RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059

Bachelor of Engineering (B.E.)

Scheme and Syllabus of VII & VIII Semesters

2016 SCHEME

INFORMATION SCIENCE & ENGINEERING

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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2016 SCHEME

DEPARTMENT OF
INFORATION SCIENCE & ENGINEERING

DEPARTMENT VISION

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

DEPARTMENT MISSION

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

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

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

Lead Society:

Program Criteria

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

PROGRAM CRITERIA FOR COMPUTER SCIENCE AND SIMILARLY NAMED COMPUTING PROGRAMS

Lead Society: CSAB

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

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	PE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics

INDEX

RV COLLEGE OF ENGINEERING®

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INFORMATION SCIENCE & ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME								
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS**	
1	16IS71	Human Computer Interaction	IS	3	0	0	0	3
2	16IS72	Data Science and Engineering	IS	4	0	1	0	5
3	16IS73	Cryptography and Network Security	IS	4	0	1	0	5
4	16IS7FX	Elective F	IS	4	0	0	0	4
5	16IS7GX	Elective G	IS	4	0	0	0	4
6	16G7HXX	Elective H (GE)*	Respective BOS	3	0	0	0	3
Total No. of Credits				**22**	**0**	**2**	**0**	**24**
No. Of Hrs.				**22**	**0**	**4**	**0**	

*Students should take other department Global Elective courses;

EIGTH SEMESTER CREDIT SCHEME								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS**	
1.	16IS81	Major Project	IS	0	0	16	0	16
2.	16IS82	Technical Seminar	IS	0	0	2	0	2
3.	16HS83	Innovation and Social Skills	HSS	0	0	2	0	2
Total No. of Credits				**0**	**0**	**20**	**0**	**20**
No. Of Hrs.				**0**	**0**	**40**	**0**	

VII Semester		
GROUP F: PROFESSIONAL ELECTIVES		
Sl No	**Course Code**	**Course Title**
1.	16IS7F1	Internet of Things
2.	16IS7F2	Software Defined Networks
3.	16IS7F3	Software Architecture
4.	16IS7F4	Cloud Computing
GROUP G: PROFESSIONAL ELECTIVES		
1.	16IS7G1	Image Processing and Computer Vision
2.	16IS7G2	Cyber Security and Digital Forensics
3.	16IS7G3	Information Retrieval
4.	16IS7G4	Big Data Analytics

GROUP H: GLOBAL ELECTIVES				
Sl. No.	**Host Dept**	**Course Code**	**Course Title**	**Credits**
1.	BT	16G7H01	Nanotechnology	3
2.	CH	16G7H02	Industrial Safety and Risk Management	3
3.	CV	16G7H03	Intelligent Transport System	3
4.	CS	16G7H04	Intelligent Systems	3
5.	EC	16G7H05	Image Processing and Machine Learning	3
6.	EE	16G7H06	Design of Renewable Energy Systems	3
7.	IM	16G7H07	Systems Engineering	3
8.	EI	16G7H08	MEMS and Applications	3
9.	IS	16G7H09	Introduction to Internet of Things	3
10.	ME	16G7H10	Industry 4.0 – Smart Manufacturing for The Future	3
11.	TE	16G7H11	Space Technology and Applications	3
12.	MA	16G7H12	Advanced linear Algebra	3
13.	PY	16G7H13	Thin Film Nanotechnology	3
14.	CY	16G7H14	Engineering Materials for Advanced Technology	3
15.	HSS	16G7H15	Applied Psychology for Engineers	3
16.	HSS	16G7H16	Foundational Course on Entrepreneurship	3
17.	AS	16G7H17	Unmanned Aerial Vehicles	3

Semester: VII						
HUMAN COMPUTER INTERACTION (Theory)						
Course Code	**:**	16IS71		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	38L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To Comprehend about foundations of Human Computer Interaction
2	To familiar with the design technologies for individuals and persons with disabilities.
3	To describe and discuss current research in the field of HCI.
4	To motivate towards design, implement and evaluate effective and usable graphical computer interfaces.

Unit-I	**07 Hrs**
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..	
Unit – II	**07 Hrs**
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 **Interaction Styles, Direct Manipulation and Virtual Environment :** Introduction Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces Teleoperation, Virtual and Augmented Reality..	
Unit –III	**07 Hrs**
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 **Command and Natural Languages:** Introduction, Command-Organization, Functionality, Strategies, and Structure, Naming and Abbreviations, Natural Language in Computing. **Interaction Devices:** Introduction, Keyboards and Keypads, Pointing Devices Speech and Auditory Interfaces, Displays – Small and Large.	
Unit –IV	**07 Hrs**
Quality of Service: Introduction, Models of Response Time Impacts Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences. **Balancing Function and Fashion**: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color.	
Unit –V	**06 Hrs**
User Documentation and Online Help: Introduction, Online versus Paper, Documentation, Reading from Paper versus from Displays, **Information Search:** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interface	

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 core theories, models and methodologies from the field of HCI.
CO3:	Design prototypes and come up with methods and criteria for evaluation of the design.
CO4:	Implement simple graphical user interfaces using the Java Swing toolkit.

Reference Books	
1	Designing the User Interface: Techniques for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 5th Edition, 2014, Pearson Publications, ISBN: 9789332518735, 9332518734.
2	Human – Computer Interaction, Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, 3rd Edition,2004, Pearson, ISBN 0-13-046109-1.
3	The essential guide to user interface design, Wilbert O Galitz, 3rd Edition,2007, Wiley, ISBN: 978-0-471-27139-0.
4	Interaction Design,Prece, Rogers, Sharps, 3rd Edition,2011, Wiley, ISBN: 978-1-119-02075-2.

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

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

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

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

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

High-3: Medium-2 : Low-1

Semester: VII						
DATA SCIENCE AND ENGINEERING (Theory & Practice)						
Course Code	**:**	16IS72		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	4:0:1:0		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	44		**SEE Duration**	**:**	**3.00 Hours**

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	**08 Hrs**
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.	
Unit – II	**09 Hrs**
Data Pre-Processing And Predictions: Data cleaning, data integration, data reduction, data transformation and discretization, Data Warehouse, Simple linear regression, multiple linear regression.	
Unit –III	**09 Hrs**
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.	
Unit –IV	**09 Hrs**
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.	
Unit –V	**09 Hrs**
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.	

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	Data Mining: Concepts and Techniques , Jiawei Han, Micheline Kamber, 2nd Edition (January 13, 2006), Morgan Kaufmann Publications, ISBN-10: 1558609016, ISBN-13: 978-1558609013
2	Hadoop: The Definitive Guide, Tom White, 4th Edition, 2015,O'Reilly Publications, ISBN-10: 9352130677, ISBN-13: 978-9352130672
3	Discovering Knowledge in Data, Daniel T. Larose, Publisher: 1st Edition (November 18, 2004), Wiley, ISBN-10: 0471666572, ISBN-13: 978-0471666578
4	Data Science & Big Data Analytics, David Dietrich, Barry Heller, Beibei Yang, 2015, Wiley Publications, ISBN-10: 8126556536, ISBN-13: 978-8126556533

Laboratory Component:

Part-A

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. Implement 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.

Part-B

CaseStudy: Implementing an ML model for a given case study.

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

Theory – 100 Marks

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

Laboratory- 50 Marks

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

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

High-3: Medium-2 : Low-1

Semester: VII						
CRYPTOGRAPHY & NETWORK SECURITY (Theory & Practice)						
Course Code	**:**	16IS73		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	4:0:1		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

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	**09 Hrs**
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.	
Unit – II	**09 Hrs**
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.	
Unit –III	**09 Hrs**
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.	
Unit –IV	**09 Hrs**
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	
Unit –V	**09 Hrs**
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.	

Cryptography and Network Security Lab	
PART – A	
1.	Write a program for error detecting code using CRC-CCITT (3/4/ bits or more).
2.	Demonstrate the working of Leaky bucket algorithm
3.	Write a program to create Ceaser and Play fair ciphers
4.	Write a program to implement Vigenere Cipher
5.	Write a program for simple RSA algorithm to encrypt and decrypt the data
6.	Implement the Diffie-Hellman protocol
	PART – B
	Note: The following are the possible list of topics to carry out mini project (With a group of 2 students) but not limited to: • Working with Sniffers for monitoring network communication (Ethereal Packets) • Implementation of HILL CIPHER for 4 × 4 matrix • Simulation of Distance Vector algorithm. • Security analysis for TELNET protocol. • Employee website monitoring using packet analysis. • Small Business Network Design with Secure E-commerce server. • IP spoofing demonstration. • ARP Spoofing demonstration. • Prevention of congestion collapse. • Network border patrol. • Evacuation of delayed packets in the network. • Implementation of Access Control List. • Network monitoring Tool. • Use of the performance monitoring system. • Management of the IIS and FTP server.

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

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	Cryptography and Network Security, Principles and Practice,William Stallings –6th Edition, 2014,Pearson India Education, ISBN: 978-93-325-1877-3.
2	Cryptography and Network Security, Behrouz A Forouzan, Debdeep Mukhopadhyay, 2nd Edition, Special Indian Edition, McGraw Hill Publication.ISBN : 9780070702080
3	Introduction to Computer Security, Matt Bishop,2nd Edition,2004 Pearson Publications. ISBN: 0321247442
4	Network Security and Cryptography, Menezes Bernard 1st Edition, 2010,Cengage Learning India, ISBN: 9788131513491
5	Cryptography Theory and Practice, Douglas Stinson, 2nd Edition, Chapman & Hall/CRC, ISBN: 978-1584885085.

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

Theory – 100 Marks

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

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Laboratory- 50 Marks

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

High-3: Medium-2 : Low-1

Semester: VII						
INTERNET OF THINGS (Elective)						
Course Code	**:**	16IS7F1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To understand the fundamentals of Internet of Things.
2	To learn about the basics of IOT protocols.
3	To build a small low cost embedded system using Raspberry Pi.
4	To apply the concept of Internet of Things in the real world scenario.

Unit-I	**09 Hrs**
Introduction To IoT: Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.	
Unit – II	**09 Hrs**
IoT Architecture: M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture	
Unit –III	**09 Hrs**
IoT Protocols: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.	
Unit –IV	**09 Hrs**
Building IOT with Rasperry PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device - Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.	
Unit –V	**09 Hrs**
Case Studies And Real World Applications: Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.	

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

CO1:	Analyze various protocols for IoT
CO2:	Develop web services to access/control IoT devices.
CO3:	Design a portable IoT using Rasperry Pi AND CONNECT TO THE CLOUD.
CO4:	Analyze applications of IoT in real time scenrio

Reference Books

1	Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2015, ISBN: 978-81-7371-954-7.
2	Architecting the Internet of Things‖, Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), 2011, Springer.
3	The Internet of Things in the Cloud: A Middleware Perspective‖, Honbo Zhou, CRC Press, 2012.
4	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, Elsevier, 2014.

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

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

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

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

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

High-3: Medium-2 : Low-1

Semester: VII						
SOFTWARE DEFINED NETWORKS (Elective)						
Course Code	**:**	18IS7F2		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basics of software defined networking
2	Identify an emerging paradigm in computer networking that allows a logically centralized software program to control the behaviour of an entire network
3	Learn the skills to do advanced networking programming
4	Analyse to use software programs to perform varying and complex networking tasks

Unit-I	**07 Hrs**
Introduction To SDN : SDN Origins And Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis Of SDN	
Unit – II	**08 Hrs**
SDN Abstractions : How SDN Works - The Openflow Protocol - SDN Controllers: Introduction - General Concepts - VMware - Nicira - VMware/Nicira - OpenFlow-Related - Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight	
Unit –III	**08 Hrs**
Programming SDN'S : Network Programmability - Network Function Virtualization - NetApp Development	
Unit –IV	**08 Hrs**
SDN Applications And Use Cases : SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases	
Unit –V	**08 Hrs**
SDN'S Future And Perspectives : SDN Open Source - SDN Futures - Final Thoughts and Conclusions	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Differentiate between traditional networks and software defined networks
CO2:	Understand advanced and emerging networking technologies
CO3:	Obtain skills to do advanced networking research and programming
CO4:	Expand upon the knowledge learned and apply it to solve real world problems

Reference Books	
1	Software Defined Networks: A Comprehensive Approach, Paul Goransson and Chuck Black,2nd Edition, 2014, Morgan Kaufmann Publications,ISBN-13:978-0124166752
2	SDN - Software Defined Networks , Thomas D. Nadeau & Ken Gray,1st Edition, 2013,O'Reilly, ISBN-13: 978-1449342302
3	Software Defined Networking withOpenFlow , SiamakAzodolmolky, 2nd Edition 2013,Packt Publishing, ISBN-13: 978-1783984282
4	Software Defined Networking (SDN) with OpenStack ,SreenivasVoruganti, Sriram Subramanian, 1st Edition,2016, Packt PublishingISBN-13: 978-1786465993

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: VII						
SOFTWARE ARCHITECTURE (Elective)						
Course Code	**:**	16IS7F3		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

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	**09 Hrs**
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.	
Unit – II	**09 Hrs**
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.	
Unit –III	**09 Hrs**
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.	
Unit –IV	**09 Hrs**
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.	
Unit –V	**09 Hrs**
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.	

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

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

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

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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: IV						
CLOUD COMPUTING (Elective)						
Course Code	**:**	16IS7F4		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	52L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To learn advanced and cutting edge state-of-the-art knowledge and implementation in cloud computing.
2	To read and understand research publications in the technical area of cloud computing, beyond that of the traditional textbook level.
3	To learn advanced services and applications in stacks of cloud.
4	Explore the cloud Infrastructure and understanding Abstraction & Virtualization in cloud computing.

Unit-I	**12 Hrs**
Introduction To Cloud Computing: Defining cloud computing, types of cloud, Characteristics of cloud computing,benefits of cloud computing,Disadvantages of cloud computing. Assessing the value proposition,avoiding capital expenditures,computing the total cost of ownership,defining the licensing models. **Cloud Architecture:** Exploring the cloud computing stack; infrastructure; virtual applications; communication protocols; Connecting to the cloud.	
Unit – II	**10 Hrs**
Services & Applications: Defining infrastructure as a service (Iaas); Defining Software as a service (SaaS); Defining Platform as a service (PaaS); Defining identity management as a service (IDaaS); Defining Communications as a Service (CaaS).	
Unit –III	**10 Hrs**
Understanding Abstraction & Virtualization: Using Virtualization technologies; Load balancing & Virtualization; advance load balancing; the Google cloud; exploring Microsoft cloud service; Understanding Amazon web services; surveying the Google application portfolio; Understanding hypervisors; virtual machine types; VMware Vsphere.	
Unit –IV	**10 Hrs**
Exploring The Cloud Infrastructure: Administration the cloud; cloud management lifecycle; cloud management products; Emerging cloud management standards; securing the cloud: boundaries & mapping; securing data: brokered storage & access, Encryption; Establishing identity & presence.	
Unit –V	**10 Hrs**
Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Event management, Collaborating on Contact management, collaborating on Project Management, Collaborating on Word Processing, Collaborating on Spread sheets, Collaborating on Databases, collaborating on presentations, Storing and sharing Files and other online content, sharing Digital Photographs, controlling the collaborations with Web-Based Desktops.	

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:	Analyse real world case studies of existing cloud based software solutions.

Reference Books	
1	Cloud computing bible, Barrie Sosinsky,CRC Press, 2010, ISBN: 978-0-470-90356-8.
2	Cloud Computing, A practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, 2011, Wiley India, ISBN: 0071626948.
3	Cloud Computing-Web Based applications that change the way you work and collaborate online, Michael Miller, Pearson Education, 2009, ISBN: 9780789738035.
4	Cloud Application Architectures, George Reese, Wiley India 2011, ISBN: 978-0596156367.

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

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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: IV						
IMAGE PROCESSING AND COMPUTER VISION (Elective)						
Course Code	**:**	16IS7G1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**			**SEE Duration**	**:**	**3.00 Hours**

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 preprocessing, 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	**08 Hrs**

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.

Unit – II	**09 Hrs**

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.

Unit –III	**09 Hrs**

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, Matching, active contour models – snakes, segmentation using morphological watersheds, Evaluation issues in segmentation.

Unit –IV	**09 Hrs**

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, Gray scale morphology.
Shape Representation and description –
Representation: Boundary following, chain codes, polygonal approximations using minimum-perimeter polygons, other polygonal approximations, skeletons, boundary descriptors, regional descriptors.

Unit –V	**08 Hrs**

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

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	Digital Image Processing and Computer, Sonka, Hlavac, Boyle, 4th Edition, 2014, Vision Cengage Learning, ISBN: 9781133593607.
2	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 4th Edition, 2018, Pearson Education, ISBN: ISBN-13: 978-0131687288
3	Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, 5th Edition, 2015,Tata McGraw Hill, ISBN 13: 9780070144798.
4	Digital Image Processing and Analysis, Chanda, D, Dutta Majumdar, 2nd Edition, 20011, PHI, ISBN: 978-81-203-4325-2.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

High-3: Medium-2 : Low-1

Semester: VII						
CYBER SECURITY AND DIGITAL FORENSICS (Elective)						
Course Code	**:**	1GIS7G2		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	52L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To provide an understanding Computer forensics fundamentals and comprehend the impact of cybercrime and forensics.
2	Describe the motive and remedial measures for cybercrime, detection and handling.
3	Demonstrate and investigate the use of Tools used in cyber forensics.
4	Analyse areas affected by cybercrime and identify Legal Perspectives in cyber security.

Unit-I	**11 Hrs**
Introduction To Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes,Cybercrime Era: Survival Mantra for the Netizens. **Cyber offenses: How Criminals Plan Them**: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	
Unit – II	**11 Hrs**
Cybercrime: Mobile And Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile devices, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	
Unit –III	**10 Hrs**
Tools And Methods Used In Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. **Phishing and Identity Theft**: Introduction, Phishing, Identity Theft (ID Theft).	
Unit –IV	**11 Hrs**
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti-forensics.	
Unit –V	**09 Hrs**
Cybercrime And Cyber Security: **The Legal Perspectives-**Introduction,Why Do We Need Cyberlaws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	

Course Outcomes: After going through this course the student will be able to:	
CO1:	Interpret the basic concepts of cyber security, cyber law and their roles.
CO2:	Articulate evidence collection and legal challenges.
CO3:	Discuss tool support for detection of various attacks.
CO4:	Demonstrate through use of proper tools knowledge on the cyber security, Cybercrime and forensics

Reference Books	
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, SunitBelapure and Nina Godbole, , Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2013.
2	Introduction to information security and cyber laws, Dr. Surya PrakashTripathi, RitendraGoyal, Praveen Kumar Shukla, KLSI. Dreamtech Press, ISBN: 9789351194736, 2015.
3	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions, Thomas J. Mowbray, Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 84965 -1
4	Cyber Forensics , Technical Publications, I. A. Dhotre 1st Edition edition (2016), ISBN-13: 978-9333211475

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: VII						
INFORMATION RETRIEVEL (Elective)						
Course Code	**:**	12IS7G3		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	52		**SEE Duration**	**:**	**3.00 Hours**

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	**10 Hrs**
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.	
Unit – II	**11 Hrs**
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.	
Unit –III	**11 Hrs**
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.	
Unit –IV	**10 Hrs**
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.	
Unit –V	**10 Hrs**
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.	

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

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: IV						
BIG DATA ANALYTICS (Elective)						
Course Code	**:**	16IS7G4		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Learn and know the Big Data flow in different aspects.
2	Select the correct big data stores for disparate data sets
3	Being able to utilize and apply the Data Analytics lifecycle to Big Data analytics projects
4	Process large data sets using Hadoop to extract value

Unit-I	**09 Hrs**
Introduction To Big Data Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data -Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Big data characteristics -Data Appliance and Integration tools – Greenplum – Informatica	
Unit – II	**09 Hrs**
Data Analysis – Evolution of analytic scalability – Convergence – parallel processing systems – Cloud computing – grid computing – map reduce – enterprise analytic sand box – analytic data sets – Analytic methods – analytic tools – Cognos – Microstrategy - Pentaho. Analysis approaches – Statistical significance – business approaches – Analytic innovation – Traditional approaches – Iterative	
Unit –III	**09 Hrs**
Stream Computing- Introduction to Streams Concepts – Stream data model and architecture - Stream Computing,Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Realtime Analytics Platform(RTAP) applications IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis– Intelligent scheduler – Infosphere Streams	
Unit –IV	**09 Hrs**
. **Predictive Analytics And visualization-** Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry - Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques –Hierarchical – K- Means – Clustering high dimensional data Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications:	
Unit –V	**09 Hrs**
Frameworks And Applications- **IBM** for Big Data – Map Reduce Framework - Hadoop – Hive - – Sharding – NoSQL Databases - S3 -Hadoop Distributed file systems – HBase – Impala –Big Data on Mobile & Cloud Computing- Image Cloud Processing(ICP) Framework- Mnemonic Approachintermediate data generation- Analyzing big data with twitter – Big data for Ecommerce– Big data for blogs	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and explore the concepts of Big data analytics
CO2:	Analyze map reduce concepts to solve complex problems.
CO3:	Design and implement multi-cluster nodes using Hadoop related tools.
CO4:	Apply big data analytics techniques using HBase, Hive, Impala tools for real world problems.

Reference Books	
1	Big Data Analytics: Turning Big Data into Big Money, Frank J. Ohlhorst, John Wiley & Sons, 2012, ISBN: 9781118239049
2	Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, Wiley and SAS business series, 2012
3	Mining of Massive Datasets, AnandRajaraman and Jeffrey David Ullman, 2012 Edition, Cambridge University,Press, ISBN-13: 978-1107015357.
4	Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis ,Colleen Mccue, 2007, Elsevier, ,ISSN-13: 978-0750677967
5	Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Paul Zikopoulos, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, McGrawHill, 2011, **ISBN-13:** 978-0071790536 .

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

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

High-3: Medium-2 : Low-1

Semester: VII						
NANOTECHNOLOGY (Group H: Global Elective)						
Course Code	**:**	16G7H01		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To have the basic knowledge of nanomaterials and the process.
2	Describe methods of nanoscale manufacturing and characterization can be enabled.
3	To learn about Nano sensors and their applications in mechanical, electrical, electronic, Magnetic, Chemical field.
4	To understand the concept for a nanoscale product based on sensing, transducing, and actuating mechanism.
5	To have awareness about the nanoscale products used in multidisciplinary fields.

Unit-I	**06 Hrs**
Introduction to Nanomaterials: History of Nanotechnology, structures and properties of carbon based: Fullerenes (Bucky Ball, Nanotubes), metal based: Nano Shells, Quantum Dots, Dendrimers, Diamond like carbon(DLC) Nanocarriers, bionanomaterails: protein & DNA based nanostructures, Hybrids: hybrid biological/inorganic, Nanosafety Issues: Toxicology health effects caused by nanoparticles.	
Unit – II	**08 Hrs**
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), plsma arching and various lithography techniques (Hard & Soft lithography).	
Unit –III	**09 Hrs**
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.	
Unit –IV	**06 Hrs**
. **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.	
Unit –V	**07 Hrs**
Applications of Nanotechnology: Molecular electronics, molecular switches, mechanical cutting tools, machine components, DLC coated grinding wheels. solar cells, Batteries, fuel cells, Nanofilters. Medical nanotechnology: in Diagnostics, Therapeutics, Drug delivery and Nanosurgery.	

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

Reference 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).
3	Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th Edition, 2016, Pearson Education, ISBN-13: 978-0134115856.
4	Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, 1979, Prentice Hall India Learning Private Limited, ISBN-13: 978-8120301450.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
INDUSTRIAL SAFETY AND RISK MANAGEMENT (Group H: Global Elective)						
Course Code	**:**	16G7H02		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basics of risk assessment methodologies
2	Select appropriate risk assessment techniques
3	Analyze public and individual perception of risk
4	Relate safety, ergonomics and human factors
5	Carry out risk assessment in process industries

Unit-I	**08 Hrs**
General Risk Identification Methods – I: Hazard identification methodologies, risk assessment methods-PHA, HAZOP, MCA, consequence analysis, hazards in workplaces-nature and type of work places, types of hazards, hazards due to improper housekeeping, hazards due to fire in multi floor industries and buildings.	
Unit – II	**07 Hrs**
Risk Assessment Methods – II: Risk adjusted discounted rate method, certainty equivalent coefficient method, quantitative analysis, probability distribution, coefficient of variation method, Simulation method, Shackle approach, Hiller‟s model, Hertz Model.	
Unit –III	**09 Hrs**
Risk Management – III: Emergency relief Systems, Diers program, bench scale experiments, design of emergency relief systems, 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.	
Unit –IV	**07 Hrs**
Risk Assurance and Assessment – IV: Property insurance, transport insurance, liability insurance, risk Assessment, low Probability high consequence events. Fault tree analysis, Event tree analysis.	
Unit –V	**07Hrs**
Risk Analysis in Chemical Industries– V: Handling and storage of chemicals, process plants, personnel protection equipment's. International environmental management system.	

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 publications, New Delhi,1992,ISBN: 8120406907

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
INTELLIGENT TRANSPORT SYSTEM (Group H: Global Elective)						
Course Code	**:**	16G7H03		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

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	**8 Hrs**
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	
Unit – II	**6 Hrs**
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	
Unit –III	**7 Hrs**
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	
Unit –IV	**7 Hrs**
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.	
Unit –V	**8 Hrs**
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.	

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

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
INTELLIGENT SYSTEMS (Group H: Global Elective)						
Course Code	**:**	16G7H04		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

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	**07 Hrs**
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	
Unit – II	**07 Hrs**
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	
Unit –III	**07 Hrs**
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.	
Unit –IV	**07 Hrs**
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	
Unit –V	**07 Hrs**
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.	

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

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

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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
IMAGE PROCESSING AND MACHINE LEARNING (Group H: Global Elective)						
Course Code	**:**	16G7H05		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the major concepts and techniques in image processing and Machine Learning
2	To explore, manipulate and analyze image processing techniques
3	To become familiar with regression methods, classification methods, clustering methods.
4	Demonstrate image processing and Machine Learning knowledge by designing and implementing algorithms to solve practical problems

Unit-I	**08 Hrs**
Introduction to image processing: Images, Pixels, Image resolution, PPI and DPI, Bitmap images, Lossless and lossy compression, Image file formats, Color spaces, Bezier curve, Ellipsoid, Gamma correction, Advanced image concepts	
Unit – II	**08 Hrs**
Basics of Python & Scikit image: Basics of python, variables & data types, data structures, control flow & conditional statements, uploading & viewing an image, Image resolution, gamma correction, determining structural similarities.	
Unit –III	**08 Hrs**
Advanced Image processing using Open CV Blending Two Images, Changing Contrast and Brightness Adding Text to Images Smoothing Images , Median Filter ,Gaussian Filter ,Bilateral Filter ,Changing the Shape of Images ,Effecting Image Thresholding ,Calculating Gradients , Performing Histogram Equalization	
Unit –IV	**08 Hrs**
Machine Learning Techniques in Image Processing Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation, Support Vector Machines, Logistic Regression	
Unit –V	**08 Hrs**
Introduction to object Tracking , Modeling & Recognition Exhaustive vs. Stochastic Search, Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, Adaboost approaches: Face Detection / Recognition, Tracking.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Gain knowledge about basic concepts of Image Processing
CO2:	Identify machine learning techniques suitable for a given problem
CO3:	Write programs for specific applications in image processing
CO4:	Apply different techniques for various applications using machine learning techniques.

Reference Books	
1	Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python", by Himanshu Singh, Apress publisher.
2	Pattern Recognition and Machine Learning, by Christopher Bishop, Springer, 2008
3	Computer Vision: A modern Approach" by David Forsyth and Jean Ponce, Prentice Hall India 2004.
4	Machine Vision : Theory Algorithms Practicalities ,by E.R. Davies Elsevier 2005.
5	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Pearson Education, Ed, 2001.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
DESIGN OF RENEWABLE ENERGY SYSTEMS (GROUP H: GLOBAL ELECTIVE)						
Course Code	**:**	16G7H06		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To provide opportunity for students to work on multidisciplinary projects.
2	To familiarize the students with the basic concepts of nonconventional energy sources and allied technological systems for energy conversion
3	To impart skill to formulate, solve and analyze basic Non – conventional energy problems and prepare them for graduate studies.
4	To enable the student to design primarily solar and wind power systems.
5	To expose the students to various applications of solar, wind and tidal systems.

UNIT – I	**07 Hrs**
An introduction to energy sources: Industry overview, incentives for renewable, utility perspective, Relevant problems discussion, current positions of renewable energy conditions	
UNIT – II	**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.	
UNIT – III	**09 Hrs**
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.	
UNIT – IV	**07 Hrs**
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	
UNIT – V	**08 Hrs**
Stand alone system: PV stand-alone, Electric vehicle, wind standalone, 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.	

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	Wind and Solar Power Systems Design, Analysis and operation, Mukund R Patel, 2nd Edition, 2006, Taylor and Francis publishers, ISBN 978-0-8493-1570-1.
2	Non-Conventional sources of energy, G.D.Rai, 4th Edition, 2009, Khanna Publishers, ISBN 8174090738, 9788174090737,
3	Solar Energy, Sukhatme, 4th Edition, 2017, McGraw Hill Education, **ISBN-13:** 978-9352607112
4	Renewable energy sources, John Twidell, Tony Weir, 3rd Edition, 2015, Routledge Publisher, ISBN-13: 978-0415584388.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
SYSTEMS ENGINEERING (Group H: Global Elective)						
Course Code	**:**	16G7H07		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	33L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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	**07 Hrs**

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.

Unit – II	**07 Hrs**

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.

Unit – III	**07 Hrs**

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.

Unit – IV	**06 Hrs**

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.

Unit – V	**06 Hrs**

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.

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	Systems Engineering – Principles and Practice, Alexander Kossoakoff, William N Sweet, 2012, John Wiley & Sons, Inc, ISBN: 978-81-265-2453-2
2	Systems Engineering and Analysis, Blanchard, B., and Fabrycky W, 5th Edition, 2010, Saddle River, NJ, USA: Prentice Hall.
3	Handbook of Human Systems Integration, Booher, H. (ed.) 2003. Hoboken, NJ, USA: Wiley.
4	Systems Engineering: A 21st Century Methodology, Hitchins, D., 2007. Chichester, England: Wiley.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
MEMS AND APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	16G7H08		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	35L		**SEE Duration**	**:**	**3.00 Hours**

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	**06 Hrs**
Overview of MEMS & 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.	
Unit – II	**08 Hrs**
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.	
Unit – III	**08 Hrs**
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.	
Unit – IV	**06 Hrs**
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.	
UNIT – V	**07 Hrs**
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 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	MEMS & Microsystems Design and Manufacture, Tai-Ran Hsu, 2nd Edition, 2002, Tata McGraw Hill Education, New Delhi, ISBN-13:978-0-07-048709-3.
2	Foundations of MEMS, Chang Liu, 2012, Pearson Education Inc., ISBN-13:978-0-13-249736-7.
3	Smart Material Systems and MEMS, Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, 2006, Wiley-INDIA, ISBN-978-81-265-3170-7.
4	Micro and Smart Systems, G.K. Ananthasuresh, K.J .Vinoy, K.N. Bhat, V.K. Aatre, 2015, Wiley Publications, ISBN-:978-81-265-2715-1.

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

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

Total CIE is 30(Q) + 60(T) + 10(A) =100.

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

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

Semester: VII						
INTRODUCTION TO INTERNET OF THINGS (Group H: Global Elective)						
Course Code	**:**	16G7H09		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Learn the fundamentals of IoT					
2	Understands the hardware, networks & protocols used in IoT development					
3	Illustrate smart applications using IoT devices and building applications					
4	Know more advanced concepts like cloud connectivity in IoT					
5	Learn the fundamentals of IoT					

Unit-I	**06 Hrs**
Fundamentals Of IOT: Introduction, Physical design of IoT, Logical design of IoT, IoT Enabling technologies, IoT Levels and Deployment Templates, , IoTvs M2M	
Unit – II	**06 Hrs**
IOT Design Methodology: Need for IoT systems management, IoT Design Methodology **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.	
Unit –III	**11 Hrs**
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.	
Unit –IV	**09 Hrs**
IOT Physical Devices & Endpoints: What is an IoT device, Raspberry Pi device, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.	
Unit –V	**07 Hrs**
IOT Physical Servers & Cloud Offerings: Provides an introduction to the use of cloud platforms and frameworks such as Xively and AWS for developing IoT applications.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of IoT.
CO2:	Analyse the IoT devices, programming, networking requirements and protocols for building IoT products.
CO3:	Apply the concepts to design and develop IoT applications
CO4:	Creating applications of IoT using physical devices and interfacing with cloud.

Reference Books	
1	Internet of Things (A Hands-on-Approach), Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014, ISBN-13: 978-0996025515.
2	Internet of Things – From Research and Innovation to Market Deployment, OvidiuVermesan, Peter Friess, River Publishers Series in Communication, River Publishers, 2014, ISBN: ISBN: 978-87-93102-94-1 (Hard copy), 978-87-93102-95-8 (Ebook) (UnitsII 2nd part)
3	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Francis daCosta, , 1st Edition, Apress Publications, 2013, ISBN-13: 978-1430257400.
4	Meta products - Building the Internet of Things, WimerHazenberg, Menno Huisman, BIS Publishers, 2012, ISBN: 9789863692515.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
INDUSTRY 4.0– SMART MANUFACTURING FOR THE FUTURE (Group H: Global Elective)						
Course Code	**:**	16G7H10		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the importance and role of Smart Manufacturing Systems, IoT and 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	**06 Hrs**
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	
Unit – II	**09 Hrs**
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	
Unit –III	**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	
Unit –IV	**06 Hrs**
Simulation, Modeling and Analysis: Simulation - system entities, input variables, performance measures, and Functional relationships, types of simulation. Predictive modeling and simulation tools, Knowledge Modeling –types and technology options, Functional analysis of control systems – Linear and Non-linear, Functional decomposition, Functional sequencing, Information / dataflow, Interface	
Unit –V	**09 Hrs**
Performance Measures of Smart Manufacturing Systems: Smart manufacturing- Sensing and Perception, Manipulation, Mobility and Autonomy, Factory Networks, Information Modeling and Testing, Performance Measurement and Optimization, Engineering System integration, Production 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 and IIoT
CO2:	Explain importance of automation technologies, sensors, robotics and machine vision
CO3:	Illustrate the application of artificial intelligence and need for data transformation, handling
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, 1st 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)

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	16G7H11		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	35L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: 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	**07 Hrs**
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.	
UNIT-II	**07 Hrs**
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability, Payloads, Space simulation. **Satellite structure:** Satellite Communications, Transponders, Satellite antennas.	
UNIT-III	**07 Hrs**
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.	
UNIT-IV	**07 Hrs**
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. **Metrology:** Weather forecast (Long term and Short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.	
UNIT-V	**07Hrs**
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.	

Course Outcomes: After completing 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	Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN- 10 :0415465702.
2	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN:9788120324015.
3	Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9, ISBN 10: 047137007X.
4	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII

ADVANCED LINEAR ALGEBRA (Group G: Global Elective)						
Course Code	**:**	16G7H12		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Adequate exposure to learn the fundamental concepts to model a system of linear equations and to obtain the solution of system of linear equations.
2	Analyze and extend the structure of vector spaces, linear transformations, Symmetric matrices, quadratic forms required in applications of Business, Science and Engineering.
3	Apply the concept of Eigenvalues to study differential equations and dynamical systems. Apply the concept of Orthogonality to examine some of the least-squares problems.
4	Apply Linear Programming to Network problems and Game theory.

Unit-I	**07 Hrs**
System of linear equations : Matrices and system of linear equations, Geometry of linear equations, Linear models in Business, Science and Engineering-Input-Output model in Economics, Balancing chemical equations and Electrical networks.	
Unit – II	**09 Hrs**
Vector spaces and linear transformations: Revision of Vector Spaces, Subspaces, Linear independence, Basis, Dimension and Change of basis. Applications to Difference equations, Markov chains. Intersection, Sum, Product of spaces and Tensor product of two vector spaces. Introduction to Linear transformations, Geometrical interpretations in 2-dimensions and 3-dimensions.	
Unit –III	**09 Hrs**
Orthogonality, Eigen values and Eigen vectors: Orthogonality, Inner product spaces, Applications to Weighted least-squares and Fourier series, Fast Fourier transform. Eigen values and Eigen vectors, Applications to Differential equations, Discrete dynamical systems.	
Unit –IV	**07 Hrs**
Symmetric matrices and quadratic forms: Introduction to symmetric matrices, Quadratic forms, Test for Positive definiteness, Constrained Optimization, Singular Value Decomposition. Applications to image processing.	
Unit –V	**07 Hrs**
Linear programming and game theory: A Geometrical introduction to Linear programming, Simplex method and its geometrical meaning, Network models-Max flow-min cut theorem, Payoff matrix and Matrix games.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and interpret the fundamental concepts of linear equations, vector spaces, linear transformations, Orthogonality, Eigen values, symmetric matrices, quadratic forms, linear programming and game theory.
CO2:	Apply the knowledge and skills of Linear algebra to solve linear equations, difference and differential equations, constrained optimization problems, linear programming problems and related problems.
CO3:	Analyze the input-output models, Markov chains, discrete dynamical systems, singular value decomposition, network models and related problems.
CO4:	Using the overall mathematical knowledge of Linear Algebra to solve problems arising in practical situations.

Reference Books	
1	David C Lay; Linear Algebra and Its Applications; Pearson Education; III Edition; 2003; ISBN: 978-81-775-8333-5.
2	Gareth Williams; Linear Algebra with Applications; 6th edition; 2008; Narosa publications; ISBN: 978-81-7319-981-3.
3	Gilbert Strang; Linear Algebra and Its Applications; IV Edition; Cengage Learning India Edition; 2006; ISBN: 81-315-0172-8.
4	Howard Anton and Chris Rorres; Elementary Linear Algebra Applications Version; Wiley Global Education; 11th Edition; 2013; ISBN: 9781118879160.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
THIN FILM NANOTECHNOLOGY (Group G: Global Elective)						
Course Code	**:**	16G7H13		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the importance of vacuum in thin film fabrication
2	Acquire the knowledge of thin film preparation by various techniques
3	Analyze the properties of thin films using different characterization methods
4	Optimize the process parameter and property dependence
5	Apply the knowledge for developing thin film devices.

Unit-I	**08 Hrs**

Vacuum Technology:

Basics of Vacuum - Principles of different vacuum pumps: Rotary, Roots, Diffusion, Turbo molecular and Cryogenic pumps; Measurement of vacuum - Concept of Capacitance Manometer, Pirani and Penning gauges - Vacuum Systems & Applications.

Unit – II	**08 Hrs**

Methods of thin film preparation :

Physical Vapor Deposition (PVD) Techniques**:**

Evaporation: Thermal evaporation, Electron beam evaporation, Laser ablation, and Cathode arc deposition. *Sputtering*: DC sputtering, RF Sputtering, Magnetron sputtering, Reactive Sputtering, and Ion beam sputtering.

Chemical Vapor Deposition (CVD) Techniques**:** Conventional CVD, Plasma Enhance CVD (PECVD) and Atomic layer deposition (ALD).

Other Methods: Spin coating and Spray Pyrolysis.

Unit –III	**07 Hrs**

Surface Modification and Growth of Thin Films:

Surface preparation & Engineering for Thin film growth: Cleaning, Modification, Masking & Patterning, Base Coats and Top Coats.

Thin Film growth: Sequence of thin film growth, Defects and impurities, Effect of Deposition Parameters on film growth.

Unit –IV	**08 Hrs**

Properties and Characterization of Thin Films:

Film thickness (Quartz crystal thickness monitor and Stylus Profiler);
Film Adhesion (Tape, Cross-hatch test, and Humidity methods);
Surface morphology and topography (SEM and AFM);
Film composition (X-ray Photoelectron Spectroscopy);
Film structure (X-ray diffraction and Raman studies);
Electrical characterization (Four Probe and Semiconductor Analyzer); and
Optical characterization (Spectrophotometer).

Unit –V	**08 Hrs**

Thin Film Applications:

- Electrodes: Deposition of a Metal film, Ex: Aluminum.
- Transparent conducting oxides (TCO) – Preparation and Optimization of a semiconducting film, Ex: ZnO.
- Optimization of a dielectric film, Ex: Al_2O_3 or Si_3N_4.

Thin Film Devices:

- Thin Film Transistors (TFT),
- Thin Film Sensors
- Thin Film Capacitors
- Thin film Solar Cells,

- Thin film Solar Absorbers
- Diamond-like carbon (DLC) coating
- EMI Shielding coatings
- Hard coatings
- Coatings on Plastics/Polymers.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the importance of vacuum technology for thin film growth
CO2:	Prepare various kinds of thin films using different deposition techniques
CO3:	Characterize the deposited films for various properties
CO4:	Fabricate thin film based devices.

Reference Books	
1	Vacuum Technology by A. Roth, Elsevier, 3rd Edition, 1976, ISBN: 9780444880109, 9780444598745,
2	Thin Film Phenomenon by K.L. Chopra, McGraw-Hill, 1st Edition, 1969, ISBN: 0070107998, 978-0070107991
3	Materials Science of Thin Films by Milton Ohring, Elsevier, 2rdEdition, 2001, **ISBN:** 9780125249751
4	Thin-Film Deposition: Principles and Practice by Donald Smith, McGraw-Hill, 1st Edition, 1995, ISBN: 0070585024, 9780070585027

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
ENGINEERING MATERIALS FOR ADVANCED TECHNOLOGY (Group H: Global Elective)						
Course Code	**:**	16G7H14		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	39L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Apply the basic concepts of Chemistry to develop futuristic materials for high-tech applications in the area of Engineering.
2	Impart sound knowledge in the different fields of material chemistry so as to apply it to the problems in engineering field.
3	Develop analytical capabilities of students so that they can characterize, transform and use materials in engineering and apply knowledge gained in solving related engineering problems.

UNIT-I	**08 Hrs**

Coating and packaging materials

Surface Coating materials:

Synthesis and applications of Polymer coating materials: Teflon, Silicone films Polyvinyl chloride & its copolymers, Poly vinyl acetate, Poly ethylene-HDPE, LDPE, Polyurethane.

Properties required in a pigment and extenders.

Inorganic pigments-titanium dioxide, zinc oxide, carbon black, chromate pigments, chrome green, ultramarine blue, iron blue, cadmium red.

Corrosion inhibiting pigments- zinc phosphate, zinc and barium chromate pigments, ceramic pigments, metal flake pigments, extenders.

Developments in new polymers such as dendrimers, biopoplymers & biodegradable polymers.

Packaging materials:

Food products: Cellulosic and Polymeric packaging materials and their properties – including barrier properties, strength properties, optical properties. Glass, aluminium, tin, paper, plastics, composites.

Pharmaceutical products: Injectibles and tablet packaging materials.

UNIT-II	**07 Hrs**

Adhesives

Introduction-Classification of Adhesives-Natural adhesives, synthetic adhesives-drying adhesives, pressure sensitive adhesives, contact adhesives, hot adhesives. One part adhesives, multi part adhesives. Adhesive Action. Development of Adhesive strength- Physical factors influencing Adhesive Action-surface tension, surface smoothness, thickness of adhesive film, elasticity and tensile strength. Chemical Factors Influencing Adhesive action - presence of polar groups, degree of polymerization, complexity of the adhesive molecules, effect of pH. Adhesive action- specific adhesive action, mechanical adhesive action, fusion adhesion. Development of adhesive strength- adsorption theory and diffusion theory. Preparation, curing and bonding Processes by adhesives-with reference to Epoxy, phenolics, Silicone, Polyurethane, Acrylic adhesives, Poly vinyl alcohol, Polyvinyl acetate.

UNIT-III	**08 Hrs**

Optical fibre materials

Fiber Optics, Advantages of optical fiber communication over analog communication, Classification based on refractive index of the core- step index and graded index optical fibres, Classification based on core radius-single mode and multimode optical fibres, Fibre fabrication.-Methods to manufacture optical glass fibres. Double crucible method and preform methods. Manufacture of perform- Chemical Vapour Deposition (CVD), Modified vapour deposition (MCVD) Plasma activated vapour deposition (PCVD), Outside vapour deposition (OVD)-Vapour-phase axial deposition (VAD). Drawing the fibres from perform, coating and jacketing process.

Ion exchange resins and membranes

Ion exchange resins-Introduction, Types, physical properties, chemical properties-capacity, swelling, kinetics, stability, ion exchange equilibrium, regeneration. Applications of ion exchange resins-softening of water, demineralization of water, advantages and disadvantages of ion exchange resins-calcium sulphate fouling, iron fouling, adsorption of organic matter, bacterial contamination. Ion exchange membranes, Types, Classification, Fabrication of ion exchange cottons- anion exchange

cotton and cation exchange cotton. Application of ion exchange membranes in purification of water by electro dialysis method.	
UNIT-IV	**08 Hrs**
Spectroscopic Characterization of materials: Electromagnetic radiation, interaction of materials with electromagnetic radiation. UV- visible spectrophotometry :Introduction-Electronic transitions- factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and α,β-unsaturated carbonyl compounds, Working of UV-Vis spectrophotometer, Theoretical calculation of λ_{max} by using Woodward-Fieser rules- for cyclic and α,β-unsaturated carbonyl compounds. IR Spectroscopy: Introduction, principle, molecular vibrations, vibrational frequency, number of fundamental vibrations, factors influencing fundamental vibrations, instrumentation of IR spectrophotometer, sampling techniques and application of IR spectroscopy in characterization of functional groups.	
UNIT-V	**08 Hrs**
NMR spectroscopy: H^1 NMR Spectroscopy: Basic concepts- relaxation process. NMR spectrometer-FT NMR-Solvents used in NMR, internal standards-Chemical equivalence -Integrals and Integrations- chemical shift-Factors affecting chemical shifts- shielding and deshielding effects – chemical and magnetic equivalent – magnetic anisotropy-spin-spin splitting rules- Application of NMR on various compounds such as alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides & mono substituted aromatic compounds. Problems on prediction of structure of compounds.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify sustainable engineering materials and understand their properties.
CO2:	Apply the basic concepts of chemistry to develop futuristic materials for high-tech applications in different areas of engineering.
CO3:	Analyze and evaluate the specific application of materials.
CO4:	Design the route for synthesis of material and its characterization.

Reference Books	
1	Materials Science, G.K.Narula, K.S.Narula & V.K.Gupta. 38th Edtion, 2015, Tata McGraw-Hill Publishing Company Limited ISBN: 978-0-07-451796-3.
2	Solar Lighting, Ramachandra Pode and Boucar Diouf, Springer e-book, 2011, ISBN: 978-1-44-712133-6 (Print) 978-1-44-712134-3 (Online),
3	Spectroscopy of organic compounds, P.S.Kalsi, 6th Edition, 2013, New Age International(P) ltd,publisher, ISBN: 978-1-22-415438-6.
4	Food Packaging Materials, Mahadeviah M & Gowramma RV, 6th Edition, 1996, Tata McGraw Hill Publishing Company Ltd, ISBN :746-2-23-82 9780-0.

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

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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII

APPLIED PSYCHOLOGY FOR ENGINEERS (Global elective)						
Course Code	**:**	16G7H15		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	35L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To appreciate human behavior and human mind in the context of learner's immediate society and environment.
2	To understand the importance of lifelong learning and personal flexibility to sustain personal and Professional development as the nature of work evolves.
3	To provide students with knowledge and skills for building firm foundation for the suitable engineering professions.
4	To prepare students to function as effective Engineering Psychologists in an Industrial, Governmental or consulting organization.
5	To enable students to use psychological knowledge, skills, and values in occupational pursuits in a variety of settings that meet personal goals and societal needs.

Unit – I	**7 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit - II	**7 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit – III	**7 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio- Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment. Psychological Stress: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control.	
Unit – IV	**7 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. Distance learning, Psychological consequences of recent developments in Information Technology. Type A and Type B Psychological Counseling - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	
Unit – V	**7 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	
Experimental Psychology (Practicals)- Self Study 2 Hrs /Week	
1.Bhatia's Battery of Performance and intelligence test 2.Multidimensional Assessment of Personality 3.David's Battery of Differential Abilities (Aptitude test)	

4.Bilateral Transfer of Training Mirror drawing apparatus with Electronic Digital Reset Error Counter (Performance) 5. Student Stress Scale.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the basic theories, principles, and concepts of applied psychology as they relate to behaviors and mental processes.
CO2:	Define learning and compare and contrast the factors that cognitive, behavioral, and Humanistic theorists believe influence the learning process.
CO3:	Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4:	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.
CO5:	Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.

Reference Books	
1	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India
2	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4	Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5
5	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

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

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Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII

FOUNDATIONAL COURSE ON ENTREPRENEURSHIP (Group H : Global Elective)						
Course Code	**:**	16G7H16		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To make participants self-discover their innate flow, entrepreneurial style, and identify problems worth solving thereby becoming entrepreneurs
2	To handhold participants on lean methodology to craft value proposition and get ready with lean canvas
3	To create solution demo by conducting customer interviews and finding problem-solution fit for building Minimum Viable Product (MVP)
4	To make participants understand cost structure, pricing, revenue types and importance of adopting shared leadership to build good team
5	To help participants build a strong brand and identify various sales channels for their products and services
6	To take participants through basics of business regulations and other legal terms along-with understanding of Intellectual Property Rights

Unit-I	**07 Hrs**
Self Discovery and Opportunity Discovery: Finding the Flow; Effectuation; Identifying the Effectuation principles used in activities; Identifying Problem Worth Solving; Design Thinking; Brainstorming; Presenting the Identified problems; Identifying the Entrepreneurial Style.	
Unit – II	**07 Hrs**
Customer, Solution and Lean Methodology: Customers and Markets; Segmentation and Targeting; Identifying Jobs, Pains, and Gains and Early Adopters; Crafting Value Proposition Canvas (VPC); Presenting VPC; Basics of Business Model and Lean Approach; Sketching the Lean Canvas; Risks and Assumptions; Presenting Lean Canvas.	
Unit – III	**07 Hrs**
Problem-Solution Fit and Building MVP: Blue Ocean Strategy - Plotting the Strategy Canvas; Four Action Framework: Eliminate-Reduce-Raise-Create Grid of Blue Ocean Strategy; Building Solution Demo and Conducting Solution Interviews; Problem-Solution Fit; Building MVP; Product-Market Fit; Presenting MVP.	
Unit – IV	**06 Hrs**
Financial Planning & Team Building: Cost Structure - Estimating Costs; Revenues and Pricing: Revenue Streams, Revenue Types, Identifying Secondary Revenue Streams, Estimating Revenue and Price; Profitability Checks; Bootstrapping and Initial Financing; Practising Pitch; Shared Leadership; Hiring and Fitment, Team Role and Responsibilities.	
Unit – V	**09 Hrs**
Marketing, Sales, Regulations and Intellectual Property: Positioning and Branding; Channels; Sales Planning; Project Management; Basics of Business Regulations; How to Get Help to Get Started; Patents, Trademark, Licensing, Contracts; Common Legal mistakes, Types of Permits, Tax Registration Documents, Compliance; Infringement and Remedies, Ownership and Transfer.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Showcase the ability to discern distinct entrepreneurial traits
CO2:	Know the parameters to assess opportunities and constraints for new business ideas
CO3:	Understand the systematic process to select and screen a business idea
CO4:	Design strategies for successful implementation of ideas
CO5:	Create Business Model and develop Minimum Viable Product

Reference Books	
1	Running Lean: Iterate from Plan A to a Plan That Works. O'Reilly Media, Maurya, A., 2012.
2	Entrepreneurship.Roy, R., 2012. Oxford University Press
3	Intellectual Property Law in India. Gupta, T. S., 2011. Kluwer Law International
4	Flow: The Psychology of Optimal Experience. Czikszentmihalyi, M., 2008. Harper Perennial Modern Classics
5	Effectuation: Elements of Entrepreneurial Expertise. Sarasvathy, S. D., 2009. Edward Elgar Publishing Ltd.

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VII						
UNMANNED AERIAL VEHICLES (Group H: Global Elective)						
Course Code	**:**	16G7H17		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Get an overview of the history of UAV systems
2	Understand the importance of aerodynamics, propulsion, structures and avionics in the design of UAV
3	Demonstrate ability to address the various mission payloads - on-board & off-board, propulsion systems, integration with manned systems
4	Assess the performance and airworthiness of the designed UAV

Unit-I	**06 Hrs**
Introduction to Flight Vehicles: History of Flight Vehicles and UAVs, Classifications, Woking principles of flight vehicle. **Introduction to Unmanned Aircraft Systems** Types of UAVs, configurations and their advantages disadvantages, System Composition, Applications of UAVs, Characteristics of Aircraft	
Unit – II	**07 Hrs**
Design of UAV Systems: Governing aspects: **a. Aerodynamics, b. Propulsion, C. structure, d. Controls** **Aerodynamics:** Introduction basic Aerodynamics, lift, drag, Aerofoils, wing area optimization. **Propulsion:** Introduction to propulsion system in UAV, Propulsion system for fixed wing UAV and VTOL (Vertical take-off and landing) UAV, Advanced propulsion systems, fuel cells, generators based systems.	
Unit -III	**07Hrs**
Structures of UAV: Mechanic loading, basics of types of load calculation and structural engineering, Material used for UAV (general introduction), FRP and methods of usage in UAV, Testing of FRP specimens for UAV, selection criteria for structure, Types of structural elements used in UAV their significance and characteristics, Methods of manufacturing UAV structure.	
Unit -IV	**07 Hrs**
Controls, Avionics, Hardware, Communication, Payloads: Basics of control system and Systems for control system in UAV, PID control, simulation introduction to Hardware in loop system (HILS), Avionics: Autopilot (AP) – architecture of AP, sensors, actuators, power supply, integration, installation, configuration, and testing. **Hardware, Communication** Electronics Hardware in UAV, Communication methods, communication antenna and their significance. **Payloads:** Payload types and their applications	
Unit -V	**09 Hrs**
Design of UAV Systems: Fixed wing UAV and Rotary wing UAV (VTOL) Task specific, activity based exercise	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Appraise the evolution of UAVs and understand the current potential benefits of UAVs
CO2:	Apply the principles of Aerospace Engineering in design and development of UAVs
CO3:	Determine and evaluate the performance of UAV designed for various Missions and applications
CO4:	Assess the performance and airworthiness of the designed UAV

Reference Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1st Edition, 2010, Wiley, ISBN 9780470058190.
2	Flight Stability and Automatic Control, Robert C. Nelson, 2nd Edition, October 1, 1997, McGraw-Hill, Inc, ISBN 978-0070462731.
3	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, 1st Edition,2007, Springer ISBN 9781402061141
4	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4
5	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, 3rd Edition, 2001, Lockheed Martin Aeronautics Company, ISBN: 978-1-60086-843-6

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

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

Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Semester: VIII						
MAJOR PROJECT						
Course Code	**:**	16IS81		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	0:0:16:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	32		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	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	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both written and oral forms.
3	Acquire collaborative skills through working in a team to achieve common goals.
4	Self-learn, reflect on their learning and take appropriate action to improve it.
5	Prepare schedules and budgets and keep track of the progress and expenditure.

Major Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
2. 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 programme or any other programme.
- 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.**

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 have continuous interaction with external guides and will visit the industry at least twice 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 justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course Outcomes of Major Project	
CO1:	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.
CO2:	Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.
CO3:	Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.
CO4:	Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

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 & Publication 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%

Semester: VIII						
TECHNICAL SEMINAR						
Course Code	**:**	16IS82		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	0:0:2:0		**SEE**	**:**	**00 Marks**
Total Hours	**:**	4		**SEE Duration**	**:**	**NA Hours**

Course Learning Objectives: The students will be able to	
1	Recognize recent developments in specific program and in multidisciplinary fields.
2	Summarize the recent technologies and inculcate the skills for literature survey.
3	Demonstrate good presentation skills.
4	Plan and improve the Technical Report writing skills.
5	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 along with consultation with the guide.
3. The topic can be based on standard papers (like IEEE/ACM/CSI etc.) in the thrust area for the selected topic.
4. Presenting/publishing this paper in conference/ Journal will be given weightage in CIE.
5. The student needs to submit both hard & soft copy of the seminar report.
6. **As Outcome of Technical Seminar, each student has to prepare a technical paper out of seminar topic.**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Communicate effectively on complex engineering problems and demonstrate contextual knowledge to assess societal and environmental contexts.
CO2:	Identify, formulate, review research literature, analyze and Design solutions for complex engineering problems using appropriate techniques with effective documentation.
CO3:	Analyze, interpret and synthesize the information to provide valid conclusions with innovative ideas and ethical principles.
CO4:	Apply the knowledge of engineering specialization to suggest solutions to complex engineering problems and recognize the need for technological changes.

Evaluation of CIE Marks:

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

Semester: VIII						
INNOVATION AND SOCIAL SKILLS						
Course Code	**:**	16HS83		**CIE**	**:**	**NA**
Credits: L:T:P	**:**	0:0:1:0		**SEE**	**:**	**NA**
Total Hours	**:**	2		**SEE Duration**	**:**	**NA**

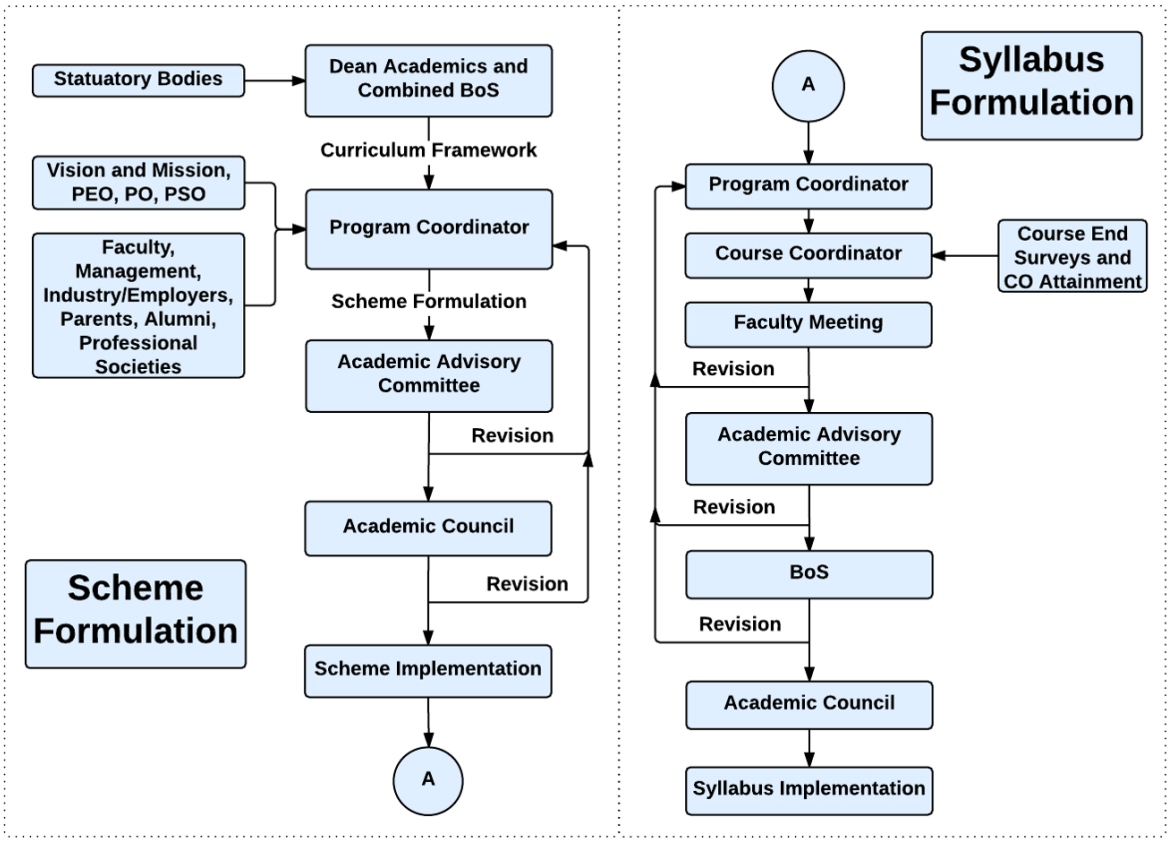
Course Learning Objectives: The students will be able to	
1	To provide a platform for the students to exhibit their organizational capabilities, team building, ethical values and extra mural abilities.
2	To encourage to carryout innovative ideas and projects.
3	Take part in societal and community building activities.
4	Make self-learning, ethics and lifelong learning a motto.

Guidelines

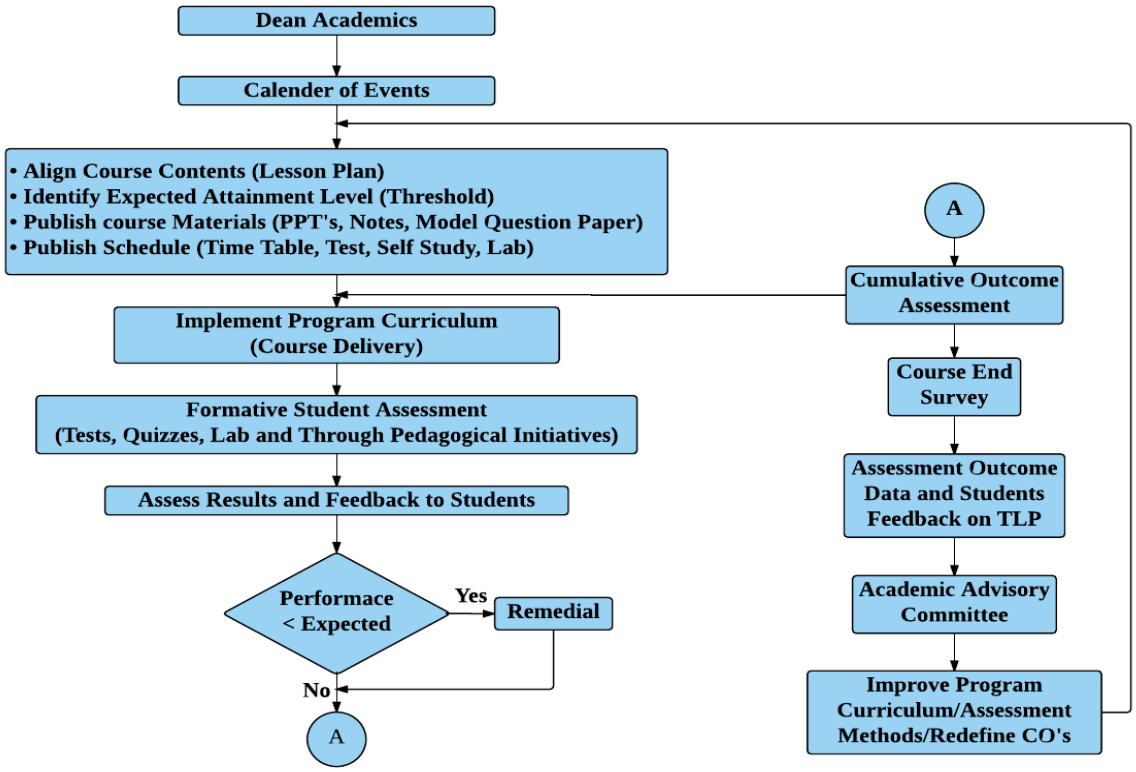
1. The HSS will be evaluated individually based on the broad parameters which include the progress made by student during 3rd& 4th year in innovative projects, Seminar, Paper Presentation, Field activity & other Co-curricular activities.
2. Students shall submit a report and documents as a proof his/her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

Course Outcomes of Innovation and Social Skills	
CO1:	Apply the knowledge and skills for solving societal issues
CO2:	Plan to work in team in various areas with inclusive effort and sustainability
CO3:	Organize various events and use managerial and budgeting abilities
CO4:	Demonstrate leadership qualities and ethics

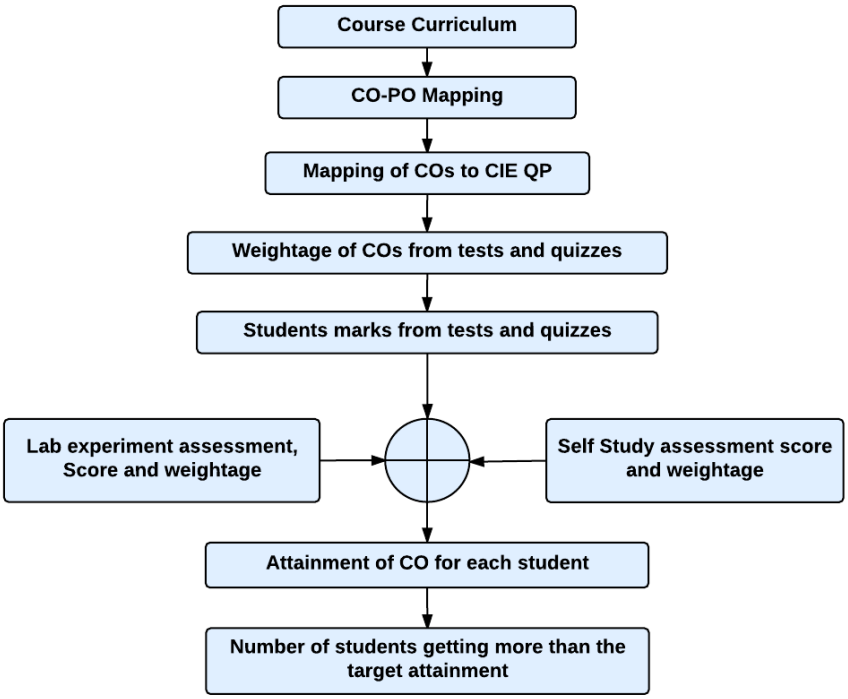
Curriculum Design Process



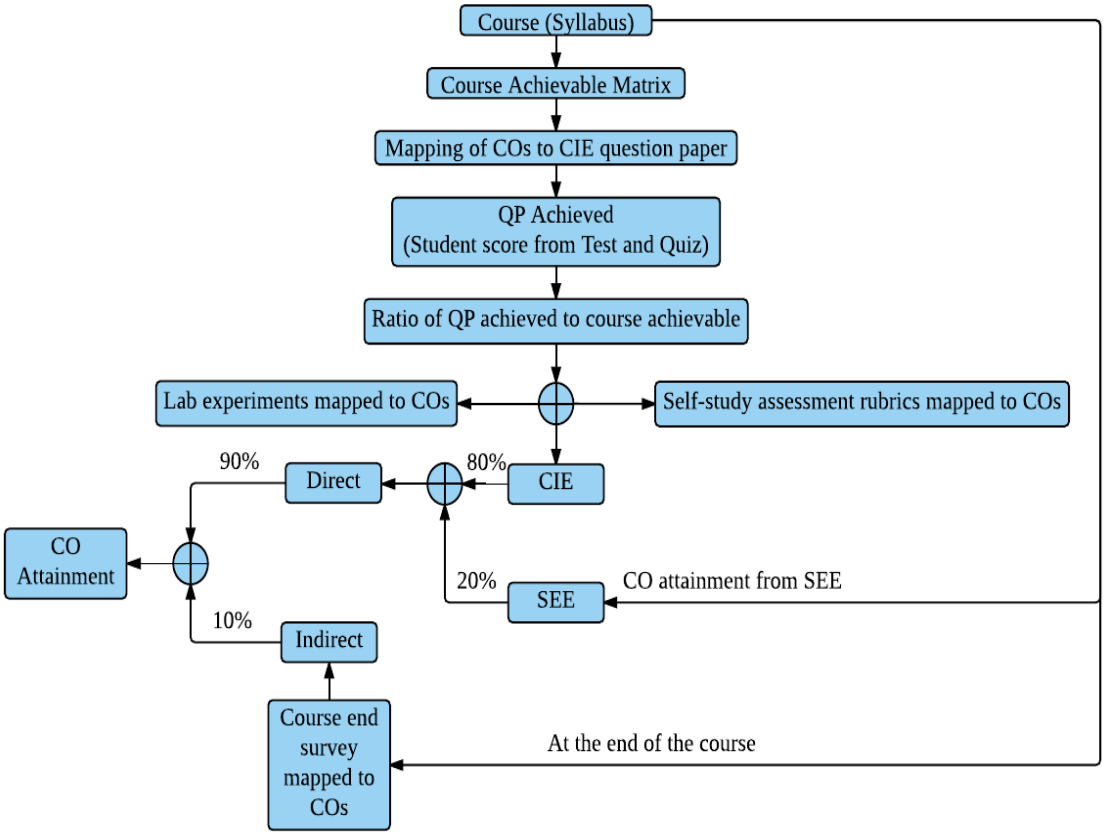
Academic Planning and Implementation



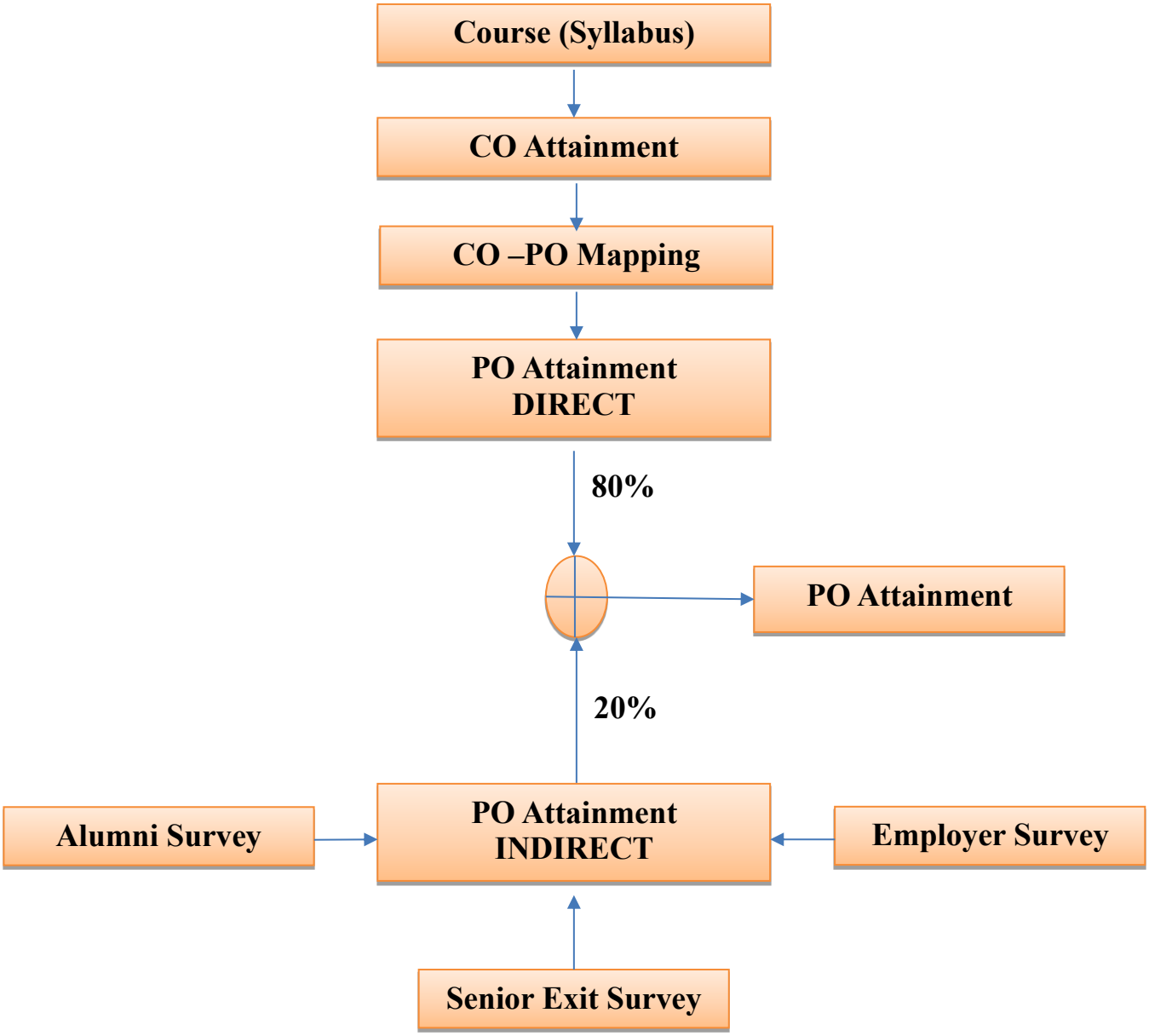
PROCESS FOR COURSE OUTCOME ATTAINMENT



Final CO Attainment Process



Program Outcome Attainment Process



Guidelines for Fixing Targets

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

PROGRAM OUTCOMES (POs)

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

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

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

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

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

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with t h e society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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