Rashtreeya Sikshana Samithi Trust

R.V COLLEGE OF ENGINEERING

(Autonomous Institution affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysuru Road
Bengaluru – 560 059

SCHEME & SYLLABUS

5th to 8th Semesters

Information Science and Engineering

(2016 Scheme)

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)

PEO	Description
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 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.

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 softwares 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

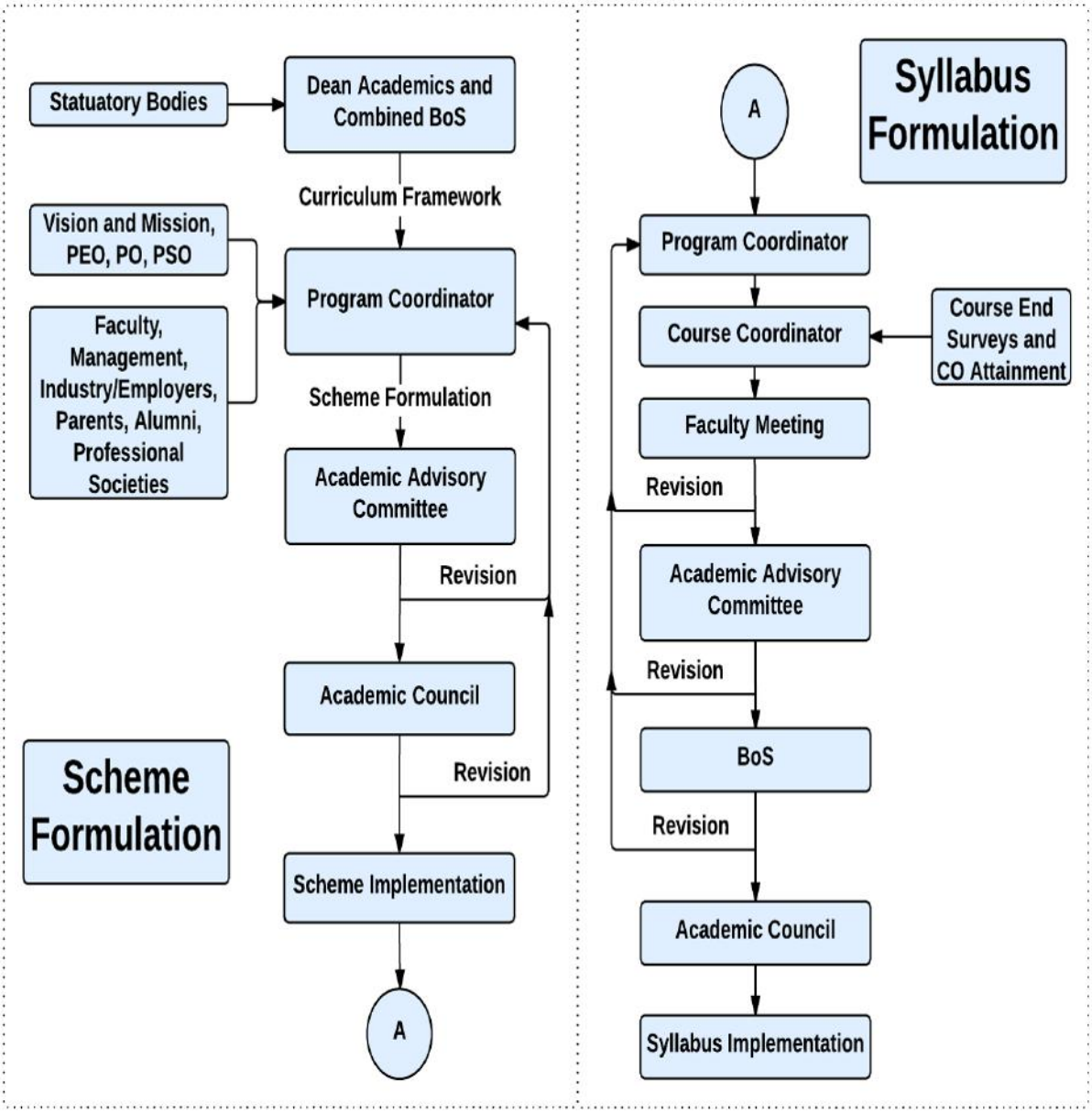
All programs seeking accreditation from the Computing Accreditation Commission of ABET must demonstrate that they satisfy all of the specific Program Criteria implied by the program title.

PROGRAM CRITERIA FOR COMPUTER SCIENCE AND SIMILARLY NAMED COMPUTING PROGRAMS

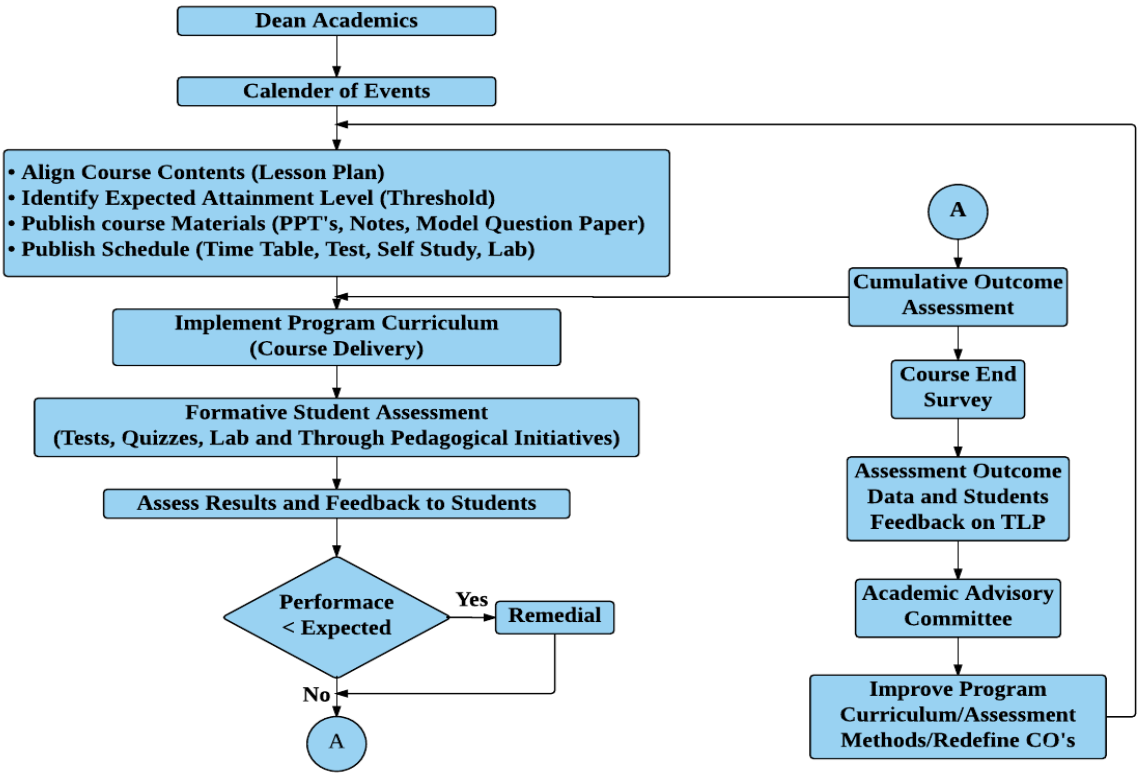
Lead Society: CSAB

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 atleast 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]

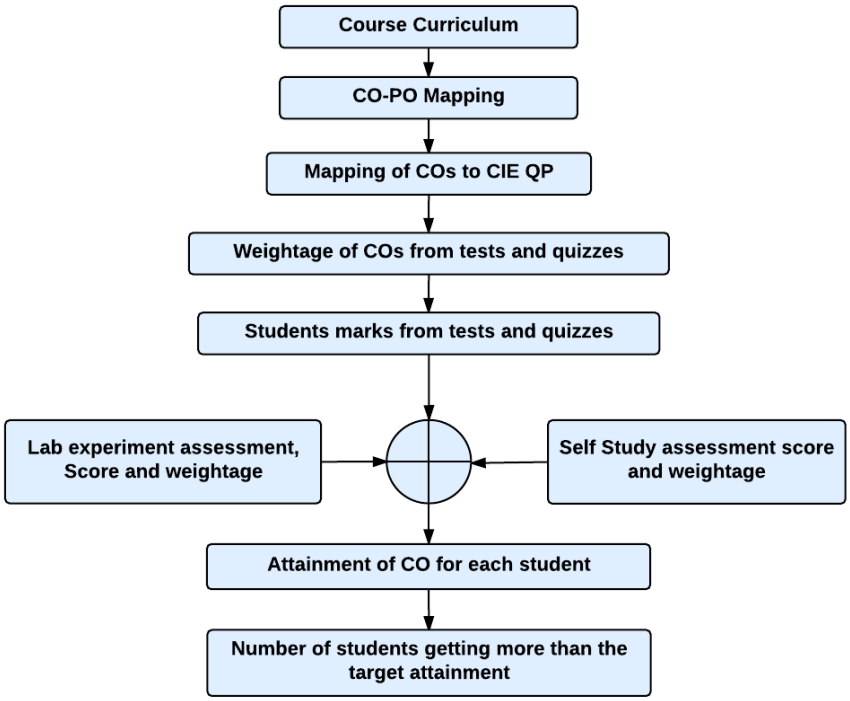
CURRICULUM DESIGN PROCESS



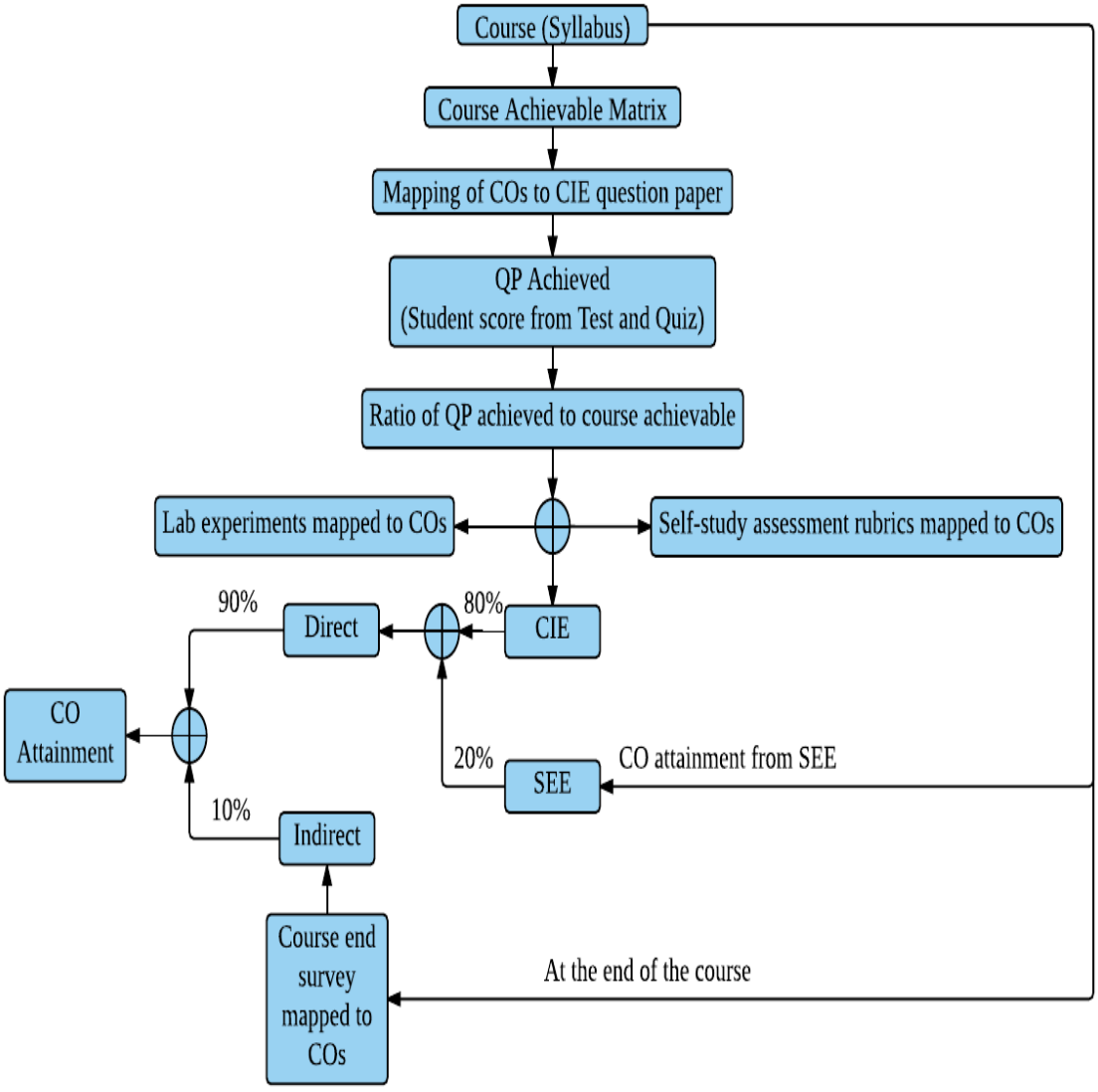
ACADEMIC PLANNING AND IMPLEMENTATION



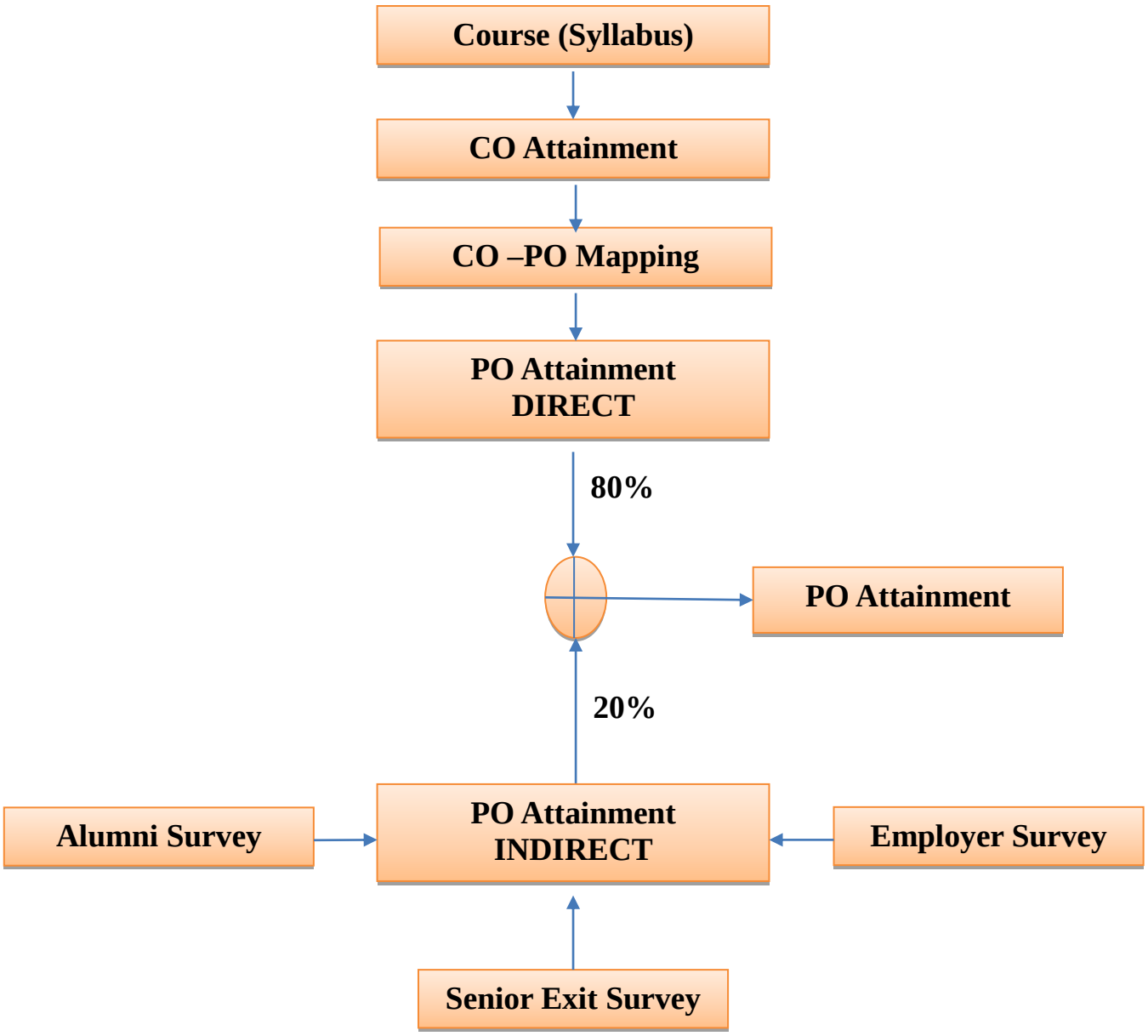
PROCESS FOR COURSE OUTCOME ATTAINMENT



CO ATTAINMENT PROCESS



PROGRAM OUTCOME ATTAINMENT PROCESS



Guidelines for Fixing Targets

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

Credits Distribution as per UGC/VTU

Sl. No.	Category	Percentage (%)	Minimum No. of credits	2016 scheme	
				Without Mini Project	With Mini Project
1	Humanities	5-10	10	9+2	9+2
2	Basic Science	15-20	30	30	30
3	Engineering Science	15-20	30	30	30
4	Professional Core Courses (PC)	30-40	60	78+3=81 (3 credits core in place of Minor project in 7th semester)	81-3=78 (3 Credits for minor project in 7th semester)
5	Professional Elective Courses	10-15	20	20	20
6	Other Electives	5-10	10	10	10
7	Project Work	10-15	20	16+2 Major project +Tech. Seminar	16+2+3 Major project +Tech. Seminar +Mini Project
				200	200

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

FIFTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS (EL)**	
1	16HSI51	IPR & 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)		3	0	0	1	4
7	16GB5XX	Elective B (OE)		4	0	0	0	4
		Total No. of Credits						28
		No. Of Hrs.					**	

**Non contact hours

Elective A (PE)		Elective B (OE)	
16IS5A1	Natural Language Processing with Python	16G5B09	Introduction to Management Information System
16IS5A2	Management Information System		
16IS5A3	Information Theory and Coding		
16IS5A4	Java and J2EE		
16IS5A5	Advanced Algorithm		

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

SIXTH SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS (EL)**	
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(O E)		3	0	0	0	3
8	16HSE68	Professional Practice-III (Employability Skills and Professional Development of Engineers)$$	HSS	1	0	0	0	1
		Total No. of Credits						27
		No. Of Hrs.					**16	

$$ 3 days (18 Hrs) in 5th semester and 3 days (18 Hrs) in 6th semester **Non contact hours

Elective C (PE)	Elective Title	Elective D (PE)	Elective Title	Elective E (OE)	Elective Title
16IS6C1	Information Security	16IS6D1	Machine Learning and Pattern Recognition	16GE6E09	Introduction to Mobile Application Development
16IS6C2	System Simulation and Modeling	16IS6D2	Wireless Sensor Networks		
16IS6C3	Supply Chain Management	16IS6D3	Fuzzy Logic and Genetic Algorithm		
16IS6C4	Mobile Application Development	16IS6D4	Advanced Compiler Design		
16IS6C5	Data Storage Technologies and Networking	16IS6D5	Computer System Performance Analysis		

Semester: V		
Course Title: Intellectual Property Rights And Entrepreneurship		
Course Code:16HSI51		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Build awareness on the various forms of IPR and to educate on the link between technology innovation and IPR
2	Promote linkages with industries and stimulate research through developing and utilizing novel technologies.
3	Assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur.
4	Acquire the skills and knowledge related to the various phases in the venture creation process such as creating a business model and building a prototype

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 – a. Meaning and Definition, E-Cell, Entrepreneurial DNA, Traits and Gap analysis, Entrepreneurial Success Stories, Creative and Design Thinking, Communication, **Personal Selling**: Show and Tell, Risk -taking and Resilience. Concept of prototyping, Idea Validation (Product-Market Fit), Early attempts to sell the product or service, **Understand customer perspective**: how the proposed product/solution will be used, value perception, Early insights on customer segmentation - primary customer segment, alternate customer segments, Early insights on pricing, cost and margins.	**08 Hrs**

UNIT-V	
Business Model and Plan: Develop and validate a business model, Visioning for venture, Marketing the Business, Establish the success and operational metrics , Minimum Viable Product and the lean method, **Managing start - up finance**, Customer Development and Experience, Early insights on cost of customer acquisition, Clarifying the value proposition. Legal and regulatory aspects for starting up specific to the venture. Enhancing the growth process and creating scalability ((customers, market share and/or sales).	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Comprehend the applicable source, scope and limitations of Intellectual Property within the perview of engineering domain.
2	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.
3	Learn about opportunity discovery and evaluation of viable business ideas for new venture creation.

Reference Books	
1.	Wadehra B L "Law Relating to Intellectual Property", 5th Edition Publisher: Universal Law Pub Co. Ltd.-Delhi, ISBN: 9789350350300, 9350350300, 5th Edition, 2012
2.	Prabuddha Ganguly, "Intellectual Property Rights: Unleashing Knowledge Economy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1st Edition, 2001. ISBN: 0074638602.
3.	Rodney Ryder "Intellectual Property and the Internet", Publisher Lexis Nexis U.K., 2002 ISBN: 8180380025, 9788180380020

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

		What	To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	C I E	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/Self -study		2 phases	10/20	Reports / Record Books			
	S E E	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: V		
Course Title: Theory of Computation		
Course Code:16IS52		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand various Computing models like Finite Automata, Pushdown Automata, and Turing Machine and their limitations.
2	Be aware of formal languages and their equivalence to different computing models.
3	Understand different language representations like grammars and regular expressions and their equivalence with different languages.
4	Be aware of Decidability and Un-decidability of various 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.	Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2008, ISBN: 9788131720479
2.	John C Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007. ISBN 13: 9780070660489
3.	MichealSipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997, ISBN:978-0-557-24979-4
4.	Peter Linz, "An Introduction To Formal Languages & Automata", VI Edition, Narosa Publishing House, 2007, ISBN:978-1-4496-1552-9

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	3	1	-	-	-	-	-	2	2	3	2	-
CO2	2	3	2	1	1	-	-	-	2	1	1	1	3	-	-
CO3	2	2	1	1	-	-	-	-	-	-	1	1	3	3	-
CO4	3	2	2	2	-	-	-	-	1	-	1	3	3	1	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS52	2	2	2	2	1	-	-	-	1	1	1	2	3	2	-

Low-1 Medium-2 High-3

Semester: V		
Course Title: Computer Networks		
Course Code:16IS53		**CIE Marks: 100**
Credits: L:T:P:S: 3:1:0:0		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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: Magenetic 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. **The Medium Access Control Sublayer:** The Channel Allocation Problem : Static channel Allocation, Dynamic channel allocation, Multiple Access Protocols: Aloha, CSMA, collision free Protocols, Limited- Contention protocols, Wireless LAN Protocols, Data Link Layer Switching: Uses of bridges, Spanning tree bridges, Repeaters, Hubs, Bridges, Switches, Routers and Gateways, Virtual LANs.	**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.	Andrew S Tannenbaum, David J Wetherall, "Computer Networks", 5th Edition, Pearson Publications.ISBN-13: 978-0-13-212695-3.
2.	James F. Kurose, Keith W. Ross – "Computer Networking, A Top-Down Approach Featuring the Internet", 6th Edition, Pearson Education, 2012, ISBN: 0132856204, 9780132856201.
3.	Behrouz A. Forouzan – "Computer Networks, A Top Down Approach", Special Indian Edition, Tata McGraw Hill, 2012, ISBN-13: 978-1-25-900156-7.
4.	William Stallings – "Data and Computer Communication", 10th Edition, Pearson Education, 2010, ISBN-10: 0131392050.ISBN-13: 978-0-13-212695-3.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment /Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**3**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**
CO3	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**
CO4	**3**	**2**	**2**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**-**
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS53	**3**	**2**	**2**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**-**

Low-1 Medium-2 High-3

Semester: V		
Course Title: Introduction to Parallel Programming		
Course Code:16IS54		**CIE Marks: 100 + 50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100 + 50**
Hours: 35		**SEE Duration: 3 Hrs**

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

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

Parallel Programming with OpenMP and MPI
Laboratory Component

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.

<table>
<tr><th colspan="4">Continuous Internal Evaluation (CIE)</th></tr>
<tr><th colspan="2">(Theory – 100 Marks)</th><th colspan="2">(Laboratory- 50 Marks)</th><th>Total (150)</th></tr>
<tr><th>Evaluation method</th><th>Course with assignment</th><th colspan="2"></th><th></th></tr>
<tr><td>Quiz -1</td><td>10</td><td rowspan="3">Performance of the student in the laboratory, every week</td><td rowspan="3">40</td><td rowspan="7"></td></tr>
<tr><td>Test -1</td><td>50</td></tr>
<tr><td>Quiz -2</td><td>10</td></tr>
<tr><td>Test -2</td><td>50</td><td rowspan="3">Test at the end of the semester</td><td rowspan="3">10</td></tr>
<tr><td>Quiz -3</td><td>10</td></tr>
<tr><td>Test -3</td><td>50</td></tr>
<tr><td>Self Study</td><td>20</td><td rowspan="3">Total</td><td rowspan="3">50</td></tr>
<tr><td colspan="2">Final Evaluation
Quiz – 10 + 10 + 10 = 30;
Test = 50 + 50 + 50 = 150 Reduced to 50;
Self Study = 20</td></tr>
<tr><td>Total</td><td>100</td><td>150</td></tr>
</table>

<table>
<tr><th colspan="5">Semester End Evaluation (SEE)</th></tr>
<tr><th colspan="2">Theory (100 Marks)</th><th colspan="2">Laboratory(50 Marks)</th><th>Total (150)</th></tr>
<tr><td>Part- –A
Objective type questions</td><td>20</td><td>Experiment Conduction with proper results</td><td>40</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">Part –B
There should be five questions from five units. Each question should be for maximum of 16 Marks.

The UNIT-1, UNIT-4 and UNIT-5 should not have any choice.

The UNIT-2 and UNIT-3 should have an internal choice.
Both the questions should be of the same complexity in terms of COs and Bloom’s taxonomy level.</td><td rowspan="2">80</td><td>Viva</td><td>10</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Total</td><td>100</td><td>Total</td><td>50</td><td>150</td></tr>
</table>

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	-	3	-	-	-	-	-	-	-	**2**	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	1	**2**	-	-
CO3	3	2	-	3	3	-	-	2	2	-	-	3	-	**2**	-
CO4	3	3	2	2	2	1	1	-	-	-	-	2	-	**3**	**1**
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS54	3	2	-	1	2	1	-	-	-	-	-	2	2	2	-

Low-1 Medium-2 High-3

Semester: V		
Course Title: System Software		
Course Code:16IS55		**CIE Marks: 100 + 50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100 + 50**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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	
Machine Architecture: System software and machine architecture, Simplified instructionalComputer (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**

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

Laboratory Component

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

Continuous Internal Evaluation (CIE)				
(Theory – 100 Marks)		**(Laboratory- 50 Marks)**		**Total (150)**
Evaluation method	**Course with assignment**			
Quiz -1	10	Performance of the student in the laboratory, every week	40	
Test -1	50			
Quiz -2	10			
Test -2	50	Test at the end of the semester	10	
Quiz -3	10			
Test -3	50			
Self Study	20			
Final Evaluation Quiz – 10 + 10 + 10 = 30; Test = 50 + 50 + 50 = 150 Reduced to 50; Self Study = 20		**Total**	**50**	
Total	**100**			**150**

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	40				
		Lab Test		Test	10	Answer Scripts			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

	CO-PO Mapping												CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	-	-	-	1	-	-	-	1	-	-
CO2	3	3	3	3	2	-	-	-	1	-	-	-	2	-	-
CO3	3	3	3	2	3	-	-	-	2	2	-	-	-	1	-
CO4	3	3	3	3	3	-	-	-	3	2	-	-	-	2	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS55	3	3	3	3	3	-	-	-	-2	1	-	-	1	1	-

Low-1 Medium-2 High-3

Semester: V		
Course Title: Natural Language Processing With Python		
Course Code:16IS5A1		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to		
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	**08 Hrs**

Parsing **Applications:** Machine translation, Text summarization, Word-sense disambiguation, phrase-based translation, sentiment analysis, document classification	

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**

Total	100

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Synthesis and Evaluation

1. Regular class will be conducted by explaining the NLP packages by executing the programs in the system and students are expected to execute programs in the regular class.

   Regular classes provide students first-hand experience with course concepts and the opportunity to explore methods used.
2. All CIE's will be conducted as open book exam. Students will be executing programs in the lab and evaluation will be done during the program execution.
3. Final CIE marks is based on CIE-I,II and III and programming assignments.

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	3	3	-	-	-	-	-	-	-	-	1	-
CO2	1	2	3	3	2	-	-	-	-	2	-	-	2	-	-
CO3	2	1	2	3	3	-	-	-	-	2	-	2	2	1	-
CO4	2	1	2	1	2	-	-	-	-	-	-	-	-	-	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS5A1	2	2	3	3	3	-	-	-	-	2	-	2	2	1	-

Low-1 Medium-2 High-3

Semester: V		
Course Title: Management Information Systems		
Course Code:16IS5A2		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 45		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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.	Kenneth C. Laudon and Jane P. Laudon: "Management Information System, Managing the Digital Firm", 14th Global edition, Pearson Education, 2016, ISBN:9781292094007.
2.	James A. O' Brien, George M. Marakas: "Management Information Systems", Global 10th Edition, McGraw Hill, 2011, ISBN: 978-0072823110.
3.	Steven Alter: "Information Systems The Foundation of E-Business", 4th Edition, Pearson Education, 2002, ISBN:978-0130617736.
4.	W.S. Jawadekar: "Management Information Systems", Tata McGraw Hill 2006, ISBN: 9780070616349.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	3	-	1	-	-	-	1	-	-	1	-	1	-	1
CO2	1	2	-	1	-	-	-	1	-	-	1	-	-	2	-
CO3	-	-	3	2	2	-	-	1	-	1	1	-	2	2	-
CO4	-	-	2	1	-	-	-	1	-	1	1	-	-	-	3
Course – CO-PO Mapping													**Course – PSO Mapping**		
16IS5A2	1	1	1	1	1	-	-	-	-	-	-	-	1	1	1

Low-1 Medium-2 High-3

Semester: V		
Course Title: Information Theory And Coding		
Course Code:16IS5A3		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 45		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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 paritycodes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC.	**09Hrs**
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.	R Bose, “Information Theory, Coding and Cryptography”, Second Edition, TMH 2013,ISBN : 9788126536801
2.	Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Pearson Education Asia, 2012,ISBN: 0-13-035548-8.
3.	K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2012,ISBN: 9780124157965
4.	S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2010,ISBN 13. 9780198562313

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom’s taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	2	-	-	3	-	1
CO2	-	3	-	-	-	-	-	-	-	2	-	-	2	-	-
CO3	-	3	-	2	3	-	-	-	-	-	-	-	3	1	-
CO4	3	2	3	-	-	-	-	-	-	-	2	1	-	3	-
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS5A3	3	3	3	2	3	-	-	-	-	2	2	1	3	2	1

Low-1 Medium-2 High-3

Semester: V		
Course Title: Java And J2EE		
Course Code:16IS5A4		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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.	**08 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.	Herbert Schildt, "Java 7 The Complete Reference", McGraw-Hill Osborne Media,8th Edition, 2011, ISBN: 9780071606301.
2.	Kogent learning solution, "Java Server Programming Java EE7 J2EE 1.7", Dreamtech press,2015. ISBN-13: 9789351194170
3.	H.M Deitel and P.J. Deitel, "Java How to Program", Pearson Education, 10th Edition, ISBN: 9780133807806
4.	Bruce Eckel, "Thinking in Java", Pearson Education, 4thEdition, 2006, ISBN: 0131872486.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	-	-	-	-	-	-	-	-	-	1	3	-	1
CO2	2	2	2	-	3	-	-	-	1	1	-	-	-	-	3
CO3	2	2	3	-	2	-	-	2	2	1	2	-	-	-	3
CO4	3	2	2	-	2	-	-	-	-	-	2	-	-	3	-
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS5A3	2	2	2	-	2	-	-	2	1	1	2	1	1	3	3

Low-1 Medium-2 High-3

Semester: V		
Course Title: Advanced Algorithm		
Course Code:16IS5A5		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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.	**09Hrs**
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.	**08Hrs**

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What	To whom	Frequency of	Max Marks	Evidence	Contribution to Course Outcome

				conduction					
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	3	-	-	-	2	2	-	3	**1**	**1**	-
CO2	3	3	2	-	-	-	-	-	3	-	3	3	-	-	-
CO3	3	2	3	3	-	-	-	-	3	2	-	3	**2**	-	-
CO4	3	2	2	-	-	-	-	-	3	-	3	3	-	**2**	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS5A5	3	3	2	3	3	-	-	-	3	2	3	3	2	2	-

Low-1 Medium-2 High-3

Global B Electives offered

V SEMESTER

Sl. No	Course	Course Code	Offering Dept.
1.	Bioinformatics	16G5B01	Biotechnology
2.	Fuel Cell Technology	16G5B02	Chemical Engineering
3.	Geoinformatics	16G5B03	Civil Engineering
4.	Graph Theory	16G5B04	Computer Science Engineering
5.	Artificial Neural Networks &Deep Learning	16G5B05	Electronics & Communication Engineering
6.	Hybrid Electric Vehicles	16G5B06	Electrical & Electronics Engineering
7.	Optimization Techniques	16G5B07	Industrial & Management Engineering
8.	Sensors & Applications	16G5B08	Electronics & Instrumentation Engineering
9.	Introduction To Management Information Systems	16G5B09	Information Science Engineering
10.	Industrial Automation	16G5B10	Mechanical Engineering
11.	Telecommunication Systems	16G5B11	Telecommunication Engineering
12.	Computational advanced numerical methods	16G5B12	Maths

Semester: V		
Course Title: Bioinformatics		
Course Code: 16G5B01		**CIE Marks:100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:100**
Hours:45		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to

1	Understand the underlying technologies of Bioinformatics and Programming
2	Explore the various algorithms behind the computational genomics and proteomic structural bioinformatics, modeling and simulation of molecular systems.
3	Apply the tools and techniques that are exclusively designed as data analytics to investigate the significant meaning hidden behind the high throughput biological data
4	Analyze and evaluate the outcome of tools and techniques employed in the processes of biological data preprocessing and data mining
5	Use effective tools and powerful techniques to compose innovative ideas to tackle potential challenges in the field of Biotechnology and chemical engineering

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.	**09 hrs**

Object Oriented Programming in Perl – Class and object, Polymorphism, inheritance and encapsulation. Perl Package – writing and calling package. Perl Module – writing and calling module.	

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 Sequence display and Annotation.	**09 hrs**

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, Paper back 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)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation (SEE) Theory (100 Marks)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

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

Low-1 Medium-2 High-3

Semester: V		
Course Title: Fuel Cell Technology		
Course Code: 16G5B02		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours:36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand 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	Learn about 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	**07 Hrs**
UNIT-II	
Fuel Cell Types: Classification of fuel cells, alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, advantages and disadvantages of each	**07 Hrs**
UNIT-III	
Fuel Cell Reaction Kinetics: activation kinetics, open circuit voltage, intrinsic maximum efficiency, voltage efficiency, Faradaic efficiency, overall efficiency, over-voltages and Tafel equation.	**08 Hrs**
UNIT-IV	
Fuel Cell Characterization: current – voltage curve, in-situ characterization, current – voltage measurement, current interrupt measurement, cyclic voltammetry, electrochemical impedance spectroscopy and ex-situ characterization techniques.	**07 Hrs**
UNIT-V	
Applications of Fuel Cells: applications of fuel cells in various sectors, hydrogen production, storage, handling and safety issues	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concepts of fuel cells and their kinetics.
CO2	Apply thermodynamics and chemical engineering principles to evaluate performance of a fuel cell
CO3	Analyze the performance of various fuel cells based on efficiencies and characteristics
CO4	Evaluate the possibility of replacing conventional energy systems with fuel cells.

Reference Books	
1.	Viswanathan and M Aulice Scibioh, Fuel Cells – "Principles and Applications", First Edition, Universities Press, 2009, ISBN – 13: 978 1 420 06028 7
2.	James Larminie and Andrew Dicks, "Fuel Cell Systems Explained", Second Edition, John Wiley & Sons, 2003, ISBN – 978 0 470 84857 9
3.	O 'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, "Fuel Cell Fundamentals", First Edition,

	Wiley, NY, 2006, ISBN – 978 0 470 25843 9
4	Bard, A. J. , L. R., Faulkner, "Electrochemical Methods", First Edition, Wiley, N.Y., 2004, ISBN – 978 0 471 04372 0
5	Basu. S, "Recent Trends in Fuel Cell Science and Technology", First Edition, Springer, N.Y., 2007, ISBN – 978 0 387 68815 2

In case of a course having only theory, the following minimum guidelines may be followed

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

CO - PO Mapping

	CO – PO Mapping												**CO – PSO Mapping**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	1	-	-	-	-	-	-	1	-
CO2	2	2	1	-	-	2	2	-	-	-	-	1	1	2	1
CO3	2	3	1	2	2	2	2	-	2	-	-	1	1	2	2
CO4	3	3	3	3	2	3	3	1	2	1	2	2	2	3	2

Low-1 Medium-2 High-3

Semester: V		
Course Title: Geoinformatics		
Course Code:16G5B03		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 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	**09 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	**09 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	**09 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	**08 Hrs**

area. Case studies on agriculture. **Applications of geo-informatics in natural resources management: Geo Technical case Studies**, site suitability analysis for various applications.	

Course Outcomes: After completing the course, the students will be able to	
CO1	To remember and understand the principle of Remote Sensing (RS) and Geographical Information Systems (GIS) data acquisition and its applications.
CO2	To apply RS and GIS technologies in various fields of engineering and social needs.
CO3	To analyze and evaluate the information obtained by applying RS and GIS technologies.
CO4	To create a feasible solution in the different fields of application of RS and GIS.

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **One mark and two mark questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Elective B		
Course Title: Graph Theory		
Course Code:16G5B04		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**

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

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

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **One mark and two mark questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100 %	90%
		Test		Two	50				
		Self-study		2 phases	20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Course - PO Mapping												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Course	2	2	2	1	-	1	-	-	2	2	-	1

CO –PSO Mapping		
CO/PSO	**PSO1**	**PSO2**
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1

Course – PSO Mapping		
	PSO1	**PSO2**
Course	2	1

Low-1 Medium-2 High-3

Semester: V		
Course Title: Artificial Neural Networks &Deep Learning(Global Elective)		
Course Code: 16G5B05		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 46		**SEE Duration: 3 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.	**09 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.	**09 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.	**09 Hrs**
UNIT-V	
Deep learning Introduction to deep learning for visual computing, Texture characterization – statistical vs. structural, Co-occurrence matrices, Orientation histograms, Local binary patterns (LBP), Texture from Fourier features; Wavelets hierarchy of machine learning, Hierarchical reasoning achieved in a multi-layer perceptron. Autoencoder for Representation Learning and MLP Initialization: Autoencoders for representation learning, Initialization of weights in a multi layer perceptron, Stacked, Sparse, Denoising Autoencoders and Ladder Training ,Introduction to Convolutional	**09 Hrs**

Neural Networks (CNN) and LeNet , Recurrent Neural Networks (RNN) for Video Classification	

Course Outcomes: After completing the course, the students will be able to	
CO1	Model Neural Network, Neuron 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	Develop detailed mathematical treatment of another class of layered networks: radial basis function networks

Reference Books	
1.	Simon Haykins, "Neural Network- A Comprehensive Foundation", Pearson Prentice Hall, 2nd Edition, 1999. ISBN-13: 978-0-13-147139-9/ISBN-10: 0-13-147139-2
2.	Zurada and Jacek M, "Introduction to Artificial Neural Systems", West Publishing Company, 1992, ISBN: 9780534954604
3.	Vojislav Kecman,"Learning & Soft Computing", Pearson Education, 1st Edition, 2004, ISBN:0-262-11255-8
4.	M T Hagan, H B Demoth, M Beale, "Neural Networks Design", Thomson Learning, 2002. ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7
5.	Goodfellow, Y, Bengio, A. Courville, "Deep Learning", MIT Press, 2016. S. Haykin, "Neural Networks and Learning Machines",3e,Pearson, 2008

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **One mark and two mark questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice.	**80**

Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: V				
Course Title: Hybrid Electric Vehicles				
Course Code: 16G5B06		**CIE Marks**	**:**	**100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks**	**:**	**100**
Hours: 36		**SEE Duration**	**:**	**03 Hrs**

Course Learning Objectives (CLO): Graduates shall be able to,

1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2	Analyze various electric drives suitable for hybrid electric vehicles
3	Discuss different energy storage technologies used for hybrid electric vehicles and their control.
4	Demonstrate modeling and simulation of electric hybrid vehicles 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, PHEV Design and Component Sizing, Component Sizing of EREVs, Component Sizing of Blended PHEVs, HEV to PHEV Conversions, Other Topics on PHEVs, Vehicle-to-Grid Technology. **Power Electronics in HEVs:** Rectifiers Used in HEVs, PWM Rectifier in HEVs, EV and PHEV, Emerging Power Electronics Devices, Circuit Packaging, Thermal Management of HEV Power Electronics	**08 Hrs**
Unit – III	
. **Batteries, Ultracapacitors, Fuel Cells, and Controls:** Introduction, Different batteries for EV, Battery Characterization, Comparison of Different Energy Storage Technologies for HEVs, Modelling Based on Equivalent Electric Circuits, 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. **Vehicular Power Control Strategy and Energy Management:** A Generic Framework, Definition, and Needs, Methodology to Implement, Benefits of Energy Management.	**07 Hrs**
Unit – IV	

Electric Machines and Drives in HEVs: Introduction, 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**)	**07 Hrs**
Unit – V	
Modelling and Simulation of Electric and Hybrid Vehicles: Introduction, Fundamentals of Vehicle System Modelling, HEV Modelling Using ADVISOR, HEV Modelling Using PSAT, Physics-Based Modelling, Bond Graph and Other Modelling Techniques, Consideration of Numerical Integration Methods, Conclusion. **HEV Component Sizing and Design Optimization**: Introduction, Global Optimization Algorithms for HEV Design, Model-in-the-Loop Design Optimization Process, Parallel HEV Design Optimization Example, Series HEV Design Optimization Example, Conclusion.	**07 Hrs**

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	Analyse the use of different power electronics devices and electrical machines in hybrid electric vehicles
CO3	Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
CO4	Simulate electric hybrid vehicles by different techniques for the performance analysis

Reference Books:	
1.	Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives", Wiley Publisher, 1st Edition, 2011,*ISBN*:0-824-77653-5
2.	Dubey G.K. "Power Semiconductor controlled drives", Prentice Hall inc, A division of Simon andSchester England cliffs, New Jersey 1989.ISBN-13: 978-0136868903
3.	M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. NewDelhi, Fourth Edition, 1994, ISBN-13: 978-0133125900
4.	R. Krishnan, "Electric motor drives: modeling, analysis and control, P.H.I Private Ltd. NewDelhi, Second Edition, 2001, ISBN 10: 0130910147 / ISBN 13: 9780130910141
5.	Bimal K Bose, "Modern Power Electronics and AC Drives" P.H.I Private Ltd. New Delhi, Second Edition, 2001, **ISBN-13:** 978-0130167439.

Text Books:	
1.	Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2nd Edition, 2003.
2.	James Larminie, John Lowry, “Electric Vehicle Technology”, Wiley publications, 1st Edition, 2003.
3.	B D McNicol, D A J Rand, “Power Sources for Electric Vehicles”, Elsevier publications, 1st Edition, 1998.
4.	Seth Leitman, “Build Your Own Electric Vehicle” MC Graw Hill, 1st Edition, 2013.
e- Books:	
1. https://www.onlinelibrary.wiley.com/book/10.1002/9781119998914 2. https://www.go2hev.com/hybrid-electric-vehicles-student-textbook.html 3. https://www.sciencedirect.com/science/book/9780444535658 4. https://accessengineeringlibrary.com/browse/hybrid-electric-vehicle-design-and-control-intelligent-omnidirectional-hybrids.	

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B	**80**
Total	**100**

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

CO1	3	2	2	2	1	2	2	1	1	2	0	1	2	2	1
CO2	3	2	2	3	3	0	1	0	1	1	1	2	3	3	1
CO3	3	2	2	3	2	2	2	1	1	2	2	2	2	2	1
CO4	3	3	3	3	2	3	2	0	1	1	1	1	3	2	1

Low- 1 Medium-2 High-3

Semester: V
Course Title: Optimization Techniques

Course Code: 16G5B07		**CIE Marks**	**:**	**100**
Credits: L: T: P: S:4:0:0:0		**SEE Marks**	**:**	**100**
Hours: 44		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO): Graduates shall be able to,	
1	Understand the concepts behind optimization techniques.
2	Explain the modeling frameworks for solving problems using optimization techniques.
3	Design and develop optimization models for real life situations.
4	Analyze solutions obtained using optimization methods.
5	Compare models developed using various techniques for optimization.

Unit – I	
Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel. **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables.	**09 Hrs**
Unit – II	
Duality and Sensitivity Analysis: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Primal-Dual relationships, Economic interpretation of duality, Post optimal analysis - changes affecting feasibility and optimality, Revised simplex method	**09 Hrs**
Unit – III	
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	**08 Hrs**
Unit – IV	
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 $M/E_k/1$ 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 completing the course, the students 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.	Taha H A, "Operation Research An Introduction", PHI, 8th Edition, 2009, ISBN: 0130488089.
2.	Philips, Ravindran and Solberg – "Principles of Operations Research – Theory and Practice", John Wiley & Sons (Asia) Pte Ltd, 2nd Edition, 2000, ISBN 13: 978-81-265-1256-0
3.	Hiller, Liberman, Nag, Basu, "Introduction to Operation Research", Tata McGraw Hill 9th Edition, 2012, ISBN 13: 978-0-07-133346-7
4.	J K Sharma, "Operations Research Theory and Application", Pearson Education Pvt Ltd, 4th Edition, 2009, ISBN 13: 978-0-23-063885-3.
5.	Prof. J Govardhan, "Principles, Methodology and Applications of Operations Research", JEM Consultants, 3rd Edition, 2012

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of Cos and Bloom's taxonomy level.	**80**
Total	**100**

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

CO2	2	3	3	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	2	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	-	1	-	-	-	-	-	-	-	-	-	-

Low-1 Medium-2 High-3

Semester: V			
Course Title: Sensors & Applications			
Course Code:16G5B08		**CIE Marks: 100**	
Credits: L:T:P:S:4:0:0:0		**SEE Marks: 100**	
Hours: 43		**SEE Duration(Theory): 3 Hrs**	
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: Transducers: 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. **Thermocouple:** Measurement of thermocouple output, compensating circuits, lead compensation, advantages and disadvantages of thermocouple.	**09 Hrs**
UNIT-II	

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. **Piezo-electric Transducers:** Principles of operation, expression for output voltage, piezo-electric materials, equivalent circuit, loading effect, and Problems.	**10 Hrs**
UNIT-III	
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, Photocell, Photo-FET, Photocell, 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, Dual slope integrated type ADC, Flash ADC, 8-bit ADC-0808, Programmable Gain Amplifier.	**06 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	A.K. Sawhney "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, 18th Edition, 2008, ISBN 81-7700-016-0.
2	Clarence W.de Silva, "Sensor systems: Fundamentals and applications" CRC Press, 2016 Edition, ISBN 9781498716246.
3	D.V.S. Murthy "Transducers and Instrumentation", PHI Publication, 2nd Edition 2008, ISBN 978-81-203-3569-1.
4	Arun K. Ghosh, "Introduction to Measurement and Instrumentation", PHI 3rd Edition, 2009, ISBN: 978-81-203-3858-6.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10

Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A Objective type questions	**20**
Part –B There should be 5 questions from 5 units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO MAPPING

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

Low-1 Medium-2 High-3

Semester: V		
Course Title: Industrial Automation		
Course Code:16G5B10		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 44		**SEE Duration: 3 Hrs**
Course Learning Objectives: The students should be able to:		
1	Identify types of actuators, sensors and switching devices for industrial automation	
2	Explain operation and controls of Hydraulic and Pneumatic systems	
3	Understand fundamentals of CNC, PLC and Industrial robots	
4	Define switching elements and sensors which are interfaced in an automation system	
5	Describe functions of Industrial switching elements and Inspection technologies for automation	
6	Select sensors to automatically detect motion of actuators	
7	Develop manual part programs for CNC and Ladder logic for PLC	
8	Develop suitable industrial automation systems using all the above concepts	

UNIT-I	
Automation in Production Systems: Manufacturing support systems, Automation principles and strategies, Levels of Automation, Production Concepts and Mathematical models, Numericals **Automated Production Lines:** Fundamentals, Applications, Analysis with no storage, Analysis with storage buffer, Numericals	**08 Hrs**
UNIT-II	
Switching theory and Industrial switching elements: Binary elements, binary variables, Basic logic gates, Theorems of switching algebra, Algebraic simplification of binary function, Karnough maps, Logic circuit design, problems. Electromechanical relays, Moving part logic elements, Fluidic elements, Timers, Comparisons between switching elements, Numericals **Industrial Detection Sensors and Actuators:** Introduction, Limit switches, Reed	**08 Hrs**

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	
UNIT-III	
Hydraulic Control circuits: Components, Symbolic representations, Control of Single and Double Acting Cylinder, Regenerative Circuit application, Pump unloading circuit, Double Pump Hydraulic System, speed control circuits, accumulator circuits **Pneumatic Control circuits:** Components, Symbolic representations as per ISO 5599, Indirect control of double acting cylinders, memory control circuit, cascading design, automatic return motion, quick exhaust valve circuit, and cyclic operation of a cylinder, pressure sequence valve and time delay valve circuits.	**10 Hrs**
UNIT-IV	
Introduction to CNC : Numerical control, components of CNC, classification, coordinate systems, motion control strategies, interpolation, programming concepts **Industrial Robotics:** Components of Robots, base types, classification of robots, end of arm tooling, robot precision of movement, programming, justifying the use of a robot, simple numericals	**08 Hrs**
UNIT-V	
Programmable logic control systems Difference between relay and PLC circuits, PLC construction, principles of operation, latching, ladder diagrams, programming instructions, types of timers, forms of counters, writing simple ladder diagrams from narrative description and Boolean logic. **Programming exercises on PLC with Allen Bradley controller** Programming exercises on motor control in two directions, traffic control, annunciator flasher, cyclic movement of cylinder, can counting, conveyor belt control, alarm system, sequential process, and continuous filling operation on a conveyor.	**10 Hrs**

Course Outcomes: After completing the course, the students will be able to	
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.	David W. Pessen, "Industrial automation; Circuit design and components", Wiley India, 1st Edition, 2011, ISBN –13–978–8126529889
2.	Joji P, "Pneumatic Controls", Wiley India, 1st Edition, ISBN – 978–81–265–1542–4
3.	Anthony Esposito, "Fluid Power with Applications", 7th Edition, 2013, ISBN – 13; 978– 9332518544

4.	Mikell P. Groover "Automation, Production systems and Computer Integrated Manufacturing", 3rd Edition, 2014, ISBN – 978–81–203–3418–2

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		Consisting of Part-A and Part-B	100	Answer Scripts	20%		

Indirect Assessment methods	Course End Survey	Students	End of course		Questionnaire Based on COs	10%

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		
Course Title: Telecommunication Systems		
Course Code :16G5B11		**CIE Marks:100**
Credits: L: T:P:S: 3:0:0:4		**SEE Marks :100**
Hours:40		**SEE Hrs:3 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. **Radio Receivers:** TRF, Super heterodyne receiver, Frequency conversions, Intermediate and Image Frequency.	**08 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, Telephone and Cable Modems. **Multiplexing and Multiple Access Techniques:** Frequency division multiplexing, Time division multiplexing, Multiple Access: FDMA, TDMA, CDMA, Duplexing.	**08 Hrs**
UNIT III	
Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.	**08 Hrs**
UNIT IV	
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	**08 Hrs**
UNIT V	
Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse. Advanced Mobile Phone System (AMPS) **Digital Cell Phone Systems:** 2 G, 2.5 G, 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.	**08 Hrs**

Course outcomes: After completion of 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.	Louis E. Frenzel, "Principles of Electronic Communication Systems", Tata McGraw Hill 3rdEdition 2008, ISBN: 978-0-07-310704-2.
2.	Roy Blake, "Electronic Communication Systems", Thomson/Delamar, 2nd edition, 2002, ISB: 978-81-315-0307-2.
3.	George Kennedy, "Electronic Communication Systems", Tata McGraw Hill 3rdEdition 2008, ISBN: 0-02-800592-9.
4.	Anu A. Gokhale "Introduction to Telecommunications", Cengage Learning, 2ndEdition 2008, ISBN: 981-240-081-8.

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluationwithin the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: V		
Course Title: Computational Advanced Numerical Methods		
Course Code: 16G5B12		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 43		**SEE Duration: 3 Hrs**

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 and partial differential equations.
4	Demonstrate elementary math functions, application of M-files to solve mathematical problems using MATLAB.

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 - cubic spline interpolation.	**08 Hrs**
Unit -III	
Differential Equations: Solution of first and second order ODE using spline interpolation. Boundary value problems (BVP's)–Trapezoidal method and Shooting method. Finite Difference method for elliptic, parabolic and hyperbolic partial differential equations.	**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	
M-Files And Computational Techniques: The use of function M-files, M-files for Fixed point iterative method, Aitken's – process, Muller's method, Chebychev method, Newton's divided difference method. Hermite interpolation, Cubic spline interpolation, Power method, Inverse Power method. Trapezoidal method, Shooting method, Elliptic, Parabolic and Hyperbolic partial differential equations, Jacobi method and Givens method.	**09 Hrs**

Course outcomes: On completion of the course, the student should have acquired the ability to	
CO1	Identify and interpret the fundamental concepts of Polynomials and roots of equations, Finite differences, Eigen values and Eigen vectors and corresponding M-files.
CO2	Apply the knowledge and skills of numerical methods to solve algebraic and transcendental equations, Solution of ODE using spline interpolation, Eigen value problems numerically using M-files.
CO3	Analyze the physical problem to establish mathematical model and use appropriate method to solve and optimize the solution of roots of equations in engineering practice, interpolating the polynomial, Boundary value problems of ODE and PDE, Eigen value problems numerically using M-files.
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 practical situations.

Reference Books:	
1	Steven C Chapra, Raymond P Canale; "Numerical Methods for Engineers", Tata Mcgraw Hill;5th edition; 2011; ISBN-10: 0-07-063416-5.
2	K. Sankara Rao; "Partial Differential Equations"; Prentice-hall of India; 3rd edition; 2012; ISBN: 978-81-203-3217-1.
3	M K Jain, S. R. K. Iyengar, R. K. Jain; "Numerical methods for scientific and engineering computation"; New Age International Publishers; 6th edition; 2012; ISBN-13: 978-81-224-2001-2.
4	Curtis F. Gerald and G. Patrick; "Applied Numerical Analysis", Wheately-Pearson Education Ltd; 7th Edition; 2004; ISBN-13: 978-0321133045.
e Books and online learning materials:	
1	http://books.google.co.in/books/about/Advanced_Engineering_Mathematics.html?id=9nFDvk9yr3kC&redir_esc=y
2	http://ocw.mit.edu/courses/mathematics/
Online Courses and Video Lectures:	
1	http://nptel.ac.in/courses.php?disciplineId=111
2	https://www.khanacademy.org/
3	https://www.class-central.com/subject/math (MOOCS)

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

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

Semester: VI		
Course Title: Foundations of Management & Economics		
Course Code:16HEM61		**CIE Marks: 50**
Credits: L:T:P:S: 2:0:0:0		**SEE Marks: 50**
Hours: 24		**SEE Duration: 2 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the evolution of management thought.	
2	Acquire knowledge of the functions of Management.	
3	Gain basic knowledge of essentials of Micro economics and Macro economics.	

UNIT-I	
Introduction to Management: Management Functions, Roles & Skills, Management History – Classical Approach: Scientific Management & Administrative Theory, Quantitative Approach: Operations Research, Behavioral Approach: Hawthorne Studies, Contemporary Approach: Systems & Contingency Theory.	**03 Hrs**
UNIT-II	
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate & Competitive Strategies.	**04 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. **Managers as Leaders:** Behavioral 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.	**05 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.	**06 Hrs**
UNIT-V	
Essentials of Macroeconomics: Prices and inflation, Exchange rate, Gross domestic product(GDP) , components of GDP, the Labor 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	**06 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.	Stephen Robbins, Mary Coulter & Neharika Vohra, "Management", Pearson Education Publications, 10th Edition, ISBN: 978-81-317-2720-1.
2.	James Stoner, Edward Freeman & Daniel Gilbert Jr, "Management, PHI, 6th Edition, ISBN: 81-203-0981-2.
3.	Douglas Bernheim B & Michael D Whinston, Microeconomics,TMHPub.Co.Ltd, 2009 Edition, ISBN: 13:978-0-07-008056-0.
4.	Dwivedi.D.N, Macroeconomics: Theory and Policy, McGraw Hill Education; 3rd Edition,2010,ISBN-13: 978-0070091450.

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.
In case of a course having both Theory & Lab, the following minimum guidelines may be followed

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment** **Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks.		**Viva**	10	

The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**			
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Web Programming		
Course Code: 16IS62		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 35		**SEE Duration: 3 Hrs**

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

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B	

There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Semester: VI		
Course Title: Software Engineering And Testing		
Course Code:16IS63		**CIE Marks: 100 + 50**
Credits: L:T:P:S: 3:0:1:1		**SEE Marks: 100 + 50**
Hours: 35		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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	List software quality standards and outline the 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,	**07Hrs**
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.	**07Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Articulate and document the requirements to Systemsmap to meet desired needs within realistic constraints
CO2	Apply and use the Project Management techniques, skills and modern engineering tools necessary for engineering practice.
CO3	Analyze, design, implement, verify, validate, implement, apply, and maintain software systems or parts of software systems.
CO4	professional and ethical responsibility of Software Engineers.

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

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

<table>
<tr><th colspan="5">Continuous Internal Evaluation (CIE)</th></tr>
<tr><th colspan="2">(Theory – 100 Marks)</th><th colspan="2" rowspan="2">(Laboratory- 50 Marks)</th><th rowspan="2">Total (150)</th></tr>
<tr><th>Evaluation method</th><th>Course with assignment</th></tr>
<tr><td>Quiz -1</td><td>10</td><td rowspan="3">Performance of the student in the laboratory, every week</td><td rowspan="3">40</td><td rowspan="9"></td></tr>
<tr><td>Test -1</td><td>50</td></tr>
<tr><td>Quiz -2</td><td>10</td></tr>
<tr><td>Test -2</td><td>50</td><td rowspan="3">Test at the end of the semester</td><td rowspan="3">10</td></tr>
<tr><td>Quiz -3</td><td>10</td></tr>
<tr><td>Test -3</td><td>50</td></tr>
<tr><td>Self Study</td><td>20</td><td rowspan="2">Total</td><td rowspan="2">50</td></tr>
<tr><td colspan="2">Final Evaluation
Quiz – 10 + 10 + 10 = 30;
Test = 50 + 50 + 50 = 150 Reduced to 50;
Self Study = 20</td></tr>
<tr><td>Total</td><td>100</td><td></td><td></td><td>150</td></tr>
</table>

Semester End Evaluation (SEE)

Theory (100 Marks)		Laboratory(50 Marks)		Total (150)
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping															
CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	3	3	-	1	2	2	-	-	-	1	1	1	2
CO2	-	2	2	2	-	1	2	2	3	3	3	2	-	-	2
CO3	1	3	2	2	2	2	2	2	2	2	-	1	3	2	-
CO4	-	-	-	-	-	-	-	3	-	-	-	1	2	-	3
16IS63	-	2	2	2	-	1	2	3	-	-	-	1	2	2	3

Low-1 Medium-2 High-3

Semester: VI

Course Title: Database Management Systems			
Course Code:16IS64			**CIE Marks: 100 + 50**
Credits: L:T:P:S: 3:0:1:1			**SEE Marks: 100 + 50**
Hours: 35			**SEE Duration: 3 Hrs**
Course Learning Objectives: The students will be able to			
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	**07 Hrs**

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.	
UNIT-IV	
Overview of Transaction Management The ACID property, Transaction and schedules, 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.	**07 Hrs**
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**

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

Laboratory Component:

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

<table>
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<tr><th colspan="2">(Theory – 100 Marks)</th><th colspan="2" rowspan="2">(Laboratory- 50 Marks)</th><th rowspan="2">Total (150)</th></tr>
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<tr><td>Quiz -1</td><td>10</td><td rowspan="3">Performance of the student in the laboratory, every week</td><td rowspan="3">40</td><td rowspan="9"></td></tr>
<tr><td>Test -1</td><td>50</td></tr>
<tr><td>Quiz -2</td><td>10</td></tr>
<tr><td>Test -2</td><td>50</td><td rowspan="3">Test at the end of the semester</td><td rowspan="3">10</td></tr>
<tr><td>Quiz -3</td><td>10</td></tr>
<tr><td>Test -3</td><td>50</td></tr>
<tr><td>Self Study</td><td>20</td><td rowspan="3">Total</td><td rowspan="3">50</td></tr>
<tr><td colspan="2">Final Evaluation
Quiz – 10 + 10 + 10 = 30;
Test = 50 + 50 + 50 = 150 Reduced to 50;
Self Study = 20</td></tr>
<tr><td>Total</td><td>100</td><td>150</td></tr>
</table>

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	1	3	1	-	-	-	1	-	-	1	1	3	-
CO2	3	3	1	3	3	-	-	-	-	-	-	2	-	3	-
CO3	2	2	2	3	-	-	-	-	1	-	-	1	-	2	-
CO4	2	3	2	2	1	-	-	-	-	-	-	1	-	3	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS64	2	3	2	3	2	-	-	-	1	-	-	1	1	2	-

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Information Security		
Course Code: 16IS6C1		**CIE Marks:100**
Credits :L:T:P:S: 3:0:0:1		**SEE Marks:100**
Hours: 44		**SEE Duration : 3Hrs**

Course Learning Objectives: The students will be able to

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.	**09 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.	**09 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, Avaliability, Reliability and Integrity: Two phase update, Redundancy, Recovery, Concurrency,Monitors. Sensitive data, Access decisions, Types of Disclosures, Security Vs Precision	**09 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	**09 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.	**08 Hrs**

Note : Students are advised to use SWEBOK for experiential learning available at http://www.ieeelms.com/rvce

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.	**80**

The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**	
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	1	1	-	-	-	-	1	3	-	-
CO2	3	2	2	1	-	1	1	-	-	-	-	1	3	-	1
CO3	3	3	3	2	2	2	2	-	-	-	-	3	3	1	-
CO4	2	3	3	2	3	2	-	-	-	-	-	1	3	1	-
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS6C1	3	3	3	2	2	2	1	-	-	-	-	2	3	1	1

Low-1 Medium-2 High-3

Semester: VI		
Course Title : System Simulation and Modelling		
Course Code:16IS6C2		**CIE Marks:100**
Credits: L:T:P:S: 3:0:0:1		**SEE Marks:100**

Hours:44		SEE Duration : 3 Hrs
Course Learning Objectives: The students will be able to		
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.	**09 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.	**09 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	**09 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.	**09 Hrs**

Expected 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 variates and apply them to develop simulation models
CO4	Analyze output data produced by a model and test validity of the model
Reference Books	
1	John A. Sokolowski, Catherine M. Banks, " Principles of Modeling and Simulation: A Multidisciplinary Approach", Wiley, 2009,ISBN: 978-0-470-28943-3

2	Jerry Bank, John S. Carson II, Barry L. Nelson, David M. Nicol ,"Discrete-Event System Simulation" , Pearson, fifth edition, 2009, ISBN-13: 978-0136062127
3	Frank L. Severance ,"System Modeling and Simulation: An Introduction", John Wiley & Sons,2001, ISBN-13: 978-0471496946
4	Bernard P. Zeigler, Herbert Praehofer, Tag GonKim,"Theory of Modeling and Simulation", Academic Press, Second Edition, 2000, ISBN-13: 978-0127784557

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
ses sm	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				

		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	1	1	2	2	-	-	-	-	1	1	3	2	-
CO2	2	2	2	1	1	-	-	-	1	-	1	1	3	-	-
CO3	2	2	3	2	-	-	-	-	1	1	1	2	3	3	-
CO4	3	3	2	1	1	1	-	1	1	2	1	2	3	1	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS6C2	3	3	2	1	1	1	-	-	1	1	1	1	3	2	-

Low-1Medium-2 High-3

Semester: VI		
Course Title :Supply Chain Management		
Course Code:16IS6C3		**CIE Marks:100 + 50**
Credits: L:T:P:S:3:0:0:1		**SEE Marks:100 + 50**

Hours:44		SEE Duration: 3 Hrs

Course Learning Objectives: The students will be able to

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

09 Hrs

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.

UNIT-II

09 Hrs

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.

UNIT-III

09 Hrs

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.

UNIT-IV

09 Hrs

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 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.	**08Hrs**

Note: Students are advised to use SWEBOK for experiential learning available at

http://www.ieeelms.com/rvce

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment** **Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What	To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome

Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Semester: VI		
Course Title : Mobile Application Development		
Course Code: 16IS6C4		**CIE Marks:100**
Credits: L:T:P:S:3:0:0:1		**SEE Marks:100**
Hours:44		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to

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 vsVoLTE. 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.	**10 Hrs**
UNIT-II	
User experience: User interaction, User Input Controls, Menus, Screen Navigation, RecyclerView, Delightful user experience, Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts, Testing app UI, Testing the User Interface	**09 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.	**09 Hrs**
UNIT-V	
Hardware Support & devices, Permissions and Libraries, Performance and Security. Firebase and AdMob, Publish and Polish, Multiple Form Factors, Using Google Services.	**08Hrs**

Note : Students are advised to use SWEBOK for experiential learning available at http://www.ieeelms.com/rvce

Expected 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	Phillips, Stewart, Hardy and Marsicano; "Android Programming", Big Nerd Ranch Guide;2nd Edition, 2015; ISBN-13 978-0134171494
2	Neil Smyth, "Android Studio Development Essentials - Android 6, Createspace Independent Publishing Platform", 2015, ISBN: 9781519722089
3	Eric Hellman; "Android Programming – Pushing the limits", by Hellman; Wiley; 2013; ISBN-13: 978-1118717370
4	Reto Meier; "Professional Android 2 Application Development", Wiley India Pvt.ltd; 1st Edition; 2012; ISBN-13: 9788126525898
5	Mark Murphy; "Beginning Android 3" ; 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)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice.	**80**

The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	3	-	-	-	-	-	-	2	1	1	-
CO2	3	-	-	-	3	-	-	-	-	-	1	2	1	2	1
CO3	-	3	3	-	3	-	1	-	-	2	1	3	2	3	2
CO4	3	3	3	1	3	2	1	2	2	1	1	3	3	3	3
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS6C4	3	3	3	1	3	2	1	1	2	1	1	2	2	3	2

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Data Storage Technologies and Networking		
Course Code:16IS6C5		**CIE Marks: 100**
Hrs/Week: L:T:P:S: 3:0:0:1		**SEE Marks: 100**
Credits:45		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to

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.	**09 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	**09 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.	**09 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 RecoverPoint	**09 Hrs**
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.	**09 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 Education Services, "EMC^2: "Information Storage and Management", Willey India, 2nd Edition, 2013, ISBN-13: 978-1118094839.
2	Robert Spalding, "Storage Networks: "The Complete Reference", Tata McGraw Hill India, 1st Edition, 2003, ISBN: 9780070532922.
3	Ulf Troppens, Rainer Erkens, Wolfgang Muller-Friedt, Rainer Wolafka, Nils Haustein, "Storage Networks Explained", Wiley India, 2nd Edition, 2009, ISBN: 978-0-470-74143-6
4	Marc Farley, "Building Storage Networks", Tata McGraw Hill India, 2nd Edition, 2001, ISBN-13: 978-0070447455.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Self Study	20
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 50, Self Study 20	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		

Indirect Assessment methods	Course End Survey	Students	End of course		Questionnaire Based on COs	10%

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	-	-	-	-	-	-	-	-	-	-	3	-	1
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	2	-	-	2	-	-	-	-	-	-	-	3	-	-
CO4	1	2	-	-	2	-	-	-	-	-	-	-	-	-	3
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS6C5	1	2	2	-	2	-	-	-	-	-	-	-	3	2	2

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Machine Learning and Pattern Recognition		
Course Code:16IS6D1		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours:44		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
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: Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm, Remarks on version spaces and Candidate Elimination, Inductive bias.	**08 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.	**09 Hrs**
UNIT-III	
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.	**09 Hrs**
UNIT-IV	
Nearest Neighbor based classifiers & Bayes classifier: Nearest neighb or 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.	**09 Hrs**
UNIT-V	
Analytical Learning ,Combining Inductive and analytical learning : Introduction, Learning with perfect domain theories: PROLOG-EBG, Remarks on explanation based learning. Explanation Based Learning of search control knowledge. Motivation – Inductive-Analytical Approaches to learning using prior knowledge to initialise the hypothesis-KBANN algorithm, An illustrative example, using prior knowledge to alter the search objective **Reinforced Learning:** Introduction, Learning task, Q Learning-Q Function, Algorithm for learning Q, Example, Convergence	**09 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	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013, ISBN:978-1-25-909695-2.
2	V SusheelaDevi, M Narsimha Murthy, "Pattern Recognition (An Introduction)", Universities Press, 2011,ISBN : 978-81-7371-725-3.
3	Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer, Reprint 2013,ISBN : 978-81-322-0906-5
4	EthemAlpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd., 3rd Ed., 2015, ISBN: 978-0262-02818-9.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	--	2	1	--	--	--	1	--	--	1	3	2	--
CO2	2	2	--	1	1	--	--	--	--	--	--	1	2	2	--
CO3	3	3	3	3	2	--	--	--	--	--	--	2	1	3	2
CO4	1	2	2	3	1	--	--	--	--	--	--	1	2	1	1
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS6D1	2	3	1	2	1	-	-	-	-	--	--	1	2	2	1

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Wireless Sensor Networks		
Course Code:16IS6D2		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours:44		**SEE Duration:3 Hrs**

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

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and design the various components of aWireless 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 awireless sensor network using the available simulation tools.

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessmen	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			

	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	-	-	-	-	-	3	-	-	3	-	-
CO2	3	2	2	3	-	-	-	-	-	3	-	-	-	2	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	3	3	-	-	-	-	3	2	-	-	-	1
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS6D2	3	3	3	3	2	-	-	-	-	3	2	-	3	2	1

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Fuzzy Logic And Genetic Algorithm		
Course Code:16IS6D3		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours:44		**SEE Duration:3 Hrs**

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

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	-	1	2	-	-	-	-	-	-	-	3	2	-
CO2	1	1	-	-	-	-	-	-	-	1	-	-	3	-	-
CO3	2	1	-	-	-	-	-	-	-	1	-	-	3	3	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	3	1	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS6D3	2	1	-	1	1	-	-	-	-	1	-	-	3	2	-

Low-1 Medium-2 High-3

Semester: VI		
Course Title : Advanced Compiler Design		
Course Code:16IS6D4		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours:44		**SEE Duration:3 Hrs**

Course Learning Objectives: The students will be able to	
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 declarationsTranslation 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**

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	2	2	-	-	-	1	-	-	2	3	3	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS6D4	3	2	2	2	1				1			1	3	2	-

Semester: VI		
Course Title : Computer System Performance Analysis		
Course Code: 16IS6D5		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours: 45		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
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. **Queueing Analysis:** Queuing Network models, basic assumptions and notation, Operational analysis, stochastic analysis, summary.	**09 Hrs**

Note : Students are advised to refer to NPTEL course for assignments.

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													CO-PSO Mapping		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	1	2	-	-	-	-	-	-	-	3	2	-
CO2	1	2	1	-	-	-	-	-	-	1	-	-	3	-	-
CO3	2	2	-	-	-	-	-	-	-	1	-	-	3	3	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	3	1	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS6D5	2	2	1	1	1	-	-	-	-	1	-	-	3	2	-

Low-1 Medium-2 High-3

Global Electives offered
VI SEMESTER

Sl. No	Course	Course Code	Offering Dept.
1.	Bioinspired Engineering	16GE6E01	Biotechnology
2.	Green Technology	16GE6E02	Chemical Engineering
3.	Solid Waste Management	16GE6E03	Civil Engineering
4.	Introduction To Web Programming	16GE6E04	Computer Science Engineering
5.	Automotive Electronics	16GE6E05	Electronics & Communication Engineering
6.	Industrial Electronics	16GE6E06	Electrical & Electronics Engineering
7.	Project Management	16GE6E07	Industrial & Management Engineering
8.	Virtual Instrumentation	16GE6E08	Electronics & Instrumentation Engineering
9.	Introduction To Mobile Application Development	16GE6E09	Information Science Engineering
10.	Automotive Engineering	16GE6E10	Mechanical Engineering
11.	Mobile Network System And Standards	16GE6E11	Telecommunication Engineering
12.	Partial Differential Equations	16GE6E12	Maths

Semester: VI

Course Title: Bioinspired Engineering

(Theory)

Course Code:16G6E01		**CIE Marks:100**
Credits: L:T:P:S:3:0:0:0		**SEE Marks:100**
Hours:33		**SEE Duration : 3 Hrs**

Course Learning Objectives: The students will be able to

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 of smart structures, self-healing materials and biosimilars
4. To gain an understanding, that the design principles from nature can be translated into novel devices and structures.

UNIT-I	
Introduction to Biology: Biomolecules-Proteins, carbohydrates, lipids and Nucleic acids. Cell types- Microbial, plant, animal. Stem cells. Antibodies. Organ system- Circulatory, digestive, respiratory, excretory and nervous system.	**07 Hrs**
UNIT II	
Nature as a source of Inspiring innovation: Super hydrophobic and self-cleaning surfaces - lotus leaf effect, Ultrasonography - echolocation of bats and whales, high performance fibers and flexible medical tapes - silk processing and assembly by insects and spiders, Velcro - plant burrs. Strong light weight structure: Honey comb structures.	**07 Hrs**
UNIT III	
Biomimetics – Orthopedic; Artificial hips, discs and artificial knees. Dental; Dentures, tooth cap, single tooth and multiple tooth replacement. Cardiovascular; Heart pacemakers, coronary stents, implantable cardioverter-defibrillator. Sense organs: Optical; Artificial lenses, retinal implant. Auditory; cochlear implant, ear tubes,	**07 Hrs**
UNIT IV	
Biosimilar Drugs: Basics of Biosimilars, FDA approval, Current status of Biosimilars, Ten most used drugs: Pharmaceutical and Biotech drugs, eg; Clinical development of insulin biosimilar.	**06 Hrs**
UNIT V	
Biological inspired process and products: Biosensors -natural recognition receptors. Artificial senses- Electronic nose and tongue. Bionic eyes.Artificial muscles. Plant as Bio-inspirations: Plant process- Photosynthesis. Bionic leaf and Photovoltaic cells	**06 Hrs**

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

CO1	Remember and explain the fundamental aspects of Biology
CO2	Differentiate biological phenomena to support inspiration for visual and conceptual design problems.
CO3	Analyze and comprehend the applications of biological, self-healing materials and biosimilars.
CO4	Address the problems associated with the interaction between living and non-living materials and systems.

Text Books	
1	Donald Voet, Charlotte W. Pratt. Principles of Biochemistry: International Student Version. Wiley John and Sons, 2012. ISBN: 1118092449.
2	Jen- Louios Prugnaud, Jean-Hugues Trouvin. Biosimilars. A New Generation of Biologics. Springer-Verlag Paris. 2011. 9782817803357
3	Yoseph Bar-Cohen, Biomimetics-Nature Based Innovation, 2011, CRC press, ISBN: 9781439834763
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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation (SEE) Theory (100 Marks)	
Part- –A	**20**
Objective type questions	**80**
Part –B	
There should be five questions from five units.	
Each question should be for maximum of 16 Marks.	
The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice.	
The **UNIT-2 and UNIT-3** should have an internal choice.	
Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

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

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Green Technology		
Course Code: 16G6E02		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours:36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
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.	**08 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.	**07 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, 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.	**07Hrs**
UNIT-V	
Hydrogen, Hydrogen Energy: Introduction, methods of hydrogen production (principles only), storage transportation, utilization of hydrogen gas, hydrogen as alternative fuel for motor vehicle, safety and management, hydrogen technology development in India **Application of Green Technology:** Electronic waste management, bioprocesses, green composite materials, green construction technology **Sustainability of industrial waste management:** Case studies on cement industry, iron and steel industry, petroleum sectors, marble and granite industry, sugar industry.	**07Hrs**

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

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

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks.	
The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom"s taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

CO-PO Mapping												
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	2	2	3	2	-	2	-	2
CO2	3	3	3	2	3	3	3	-	-	2	2	-
CO3	3	3	3	2	2	3	3	-	-	-	3	-
CO4	3	3	3	3	2	3	3	-	-	-	3	-

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Solid Waste Management		
Course Code: 16G6E03		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 34		**SEE Duration: 3Hrs**

Course Learning Objectives: The students will be able to	
1	Impart the knowledge of present methods of solid waste management system and to analyze the drawbacks.
2	Understand various waste management statutory rules.
3	Analyze different elements of solid waste management , design and develop recycling options for biodegradable waste by composting.
4	Identify hazardous waste, e-waste, plastic waste and bio medical waste and their management systems.

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

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the existing solid waste management system and to identify their drawbacks.
CO2	Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste.
CO3	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.
CO4	Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment & Forest.

Text Books	
1.	Integrated Solid Waste Management: Engineering principles and management issues George Tchobanoglous, Hilary Theisen , Samuel A Vigil, published by M/c Graw hill Education . Indian edition 2014. ISBN – 13: 978- 9339205249, ISBN-10 : 9339205243
2.	Environmental Engineering, Howard S Peavy, Donald R Rowe and George Tchobanoglous, Tata Mcgraw Hill Publishing Co ltd., 2013, ISBN-13 9789351340263.
3.	R.E. Hester, Roy M Harrison, "Electronic waste management", Cambridge, UK, RSC Publication, 2009, ISBN 9780854041121

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **One mark and two mark questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping

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

Low-1 Medium-2 High-3

CO-PSO Mapping

CO/PO	PSO1	PSO2	PSO3	PSO4
CO1	2	-	-	-
CO2	2	-	-	-
CO3	3	2	-	-
CO4	3	2	-	-

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Introduction To Web Programming		
Course Code: 16G6E04		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

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

UNIT-I	
Introduction to Web Concepts: Fundamentals of Web, HTML 5 - Core HTML attributes, headings, paragraphs and breaks, divisions and centering, quotations, preformatted text, lists, horizontal rules, block-level elements, text-level elements.XHTML – 1: Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox. XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links.XHTML (continued): Lists, Tables, Forms, Frames.	**07 Hrs**
UNIT-II	
Cascading Style Sheets (CSS): Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **The Basics of JavaScript:** Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements;	**09 Hrs**
UNIT-III	
JavaScript (continued): Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts. **JavaScript and HTML Documents:** The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object; DOM tree traversal and modification.	**09 Hrs**
UNIT-IV	
Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. **Introduction to PHP:** Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling; Files; Cookies; Session Tracking.	**06 Hrs**
UNIT-V	
XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML	**05 Hrs**

documents with CSS; XSLT Style sheets; XML processors; Web services.	

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, Pearson Education, 2013,ISBN: ISBN-13:978-0132665810.
2.	"Web Programming Building Internet Applications:, Chris Bates, 3rd Edition, Wiley India, 2006, ISBN : 978-81-265-1290-4.
3.	"Internet & World Wide Web How to H program", M. Deitel, P.J. Deitel, A. B. Goldberg, 2004, 3rd Edition, 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)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Course - PO Mapping												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Course	1	-	2	-	2	1	1	-	1	-	-	2

CO –PSO Mapping		
CO/PSO	**PSO1**	**PSO2**
CO1	-	-
CO2	2	1
CO3	2	-
CO4	3	-

Course – PSO Mapping		
	PSO1	**PSO2**
Course	2	1

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Automotive Electronics		
Course Code: 16G6E05		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

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).	**07 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. Use of Actuators: Types, Working principle..	**08 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. Objective of Electronic Engine control. Spark Ignition and Compression Ignition Engines and their electronic controls. Engine management testing: Engine management system strategies and implementation.	**0 7 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, Communication protocols for automotive applications. Automotive Buses: Use of various buses such as CAN, LIN, Flex Ray. Recent trends in automotive buses (Such as MOST and D2B). Application of	**07 Hrs**

Telematics in Automotive: Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an automotive environment.	
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. Future trends in Automotive Electronics.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
1	Understand the automotive domain fundamentals and need of electronics in Automotive systems
2	Apply various sensors and actuators for Automotive applications
3	Analyze different control systems and communication interfaces used in automotive systems.
4	Evaluate the performance of telematics Diagnostics and safety norms in Automotive Systems.

Reference Books	
1.	Williams. B. Ribbens, "Understanding Automotive Electronics", Elsevier science, 6th Edition, Newness publication,2003, ISBN-9780080481494.
2.	Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004
3.	Nitaigour Mahalik, "Mechatronics: Principles, Concepts and Applications", TMH, 2003, ISBN:0070483744/9780070483743
4.	Uwekiencke and lars Nielsen, "Automotive Control Systems Engine, Driveline and vehicle", Springer, 2nd Edition, 2005, ISBN 0-387-95368X

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.
In case of a course having both Theory & Lab, the following minimum guidelines may be followed

Continuous Internal Evaluation (CIE)				
(Theory – 100 Marks)		**(Laboratory- 50 Marks)**		**Total (150)**
Evaluation method	**Course with assignment**			
Quiz -1	10	Performance of the student in the laboratory, every week	40	
Test -1	30			
Quiz -2	10			
Quiz -3	10	Test at the end of the semester	10	
Test -2	30			
Assignments	10			
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Semester: VI		
Course Title: Industrial Electronics		
Course Code : 16G6E06		**CIE Marks: 100**
Credits: L:T:P:S 3:0:0:0		**SEE Marks: 100**
Hours : 36		**SEE : 3 Hrs**

Course Learning Objectives:

Assimilate information and techniques for management of electrical energy.

1. Explain the working of power electronic components used in design of electronic circuits of conversion and control of electrical energy in Industry.
2. Apply the strong knowledge base acquired for analyzing and designing electronic circuits which handle the electrical energy efficiently and economically.
3. Sort-out design problems through the practical and industrial exposure acquired.
4. Use basic concepts of practical design and working of electronic circuits for conversion and control of electrical energy.
5. Make use of the opportunities 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.	**07 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(Class A,B,C,D) Gate protection of SCR.Gate drive circuits for SCR.	**07 Hrs**
UNIT – III	
Converters: Single Phase Controlled Convertor- Full wave Half and Fully controlled line commutated bridge converters(R,RL load). Three phase converters –Six pulse converters- with R, RL load- Derivation of average load voltage and current. **Converter applications**: Industrial Applications of Half and Fully controlled converters to DC drive (Control of DC drives). Single phase dual converters	**08 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 and RLE loads of Step down, Step up Chopper, Step up/Down Chopper – load voltage expression.	**07 Hrs**
UNIT – V	
Classification of Choppers and Applications: Type A, Type B, Type C, Type D, Type E choppers and their industrial Applications, Morgan's chopper, Jones chopper (Principle of operation only), AC Chopper –phase control type. **Inverters** – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter, bridge inverter – Voltage control techniques for inverters Pulse width modulation techniques. – UPS-online, offline (Principle of operation only).	**07 Hrs**

Course outcomes:

1. Understand the comprehensive working of different devices and their applications.
2. Analyze the application of skills in controlling and conversion of electrical energy.
3. Evaluate and distinguish the performance of converters and inverters.
4. Ability to implement their knowledge and skills in design of applications.

Reference Books

1. M. D. Singh & K. B. Kanchandhani, "Power Electronics", Tata Mc Graw – Hill Publishin company, ISBN : 978-0-07-058389-4, 2008
2. M. H. Rashid, "Power Electronics : Circuits, Devices and Applications", Prentice Hall of Indi 2nd edition, ISBN : 0131228153, 9780131228153, 2004
3. P.C.Sen, "Power Electronics", Tata McGraw-Hill Publishing, ISBN: 978-0-07-462400-5, 2008.

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**

Total	100

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

Low-1 Medium-2 High-3

Semester: VI				
Course Title: Project Management				
Course Code: 16G6E07		**CIE Marks**	**:**	**100**
Credits: L: T: P: S:3:0:0:0		**SEE Marks**	**:**	**100**
Hours:33		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the principles and components of project management.
2	Appreciate the integrated approach to managing projects.
3	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 completing the course, the students 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.	Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2.	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
3.	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, CBS Publishers and Distributors, 10th Edition, 2009, ISBN 047027806.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of Cos and Bloom's taxonomy level.	**80**
Total	**100**

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	2	-	-	-	-	-	2	-
CO2	1	2	2	1	2	-	-	-	-	-	2	-
CO3	-	2	2	1	2	1	-	-	-	1	2	1

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

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Virtual Instrumentation		
Course Code: 16G6E08		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 34		**SEE Duration(Theory): 3 Hrs**
Course Learning Objectives: The students will be able to		
1	Understand the difference between conventional and graphical programming, basic data acquisition concepts	
2	Differentiating the real time and virtual instrument	
3	Develop ability for programming in LabVIEW using various data structures and program structures	
4	Analyze the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.	

UNIT-I	
Graphical Programming Environment: Basic of Virtual Instrumentation, Conventional and Graphical Programming. Introduction to LabVIEW, Components of LabVIEW and Labels. **Fundamentals:** Data Types, Tool Pallets, Arranging Objects, Color Coding, Code Debugging, Context Help, Creating Sub-VIs Boolean, Mechanical action- switch, and latch actions, String data types, enum, ring, Dynamics.	**05 Hrs**
UNIT-II	
Fundamentals of Virtual Instrumentation Programming: For Loop, While Loop, shift registers, stack shift register, feedback node, and tunnel. **Timing function**: timing VI, elapsed time, wait function. Case structures, formula node, Sequence structures, Arrays and clusters, visual display types- graphs, charts, XY graph. Local and Global variables.	**09 Hrs**
UNIT-III	
Error Handling- error and warning, default error node, error node cluster, automatic and manual error handling. **String Handling:** Introduction, String Functions, LabVIEW String Formats. **File Input/ Output:** Introduction, File Formats, File I/O Functions and file Path functions. **Design patterns:** Producer/consumer, event handler, derived design pattern, Queued message handler, Producer/consumer (events), Producer/consumer (state machine).	**08 Hrs**
UNIT-IV	
Data Acquisition: Introduction to data acquisition, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O, counters, NI-DAQmx	**06 Hrs**

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.	
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	Jovitha Jerome, "Virtual instrumentation Using LabVIEW", PHI Learning Pvt.Ltd,4th Edition,2010, ISBN:978-812034035.
2	Sanjay Gupta & Joseph John, Virtual Instrumentation Using LabVIEW, Tata Mc Graw Hill Publisher Ltd.,2nd Edition, New Delhi, 2010, ISBN : 978-0070700284
3	Lisa. K. Wills, "LabVIEW for Everyone" Prentice Hall of India, 2nd Edition, 2008, ISBN : 978-0132681940
4	Garry Johnson, Richard Jennings, LabVIEW Graphical Programming,4th Edition McGraw Hill Professional, 17-Jul- 2006 ,ISBN No-978- 12595336.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A Objective type questions	**20**

Part –B There should be 5 questions from 5 units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment		2 phases	10/20	Reports / Record Books			
				Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Automotive Engineering		
Course Code: 16G6E10		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 34		**SEE Duration: 3 Hrs**

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	**06 Hrs**

biodiesel.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the different types of automotive systems. (L1- L2)
CO2	Construct the Valve Timing Diagram for multi-cylinder engines. (L3)
CO3	Detect the automotive exhaust pollutants using gas analyzer. (L4)
CO4	Evaluate the performance of engines by determining Brake Power. (L6)

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

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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		
Course Title: Mobile Network System And Standards		
Course Code : 16G6E11		**CIE Marks:100**
Credits: L:T:P:S:3:0:0:0		**SEE Marks :100**
Hours: 40		**SEE Hrs: 3 Hrs**

Course Learning Objectives (CLO): The students will be able to	
1.	Understand land mobile concepts, radio link design and remember different generations of the cellular network.
2.	Analyze and compare the concepts of WPAN, WLAN and WMAN standards and their architecture.
3.	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	**08 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	**08 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.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the architectures and characteristics of different mobile networks.
CO2	Analyze the operation of various network technologies and standards
CO3	Apply the Network standards to a suitable application
CO4	Compare the advantages of various networks

Reference Books	
1.	UpenaDalal , “Wireless Communication” 1st Edition , Oxford higher Eductaion,2009 ISBN-13 :978-0-19-806066-6.
2.	Dr. Sunil Kumar s Manvi “Wireless and Mobile Networks Concepts and Protocols”, Willey India Pvt. Ltd., 2010, ISBN:978-81-265-2069-5
3.	Theodore S Rappaport,” Wireless Communications Principles and practice”, 2nd Edition, Pearson, ISBN 97881-317-3186-4.

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		

Indirect Assessment methods	Course End Survey	Students	End of course		Questionnaire Based on COs	10%

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: VI		
Course Title: Partial Differential Equations (Global Elective)		
Course Code: 16GE6E12		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 35		**SEE Duration: 3 Hrs**

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 and solution of PDE, Cauchy problem, Orthogonal surfaces, First order non-linear PDE-Charpits method, Classification and canonical forms of PDE.	**07 Hrs**
Unit -II	
Elliptic Differential Equations: Derivation of Laplace and Poisson equation, Separation of variable method, Direchlet's problem and 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, IVP and BVP for two-dimensional wave equation, Periodic solution one dimensional wave equation in cylindrical and spherical coordinates, Vibration of Circular membrane.	**07 Hrs**
Unit -V	
Finite Element Methods: Fundamentals- Initial, boundary and eigen value problems, Weighted residual Galerkin and Rayleigh Ritz methods, Basics of variational formulation-Polynomial and Nodal approximation.	**07 Hrs**

Course outcomes: On completion of the course, the student should have acquired the ability to	
CO1	Identify and interpret the formation, classification of parabolic, hyperbolic and elliptic differential equations using the appropriate governing equations and obtain the solution 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 parabolic, hyperbolic and elliptic differential equations arising in practical situations.

Reference Books:	
1	K. Sankara Rao; "Partial Differential Equations"; Prentice-hall of India; 3rd edition; 2012; ISBN: 978-81-203-3217-1.
2	J. N. Reddy; "An Introduction to the finite element method", McGraw Hill, 1985.
3	I. N. Sneddon; "Elements of Partial differential equations", McGraw Hill, 1983.
4	M K Jain, S. R. K. Iyengar, R. K. Jain; "Numerical methods for scientific and engineering computation"; New Age International Publishers; 6th edition;2012;. ISBN-13: 978-81-224-2001-2.
e-Books and online learning materials:	
1	http://books.google.co.in/books/about/Advanced_Engineering_Mathematics.html?id=9nFDvk9yr3kC&redir_esc=y
2	http://ocw.mit.edu/courses/mathematics/
Online Courses and Video Lectures:	
1	http://nptel.ac.in/courses.php?disciplineId=111
2	https://www.khanacademy.org/
3	https://www.class-central.com/subject/math (MOOCS)

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

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

Low-1 Medium-2 High-3

Semester:		
Course Title: Employability Skills and Professional Development of Engineers (V and VI Semester)		
Course Code: 16HSE68		**CIE Marks: 50**
Credits: L:T:P:S:1:0:0:0		**Hours: 32**

Course Learning Objectives: Students are able to

1. Improve qualitative and quantitative problem solving skills.
2. Apply critical and logical thinking process to specific problems.

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	
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 **Technical Documentation** - Introduction 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..	**08 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**

Note: The respective departments should discuss case studies and standards pertaining to their domain

Course outcomes: On completion of the course, the student should have acquired the ability to	
CO1	Develop professional skill to suit the industry requirement
CO2	Analyze problems using quantitative and reasoning skills
CO3	Develop leadership and interpersonal working skills
CO4	Demonstrate verbal communication skills with appropriate body language.

Reference Books:	
1	Stephen R Covey, "The 7 Habits of Highly Effective People", Free Press, 2004 Edition, ISBN: 0743272455
2	Dale Carnegie, "How to win friends and influence people", General Press, 1st Edition, 2016, ISBN: 9789380914787
3	Kerry Patterson, Joseph Grenny, Ron Mcmillan, "Crucial Conversation: Tools for Talking When Stakes are High", McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4	Ethnus, "Aptimithra: Best Aptitude Book", Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in TWO Phases.

Phase	**Activity**	**Weightage**
I	Test 1 is conducted in III Sem for 50 marks (15 Marks Quiz and 35 Marks Descriptive answers) after completion of 2.5 units for 18 hours of training sessions.	50%
II	Test 2 is conducted in IV Sem for 50 marks ((15 Marks Quiz and 35 Marks Descriptive answers) after completion of half of IIIrd unit and complete of unit IV and V for 18 hours of training sessions.	50%
	At the end of the IV sem Marks of Test 1 and Test 2 is consolidated for 50 marks and grading is done.	

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1											
CO2											
CO3											
CO4											

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	**PSO2**	**PSO3**
CO1			
CO2			
CO3			
CO4			

R. V. COLLEGE OF ENGINEERING, BENGALURU – 59.

(An Autonomous Institution affiliated to VTU, Belgavi)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

SEVENTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS (EL)**	
1	16IS71	Human Computer Interaction	ISE	3	0	0	0	3
2	16IS72	Data Science and Engineering	ISE	4	0	1	0	5
3	16IS73	Cryptography and Network Security	ISE	4	0	1	0	5
4	16IS7FX	Elective F (PE)		4	0	0	0	4
5	16IS7GX	Elective G(PE)		4	0	0	0	4
6	16G7HXX	Elective H (OE)		3	0	0	0	3
		Total No. of Credits						24
		No. Of Hrs.						

* EI, EE, CV, EC, ME – 6 hrs. / week Minor Project.

Elective F (PE)	Elective Title	Elective G(PE)	Elective Title	Elective H (OE)	Elective Title
16IS7F1	Internet of Things	16IS7G1	Image Processing and Computer Vision	16G7HXX	Introduction to Internet of Things
16IS7F2	Software Defined Networks	16IS7G2	Cyber Security and Digital Forensics		
16IS7F3	Software Architecture	16IS7G3	Information Retrieval		
16IS7F4	Cloud Computing	16IS7G4	Big Data Analytics		
PE - PROFESSIONAL ELECTIVE			**OE- OTHER ELECTIVES**		

R. V. COLLEGE OF ENGINEERING, BENGALURU – 59.

(An Autonomous Institution affiliated to VTU, Belgavi)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

EIGTH SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**EL**	
1	16ISP81	Major Project		0	0	16	0	16
2	16ISS82	Technical Seminar		0	0	2	0	2
3	16HSS83	Innovation and Social Skills	HSS	0	0	2	0	2
		Total No. of Credits						20
		No. Of Hrs.		0	0	40	0	

Semester: VII		
Course Title : Human Computer Interaction		
Course Code: 16IS71		**CIE Marks:100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks:100**
Hours: 35		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to

1	Demonstrate knowledge of human computer interaction design concepts and related methodologies.
2	Recognize theories and concepts associated with effective user interface design to real-world application.
3	Improve quality and usability of the design, and will understand the theory behind by making use of necessary interfaces.
4	Conceptualize, design and evaluate interactive products systematically.

UNIT-I	
Usability of Interactive Systems: Introduction, Usability goals and Measures, Usability Motivations, Universal Usability, Goals for Our Profession, **Guidelines, Principles, and Theories**: Introduction, Guidelines, Principles, Theories.	**06 Hrs**
UNIT-II	
Managing Design Processes: Introduction, Organizational Design to Support Usability, The Four Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact Statement for Early Design Review, Legal Issues.**Evaluating Interface Designs**: Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation During Active Use Controlled Psychologically Oriented Experiments.	**08 Hrs**
UNIT-III	
Direct Manipulation and Virtual Environment: Introduction Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces Teleoperation, Virtual and Augmented Reality. **Menu Selection, Form Fill-in, and Dialog Boxes:** Introduction, Task-Related Menu Organization, Single Menus, Combinations of Multiple Menus, Content Organization Fast Movement through Menus, Data Entry with Menus: Form Fill-in, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays.	**07 Hrs**
UNIT-IV	
Collaboration and Social Media Participation: Introduction, Goals of Collaboration and Participation, Asynchronous Distributed Interfaces: Different Place, Different Time Synchronous Distributed Interfaces: Different Place, Same Time, Face-to-Face Interfaces: Same Place, Same Time. **Quality of Service:** Introduction, Models of Response Time Impacts Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences.	**07Hrs**
UNIT-V	
Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color. **User Documentation and Online Help:** Introduction, Online versus Paper, Documentation, Reading from Paper versus from Displays, Shaping the Content of the Documentation, Accessing the Documentation, Online Tutorials	**07Hrs**

and Animated Demonstrations, Online Communities for User Assistance, The Development Process. **Information Search:** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interface.	

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate Understanding of Interaction between the human and computer components.
CO2	Apply and analyse HCI design principles and guidelines in the software process.
CO3	Compare and Implement Interaction design rules.
CO4	Design prototypes and come up with methods and criteria for evaluation of the design.

Reference Books	
1	Ben Shneiderman and Catherine Plaisant, "Designing the User Interface: Techniques for Effective Human-Computer Interaction", Pearson Publications, 6th Edition, 2016, ISBN: 9780123822291.
2	Wilbert O Galitz, "The essential guide to user interface design", Wiley, 3rd Ed,2007, ISBN: 978-0-471-27139-0.
3	Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, "Human – Computer Interaction", Pearson 3rd Edition,2004, ISBN 0-13-046109-1.
4	Prece, Rogers, Sharps, "Interaction Design", Wiley, 3rd Edition,2011, ISBN: 978-1-119-02075-2.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	-	1	1	-	-	-	-	-	-	-	-	1
CO2	2	2	3	-	1	-	-	1	-	-	-	-	-	2	-
CO3	1	1	3	-	1	-	-	-	-	-	-	-	2	-	-
CO4	1	2	2	3	2	-	-	-	-	-	-	-	-	2	3
Course – CO-PO-PSO Mapping													**Course – PSO Mapping**		
16IS71	2	2	3	1	2	-	-	-	-	-	-	-	1	2	2

Low-1 Medium-2 High-3

Semester: VII		
Course Title: Data Science and Engineering		
Course Code: 16IS72		**CIE Marks: 100 + 50**
Credits: L: T: P: S: 4:0:1:0		**SEE Marks: 100 + 50**
Hours: 44		**SEE Duration(Theory): 3 Hrs** **SEE Duration(Laboratory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand data mining techniques to analyse the data.
2	Identify, gather and analyse large sets of data to gain insights of the underlying patterns.
3	Use appropriate models to produce a quantitative analysis report of the given data.
4	Adapt data mining techniques to real life applications to make important decisions.

UNIT-I	
Introduction: Introduction to Data mining, applications of data mining, tasks that the data mining can accomplish, issues in data mining, Different phases of Data mining, supervised and unsupervised learning.	**08 Hrs**
UNIT-II	
Data Pre-processing and Predictions: Data cleaning, data integration, data reduction, data transformation and discretization, Data Warehouse, Simple linear regression, multiple linear regression.	**09 Hrs**
UNIT-III	
Classifications and Association Rules: Introduction to classification, Decision tree, K-nearest neighbour, Naïve bayes, Support vector machine. Market basket analysis**,** Apriori algorithm, generating association rules, FP-growth.	**09 Hrs**
UNIT-IV	
Advanced Analytics - I: Cluster analysis and K-means clustering, Introduction to big data – why big data, Applications of big data, Introduction to Hadoop, The Hadoop Ecosystem, The Hadoop Architecture, The design of HDFS, HDFS Concepts.	**09 Hrs**
UNIT-V	
Advanced Analytics - II: Data format – analyzing the data with Hadoop, Dataflow in Hadoop – Anatomy of a File Read, Anatomy of a File Write, Anatomy of a MapReduce Job Run, YARN, Phases of a MapReduce application, Partitioners, Combiners.	**09 Hrs**

Note: Students are advised to use SWEBOK for experiential learning available at http://www.ieeelms.com/rvce

Course Outcomes: After completing the course, the students will be able to	
CO1	Use appropriate models to analyse and process the data.
CO2	Gain insights into the data patterns by visualizing the data models.
CO3	To fit the model which is suitable for problem in hand.
CO4	Extract value out of the data to make important business decisions and accurate predictions.

Reference Books:	
1	Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publications, second edition (January 13, 2006), ISBN-10: 1558609016, ISBN-13: 978-1558609013
2	Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 4th edition, 2015, ISBN-10: 9352130677, ISBN-13: 978-9352130672
3	Daniel T. Larose, "Discovering Knowledge in Data", Publisher: Wiley, first edition (November 18, 2004), ISBN-10: 0471666572, ISBN-13: 978-0471666578
4	David Dietrich, Barry Heller, Beibei Yang, Data Science & Big Data Analytics, Wiley Publications, 2015, ISBN-10: 8126556536, ISBN-13: 978-8126556533
5	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer Publications, 2011 edition, ISBN-10: 0387310738, ISBN-13: 978-0387310732

Laboratory Component:

1. Process the Movie dataset and visualize the correlations using R.
2. Implement data preprocessing techniques in R.
3. Implement simple linear regression and multiple linear regression in R using relevant datasets for prediction.
4. Implement k- nearest neighbour algorithm in R using relevant datasets.
5. Implement decision tree algorithm for classification in R using relevant datasets.
6. Implement Naïve bayes classification in R using relevant datasets.
7. Compare support vector machine and kernel based support vector machine in R using relevant datasets.
8. Implement Association rule process using Apriori algorithm in R using relevant datasets.
9. Implement K- means clustering to classify the clusters in a given data set using R.
10. Review the commands available for the Hadoop Distributed File System.
11. Using HDFS and MapReduce, implement a program to process call-log data.
12. Using HDFS and MapReduce, implement a word count program.

<table>
<tr><th colspan="5">Continuous Internal Evaluation (CIE)</th></tr>
<tr><th colspan="2">(Theory – 100 Marks)</th><th colspan="2" rowspan="2">(Laboratory- 50 Marks)</th><th rowspan="2">Total (150)</th></tr>
<tr><th>Evaluation method</th><th>Course with assignment</th></tr>
<tr><td>Quiz -1</td><td>10</td><td colspan="2" rowspan="3">Performance of the student in the laboratory, every week</td><td rowspan="9"></td></tr>
<tr><td>Test -1</td><td>50</td></tr>
<tr><td>Quiz -2</td><td>10</td><td rowspan="2">40</td></tr>
<tr><td>Test -2</td><td>50</td><td colspan="2" rowspan="3">Test at the end of the semester</td></tr>
<tr><td>Quiz -3</td><td>10</td><td rowspan="2">10</td></tr>
<tr><td>Test -3</td><td>50</td></tr>
<tr><td>Assignments</td><td>10</td><td colspan="2" rowspan="3">Total</td><td rowspan="3">50</td></tr>
<tr><td colspan="2">Final Evaluation
Quiz – 10 + 10 + 10 = 30;
Test = 50 + 50 + 50 = 150 Reduced to 60;
Assignment = 10</td></tr>
<tr><td>Total</td><td>100</td><td>150</td></tr>
</table>

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester: VII		
Course Title : Cryptography And Network Security		
Course Code: 16IS73		**CIE Marks:100 + 50**
Credits: L:T:P:S:4:0:1:0		**SEE Marks:100 + 50**
Hours: 44		**SEE Duration(Theory): 3 Hrs** **SEE Duration(Laboratory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the basic principles of computer and network security
2	Analyze and compare different cryptographic algorithms.
3	Apply network security principles and techniques for application development
4	Demonstrate secure communications in network using socket programming.

UNIT-I	
Classical Encryption Techniques : Symmetric Cipher Model: Cryptrography, Cryptanalysis and Brute Force Attack, Substitution Techniques: Caeser cipher, Monoalphabatic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One time pad., Transposition techniques, Rotor Machines, Steganography.	**08 Hrs**
UNIT-II	
Block Ciphers and the DES: Traditional Block Cipher Structure, Data Encryption Standard, A DES Example, Avalanche Effect, Strength of DES, Block Cipher Design principle. **Block Cipher Operation**: Multiple Encryption and Triple DES, Electronic Code Book, Cipher Block Chaining mode, Cipher Feedback mode, Output Feedback mode, Counter Mode,XTS- AES mode for block oriented storage device.	**09 Hrs**
UNIT-III	
Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA Algorithm, Diffie Hellman Key Exchange- Algorithm, Key exchange protocols, Man in the middle attack. **Cryptographic Hash functions**: Applications, Two Simple hash functions, Requirements and Security, Hash functions based on Cipher block chaining, SHA-512 Logic, Round function, Example.	**09 Hrs**
UNIT-IV	
Message Authentication Codes: Message Authentication requirements, Functions, Requirements for MAC, Security of MAC, MAC Based on Hash functions: HMAC, MAC's based on block ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM, Digital Signatures: Properties, Attacks and Forgeries, Requirements, Direct digital signature. **Key Management and Distribution:** Symmetric key distribution using symmetric encryption and asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key infrastructure.	**09 Hrs**
UNIT-V	
User Authentication: Remote User authentication principles and authentication using Symmetric encryption, Kerberos Version4, Version 5.**Transport Level Security:** Web Security, SSL, TLS **Electronic Mail Security**: PGP, **IP Security:** Encapsulating Security Payload, Format, Encryption and Authentication algorithms, padding, anti-replay service, transport and tunnel modes.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and investigate for new solutions of network security threats, focusing on cryptography and network security concepts.
CO2	Apply security principles to design different computer applications.
CO3	Demonstrate experiments for new network security solutions using cryptographic algorithms, protocols to incorporate security in applications.
CO4	Create and design simple network applications using the knowledge acquired about the services of transport layer.

Reference Books	
1	William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson India Education, 2014, ISBN: 978-93-325-1877-3.
2	Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 2nd Edition, Special Indian Edition, McGraw Hill Publication.
3	Matt Bishop, "Introduction to Computer Security", Pearson Publications.
4	Menezes Bernard, "Network Security and Cryptography", 1st Edition, Cengage Learning India, 2010, ISBN: 9788131513491
5	Douglas Stinson "Cryptography Theory and Practice", 2nd Edition, Chapman & Hall/CRC, ISBN: 978-1584885085.

Laboratory Component:

PART-A

1. Write a program for error detecting code using CRC-CCITT (3/4/ bits or more).
2. Implement a Sliding window protocol and demonstrate its working.
3. Demonstrate the working of Leaky bucket algorithm.
4. Write a program to create Ceaser and Play fair ciphers.
5. Write a program to implement Vigenere Cipher.
6. Write a program for simple RSA algorithm to encrypt and decrypt the data.
7. Implement the Diffie-Hellman protocol.
8. Write a program to demonstrate Client-Server programming using SSL.

PART-B

Students are expected to develop a security application using tools like (but not limited to):

- Qualnet
- NS3
- WireShark
- Nmap
- CISCO packet Tracer
- Winpcap

Continuous Internal Evaluation (CIE)				
(Theory – 100 Marks)		**(Laboratory- 50 Marks)**		**Total (150)**
Evaluation method	**Course with assignment**			
Quiz -1	10	Performance of the student in the laboratory, every week	40	
Test -1	50			
Quiz -2	10			
Test -2	50	Test at the end of the semester	10	
Quiz -3	10			
Test -3	50			
Assignments	10	**Total**	**50**	
Final Evaluation Quiz – 10 + 10 + 10 = 30; Test = 50 + 50 + 50 = 150 Reduced to 60; Assignment = 10				
Total	**100**			**150**

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
		Laboratory		Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A	100	Answer Scripts	20 %		

				and Part-B					
		Semester End Laboratory		End of every semester laboratory	50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	3	-	-	-	-	-	-	-	2	3	-	-
CO2	3	2	2	1	1	1	-	-	-	-	-	2	3	1	-
CO3	3	2	3	3	2	1	1	-	1	1	-	2	3	1	-
CO4	2	2	3	2	2	1	-	1	1	1	-	2	3	2	-
Course – CO-PO- Mapping													**Course-PSO Mapping**		
16IS73	3	2	2	2	1	1	1	1	1	1	-	2	3	2	-

Low-1 Medium-2 High-3

Semester: VII		
Course Title : Internet of Things		
Course Code: 16IS7F1		**CIE Marks:100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks:100**
Hours: 44		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Learn the research orientation in IoT area
2	Digest the networks & protocols used in IoT development
3	Illustrate smart applications building and system design
4	Know more advanced concepts like cloud connectivity in IoT

UNIT-I	
Internet of Things Strategic Research and Innovation Agenda: Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Smart-X Applications, Internet of Things and Related Future Internet Technologies.	**08 Hrs**
UNIT-II	
Networks and Communication: Networking Technology, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, IoT Protocols Convergence	**08 Hrs**
UNIT-III	
Scalable Integration Framework for Heterogeneous Smart Objects, Applications and Services: Introduction, IPv6 Potential, IoT6, IPv6 for IoT Adapting IPv6 to IoT Requirements, IoT6 Architecture, DigCovery, IoT6 Integration with the Cloud and EPICS, Enabling Heterogeneous Integration, IoT6 Smart Office Use-case, Scalability Perspective	**09 Hrs**
UNIT-IV	
IoT Systems - Logical Design using Python: Provides an introduction to Python, installing Python, Python data types & data structures, control flow, functions, modules, packages, file input/output, data/time operations and classes.	**09 Hrs**
UNIT-V	
IoT Physical Devices & Endpoints: Provides an introduction to Raspberry Pi device, programming Raspberry Pi with Python, interfacing sensors and actuators with Raspberry Pi. IoT Physical Servers & Cloud Offerings: Provides an introduction to the use of cloud platforms and frameworks such as WAMP-AutoBahn, Xively and AWS for developing IoT applications.	**10 Hrs**

Expected Course Outcomes:After completing the course, the students will be able to	
CO1	Understand the IoT concepts from research point of view.
CO2	Analyse the networking requirements and protocols for building IoT products.
CO3	Apply the system design languages to build IoT systems
CO4	Creating applications of IoT using physical devices, interfacing and cloud.

Reference Books	
1	Ovidiu Vermesan, Peter Friess, " Internet of Things – From Research and Innovation to Market Deployment", River Publishers Series in Communication, River Publishers, 2014, ISBN: ISBN: 978-87-93102-94-1 (Hard copy), 978-87-93102-95-8 (Ebook).
2	Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", VPT, 1st Edition, 2014, ISBN-13: 978-0996025515.
3	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition, 2013, ISBN-13: 978-1430257400.
4	Wimer Hazenberg, Menno Huisman,"Meta products - Building the Internet of Things", BIS Publishers, 2012, ISBN: 9789863692515.
5	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Academic Press, 1st Edition, 2014, ISBN: 978-0-12-407684-6

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester: VII			
Course Title : Software Defined Networks			
Course Code: 16IS7F2		**CIE Marks:100**	
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**	
Hours:45		**SEE Duration(Theory): 3 Hrs**	
Course Learning Objectives: The students will be able to			
1	Describe the basics of Software Defined Networks and implications		
2	Digest the SDN features, devices and openflow basics		
3	Illustrate SDN data centres and other SDN network environments		
4	Know more advanced concepts like SDN application development using open source		
UNIT-I			
Introduction: Basic Packet-Switching Terminology, Historical Background, The Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Can We Increase the Packet-Forwarding, Open Source and Technological Shifts, Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Centre Needs			**09 Hrs**
UNIT-II			
The Genesis of SDN: The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Legacy Mechanisms Evolve Toward SDN, Network Virtualization, **Fundamental Characteristics of SDN**: SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods.			**09 Hrs**
UNIT-III			
The OpenFlow Specification: Specific Terminology, OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations. **Alternative Definitions of SDN**: Potential Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays, SDN via Opening Up the Device, Network Functions Virtualization.			**09 Hrs**
UNIT-IV			
SDN in the Data Center: Data Center Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations, **SDN in Other Environments:** Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, Optical Networks, SDN vs. P2P/Overlay Networks			**09 Hrs**
UNIT-V			
SDN Applications: Reactive versus Proactive Applications, Analyzing Simple SDN Applications, A Simple Reactive Java Application, Background on Controllers, Using the Floodlight Controller, Using the Cisco XNC Controller, Creating Network Virtualization Tunnels, Offloading Flows in the Data Center, Access Control for the Campus, Traffic Engineering for Service Providers, **SDN Open Source**: OpenFlow Source Code, Switch Implementations, Controller Implementations, SDN Applications, Orchestration and Network Virtualization, Simulation, Testing, and Tools, OpenStack, Example: Applying SDN Open Source			**09 Hrs**

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the SDN basics and implication concepts.
CO2	Analyse the networking requirement specifications and openflow.
CO3	Apply the SDN concepts to data center and other network building.
CO4	Designing/Creating applications of SDN using open source.

Reference Books	
1	Paul Goransson, ChuckBlack , "Software Defined Networks-A Comprehensive Approach", Morgan Kaufmann Publishers, 1st Edition, 2014, ISBN: 9780124166752 New edition , eBook ISBN : 9780124166844 .
2	Patricia A. Morreale, James M. Anderson, "Software Defined Networking: Design and Deployment', CRC Press, 2014, ISBN-10: 1482238632, ISBN-13: 978-1482238631.
3	SiamakAzodolmolky, "Software Defined Networking with OpenFlow", Packt Publishing, 2013, ISBN-10: 1849698724, ISBN-13: 978-1849698726.
4	Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", O'Reilly Media Publishers, 1st Edition, 2013, ISBN-10: 1449342302, ISBN-13: 978-1449342302.
5	Vishal Shukla, "Introduction to Software Defined Networking - OpenFlow&VxLAN", CreateSpace Independent Publishing Platform, 2013, ISBN-10: 1482678136, ISBN-13: 978-1482678130.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester : VII		
Course Title : Software Architecture		
Course Code:16IS7F3		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours: 45		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the basic concepts of Software Architecture
2	Recognise the benefits associated with and Software Architecture
3	Illustrate the concepts of Software Architectures in an organisational context
4	Examine the forms and functions of Software Architectures

UNIT-I	
Introduction to Software Architectures: The Architecture Business Cycle: Where do architectures come from? Software processes and the architecture business cycle; What makes a "good" architecture? What software architecture is and what it is not; Other points of view; Architectural patterns, reference models and reference architectures; Importance of software architecture; Architectural structures and views.	**09 Hrs**
UNIT-II	
Architectural Styles and Case Studies : Architectural styles; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Repositories; Interpreters; Process control; Other familiar architectures; Heterogeneous architectures. Case Studies: Keyword in Context; Instrumentation software; Mobile robotics; Cruise control; Three vignettes in mixed style.	**09 Hrs**
UNIT-III	
Quality: Functionality and architecture; Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Other system quality attributes; Business qualities; Architecture qualities. Functionality and architecture; Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Other system quality attributes; Business qualities; Architecture qualities.	**09 Hrs**
UNIT-IV	
Achieving Quality: Achieving Quality: Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics; Security tactics; Testability tactics; Usability tactics; Relationship of tactics to architectural patterns; Architectural patterns and styles. Using an Enterprise Architecture, The Role of Investment Planning and Project Management, The Role of Security and Privacy, The Enterprise Architecture Repository and Support Tools.	**09 Hrs**
UNIT-V	
Designing and Documenting Software Architecture: Architecture in the life cycle; Designing the architecture; Forming the team structure; Creating a skeletal system. Uses of architectural documentation; Views; Choosing the relevant views; Documenting a view; Documentation across views.	**09Hrs**

Note : Students are advised to refer to NPTEL, MOOC course for assignments.

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the basic concepts of Software Architectures.
CO2	Apply the concepts of Software Architectures in an organizational context.
CO3	Analyze the Software Architectural styles for quality.
CO4	Evaluate Software Architectures based on quality, tactics and design.

Reference Books	
1	Len Bass, Paul Clements, Rick Kazman: "Software Architecture in Practice", Pearson Education Limited, 2015. ISBN-13: 9789332502307
2	Mary Shaw and David Garlan: "Software Architecture- Perspectives on an Emerging Discipline", Pearson Education Limited, 2015. ISBN-13: 9789332551954
3	Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: "Pattern-Oriented Software Architecture, A System of Patterns", Volume 1, 1st Edition, Wiley India Pvt.ltd, 2014. ISBN-13: 9788126516117
4	Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison-Wesley, 2010. ISBN - 9780321552686.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	2	2	2	2	2	1	1	1	-	1	1	2
CO2	3	3	3	2	2	-	2	2	2	2	1	-	1	1	2
CO3	3	2	2	2	2	-	2	2	2	2	-	2	-	-	2
CO4	3	2	2	2	2	-	2	2	3	3	-	2	-	-	2
Course – CO-PO- PSO Mapping													Course – PSO Mapping		
16IS7F3	3	2	2	2	2	2	2	2	2	2	1	2	1	1	2

Low-1 Medium-2 High-3

Semester: VII		
Course Title : Cloud Computing		
Course Code:16IS7F4		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours: 45		**SEE Duration(Theory): 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Comprehend the concept of cloud Infrastructure and understanding Abstraction & Virtualization in cloud computing
2	Understand advanced and cutting edge state-of-the-art knowledge and implementation in cloud computing.
3	Analyze research gaps in the area of cloud computing
4	Explore advanced services and applications in stacks of cloud

UNIT-I	
System models for advanced computing: Clusters of cooperative computing, grid computing and cloud computing; software systems for advanced computing-service oriented software and parallel and distributed programming models with introductory details, Features of grid and cloud platform.	**09 Hrs**
UNIT-II	
Cloud Computing services models: Cloud Computing services models and features in Saas, Paas and Iaas. Service oriented architecture and web services; Features of cloud computing architectures and simple case studies.	**09 Hrs**
UNIT-III	
Virtualization: Characteristic features, Taxonomy Hypervisor, Virtualization and Cloud Computing, Pros and Cons of Cloud Computing, Technology Examples/Case Studies.	**09 Hrs**
UNIT-IV	
Cloud programming Environment: Map Reduce Hadoop Library from Apache, Open Source Cloud Software Systems –Eucalyptus.	**09 Hrs**
UNIT-V	
Grid computing: Architecture and Service modeling, Grid resource management, Grid Application trends.	**09 Hrs**

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the basics of cloud computing models and virtualization.
CO2	Evaluate the issues related to the development of cloud applications.
CO3	Apply the concepts to design cloud based simple applications.
CO4	Analyze real world case studies of existing cloud based software solutions.

Reference Books	
1	Kaittwang Geoffrey C.Fox and Jack J Dongrr , "Distributed and Cloud Computing", Elsevier India , 2nd edition , 2012. ISBN-11: 92883421101610
2	Raj Kumar Buyya, Christian Vecchiola and S.TanuraiSelvi "Mastering Cloud Computing", TMH, 6th edition, 2012, ISBN-13: 97881832101610.
3	John W. Ritting House and James F Ramsome , "Cloud Computing" CRC Press,5th edition 2012, ISBN: 9578902210489.
4	Judith Hurwitz, Robin Bloor, Marcia Kaufman, and Dr. Fern Halper, "Cloud Computing for Dummies" Wiley Publishing, 5th edition2012 , ISBN: 9754683210456.
5	Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing : A Practical Approach", The McGraw-Hill , 4th edition2010 , ISBN: 9342683210012.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1	2	2	1	1	1	-	1	1	1	1	2
CO2	2	3	2	1	2	2	1	-	1	-	1	-	1	1	2
CO3	1	1	1	3	1	2	-	1	-	-	-	1	-	-	1
CO4	1	1	1	2	1	1	1	-	1	-	-	-	-	-	2
Course – CO-PO- PSO Mapping													Course – PSO Mapping		
16IS7F4	2	2	2	2	2	2	1	1	1	-	1	1	1	1	2

Low-1 Medium-2 High-3

Semester: VII		
Course Title : Image Processing And Computer Vision		
Course Code:16IS7G1		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours: 43		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Comprehend the fundamentals of Digital Image Processing, including physics in image formation, mathematical tools used in image processing.
2	Comprehend the essentials of image pre-processing, using filters, intensity transformations.
3	Understand and perform image segmentation and morphological operations using various techniques.
4	Perform object detection, object recognition and image analysis.

UNIT-I	
Introduction: Image representation and image analysis tasks. **The image, its representations and properties** – image representations, image digitization, digital image properties, color images, cameras: an overview. **Some basic relationships between pixels –** Neighbors of a pixel, adjacency, connectivity, regions and boundaries, distance measures **An introduction to the mathematical tools used in digital image** processing - Array versus matrix operations, linear versus nonlinear operations, arithmetic operations, set and logical operations, spatial operations, vector and matrix operations, image transforms. **Data structures for image analysis** – Levels of image data representation, traditional image data structures.	**08 Hrs**
UNIT-II	
Intensity transformations: Some basic intensity transformation functions : Image negatives, Log Transformations, Power-Law Transformations **Histogram Processing** – histogram equalization, histogram matching, local histogram processing, using histogram statistics for image enhancements. **Spatial filtering** - Smoothing Spatial Filters, Sharpening Spatial Filters. **Frequency domain filtering** -The basics of filtering in frequency domain, Image smoothing usingfrequency domain filtering, image sharpening usingfrequency domain filtering	**09 Hrs**
UNIT-III	
Segmentation: Thresholding: basic global thresholding, optimum global thresholding using Ostu's Method , local thresholding, edge-based segmentation, region based segmentation: region growing, region splitting and merging, Mean shift segmentation, active contour models – snakes, segmentation using morphological watersheds, Evaluation issues in segmentation.	**09 Hrs**
UNIT-IV	
Morphological image processing: Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms– boundary extraction, hole filling, extraction of connected components, convex hull, thinning, thickening, skeletons, morphological reconstruction. **Shape Representation and description**: Representation: Boundary following, chain codes, polygonal approximations using minimum-perimeter polygons, other polygonal approximations, skeletons, boundary descriptors, regional	**09 Hrs**

descriptors.	
UNIT-V	
Texture: Statistical texture descriptions, syntactic texture description methods, hybrid texture description methods, texture recognition method applications. **Object recognition**: Knowledge representation, Statistical pattern recognition, neural nets, syntactic pattern recognition, recognition as graph matching, optimization techniques in recognition, fuzzy systems, boosting in pattern recognition	**08 Hrs**

Note: Students are advised to use SWEBOK for experiential learning available at http://www.ieeelms.com/rvce

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the basic concepts of Digital Image Processing and Computer Vision.
CO2	Use Image processing tools on various domains of images to perform object detection.
CO3	Use Image processing tools on various domains of images to perform object recognition and analysis.
CO4	Use Image processing tools to implement and compare the performance of various image processing algorithms and techniques.

Reference Books	
1	Sonka, Hlavac, Boyle; " Digital Image Processing and Computer Vision"; Cengage Learning; 2010, ISBN: 9788131505557
2	Rafael C. Gonzalez, Richard E. Woods; "Digital Image Processing"; Pearson Education; 3rd Edition; 2011, ISBN-13: 978-0131687288
3	S Jayaraman, S Esakkirajan, T Veerakumar; "Digital Image Processing"; Tata McGraw Hill; 2009, ISBN 13: 9780070144798
4	Chanda, D. DuttaMajumdar; "Digital Image Processing and Analysis"; PHI; 2006, ISBN-13: 978-8120343252

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		

Indirect Assessment methods	Course End Survey	Students	End of course		Questionnaire Based on COs	10%

CO-PO Mapping													**CO-PSO Mapping**		
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	1	1	1	1	-	-	2	3	-	-	1	2	-
CO2	3	3	3	2	3	-	-	-	2	3	-	-	1	1	1
CO3	3	3	3	2	3	-	-	-	2	3	-	-	-	2	1
CO4	2	1	-	-	3	-	-	-	2	3	-	-	-	1	-
Course – CO-PO- PSO Mapping													Course – PSO Mapping		
16IS7F3	2	2	2	2	2	2	1	1	1	-	1	1	1	2	1

Low-1Medium-2 High-3

Semester: VII		
Course Title: Cyber Security And Digital Forensics		
Course Code:16IS7G2		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 45		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand Cyber Crime and Forensics
2	Analyze the nature and effect of cyber-crime in society.
3	Understand Sarbanes-Oxley Financial and Accounting Disclosure Information
4	Understand Computer Crime and Criminals
5	Understand Liturgical Procedures

UNIT-I	
Introduction: Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime.	**09 Hrs**
UNIT-II	
Cyber Crime Issues: Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation ,Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.	**09 Hrs**
UNIT-III	
Investigation: Introduction to Cyber Crime Investigation, Investigation Tools, e-Discovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.	**09 Hrs**
UNIT-IV	
Digital Forensics: Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.	**09 Hrs**
UNIT-V	
Laws and Acts: Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the importance of Computer Security and the vulnerability issues
CO2	Analyse and explain various types of computer crimes, and the legal aspects of the same along with the Indian IT act
CO3	Identify and Use appropriate tools and techniques to control and prevent the digital criminal activities.
CO4	Apply forensic analysis tools to recover important evidence for identifying computer crime.

Reference Books	
1.	Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009, ISBN 13: 9781435498839
2.	Kevin Mandia, Chris Prosise, Matt Pepe, "Incident R esponse and Computer Forensics ", Tata McGraw -Hill , New Delhi, 2006.
3.	Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005, ISBN-13:9780070603592
4.	Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004, ISBN 13: 9781851096831

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester: VII		
Course Title : Information Retrieval		
Course Code:16IS7G3		**CIE Marks: 100**
Credits: L:T:P:S: 4:0:0:0		**SEE Marks: 100**
Hours: 45		**SEE Duration:3 Hrs**

Course Learning Objectives: The students will be able to	
1	Interpret the basics of Information Retrieval with pertinence to modeling, query operations and indexing.
2	Apply the concepts of machine learning techniques for text classification and clustering.
3	Analyze the various applications of Information Retrieval giving emphasis to Multimedia IR, Web Search.
4	Demonstrate the concepts of queries specification judgment and search engine.

UNIT-I	
Introduction: Motivation, Basic concepts, Past, present, and future, The retrieval process. **Modeling:** Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing.	**09 Hrs**
UNIT-II	
Retrieval Evaluation: Introduction, Retrieval performance evaluation, Reference collections. **Query Languages**: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. **Query Operations**: Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.	**09 Hrs**
UNIT-III	
Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup languages, Multimedia. **Text Operations**: Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques.	**09 Hrs**
UNIT-IV	
User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting pints, Query specification, Context, Using relevance judgments, Interface support for the search process. **Searching the Web**: Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Finding the needle in the haystack, Searching using hyperlinks.	**09 Hrs**
UNIT-V	
Indexing and Searching: Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression. **Parallel and Distributed IR**: Introduction, Parallel IR, Distributed IR.	**09 Hrs**

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and design the various components of an Information Retrieval system.
CO2	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO3	Analyze the Web content structure and Design an efficient search engine
CO4	Build an Information Retrieval system using the available tools.

Reference Books	
1	Ricardo Baeza-Yates, Berthier Ribeiro-Neto: "Modern Information Retrieval: The concepts and technology behind search", Edition Addison Wesley professional, 2nd Edition, 2011.ISBN 10:0321416910/ISBN 13:9780321416919
2	David A. Grossman, Ophir Frieder: "Information Retrieval Algorithms and Heuristics", Springer, 2nd Edition, 2004. , *ISBN* 978-1-59829-864-3
3	Bruce Croft, Donald Metzler, Trevor Strohman Search Engines: "Information Retrieval in Practice", *Pearson* Academic,2009 *ISBN* 10: 0131364898 *ISBN* 13: 9780131364899
4	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze,: "Introduction to Information Retrieval" ,Cambridge University Press, 2nd Edition, 2008. ISBN-10: 3662483122

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80 %	100 %	90 %
		Test		Two	60/50				
		Assignment/ Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20 %		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Semester : VII		
Course Title : Big Data Analytics		
Course Code:16IS7G4		**CIE Marks:100**
Credits: L:T:P:S:4:0:0:0		**SEE Marks:100**
Hours:44		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand handling huge amount of data using distributed environment.
2	Analyse large sets of data to gain insights of the underlying patterns.
3	Apply techniques to process data streams using in memory operations.
4	Adapt data mining techniques to process massive datasets.

UNIT-I	
Introduction to Big Data Analytics: Characteristics of Big Data, Importance of Big Data Analytics, Different levels of parallelization, Hadoop architecture, data blocks, speculative execution, HDFS daemons, Hadoop ecosystem, HDFS containers, Introduction to MapReduce, concepts of YARN, MapReduce phases, combiners, Partitioners, program examples.	**09 Hrs**
UNIT-II	
Introduction to: Introduction to Hive, Hive configuration, HiveQL, Partitions and buckets, user defined functions in Hive. Introduction to Pig, Pig Latin, execution modes, user defined functions in Pig, data processing operators. Concepts of NOSQL databases.	**09 Hrs**
UNIT-III	
Introduction to Scala: Basics of programming with Scala, classes, collections, options and types, implicits, loops, functions.	**08 Hrs**
UNIT-IV	
SPARK - I: Programming with RDD's, creating RDD's, RDD operations, passing functions to SPARK, transformations and actions, working of pair RDD's, data partitioning, SPARK SQL.	**09 Hrs**
UNIT-V	
Machine Learning with SPARK-ML2: Basics of machine learning, working with vectors, feature extraction, regression, classification, clustering, collaborative filtering and recommendation, dimensionality reduction, model evaluation.	**09 Hrs**

Note : Students are advised to refer to NPTEL, MOOC course for assignments.

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Handle data manipulations for massive datasets using distributed environment.
CO2	Gain insights into the patterns by processing massive datasets.
CO3	Implement techniques for real time processing of data streams.
CO4	Extract value out of the data to make important business decisions and accurate predictions.

Reference Books	
1	Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 4th edition, 2015, ISBN-10: 9352130677, ISBN-13: 978-9352130672
2	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, "Learning Spark", O'Reilly Publications, 1st edition, 2015, ISBN-10: 9351109941, ISBN-13: 978-9351109945
3	Jason Swartz, Learning Scala, O'Reilly Publications, 1st edition, 2014, ISBN-10: 9352132564, ISBN-13: 978-9352132560
4	Seema Acharya, Subhashini Chellappan, "Big Data and analytics", Wiley Publications, 2015, ISBN-10: 8126554789, ISBN-13: 978-8126554782

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Global Electives offered
VII SEMESTER

Sl.no	Course	Course Code	Offering Dept.
1.	Nanotechnology	16G7H01	Biotechnology
2.	Industrial Safety and Risk Management	16G7H02	Chemical Engineering
3.	Intelligent Transportation Systems	16G7H03	Civil Engineering
4.	Intelligent Systems	16G7H04	Computer Science Engineering
5.	Image Processing & Machine Learning	16G7H05	Electronics & Communication Engineering
6.	Design Of Renewable Energy Systems	16G7H06	Electrical & Electronics Engineering
7.	Systems Engineering	16G7H07	Industrial & Management Engineering
8.	MEMS and Applications	16G7H08	Electronics & Instrumentation Engineering
9.	Introduction to Internet of Things	16G7H09	Information Science Engineering
10.	Industry 4.0 – Smart Manufacturing For The Future	16G7H10	Mechanical Engineering
11.	Space Technology And Applications	16G7H11	Telecommunication Engineering

Semester: V		
Course Title: Nanotechnology		
Course Code : 16G7H01		**CIE Marks: 100**
Credits : L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 30		**SEE Duration: 3 Hrs**
Prerequisite: Physics, Chemistry, Biology, Mechanical engineering and electronics.		

Course Learning Objectives: The students will be able to	
1	Have the basic knowledge of nanomaterials and the process.
2	Describe methods of nanoscale manufacturing and characterization can be enabled.
3	Learn about Nano sensors and their applications in mechanical, electrical, electronic, Magnetic, Chemical field.
4	Understand the concept for a nanoscale product based on sensing, transducing, and actuating mechanism.
5	Have awareness about the nanoscale products used in multidisciplinary fields.

UNIT – I	
Introduction to Nanomaterials: History of Nanotechnology, structures and properties of carbon based, metal based, bionanomaterails and hybrids: Bucky Ball, Nanotubes, Diamond like carbon(DLC),Quantum Dots, Magnetic, Nano Shells, Dendrimers, Nanocarriers, Nanocrystals, hybrid biological/inorganic, protein & DNA based nanostructures. Nanosafety Issues: Toxicologyhealth effects caused by nanoparticles.	**06 Hrs**
UNIT– II	
Characterization of Nanostructures: Spectroscopy: UV-Visible spectroscopy, Fourier Transform infrared spectroscopy (FTIR), Raman Spectroscopy, X-ray spectroscopy. **Electron microscopy**: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM).**Scanning probe microscopy**: Atomic Force microscopy (AFM), Scanning tunnel microscopy (STM). **Nano Synthesis and Fabrication**: Introduction & overview of Nanofabrication: Bottom up and Top down approaches using processes like Ball milling, Sol-gel Process, Chemical Vapour deposition (CVD), electrodeposition and various lithography techniques (Hard & Soft lithography).	**06 Hrs**
UNIT – III	
Nanosensors: Overview of nanosensors, prospects and market. Types of Nanosensors and their applications. Electromagnetic nanosensors: Electronic nose and electronic tongue, Magnetic nanosensors. Mechanical nanosensors: Cantilever Nanosensors, Mechanics of CNTs, Biosensors: Biosensors in modern medicine.	**06 Hrs**
UNIT – IV	
Micro & Nano-Electromechanical systems and Microfluidics: MEMS/NEMS: Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators. Microfludics: Laminar flow, Hagen-Peouiselle equation, basic fluid ideas, Special considerations of flow in small channels, mixing, microvalves & micropumps.	**06 Hrs**
UNIT – V	
Applications of Nanotechnology: Molecular electronics, molecular switches, mechanical cutting tools, machine components, magnets, DLC coated grinding wheels. Electrical, electronic, solar cells, Batteries, fuel cells, Nanofilters. Medical nanotechnology: in Diagnostics, Therapeutics, Drug delivery and Nanosurgery.	**06 Hrs**

Expected Course Outcomes: After completing the course, the students will be able to	
CO1	Remember, understand, and apply knowledge about of nanomaterials and their uses.
CO2	Interpret and apply the techniques of manufacturing and characterization processes
CO3	Apply the knowledge of Nanosensors, related to nanosensors in electronics, mechanical, chemical, and biological systems.
CO4	Create and evaluate nano Design, Devices and Systems in various disciplines.

Text Books	
1	B.S. Murty., P. Shankar., B.Raj, B..B. Rath, and J. Murday, Textbook of Nanosciences and Nanotechnology, Springer, Co-publication with University Press (India) Pvt. Ltd. VCH, XII.1st Edition, 2013, ISBN- 978-3-642-28030-6.
2	V. K. Khanna, Nanosensors:, Physical, Chemical and Biological, CRC press, 1st edition, 2013, ISBN 9781439827123 (Unit III).
Reference Books	
1	**C. C. Kock., Nanostructured materials, Nanostructured materials, William Andrew Publishing, 2nd edition, 2007, ISBN 0-8155-1534-0.**
2	M .Wilson., K. Kannangara., G.Smith., M.Simmons., B. Raguse., Nanotechnology, , overseas Press (India) Private Ltd.,1st edition, 2005,ISBN 81-88689-20-3.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation (SEE) Theory (100 Marks)	
Part- –A	
Objective type questions	**20**
Part –B	
There should be five questions from five units.	**80**
Each question should be for maximum of 16 Marks.	
The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice.	
The **UNIT-2 and UNIT-3** should have an internal choice.	
Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

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

Low-1 Medium-2 High-3

Semester: VII		
Course Title: Industrial Safety and Risk Management		
Course Code: 16G7H02		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Select appropriate risk assessment techniques
2	Analyze public and individual perception of risk
3	Relate safety, ergonomics and human factors
4	Carry out risk assessment in process industries

UNIT-I	
General: Hazard identification methodologies, risk assessment methods-PHA, HAZOP, consequence analysis. Hazards in work places- electrical hazards, mechanical hazards, hazards due to improper house keeping, hazards due to fire in multi floor industries and buildings, guidelines and safe methods in above situations.	**08 Hrs**
UNIT-II	
Techniques: General, risk adjusted discounted rate method, certainty equivalent coefficient method, quantitative analysis, probability distribution, coefficient of variation method, simulation method, Hiller's model, Hertz model.	**07 Hrs**
UNIT-III	
Risk Management: Emergency relief systems, Diers program, bench scale experiments, Internal emergency planning, risk management plan, mandatory technology option analysis, risk management alternatives, risk management tools, risk management plans, risk index method, Dowfire and explosion method, Mond index Method	**07 Hrs**
UNIT-IV	
Risk Assurance and Assessment: Property Insurance, transport insurance, liability insurance, risk assessment, low Probability high consequence events. fault tree analysis, event tree analysis	**07Hrs**
UNIT-V	
Risk Analysis in Chemical Industries: Disaster & crisis management in petroleum industry, personnel protection equipments, offshore oil spill and oil spill control, environmental risk analysis	**07Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Recall risk assessment techniques used in process industry
CO2	Interpret the various risk assessment tools
CO3	Use hazard identification tools for safety management
CO4	Analyze tools and safety procedures for protection in process industries

Reference Books	
1.	Kirkcaldy K J, D Chauhan. Functional Safety in the Process Industry : A Handbook of Practical Guidance in the Application of IEC61511 and ANSI/ISA-84, North corolina , Lulu Publication, 2012, ISBN: 1291187235.
2.	Goble and William M. "Safety Instrumented Systems Verification: Practical Probabilistic Calculations", Pensulvania, ISA Publication, 2005, ISBN: 155617909X
3.	Laird Wilson and Doug Mc Cutcheon. "Industrial safety and risk Management", The university of alberta press, Canada, 1st edition, 2003, ISBN: 0888643942
4	Sincero A P and Sincero G A, "Environmental Engineering – A Design Approach", Prentice Hall of India, New Delhi, 1996, ISBN: 0024105643.
5	Pandya C G, "Risks in Chemical Units", Oxford and IBH Publishers, New Delhi, 1992, ISBN: 8120406907.

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom"s taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

CO - PO Mapping

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

CO- PSO Mapping:

	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	3	3	3
CO3	2	3	3
CO4	2	2	3

Low-1 Medium-2 High-3

Semester: VII		
Course Title: Intelligent Transportation Systems		
Course Code: 16G7H03		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand basic traffic flow and control for ITS
2	Understand user services for application in transportation system
3	Understand ITS architecture and its planning at various levels
4	Evaluate user services at various levels

UNIT-I	
Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs. **Fundamentals of Traffic Flow and Control-** Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation	**08 Hrs**
UNIT-II	
ITS User services-User services bundles, Travel and Traffic management, Public Transportation Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Management, Advanced Vehicle Control and safety systems, Information Management, Maintenance and construction Management.	**06 Hrs**
UNIT-III	
ITS Applications and their benefits-Freeway and incident management systems-objectives, functions, traffic Surveillance and incident detection, Ramp control, incident management, Advanced arterial traffic control systems- historical development, Adaptive traffic control algorithms, Advanced Public Transportation Systems-Automatic vehicle location systems, Transit Operations software and information systems, Electronic fare payment systems, Multimodal Traveler Information systems	**07 Hrs**
UNIT-IV	
ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool. **ITS Planning**-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies.	**07 Hrs**
UNIT-V	
ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas,National Transportation Communications for ITS Protocol, Standards testing. **ITS evaluation** – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify various applications of ITS
CO2	Apply ITS applications at different levels
CO3	Examine ITS architecture for planning process

CO4	Define the significance of ITS for various levels

Reference Books	
1.	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601
2.	Bob Williams, "Intelligent transportation systems standards" ,Artech House, London, 2008.ISBN-13: 978-1-59693-291-3.
3.	Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications"Wiley Publishing ©2015, ISBN:1118894782 9781118894781
4.	ITS Hand Book 2000 Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
5.	Dominique Luzeaux ,Jean-René Ruault, Michel Chavret "Intelligent Transport Systems"7 MAR 2013 Copyright © 2010 by John Wiley & Sons, Inc DOI: 10.1002/9781118557495.ch6
6.	Sussman, J. M., "Perspective on Intelligent Transport Systems", Artech House Publishers, 2005 ISBN-13: 978-0387232577.

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester: VII	
Elective H – 16CSGH7XX	
Course Title: Intelligent Systems	
Course Code: 16G7H04	**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0	**SEE Marks: 100**
Hours: 35	**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand fundamental AI concepts and current issues.
2	Understand and apply a range of AI techniques including search, logic-based reasoning, neural networks and reasoning with uncertain information.
3	Recognize computational problems suited to an intelligent system solution.
4	Identify and list the basic issues of knowledge representation, blind and heuristic search.

UNIT-I	
Introduction: The Foundations of Artificial Intelligence, History of Artificial Intelligence, The State of the Art, **Intelligent Agent:** Introduction, How Agents Should Act, Structure of Intelligent Agents, **Problem-solving**: Solving Problems by Searching Search Strategies, Avoiding Repeated States ,Avoiding Repeated States.	**07 Hrs**
UNIT-II	
Informed Search Methods: Best-First Search, Heuristic Functions, Memory Bounded Search, Iterative Improvement Algorithms. **Game Playing:** Introduction: Games as Search Problems, Perfect Decisions in Two-Person, Games Imperfect Decisions, Alpha-Beta Pruning, Games That Include an Element of Chance.	**07 Hrs**
UNIT-III	
Knowledge Inference Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayes Rule, Uncertainty Principles, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.	**07 Hrs**
UNIT-IV	
Learning from Observations: A General Model of Learning Agents, Inductive Learning, Learning Decision Trees, Using Information Theory, Learning General Logical Descriptions, Why Learning Works: Computational Learning Theory. **Reinforcement Learning:** Passive Learning in a Known Environment, Passive Learning in an Unknown Environment, Active Learning in an Unknown Environment.	**07 Hrs**
UNIT-V	
Expert Systems, Components, Production rules, Statistical reasoning, certainty factors, measure of belief and disbelief, Meta level knowledge, Introspection. Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and explore the basic concepts and challenges of Artificial Intelligence.
CO2	Analyze and explain basic intelligent system algorithms to solve problems.
CO3	Apply Artificial Intelligence and various logic-based techniques in real world problems.
CO4	Assess their applicability by comparing different Intelligent System techniques.

Reference Books	
1.	Stuart Russel, Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson, 2010, ISBN-13: 978-0137903955.
2.	Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)",McGraw Hill, 1st Edition, 2008, ISBN: 9780070087705.
3.	Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 1 st Edition ,2007. ISBN: 0132097680.
4.	Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007, ISBN-13: 978-0201876864.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation(SEE) (Theory – 100 Marks)	
Part – A **Objective type questions**	20
Part – B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4** and UNIT-**5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both questions should be of the same complexity in terms of Cos and Bloom's taxonomy level.	80
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	C I E	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60				
		Assignment		2 phases	10	Reports / Record Books			
	S E E	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Course - PO Mapping												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Course	3	3	3	3	3	2	2	1	2	1	2	2

CO –PSO Mapping		
CO/PSO	**PSO1**	**PSO2**
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2

Course – PSO Mapping		
	PSO1	**PSO2**
Course	**3**	**2**

Low-1 Medium-2 High-3

Semester: VII		
Course Title: Image Processing & Machine Learning (Global Elective)		
Course Code: 16G7H05		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 36		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Get an introduction to basic concepts and methodologies of Digital Image processing, image formation and color image representation
2	Differentiate between the image enhancement and restoration techniques. Enhance the image by various methods in spatial and frequency domain. Perform image restoration using convolution, discrete linear operators and filters
3	Perform image segmentation using different algorithms suitable for various applications.
4	Recognize the different image patterns using supervised and unsupervised classification algorithms.

UNIT-I	
Digital Image Fundamentals: Fundamentals of Image Processing, Applications of Image Processing, Components of Image Processing System, Image Formation, Representation.	**08 Hrs**
UNIT-II	
Image Enhancement & Restoration: Distinction between image enhancement and restoration, Spatial Image Enhancement Techniques, Histogram-based Contrast Enhancement, Frequency Domain Methods of Image Enhancement, Noise Modeling, Image Restoration, Image Reconstruction.	**07 Hrs**
UNIT-III	
Image Segmentation: Edge, Line, and Point Detection, Edge Detector, Image Thresholding Techniques, Region Growing, Waterfall algorithm for segmentation, Connected component labeling.	**07 Hrs**
UNIT-IV	
Recognition of Image Patterns: Decision Theoretic Pattern Classification, Bayesian Decision Theory, Nonparametric Classification, Linear Discriminant Analysis, Unsupervised Classification Strategies – clustering, K-Means Clustering Algorithm.	**07 Hrs**
UNIT-V	
Texture and Shape Analysis: Introduction, Gray Level Co-occurrence Matrix, Texture Classification using Fractals, Shape Analysis, Region Based Shape Descriptors, **Morphological image processing:** Preliminaries, Dilation and Erosion, Opening and Closing, the Hit-or-Miss Transformation, Some Basic Morphological Algorithms	**07 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand digital image processing fundamentals: hardware and software, digitization, enhancement and restoration, encoding, segmentation, feature detection

CO2	Apply image processing techniques in both the spatial and frequency (Fourier) domains
CO3	Write image processing programs in MATLAB
CO4	Perform image segmentation using different algorithms suitable for various applications.

Reference Books	
1.	Tinku Acharya and Ajoy K. Ray, "Image Processing-Principles and Applications", John Wiley & Sons Inc., 2005, ISBN: 978-0-471-71998-4.
2.	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing"**,** Pearson Education Edition, 2001, ISBN 0-201-18075-8.
3.	Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, PHI, 2001, ISBN: 0071412379
4.	Chanda and D. Dutta Majumdar, "Digital Image Processing and Analysis", PHI, 2003

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

In case of a course having both Theory & Lab, the following minimum guidelines may be followed

Continuous Internal Evaluation (CIE)				
(Theory – 100 Marks)		**(Laboratory- 50 Marks)**		**Total (150)**
Evaluation method	**Course with assignment**			
Quiz -1	10	Performance of the student in the laboratory, every week	40	
Test -1	30			
Quiz -2	10			
Quiz -3	10	Test at the end of the semester	10	
Test -2	30			
Assignments	10			
Total	**100**	**Total**	**50**	**150**

Semester End Evaluation (SEE)				
Theory (100 Marks)		**Laboratory(50 Marks)**		**Total (150)**
Part- –A **Objective type questions**	**20**	**Experiment Conduction with proper results**	40	
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1, UNIT-4 and UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**	**Viva**	10	
Total	**100**	**Total**	**50**	**150**

	What		**To whom**	**Frequency of conduction**	**Max Marks**	**Evidence**	**Contribution to Course Outcome**	
Direct Assessment Methods	C I E	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60			
		Assignment		2 phases	10	Reports / Record Books		
	S E E	Semester End Examination		End of every semester Consisting	100	Answer Scripts	20%	

				of Part-A and Part-B					
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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: VII		
Course Title: Design of Renewable Energy Systems		
Course Code : 16G7H06		**CIE Marks: 100**
Credits: L:T:P:S 3:0:0:0		**SEE Marks: 100**
Hours: 38		**SEE: 3 Hrs**

Course Learning Objectives:	
1	Provide opportunity for students to work on multidisciplinary projects.
2	Familiarize the students with the basic concepts of nonconventional energy sources and allied technological systems for energy conversion
3	Impart skill to formulate, solve and analyze basic Non – conventional energy problems and prepare them for graduate studies.
4	Enable the student to design primarily solar and wind power systems.
5	Expose the students to various applications of solar, wind and tidal systems

UNIT – I	
An introduction to energy sources: Industry overview, incentives for renewable , utility perspective, Relevant problems discussion, current positions of renewable energy conditions	**07 Hrs**
UNIT – II	
PV Technology: Photovoltaic power, PV projects, Building-integrated PV system, PV cell technologies, solar energy maps, Technology trends, **Photovoltaic Power Systems**: PV cell, Module and Array, Equivalent electrical circuit, open-circuit voltage and short-circuit current, i-v and p-v curves, Array design(different methodologies), peak-power operation, system components ,	**08 Hrs**
UNIT – III	
Wind Speed and Energy: Speed and power relations, power extracted from the wind, Air density, Global wind patterns, wind speed distribution(parameters calculations) , wind speed prediction, **Wind Power Systems :** system components , turbine rating , power vs. speed and TSR, maximum energy capture, maximum power operation, system-design trade-offs , system control requirements, environmental aspects.	**08 Hrs**
UNIT – IV	
Geothermal and ocean energy: Geothermal power, geo pressured sources ,Geothermal well drilling ,advantages and disadvantages, Comparison of flashed steam and total flow concept **Energy from ocean**: OTEC power generation, OPEN and CLOSED cycle OTEC. Estimate of Energy and power in simple single basin tidal and double basin tidal system	**07Hrs**
UNIT – V	
Stand alone system: PV stand-alone, Electric vehicle, wind stand-alone , hybrid systems(case study) , system sizing, wind farm sizing , **Grid-Connected Systems: i**ntroduction**,** interface requirements, synchronizing with the grid, operating limit, Energy storage and load scheduling**,** Grid stability issues**,** distributed power generation.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate an understanding of the scientific principles of methodology of Non-conventional energy.
CO2	Acquire working knowledge of different Renewable energy science-related topics.
CO3	Ability to analyze the system related concepts effectively in the wind energy designing.
CO4	Students will be able to decide the appropriate procedures to ensure that the working model has developed properly

Reference Books	
1.	Mukund R Patel "Wind and solar power systems Design ,Analysis andoperation"Taylor and Francis publishers ,2nd edition,2006, ISBN 978-0-8493-1570-1
2.	G.D.Rai, "Non-Conventional sources of energy", Khanna Publishers, 4th edition, 8174090738, 9788174090737, 2009.
3.	Sukhatme, "Solar Energy", 2nd edition, TMH, 2006.
4.	Renewable energy sources- Twiddle Elbs, 3rd Edition, 2006, ISBN-10: 0419253203.
5.	Solar energy hand book – edited by William.C. Dikkinson ASISES, Network, ISBN -13: 978-0865716216.
6.	Partain, L. D., "Solar Cells and Their Applications". John Wiley & Sons, 3rd edition, 2003, ISBN:9780470539675.
7.	Green, M.A., et al. Solar Cell Efficiency Tables (Version 30). 2007. Prog. Photovolt: Res. Appl. 15:425-430.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice.	**80**

Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	
Total	**100**

Low-1 Medium-2 High-3

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

Semester: VII				
Course Title: Systems Engineering				
Course Code : 16G7H07		**CIE Marks**	**:**	**100**
Credits: L: T: P: S: 3:0:0:0		**SEE Marks**	**:**	**100**
Hours:33		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives:	
1	Develop an appreciation and understanding of the role of systems engineering processes and systems management in producing products and services.
2	Document systematic measurement approaches for generally cross disciplinary development effort.
3	Discuss capability assessment models to evaluate and improve orgnizational systems engineering capabilities.

Unit – I	
System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems. **Structure of Complex Systems:** System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions. **The System Development Process:** Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.	**07 Hrs**
Unit – II	
Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **Needs Analysis:** Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems. **Concept Exploration:** Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.	**07 Hrs**
Unit – III	
Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems **Advanced Development:** Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.	**07 Hrs**

Unit – IV	
Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. **Integration and Evaluation:** Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.	**06 Hrs**
Unit – V	
Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. **Operations and support**: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.	**06 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the Life Cycle of Systems.
CO2	Explain the role of Stake holders and their needs in organizational systems.
CO3	Develop and Document the knowledge base for effective systems engineering processes.
CO4	Apply available tools, methods and technologies to support complex high technology systems.
CO5	Create the frameworks for quality processes to ensure high reliability of systems.

Reference Books	
1	Alexander Kossoakoff, William N Sweet, "Systems Engineering – Principles and Practice" John Wiley & Sons, Inc, 2012, ISBN: 978-81-265-2453-2
2	Andrew P. Sage, William B. Rouse, "Handbook of Systems Engineering And Management" John Wiley & Sons, Inc., 1998, ISBN 0-471-15405-9
3	Bertalanffy, L. von. 1968. General System Theory: Foundations, Development, Applications. Revised ed. New York, NY, USA: Braziller.
4	Blanchard, B., and Fabrycky, W. 2010. Systems Engineering and Analysis, (5th edition). Saddle River, NJ, USA: Prentice Hall.
5	Checkland, P. 1981. Systems Thinking, Systems Practice. Hoboken, NJ, USA: Wiley (2nd edition 1999).
6	Rechtin, E. 1991. Systems Architecting. Upper Saddle River, NJ,USA: Prentice Hall.
7	Booher, H. (ed.) 2003. Handbook of Human Systems Integration. Hoboken, NJ, USA: Wiley
8	Hitchins, D., 2007. Systems Engineering: A 21st Century Methodology. Chichester, England: Wiley.

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

method	
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation **Theory (100)**	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

CO-PO Mapping												
CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	2	-	-	-	2	-	-

Low-1 Medium-2 High-3

Semester: VII		
Course Title: MEMS and Applications (Elective-H)		
Course Code: 16G7H08		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours:33		**SEE Duration(Theory): 3 Hrs**

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

UNIT-I	
Overview of MEMS & Microsystems and working Principles of Microsystems: MEMS and Microsystems, Typical MEMS and micro system products, Evolution of micro fabrication, Microsystems and microelectronics, Multidisciplinary nature of Microsystems, Design and manufacture, Applications of Microsystems in automotive, healthcare, aerospace and other industries. **Working Principle of Microsystems**: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal	**05 Hrs**
UNIT-II	
Micro actuation: Using thermal forces, shape memory alloys, Piezoelectric crystals and electrostatic forces. MEMS with micro actuators: Microgrippers, micromotors, microvalves and micropumps, microaccelerometers, microfluidics**.** **Introduction to Scaling:** Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics	**08 Hrs**
UNIT-III	
Materials for MEMS and Microsystems: Substrates and wafers, Active substrate materials, Silicon as substrate material, Silicon Compounds, Si-Piezoresistors, GaAs, Quartz, Piezoelectric Crystals, Polymers and packaging materials. Three level of Microsystem packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem packaging. Essential packaging technologies: die preparation, Surface bonding, Wire bonding, Sealing,3D packaging.	**08 Hrs**
UNIT-IV	
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD,PVD-Sputtering, Deposition of Epiaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	**06 Hrs**
UNIT-V	
Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors. **Overview, Application, Fabrication Process in Applications:** Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Electrostatic Comb drive, Portable blood analyzer, Piezo electric Inkjet Print head, Micromirror array	**06 Hrs**

for Video projection	

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

Reference Books	
1	Tai Ran Tsu, "MEMS & Micro systems Design and Manufacture", Tata McGraw Hill, New Delhi, 2002,ISBN-13:978-0-07-048709-3
2	Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012, ISBN-13:978-0-13-249736-7.
3	Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000, ISBN-1:5853-865-7-2004
4	Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001 ISBN-13:978-14-0207883-5.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be 5 questions from 5 units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment		2 phases	10/20	Reports / Record Books			
				Weekly	50				
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
					50				
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: VII

Course Title: Industry 4.0 – Smart Manufacturing For The Future		
Course Code: 16G7H10		**CIE Marks: 100**
Credits: L:T:P:S: 3:0:0:0		**SEE Marks: 100**
Hours: 33		**SEE Duration: 3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the importance and role of Smart Manufacturing Systems, IoT, IIoT
2	Explain importance of automation technologies, sensors, Robotics and Machine vision.
3	Understand application of artificial intelligence and the need for data transformation, handling, storing and security.
4	Understand simulation, predictive and knowledge modeling along with analysis
5	Learn networking, sustainable technology and factory networks.

UNIT-I	
Smart Manufacturing and Industry 4.0: Need for Smart Manufacturing, Advantages, Emerging technologies in Smart manufacturing, CAD Architecture surrounding 3D Models (B-rep and CSG), MEMS, Industry 4.0 – Interoperability, Information transparency, Technical assistance, Decentralized decision-making, Internet of Things (IoT), Industry Internet of Things (IIoT), Future of Manufacturing industries	**05 Hrs**
UNIT-II	
Manufacturing Automation: Technology intensive manufacturing and cyber-physical systems, Automation using Robotics, Data storage, retrieval, manipulation and presentation; Mechanisms for sensing state and modifying processes, Material handling systems, controlling material movement and machine flow, Mechatronics, Transducers and sensors, Proximity sensors, Biosensors, Acceleration Machine Vision – Flaw detection, Positioning, Identification, Verification and Measurement – Application of Machine Vision in industries	**08 Hrs**
UNIT-III	
Data handling using Embedded systems: Data transformation – Mathematical functions, Regression, Need for different functions, Data merging – Discrete and Random variables, Transformation languages, Interfacing systems - Microprocessors, Direct memory access, Data transfer schemes and systems, Communication systems – Modulation, Time domain and frequency domain, Industrial Network Data Communications, Data Security Artificial Intelligence – Intelligent systems, Fuzzy logics, Neural networks – Supervised, Unsupervised and Reinforced learning	**08 Hrs**
UNIT-IV	
Simulation, Modeling and Analysis: Simulation - system entities, input variables, performance measures, and functional relationships, types of simulation. Predictive modelling and simulation tools, Knowledge Modelling – types and technology options, Functional analysis of control systems – Linear and Non-linear, Functional decomposition, Functional sequencing, Information/data flow, Interface definition	**06 Hrs**
UNIT-V	
Performance Measures of Smart Manufacturing Systems: Smart manufacturing - Sensing and Perception, Manipulation, Mobility and Autonomy Factory Networks, Information Modelling and Testing, Performance Measurement and Optimization, Engineering System integration, Production	**06 Hrs**

Network integration, Production network data quality, Sustainable Processes and Resources, Integration Infrastructure for Sustainable Manufacturing	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain role and importance of Smart Manufacturing Systems, IoT, IIoT
CO2	Explain importance of automation technologies, sensors, Robotics and Machine vision
CO3	Illustrate application of artificial intelligence and need for data transformation, handling, storing and security
CO4	Explain analytical and simulation for performance study of smart technologies and networks

Reference Books	
1.	Zongwei Luo, "Smart Manufacturing Innovation and Transformation": Interconnection and Intelligence, I Edition, IGI Global Publications, 2014, ISBN-13: 978-1466658363 ISBN-10: 1466658363
2.	Yan Lu. KC Morris, Simon Frechette, "Smart Manufacturing Standards", NIST, 1st Edition, 2016, Project report.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom's taxonomy level.	**80**
Total	**100**

	What	**To**	**Frequency**	**Max**	**Evidence**	**Contribution to**

			whom	of conduction	Marks		Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

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

Low-1 Medium-2 High-3

Semester: VII		
Course Title: Space Technology And Applications		
Course Code :16G7H11		**CIE Marks:100**
Credits:L:T:P:S:3:0:0:0		**SEE Marks :100**
Hours: 40		**SEE Duration :3 Hrs**

Course Learning Objectives (CLO): The students will be able to	
1.	Define the earth environment and its behavior, launching vehicles for satellites and its associated concepts.
2.	Analyze satellites in terms of technology, structure and communications.
3.	Use satellites for space applications, remote sensing and metrology.
4.	Apply the space technology, technology mission and advanced space systems to nation's growth

UNIT I	
Earth's environment: Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. **Launch Vehicles:** Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.	**08 Hrs**
UNIT II	
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and, Quality and Reliability, Payloads, Space simulation. **Satellite structure:** Satellite Communications, Transponders, Satellite Antennas.	**08 Hrs**
UNIT III	
Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques. **Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Tele-medicine, Satellite navigation, GPS.	**08 Hrs**
UNIT IV	
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource management, image processing techniques. **Metrology:**Weather forecast (Long term and Short term), weather modeling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.	**08 Hrs**
UNIT V	
Satellite payloads: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and International space Missions. **Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Inter-space communication systems.	**08 Hrs**

Course Outcomes: After completion of the course, the students will be able to	
CO1	Explain different types of satellites, orbit and associated subsystems.
CO2	Apply the basics of launching vehicles, satellites and sub systems for space applications.
CO3	Analyze the applications of satellite in the area of communication, remote sensing, metrology etc.,
CO4	Study technology trends, satellite missions and advanced space systems.

Reference Books:	
1.	R G Barry, “Atmosphere, weather and climate”, Routledge publications, 2009. ISBN-10: 0415465702
2.	K N Raja Rao, “Fundamentals of Satellite Communication”, PHI, 2012. ISBN. 9788120324015
3.	Timothy pratt, “Satellite Communication” John Wiley, 1986 ISBN: 978-0-471-37007-9 ISBN 10: 047137007X
4.	B C Panda, “Remote sensing and applications” VIVA books Pvt. Ltd., 2009 ISBN-10: 8176496308

In case of a course having only theory, the following minimum guidelines may be followed.

Continuous Internal Evaluation (CIE) (Theory – 100 Marks)	
Evaluation method	Marks
Quiz -1	10
Test -1	50
Quiz-2	10
Test -2	50
Quiz-3	10
Test-3	50
Assignment	10
Final evaluation quiz 10+10+10=30 Test 50+50+50=150 Reduced to 60, Assignment 10	

Semester End Evaluation Theory (100)	
Part- –A **Objective type questions**	**20**
Part –B There should be five questions from five units. Each question should be for maximum of 16 Marks. The **UNIT-1**, **UNIT-4** and **UNIT-5** should not have any choice. The **UNIT-2 and UNIT-3** should have an internal choice. Both the questions should be of the same complexity in terms of COs and Bloom’s taxonomy level.	**80**
Total	**100**

Note: The faculty teaching the course may adapt additional methods for evaluation within the total maximum marks.

	What		To whom	Frequency of conduction	Max Marks	Evidence	Contribution to Course Outcome		
Direct Assessment Methods	CIE	Quiz	Students	Three	30	Answer Scripts	80%	100%	90%
		Test		Two	60/50				
		Assignment/Self-study		2 phases	10/20	Reports / Record Books			
	SEE	Semester End Examination		End of every semester Consisting of Part-A and Part-B	100	Answer Scripts	20%		
Indirect Assessment methods	Course End Survey		Students	End of course		Questionnaire Based on COs	10%		

Note: Individual faculty may adopt various methods for conducting effective quizzes and evaluate the same. The frequency of quizzes may be more than three also.

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

Low-1 Medium-2 High-3

Semester: VIII
Major Project

Course Code: 16ISP81 **CIE Marks : 100**
Credits: L: T: P: S: 0:0:32:0 **SEE Marks : 100**
Hours: 16 **SEE Duration: 03 Hrs**

Objectives:

1. ***Knowledge Application:*** Students will acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
2. ***Communication:*** Students will acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both the written and oral forms.
3. ***Collaboration:*** Students will acquire collaborative skills through working in a team to achieve common goals.
4. ***Independent Learning:*** Students will be able to learn on their own, reflect on their learning and take appropriate action to improve it.
5. ***Management and Finance:*** Students will prepare schedules and budgets, they along with the guide keep track of the progress and expenditure.

Guidelines

1. Students are required to form a project team/batch before the end of 7th semester.
2. The departments must complete the Internal Guide allotment process before the end of 7th semester .
3. The project topic, title and synopsis has to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
4. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program (as interdisciplinary projects are encouraged).
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house / Industry / R & D Institution.
- ***The project work is to be carried out by a team of two to four students , in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process,*** the student can work independently.
- ***The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.***
- ***In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.***

Project Topic Selection:

The topics of the project work must be in the ***field of respective program areas or in line with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as**

given by industry/Faculty. The projects as far as possible should have societal relevance with focus on sustainability.

Place of Project Work:

- The project work should be carried out in the college.
- The project work can also be carried out in the Industry, in case the project is given by the industry ***as internship, provided the department Project Review Committee approves the project*** and the facilities for carrying out such project work are not available in the college.
- In case additional facilities are required for testing etc., students are permitted to visit research labs, where such facilities are available. The HoD should be informed in such cases and No objection obtained.

Attendance Requirement:

- Students are required to satisfy minimum attendance criteria as prescribed by the Institution, i.e. (85%)
- Students who are doing project work in the industries are required to go to the industry for full 5 days.
- Students who are doing project work in the college, are required to come to the college for full 5 days (Monday- Friday) and attendance is mandatory.
- Students are requested to adhere to the schedule of various phases of project work.
- The guides shall be responsible to send attendance details every month through HoD, to the Dean(Student affairs)

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of ***Industry project***, during the course of project work, the internal guides will be in constant touch with external guides and will visit the industry at least thrice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to defend the work done.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department and a Soft copy on a CD, to the Central library.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- The Project team is required to demonstrate the functioning of the modules and the integrated application along with a presentation on the details of the project carried out during the Semester End Examination (SEE) in the department.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course outcomes:

After the successful completion of the course, the students should be able to

CO1. Perform literature review, identify state of the art in that field and be able define the problem.

CO2. Establish a methodology using advanced tools / techniques for solving the problem including project management and finances.

CO3. Design, Develop Analytical models, Perform Numerical Analysis and Interpret the rresults.

CO4. Prepare quality document of project work for publications, patenting and final thesis.

CIE Assessment:

The following are the weightings given for the various stages of the project.

1. Selection of the topic and formulation of objectives 10%
2. Design and Development of Project methodology 25%
3. Execution of Project 25%
4. Presentation, Demonstration and Results Discussion 30%
5. Report Writing 10%

SEE Assessment:

The following are the weightages given during Viva Examination.

1. Written presentation of synopsis 10%
2. Presentation/Demonstration of the project 30%
3. Methodology and Experimental Results & Discussion 30%
4. Report 10%
5. Viva Voce 20%

Calendar of Events for the project Work:

Week	Event
Beginning of 7th Semester	Formation of Project Committee in the Department. Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment
II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	First visit of the internal guides to industry (In case of project being carried out in industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Second visit by guide to industry (In case of project being carried out in industry) & submission of draft copy of the project report
XI and XII Week	Third visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

Evaluation Scheme for CIE and SEE

Scheme of Evaluation for CIE		**Scheme of Evaluation for SEE**	
Particulars	**%Marks**	**Particulars**	**%Marks**
Project Evaluation I	10%	Project Synopsis (Initial Write up)	10%
Project Evaluation II	25%	Project Demo / Presentation	30%
Project Evaluation III	25%	Methodology and Results Discussion	30%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification**)**	30%	Project Work Report	10%
Project Evaluation Phase-V (Project Final Internal Evaluation**)**	10%	Viva-voce	20%
Total	100	Total	100

Semester: VIII
Technical Seminar

Course Code: 16ISS82 **CIE Marks : 50**
Credits: L:T:P:S: 0:0:2:0 **SEE Marks : 00**
Hours: 02 **SEE Duration : NA**

Course Learning Objectives:

1. To create awareness to recognize recent developments in Electronics & Communication and in multidisciplinary fields.
2. To summarize the recent technologies and inculcate the skills for literature survey.
3. To demonstrate good presentation skills.
4. To plan and improve the Technical Report writing skills.
5. To support Group discussion and Team work.

General Guidelines for the Seminar

1. The seminar has to be presented by individual student.
2. The topic of the seminar should be from current thrust area. This is to be decided in consent with internal guide.
3. The topic can be based on standard papers (like IEEE/ACM/CSI etc.) in the thrust area for the selected topic.
4. Each student has to prepare a technical paper out of seminar topic.
5. Presenting/publishing this paper in conference/ Journal will be given weightage in CIE.
6. The student needs to submit both hard & soft copy of the seminar report.

Course Outcome:

At the end of this course the student will be able to:

CO1. Understand and interpret latest advancements through different technical papers, reports, Journals, Data sheets, books etc..
CO2. Communicate his/her ideas with his peers as audience, which will enhance both oral and written communication skills.
CO3. Learn to manage resources effectively.
CO4. Create interest to pursue lifelong learning.

Evaluation of CIE Marks:

1. Relevance of the topic :10%
2. Literature Survey :10%
3. Presentation : 40%
4. Report : 20%
5. Paper Publication : 20%

INNOVATION & SOCIAL SKILLS

Course Code: 16HSS83
Credits: L:T:P:S : 0:0:2:0
Hours: 02

Objectives:

- To provide a platform for the students to exhibit their organizational capabilities, team building, ethical values and extra mural abilities.
- To encourage to carryout innovative ideas and projects.
- Take part in societal and community building activities.
- Make self learning, ethics and lifelong learning a motto.

Guidelines

The HSS will be evaluated individually based on the broad parameters which include the progress made by student during 3^{rd}& 4^{th} year in innovative projects, Seminar, Paper Presentation, Field activity & other Co-curricular activities. Students shall submit a report and documents as a proof his/her achievements.