini Projects** • Placement management system. • Result management & analysis system. • RVCE Blog management system. • Student Feedback system • Library management	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the different issues involved in the design and implementation of a database system
CO2:	Master the basics of SQL , NOSQL, basics of query evaluation techniques and query optimization
CO3:	Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server)
CO4:	Design and understand a simple database system and demonstrate competence with the fundamental tasks involved with Transaction Management, recovery**,** modeling, designing in Database Systems and distributed database systems

Reference Books	
1	Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7th Edition, 2016, Published by Pearson, Copyright © , ISBN-10: 0133970779
2	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2003, McGraw-Hill, ISBN: 9780071231510
3	Data Base System Concepts, Silberschatz, Korth and Sudharshan, 5th Edition, 2006, Mc-GrawHill, ISBN: 9789332901384
4	A Introduction to Database Systems, C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, 2006, Pearson Education, ISBN: 9788177585568

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. Evaluation includes phases of mini project implementation and execution. 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 which can include evaluating students based on demonstration and implementation of modifications suggested. 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

Project demonstration and implementation of suggested modifications 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	3	1	3	1	-	-	-	1	-	-	1
CO2	3	3	1	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	-	-	-	-	1	-	-	1
CO4	2	3	2	2	1	-	-	-	-	-	-	1

Low-1 Medium-2 High-3

INFORMATION SECURITY (Group C: Professional Core Elective) (Theory)		
Course Code: 16IS6C1		**CIE Marks:**100
Credits :L:T:P:S: 3:0:0:1		**SEE Marks:**100
Hours: 36L		**SEE Duration :** 03Hrs

Course Learning Objectives:	
1	Comprehend the basics of Security in computing
2	Understand security for Operating Systems and Databases and apply the concepts in designing of databases.
3	Analyze programs for security and develop secure programs.
4	Recognize the importance of administering security and be aware of legal and ethical issues in computer security.

Unit-I	
Introduction to Security Fundamentals: Meaning of "Secure": Protecting Valuables, Characteristics of Computer intrusion, Attacks: Vulnerabilities, Threats, Attacks, Controls, Method, Opportunity, Motive, Meaning of Computer Security: Security Goals. Vulnerabilities, Computer Criminals: Definition, Types, Methods of Defense: Hacking, Methodology of hacking, Hacker Classification, Controls, Effectiveness of Controls.	**07 Hrs**
Unit – II	
Program Security: Secure programs: Types of faults, fixing faults, unexpected behaviour, non-malicious program errors: Buffer overflow, Incomplete mediation, Time of check to time of use, Combination of non-malicious program flaws. Viruses and other malicious code: How Viruses attach, gain control, homes for viruses, virus signature, source of virus, Prevention of virus infection, The Brain Virus, Internet Worm Targeted malicious code: Trojans, Trap doors, Salami Attack, Privilege escalation, Interface Illusion, Keystroke logging, Man in the middle attack, Timing Attack, Covert channels. Control against Program threats: Developmental Control, Program Control.	**08 Hrs**
Unit -III	
Protection in OS: Protected Objects and methods of protection: Protected objects, Security methods of Operating system, File protection mechanisms: Basic forms, individual permissions, per object and per user protection. User Authentications: Passwords as authenticators, Attacks on Passwords, Password selection criteria, Authentication Process, Biometrics as authenticators. **Database Security**: Security requirements: Integrity, Auditability, Availability, Reliability and Integrity: Two phase update, Redundancy, Recovery, Concurrency, Monitors. Sensitive data, Access decisions, Types of Disclosures, Security Vs. Precision	**07 Hrs**
Unit –IV	
Privacy in Computing: Privacy on Web: Payments, Portal registrations, Precautions, Spyware, Shopping on the internet: Security breaches. Email Security: Interception, Monitoring email, Anonymous Emails, Remailers, Spoofing, Spamming, Impact on Emerging Technologies, RFID, E-Voting, VoIP, Skype. **Administering Security:** Security Planning, Contents of a Security plan, Security planning team members, Assuring commitment to Security plan, Risk Analysis, Nature of risk, Steps of risk analysis	**07 Hrs**
Unit –V	
Legal and Ethical Issues in Computer Security: Protecting program and data: Copyrights, Patents for software, Information and Law, Redress for Software failure, Ethical issues in Computer security.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concepts of information security, the need and issues related with it.
CO2:	Evaluate the existing systems to handle security vulnerabilities.
CO3:	Analyze and design new security solutions for software development to secure networks using firewalls and intrusion detection systems.
CO4:	Demonstrate and do computation of the secure technologies on to the networks, systems and deployment of security tools in real scenarios.

Reference Books	
1	Security in Computing, Pearson Education, Charles P. Pfleeger, Shari Lawrence Pfleeger, 4th Edition, ISBN 978-0-13-408504-3
2	Analyzing Computer Security, A Threat, Vulnerability Countermeasure Approach, Charles P. Pfleeger, Shari Lawrence Pfleeger, Pearson Education, ISBN-13: 978-0132789462
3	Network Security Essentials, William Stallings, 4th Edition, 2011, Prentice Education Pearson, ISBN 13: 9780136108054
4	Introduction to Computer Security, Matt Bishop, Addison-Wessley- Pearson Education, ISBN 13: 9780321247445

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

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

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

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

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

Low-1 Medium-2 High-3

SYSTEM SIMULATION AND MODELLING (Group C: Professional Core Elective) (Theory)		
Course Code:16IS6C2		**CIE Marks:**100
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:**100
Hours: 36L		**SEE Duration :** 03Hrs

Course Learning Objectives:	
1	Understand the major capabilities and commonly encountered limitations of discrete-event simulation for modeling systems that industrial engineers commonly encounter
2	Formulate a real world problem and select an appropriate analytical technique for modeling and ultimately solving this problem
3	Use simulation software for model development and analysis
4	Communicate the results of the modeling process to management and other non-specialist users of engineering analysis.

Unit-I	
Modeling and Simulation: Introduction. Models: Approximations of Real World Events, A Brief History of Modeling and Simulation, Application Areas, Using Modeling and Simulation, Advantages and Disadvantages. **The Role of Modeling and Simulation:** Using Simulations to Solve Problems. Uncertainty and Its Effects. Gaining Insight. A Simulation's Lifetime.	**07 Hrs**
Unit – II	
Simulation: Models That Vary Over Time. : Discrete Event Simulation. Continuous Simulation. **Queue Modeling and Simulation.** : Analytical Solution, Queuing Models, Sequential Simulation, SimPack Queuing Implementation, Parallel Simulation.	**07 Hrs**
Unit -III	
Verification and Validation: Performing Verification and Validation, Verification and Validation Examples. **Uses of Simulation: The** Many Facets of Simulation. Experimentation Aspect of Simulation, Experience Aspect of Simulation, Examples of Uses of Simulation. Ethics in the Use of Simulation, Some Excuses to Avoid Simulation	**07 Hrs**
Unit –IV	
Modeling and Simulation: Real World - Examples Introduction, Transportation, Business M&S, Medical M&S, Social Science M&S.	**08 Hrs**
Unit –V	
The Future of Simulation: Introduction, A Brief and Selective History of Simulation, Convergent Simulations, Serious Games, Human-Simulator Interfaces, Computing Technology, The Role of Education in Simulation, The Future of Simulation.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Classify various simulation models and give practical examples for each category
CO2:	Construct a model for a given set of data and motivate its validity
CO3:	Generate and test random number varieties and apply them to develop simulation models
CO4:	Analyze output data produced by a model and test validity of the model

Reference Books	
1	Principles of Modeling and Simulation: A Multidisciplinary Approach, John A. Sokolowski, Catherine M. Banks, 2009, Wiley, ISBN: 978-0-470-28943-3
2	Discrete-Event System Simulation", Jerry Bank, John S. Carson II, Barry L. Nelson, David M. Nicol , 5th Edition, 2009, Pearson, ISBN-13: 978-0136062127
3	System Modeling and Simulation: An Introduction, Frank L. Severance, 2001, John Wiley & Sons, ISBN-13: 978-0471496946
4	Theory of Modeling and Simulation, Bernard P. Zeigler, Herbert Praehofer, Tag GonKim Academic Press, 2nd Edition, 2000, ISBN-13: 978-0127784557

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

Low-1 Medium-2 High-3

SUPPLY CHAIN MANAGEMENT (Group C: Professional Core Elective) (Theory)		
Course Code:16IS6C3		**CIE Marks:**100
Credits: L:T:P:S:3:0:0:1		**SEE Marks:**100
Hours:36L		**SEE Duration: 0**3 Hrs

Course Learning Objectives:	
1	Enable students understand the overview of Supply Chain Management
2	Learn the basic concepts and key elements of Supply Chain Management.
3	Gain knowledge of Supply Chain Management performance.
4	Enable students to design models in order to achieve efficiency in Supply Chain Management using various technologies.

Unit-I	
Understanding the Supply Chain: What is Supply Chain? Historical perspective; Objective of Supply Chain; The Importance of supply Chain Decisions; Decisions Phases in a Supply Chain; Process Views of a Supply Chain; Examples of Supply Chains. Supply Chain Performance: **Achieving Strategic Fit and Scope:** Competitive and supply Chain Strategies; Achieving Strategic Fit; Expanding Strategic Scope; Obstacles to Achieving Strategic Fit. Supply Chain Drivers and Metrics: Impellers of Supply Chain; Drivers of Supply chain performance; A framework for structuring Drivers; Facilities; Inventory; Transportation; Information; Sourcing; Pricing; Obstacles to Achieving Strategic Fit.	**07 Hrs**
Unit – II	
Designing Distribution Networks and Applications to e-Business: The role of Distribution in Supply Chain; Factors influencing Distribution Network Design; Design Options for a Distribution Network; Indian Distribution Channels; Distribution Networks in Practice. **Network Design in the Supply Chain:** The Role of Network Design in the Supply Chain; Factors Influencing Network design decisions; A framework for Network design decisions; Models for Facility Location and Capacity Allocation; The role of information Technology in Network Design; Jaipur Rugs Networking Tradition with Modernity; Making Network Design Decisions in Practice; The impact of Uncertainty on Network Design.	**09 Hrs**
Unit -III	
Designing Global Supply Chain Networks: The impact of Globalization on Supply Chain Networks; The Off shoring Decision: Total Cost; Risk Management in Global Supply Chains; the Basic Aspects of Evaluating Global Supply Chain Design; Evaluating Network Design Decisions Using Decision Trees; Making Global Supply Chain Design Decisions Under uncertainty in Practice; Uncertainty in Global Supply Chain operations –An Indian Experience. Demand **Demand Forecasting in a Supply Chain:** The Role of Demand Forecasting in the Supply Chain; Characteristics of forecasts; Components of Forecast and forecasting methods; Basic approach to demand forecasting; Time-series Forecasting Methods; Measures of Forecast Error; The Role of information Technology in Forecasting; Risk Management in Forecasting; Forecasting in Practice.	**08 Hrs**
Unit –IV	
Managing Economies of Scale in a Supply Chain: Cycle Inventory: The role of Cycle Inventory in a Supply Chain; Estimating Cycle inventory-Related Costs in Practice; Economies of scale to exploit fixed costs; Economies of scale to exploit Quantity Discounts; Short-Term Discounting: Trade Promotions; Managing Multiechelon Cycle Inventory; Cycle Inventory Optimization in Indian Distribution Channels. **Transportation in a Supply Chain:** The role of transformation in a supply chain; Modes of transportation and their Performance Characteristics; Design options for a Transportation Network; Trade-offs in Transportation Design; Tailored Transportation; The Role of information Technology in Transportation; Risk Management in Transportation; Making Transportation Decisions in Practice; Transportation Network in	**07 Hrs**

Support of Indian Cooperative Endeavor-Milk Run for Milk.	
Unit –V	
Information Technology in Supply Chain: The role of information Technology in a supply chain; The Supply Chain IT Framework; Customer Relationship Management; Internal Supply Chain Management; Supplier Relationship Management; The Transaction Management Foundation; The Future of IT in the Supply Chain; Risk Management in It; Supply Chain IT in Practice; IT System Selection Processes-Indian Approach and Experiences. **Coordination in a Supply Chain:** Lack of supply chain coordination and the bullwhip effect; Effect of lack of coordination on performance; Obstacles to coordination in a supply chain; Managerial Levers to achieve coordination; Building strategic partnerships and trust within a supply chain; Continuous Replenishment and Vendor-Managed Inventories; Collaborative Planning, Forecasting, and Replenishment (CPFR); The Role of IT in Coordination; Achieving Coordination in Practice; coordination in Supply Chains-Multiechelon Models.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the Supply Chain Processes in industries.
CO2:	Demonstrate the impact of various uncertainties on various Supply Chain Drivers.
CO3:	Examine and analyse the case studies related to Supply Chain Management.
CO4:	Design, analyse models considering various factors for an efficient Supply Chain Management using various technologies.

Reference Books	
1	Supply Chain Management, Chopra & Meindl, 4th Edition, 2010, Pearson Education – Addison Wesley Longman, ISBN-13: 978-0738206677
2	Designing and Managing the Supply Chain Concepts, Strategies and Case Studies , David Simchi Levi, Philip Kaminsky & Edith Simchi Levi , 3rd Edition, 2008, Tata McGraw Hill, ISBN-13: 978-1935182399
3	Supply Chain Management Theories and Practices, R P Mohanty, S G Deshmukh, Bizmantra, 2005, ISBN-0957597118
4	Logistics and Supply Chain Management, M Martin Christopher , 4th Edition, 2011, Pearson Education, ISBN-13: 978-1493909827

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

Low-1 Medium-2 High-3

MOBILE APPLICATION DEVELOPMENT (Group C: Professional Core Elective) (Theory)		
Course Code: 16IS6C4		**CIE Marks:**100
Credits: L:T:P:S:3:0:0:1		**SEE Marks:**100
Hours:36L		**SEE Duration(Theory):** 03 Hrs

Course Learning Objectives:	
1	Comprehend the knowledge on essentials of android application development.
2	Demonstrate the basic and advanced features of android technology.
3	Develop the skills in designing and building mobile applications using android platform.
4	Create. debug and publish innovative mobile applications using android Platform.

Unit-I	
Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, LTE vs. VoLTE. Smart phone operating systems and smart phones applications. Introduction to Android, Installing Android Studio, creating an Android app project, deploying the app to the emulator and a device. UI Design: Building a layout with UI elements, Layouts, Views and Resources, Text and Scrolling Views. Activities and Intents, The Activity Lifecycle, Managing State, Activities and Implicit Intents, Testing, debugging, and using support libraries, The Android Studio Debugger, Testing android app, The Android Support Library.	**07 Hrs**
Unit – II	
User experience: User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts, Testing app UI, Testing the User Interface	**07 Hrs**
Unit -III	
Working in the background: Background Tasks, AsyncTask and Async Task Loader, Connect to the Internet, Broadcast Receivers, and Services. Triggering, scheduling and optimizing background tasks – Notifications, Scheduling Alarms, and Transferring Data Efficiently.	**08 Hrs**
Unit –IV	
All about data: Preferences and Settings, Storing Data, Shared Preferences, App Settings. Storing data using SQLite - SQLite Primer, SQLite Database. Sharing data with content providers. Loading data using loaders. Using Selection Widgets and Debugging, Displaying and Fetching Information, Using Dialogs and Fragments, Advanced Android Programming: Internet, Entertainment, and Services, Implementing drawing and animations. Displaying web pages and maps, communicating with SMS and emails. Creating and consuming services - Location based services, Sensors.	**07 Hrs**
Unit –V	
Information Technology in Supply Chain: The role of information Technology in a supply chain; The Supply Chain IT Framework; Customer Relationship Management; Internal Supply Chain Management; Supplier Relationship Management; The Transaction Management Foundation; The Future of IT in the Supply Chain; Risk Management in It; Supply Chain IT in Practice; IT System Selection Processes-Indian Approach and Experiences. **Coordination in a Supply Chain:** Lack of supply chain coordination and the bullwhip effect; Effect of lack of coordination on performance; Obstacles to coordination in a supply chain; Managerial Levers to achieve coordination; Building strategic partnerships and trust within a supply chain; Continuous Replenishment and Vendor-Managed Inventories; Collaborative Planning, Forecasting, and Replenishment (CPFR); The Role of IT in Coordination; Achieving Coordination in Practice; coordination in Supply Chains-Multiechelon Models.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of android application and its architecture.
CO2:	Apply and explore the basic framework, usage of SDK to build android applications incorporating android features in developing mobile applications.
CO3:	Demonstrate proficiency in coding on a mobile programming platform using advanced android technologies, handle Security issues, rich graphics interfaces, using debugging and troubleshooting Tools.
CO4:	Create innovative apps, understand the economics and features of the app marketplace by offering the app for download.

Reference Books	
1	Android Programming, Phillips, Stewart, Hardy and Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	Android Studio Development Essentials - Android 6, Neil Smyth, 2015, Createspace Independent Publishing Platform, ISBN: 9781519722089
3	Android Programming – Pushing the limits, Eric Hellman, 2013, Wiley, ISBN-13: 978-1118717370
4	Professional Android 2 Application Development, Reto Meier, Wiley India Pvt.Ltd 1st Edition, 2012, ISBN-13: 9788126525898
5	Beginning Android 3, Mark Murphy, Apress Springer India Pvt Ltd, 1st Edition, 2011, ISBN-13: 978-1-4302-3297-1
6	Android Developer Training - https://developers.google.com/training/android/ Android Testing Support Library - https://google.github.io/android-testing-support-library/

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

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

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

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

Low-1 Medium-2 High-3

DATA STORAGE TECHNOLOGIES AND NETWORKING (Group C: Professional Core Elective) (Theory)		
Course Code:16IS6C5		**CIE Marks:** 100
Hrs/Week: L:T:P:S: 3:0:0:1		**SEE Marks:** 100
Credits:36L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	Interpret the storage architectures and demonstrate the logical and physical components of a storage infrastructure including storage subsystems, RAID and Intelligent storage systems
2	Analyze storage networking technologies such as FC-SAN, NAS, IP-SAN, data archival solutions and virtualization technologies.
3	Apply and articulate business continuity solutions including backup technologies, local and remote replication solutions.
4	Identify security parameters for managing and monitoring storage infrastructure

Unit-I	
Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data center Infrastructure, Virtualization and cloud computing. **Data Center Environment**: Application, Database Management System(DBMS), Host(compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based On Application, Disk Native Command Queuing, Introduction to Flash Drives, Concept in Practice: VMware ESXi. **Data Protection: RAID:** RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares.	**07 Hrs**
Unit – II	
Intelligent Storage Systems: Components of an Intelligent Storage System, Storage Provisioning, Types of intelligent Storage Systems, Concepts in Practice: EMC Symmetrix and VNX. Fibre Channel Storage Area Networks: **Fiber Channel: Overview,** The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, fabric Services, Switched fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN, Concepts in Practice: EMC Connectrix and EMC VPLEX.**IP SAN and FcoE**: iSCSI, FCIP, FcoE	**07 Hrs**
Unit -III	
Network-Attached Storage: General-purpose Servers versus NAS Devices, benefits of NAS, File Systems and network File Sharing. Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, factors Affecting NAS Performance, File-Level Virtualization, Concepts in Practice: EMC Isilon and EMC VNX gateway. **Object-Based and unified Storage:** Object-Based Storage Devices, Content-Addressed Storage, CAS use Cases, unified Storage, Concepts in Practice: EMC atoms, EMC VNX, and EMC centera. **Introduction to Business Continuity**. Information Availability, BC Terminology, BC Planning life Cycle, failure Analysis, Business Impact Analysis, BC Technology solutions.	**07 Hrs**
Unit –IV	
Backup and Archive : Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operation, Backup Topologies, Backup in NAS Environments, Backup Targets, Data Dedupulication for Backup, Backup in Virtualized Environments, Data Archive ,Archiving Solution Architecture, Concepts in Practice :EMC Networker, EMC Avamar, and EMC Data domain. **Local Replication**: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas, Local Replication in Virtualized Environment, Concepts in Practice: EMC TimeFinder. **Remote Replication**: Modes of Remote Replication, Remote Replication Technologies, Three-Site Replication, Data Migration Solutions, Remote Replication and Migration in a Virtualized Environment, Concepts in Practice : EMC SRDF, EMC MirrorView, and EMC	**07 Hrs**

RecoverPoint	
Unit –V	
Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Security implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments, Concepts in practice: RSA and VMware Security Products. **Managing the Storage Infrastructure**: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Information Lifecycle Management, Storage Tiering, Concepts in Practice: EMC Infrastructure.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the decisive role and key challenges in managing information and analyze different storage networking and virtualization technologies.
CO2:	Analyze the SAN and NAS deployment for file and data sharing for a collaborative development environment of organizations.
CO3:	Apply backup, recovery, and archival solutions for business critical data.
CO4:	Evaluate various replication solutions to meet different business continuity needs and address security concerns to perform monitoring and management of information infrastructure.

Reference Books	
1	EMC^2: Information Storage and Management, EMC Education Services, 2nd Edition, 2013, Willey India, ISBN-13: 978-1118094839
2	Storage Networks: The Complete Reference, Robert Spalding, 1st Edition, 2003, Tata McGraw Hill India, ISBN: 9780070532922
3	Storage Networks Explained, Ulf Troppens, Rainer Erkens, Wolfgang Muller-Friedt, Rainer Wolafka, Nils Haustein, 2nd Edition, 2009, Wiley India, ISBN: 978-0-470-74143-6
4	Building Storage Networks, Marc Farley, 2nd Edition, 2001, Tata McGraw Hill India, ISBN-13: 978-0070447455

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

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

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

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

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

Low-1 Medium-2 High-3

MACHINE LEARNING AND PATTERN RECOGNITION (Group D: Professional Core Elective) (Theory)		
Course Code:16IS6D1		**CIE Marks:**100
Credits: L:T:P:S:4:0:0:0		**SEE Marks:**100
Hours:44L		**SEE Duration(Theory):** 03 Hrs

Course Learning Objectives:	
1	Introduce students to the basic concepts and techniques of Machine Learning.
2	Develop skills of using recent machine learning software for solving practical problems.
3	Instigate the student to various Pattern recognition classification techniques.
4	Bring out structural pattern recognition and feature extraction techniques

Unit-I	
Introduction, Concept Learning and Decision Trees: Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Decision Tree learning – Representation – Algorithm – Heuristic Space Search in Decision Tree learning.	**07 Hrs**
Unit – II	
Representation: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation	**07 Hrs**
Unit -III	
Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Basyesian belief network	**07 Hrs**
Unit –IV	
Instant Based Learning And Learning Set of Rules: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions –Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution.	**07 Hrs**
Unit –V	
Analytical Learning and Reinforced Learning: Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task . **Clustering:** Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Iso-data), clustering large data sets, examples	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems.
CO2:	Apply different estimation techniques for parameter estimation to solve real-world problems.
CO3:	Analyze the similarity measures and design the relevant model.
CO4:	Evaluate and perform diagnoses of any machine learning system.

Reference Books	
1	Machine Learning, Tom M. Mitchell, Indian Edition, 2013, McGraw-Hill Education, ISBN:978-1-25-909695-2
2	Pattern Recognition (An Introduction), V SusheelaDevi, M Narsimha Murthy, 2011, Universities Press, ISBN : 978-81-7371-725-3
3	Pattern Recognition and Machine Learning, Christopher M Bishop, Springer, Reprint 2013, ISBN : 978-81-322-0906-5
4	Introduction to Machine Learning, Ethem Alpaydin, 3rd Edition, 2015, PHI Learning Pvt. Ltd. ISBN: 978-0262-02818-9

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

Low-1 Medium-2 High-3

WIRELESS SENSOR NETWORKS (Group D: Professional Core Elective) (Theory)		
Course Code:16IS6D2		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours:44L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	Interpret the basics of Wireless sensor networks and enabling technologies.
2	Apply knowledge of wireless sensor networks to various application areas.
3	Design, implement and maintain wireless sensor networks.
4	Formulate and solve problems creatively.

Unit-I	
Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks.	**08 Hrs**
Unit – II	
Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	**09 Hrs**
Unit -III	
Networking Sensors: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	**09 Hrs**
Unit –IV	
Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control..	**09 Hrs**
Unit –V	
Sensor Network Platforms And Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and design the various components of a Wireless Sensor networks.
CO2:	Apply various wireless sensor network routing protocols and clustering technology which is used for remote sensor networks
CO3:	Analyze the programming challenges and Design an efficient sensor networks.
CO4:	Build a wireless sensor network using the available simulation tools.

Reference Books	
1	Protocols And Architectures for Wireless Sensor Networks, Holger Karl & Andreas Willig, 2014, John Wiley, ISBN:0470095105
2	Wireless Sensor Networks- An Information Processing Approach, Feng Zhao & Leonidas J. Guibas, Elsevier, 2010, ISBN: 9788122430752
3	Wireless Sensor Networks- Technology, Protocols, And Applications, Kazem Sohraby, Daniel Minoli, & Taieb Znati, , 2010, John Wiley, ISBN 978-0-471-74300-2. 1
4	Wireless Sensor Network Designs, Anna Hac, 2014, John Wiley, ISBN 10: 0470867361

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

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

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

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

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

Low-1 Medium-2 High-3

FUZZY LOGIC AND GENETIC ALGORITHM (Group D: Professional Core Elective) (Theory)		
Course Code:16IS6D3		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours:44L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	Understand about the concept of fuzziness involved in various systems.
2	Describe fuzzy logic inference with emphasis on their use in the design of intelligent systems.
3	Comprehend the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.
4	Foster competence in recognizing the feasibility and applicability of the design and implementation of intelligent systems (that employ fuzzy logic, genetic algorithm) for specific application areas.

Unit-I	
Fuzzy Set Theory: Introduction, The Case for Imprecision, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, Uncertainty and Information, Fuzzy Sets and Membership, Chance Versus Fuzziness, Fuzzy Sets, Fuzzy Set Operations, Properties of Fuzzy Sets, Alternative Fuzzy Set Operations	**08 Hrs**
Unit – II	
Fuzzy Relations: Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations, Cosine Amplitude, Max – Min Method.	**09 Hrs**
Unit -III	
Properties of Membership Functions, Fuzzification, and Defuzzification : Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, Defuzzification to Scalars, Approximate Reasoning, Natural Language, Linguistic Hedges Fuzzy (Rule-Based) Systems.	**09 Hrs**
Unit –IV	
Genetic Algorithm : Introduction to Genetic Algorithm, working cycle of Genetic Algorithm, Binary-coded Genetic Algorithm, Genetic Algorithm – parameters setting, Constraints handling in Genetic Algorithm, Advantages & disadvantages of genetic Algorithm.	**09 Hrs**
Unit –V	
Some specialized Genetic Algorithm, Real coded Genetic Algorithm, Micro Genetic Algorithm, Visualized interactive Genetic Algorithm, scheduling Genetic Algorithm, Combined Genetic Algorithm: Fuzzy logic Introduction, fuzzy-genetic algorithm, genetic-fuzzy system	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and describe soft computing techniques and their roles in building intelligent machines
CO2:	Recognize the feasibility of applying a soft computing methodology for a particular problem
CO3:	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
CO4:	Apply genetic algorithms to combinatorial optimization problems

Reference Books	
1	Fuzzy Logic with Engineering Applications, Timothy J Ross, 3rd Edition, 2010, Wiley, 9780470743768
2	Soft computing fundamentals & Applications, D K Pratihar, 2015, Alpha Science International Limited, ISBN :9781783322053
3	Genetic Algorithms ; Search, optimization and Machine Learning, Davis E Goldberg, 1989, Addison Wesley, ISBN : 9780201157673
4	Neural Networks, Fuzzy Logic and Genetic Algorithms, Rajasekaran and G A V Pai, 4th Edition, 2003, PHI, ISBN - 81-203-2186-3

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

Low-1 Medium-2 High-3

ADVANCED COMPILER DESIGN (Group D: Professional Core Elective) (Theory)		
Course Code:16IS6D4		**CIE Marks:** 100
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:** 100
Hours:44L		**SEE Duration:** 03 Hrs

Course Learning Objectives:	
1	Understand the major concept areas of language translation and compiler design.
2	Enhance their knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
3	Extend the knowledge of parser by parsing LL parser and LR parser.
4	Gain practical programming skills necessary for constructing a compiler.

Unit-I	
Introduction and Syntax-Directed Translation: Language processors; The structure of a Compiler; Syntax-directed definitions; Evaluation orders for SDDs; Applications of syntax-directed translation; Syntax-directed translation schemes; Implementing L-attributed SDD's	**09 Hrs**
Unit – II	
Intermediate Code Generation : Variants of syntax trees; Three-address code; Types and declarations, Translation of expressions; Control flow; Back patching; Switch statements, Intermediate code for procedures.	**09 Hrs**
Unit -III	
Run-Time Environments: Storage Organization; Stack allocation of space, Access to non-local data on the stack, Introduction to Trace-Based Collection, Short-Pause Garbage Collection	**09 Hrs**
Unit –IV	
Machine Independent Optimizations: Leaders, Basic blocks and flow graphs, Principle sources of optimization; Introduction to data-flow analysis; Partial redundancy elimination; Loops in flow graphs.	**09 Hrs**
Unit –V	
Code Generation: Issues in the design of Code Generator; The Target Language; Addresses in the target code; A Simple Code Generator, Peephole Optimization, Register Allocation and Assignment, Instruction selection by tree rewriting	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe working of each phase in the development of a compiler
CO2:	Apply syntax directed translation rules to generated intermediate code
CO3:	Design a compiler for a simple customized high level language
CO4:	Generation of basic block and flow graphs for intermediate code

Reference Books	
1	Compilers- Principles, Techniques and Tools, Alfred V Aho, Monica S.Lam, Ravi Sethi, Jeffrey D Ullman, 2nd Edition, 2007, Pearson Education, ISBN: 978-8-13172-101-8
2	Compiler Construction Principles & Practice, Kenneth C Louden, Cengage Learning, ISBN-10: 0534939724 | *ISBN*-13: 978-0534939724,1997
3	Crafting a Compiler with C, Pearson Education, Charles N. Fischer, Richard J. leBlanc, Jr. *ISBN*-13: 978-0805321661 *ISBN*-10: 0805321667,1991
4	Modern Compiler Implementation in C, Andrew W Apple, Cambridge University Press, ISBN 0-521-60765-5,1997

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

Low-1 Medium-2 High-3

COMPUTER SYSTEM PERFORMANCE ANALYSIS (Group D: Professional Core Elective) (Theory)		
Course Code: 16IS6D5		**CIE Marks:**100
Credits: L:T:P:S:4:0:0:0		**SEE Marks:**100
Hours: 45L		**SEE Duration(Theory):** 03 Hrs

Course Learning Objectives:	
1	Comprehend the need for performance evaluation and its systematic approach.
2	Explore various types of monitoring and capacity planning techniques.
3	Formulate experiments with various levels and factors.
4	Demonstrate working of various queues, their representations and rules.

Unit-I	
Introduction: The art of Performance Evaluation, Common mistakes in Performance Evaluation, A systematic approach to Performance Evaluation, Selecting an evaluation technique. **Metrics of Performance:** What is a performance metric? Characteristics of a good performance metric, Processor and system performance metrics, Other types of performance metrics, Speedup and relative change, Means versus ends metrics, Summary.	**09 Hrs**
Unit – II	
Average Performance and Variability: Why mean values? Indices of central tendency, Other types of means**,** Quantifying variability, Summary. **Errors in Experimental Measurements:** Accuracy, precision, and resolution, Sources of errors, A model of errors, Quantifying errors.	**09 Hrs**
Unit -III	
Comparing Alternatives: Comparing two alternatives, Comparing more than two alternatives, Summary, For further reading, Exercises. **Measurement Tools and Techniques:** Events and measurement strategies, Interval timers, Program profiling, Event tracing, Indirect and ad hoc measurements, Perturbations due to measuring.	**09 Hrs**
Unit –IV	
Benchmark Programs: Types of benchmark programs, benchmark strategies, example of benchmark programs, summary. **Linear regression models:** Least squares minimization, confidence intervals for regression parameters, correlation, multiple linear regression, verifying linearity, nonlinear models, summary.	**09 Hrs**
Unit –V	
The design of experiments: Types of experiments, terminology, two factor experiments, generalized m-factor experiments, $n2^m$ experiments, summary. **Queuing Analysis:** Queuing Network models, basic assumptions and notation, Operational analysis, stochastic analysis, summary.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the need for performance evaluation and its systematic approach.
CO2:	Apply performance measurement techniques to evaluate computer systems.
CO3:	Design and analyse various performance evaluation techniques.
CO4:	Compare and evaluate performance of computer systems using sophisticated models.

Reference Books	
1	Measuring Computer Performance: A Practitioner's Guide, David J. Lilja, Cambridge University Press, 2005 ISBN: 9781107439863
2	The Art of Computer Systems Performance Analysis, Raj Jain, 2008, John Wiley ISBN: 8126519053
3	Probability and Statistics with Reliability, Queuing and Computer Science Applications, Trivedi K S, Kishor S. Trivedi, 2nd Edition, 2008, John Wiley, ISBN: 978-0-471-33341-8
4	Research Methodology, R. Panneerselvam, 2004, Prentice Hall;, ISBN - 9788120324527

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

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

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

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

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

Low-1 Medium-2 High-3

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:** 03Hrs

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

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

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

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

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

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

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

SEE for 100 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: 0**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	**07 Hrs**

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	

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:16G6E03		**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	Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks.
2	Understand various waste management statutory rules.
3	Analyze different elements of solid waste management, design and develop recycling options for biodegradable waste by composting.
4	Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.

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

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

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

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

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 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 :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:** 03 Hrs

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

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

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

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

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

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)

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

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

CO-PO Mapping															
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	2	1	2	2	1	1	2	0	1	3	2	2
CO2	3	2	2	3	3	0	1	0	0	0	2	1	3	2	2
CO3	3	2	2	3	2	2	0	1	0	0	1	2	3	2	2
CO4	3	3	3	3	2	3	2	0	1	0	0	1	3	3	3

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)

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

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

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

Low-1 Medium-2 High-3

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)

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

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

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

Low-1 Medium-2 High-3

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:** 03Hrs

Course Learning Objectives: The students will be able to	
1	Learn Android application development platform for mobile devices and use it.
2	Understand mobile application architecture and its components.
3	Define Android specific programming concepts such as activities, intents, fragments, services, broadcast receivers and content providers.
4	Describe sensors like motion sensors, environmental sensors, and positional sensors; most commonly embedded in Android devices along with their application programming interface.

UNIT I	
Overview of Software platforms and Development: Mobile OS: Android development platform and tools, Programming language, Emulator, SDK and Development Environments **Creating Applications and Activities:** Introducing the Application Manifest File; Creating Applications and Activities; Architecture Patterns (MVC); Android Application Lifecycle.	**07 Hrs**
UNIT II	
User Interface Design: Fundamental Android UI Design; Introducing Layouts; Introducing Fragments. **Intents and Broadcasts**: Introducing Intents; Creating Intent Filters and Broadcast Receivers.	**07 Hrs**
UNIT III	
Database and Content Providers: Introducing Android Databases; Introducing SQLite; Content Values and Cursors; Working with SQLite Databases; Creating Content Providers; Using Content Providers; Case Study: Native Android Content Providers.	**07 Hrs**
UNIT IV	
Location Based Services, Telephony and SMS: Using Location-Based Services; Using the Emulator with Location-Based Services; Selecting a Location Provider; Using Proximity Alerts; Using the Geocoder; Example: Map-based activity; Hardware Support for Telephony; Using Telephony; Introducing SMS and MMS.	**08 Hrs**
UNIT V	
Hardware Support and Devices (AUDIO, VIDEO, AND USING THE CAMERA): Using Sensors and the Sensor Manager; Monitoring a Device's Movement and Orientation; Introducing the Environmental Sensors; Playing Audio and Video; Using Audio Effects; Using the Camera; Recording Video	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Assess the basic framework and usage of SDK to build GUI and apply advanced technologies in developing Android mobile applications.
CO2:	Differentiate techniques for persisting user data, such as shared preferences, traditional file systems (internal and external storage), and SQLite database
CO3:	Articulate the communication programming features and capabilities of Android platforms.
CO4:	Design and create innovative, sophisticated mobile applications using Android platform.

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

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

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

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

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

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

Low-1 Medium-2 High-3

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

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

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

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

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

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

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

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

Low-1 Medium-2 High-3

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

Course Learning Objectives:

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

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

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

CO1:	Identify and interpret the fundamental concepts of formation and solution of parabolic, hyperbolic and elliptic differential equations using analytical and numerical methods.
CO2:	Apply the knowledge and skills of analytical and numerical methods to solve the parabolic, hyperbolic and elliptic differential equations arising in the field of science and engineering.
CO3:	Analyze the physical problem to establish mathematical model and use appropriate method to solve and optimize the solution using the appropriate governing equations.
CO4:	Distinguish the overall mathematical knowledge to demonstrate and analyze the solution of parabolic, hyperbolic and elliptic differential equations arising in practical situations.

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

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

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

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

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

High-3: Medium-2: Low-1

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

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

Unit-I	
Flight Control Systems : Primary and secondary flight controls, Flight control linkage system, Conventional Systems, Power assisted and fully powered flight controls.	**07 Hrs**
Unit – II	
Aircraft Hydraulic & Pneumatic Systems : Components of a 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

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

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

V Semester	
UNIT-I	
Aptitude Test Preparation- Importance of Aptitude tests, Key Components, Quantitative Aptitude – Problem Solving, Data Sufficiency, Data Analysis - Number Systems, Math Vocabulary, fraction decimals, digit places etc. **Reasoning and Logical 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.

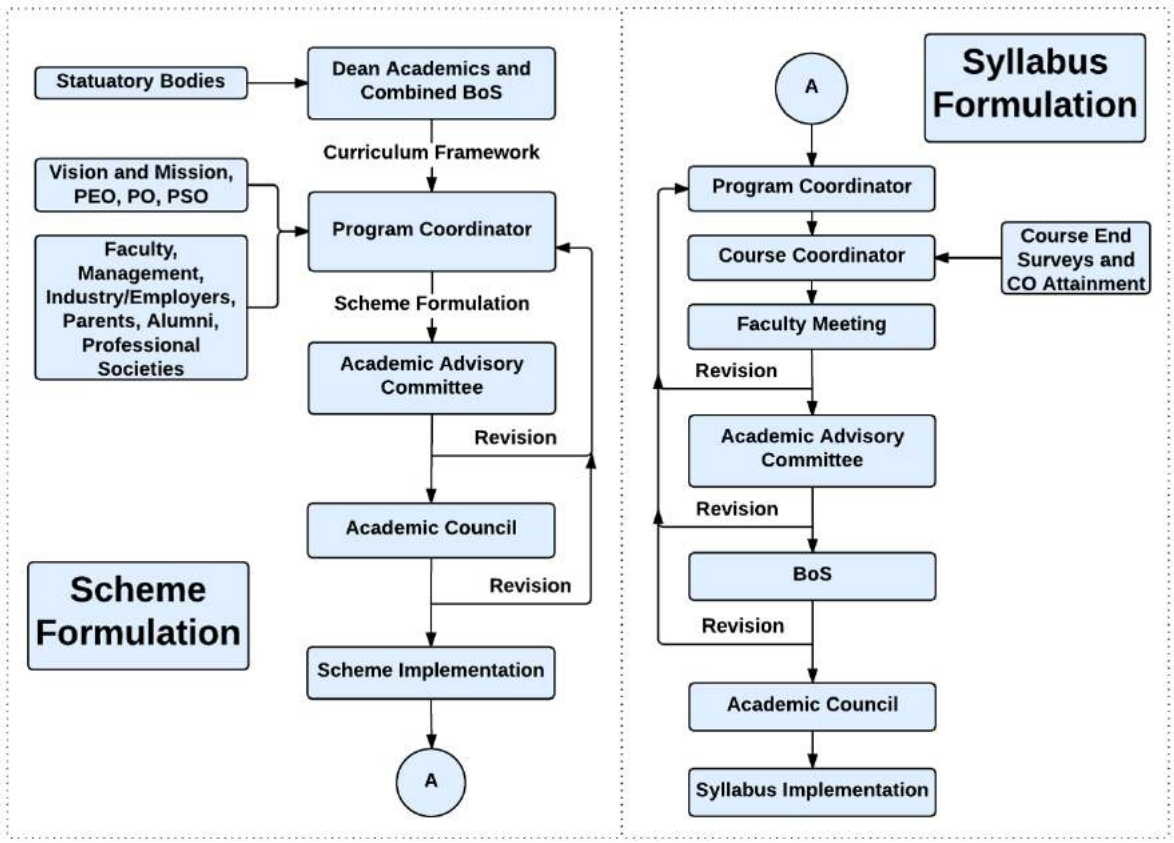
Phase	Activity	Weightage
I	Test 1 is conducted in V Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of Unit-1, Unit-2 and Unit -3.A for 18 hours of training sessions.	50%
II	Test 2 is conducted in VI Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive answers)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

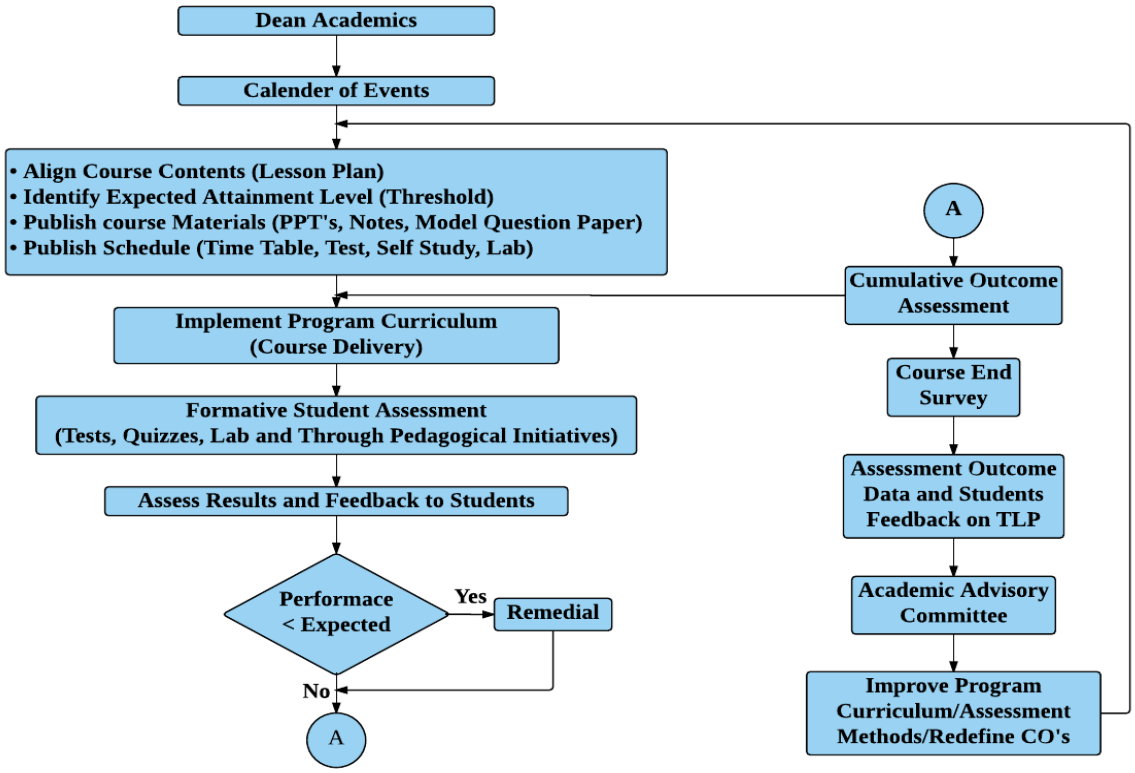
CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	-	-	-	-	1	-	1	1	1	2	1
CO2	1	2	2	-	-	-	-	1	2	1	2	1
CO3	-	-	3	-	-	1	-	2	1	2	1	-
CO4	-	-	-	-	-	1	3	1	1	1	1	-

Low-1 Medium-2 High-3

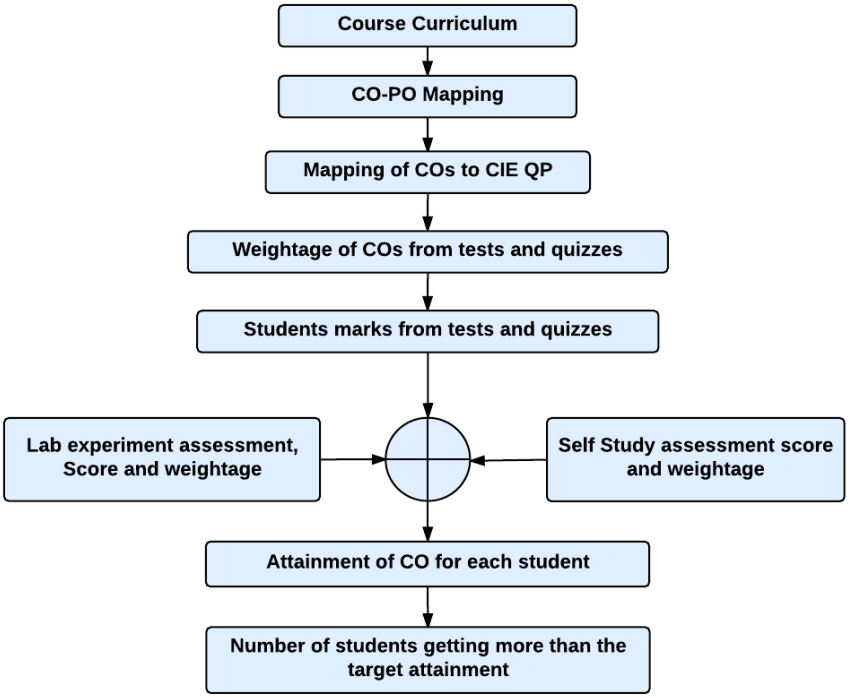
Curriculum Design Process



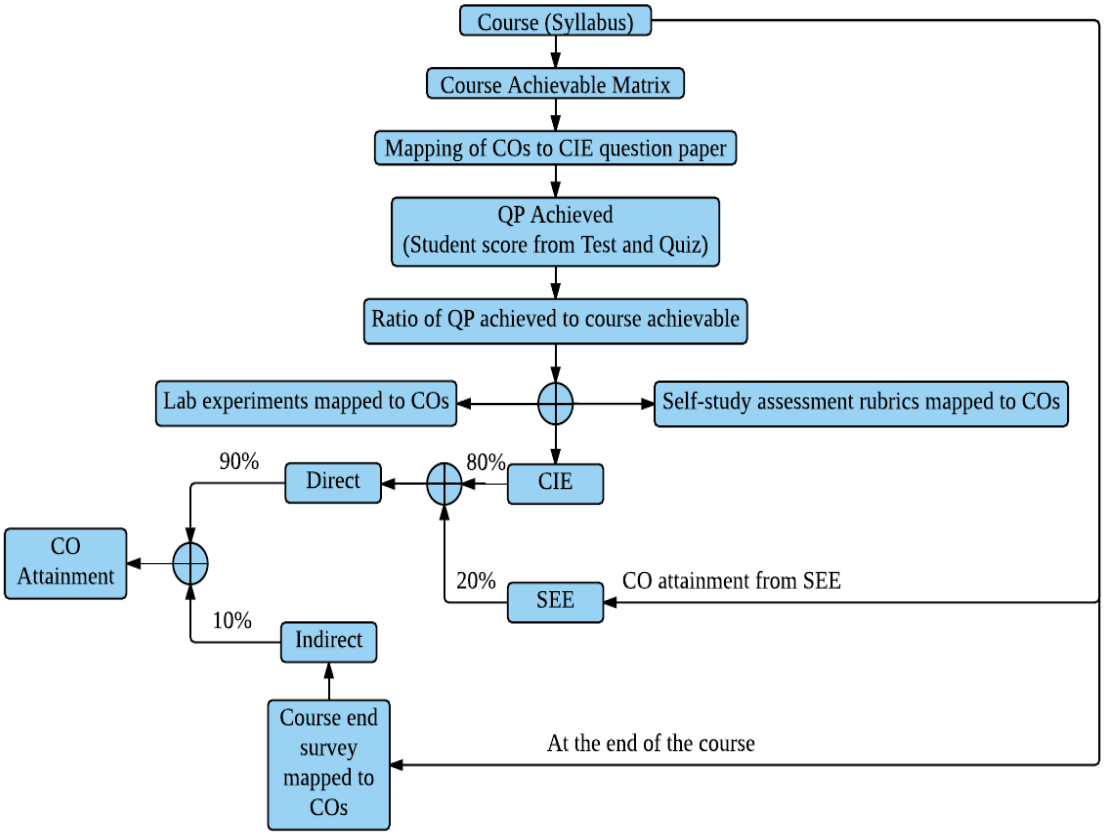
Academic Planning and Implementation



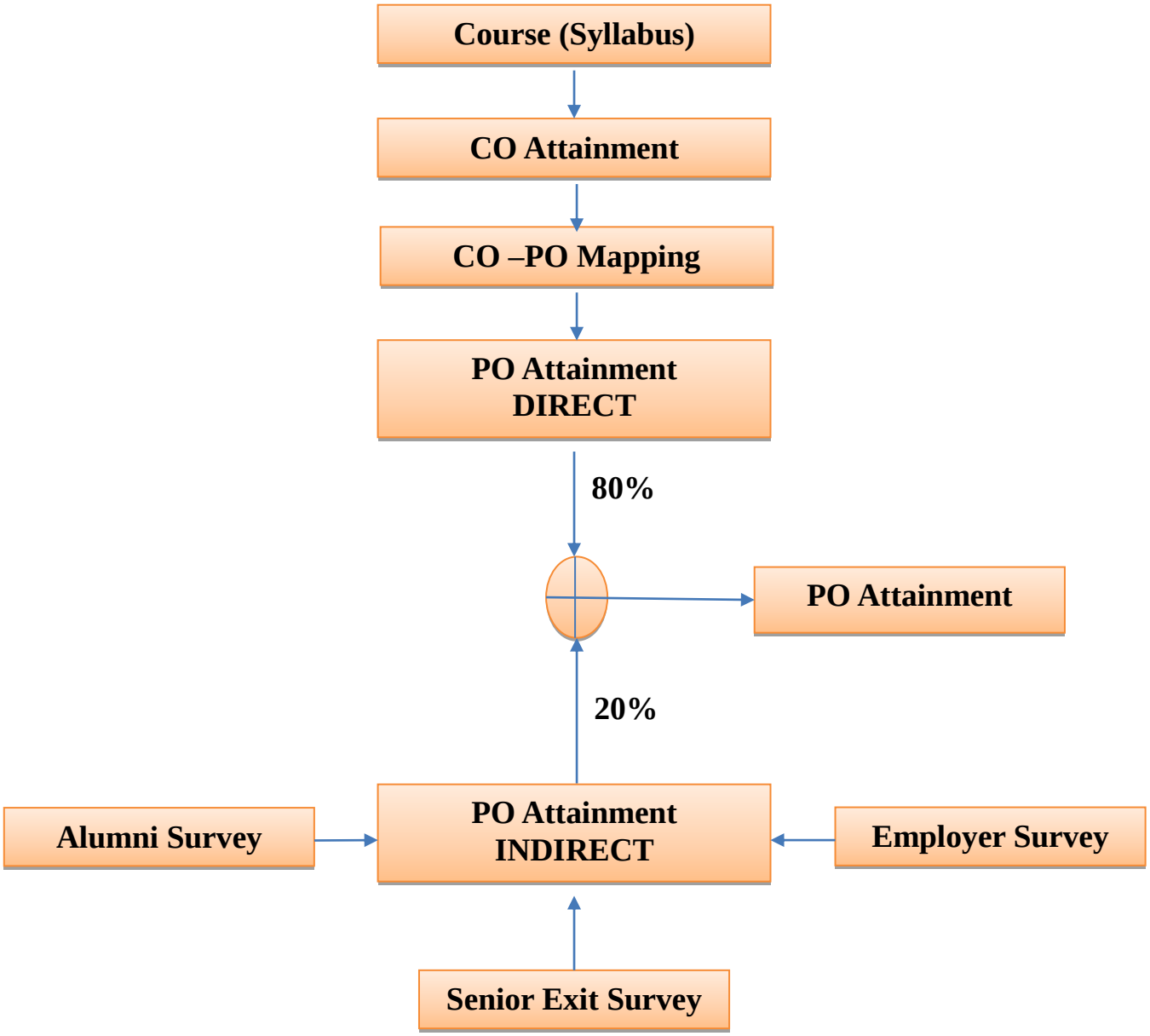
PROCESS FOR COURSE OUTCOME ATTAINMENT



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.