RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

Bachelor of Engineering (B.E)

Scheme and Syllabus of VII & VIII Semesters

2018 SCHEME

ELECTRONICS AND COMMUNICATION ENGINEERING

2021-2022

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

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

2018 SCHEME

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT VISION

Imparting quality technical education through interdisciplinary research, innovation and teamwork for developing inclusive & sustainable technology in the area of Electronics and Communication Engineering.

DEPARTMENT MISSION

- To impart quality technical education to produce industry-ready engineers with a research outlook.
- To train the Electronics & Communication Engineering graduates to meet future global challenges by inculcating a quest for modern technologies in the emerging areas.
- To create centers of excellence in the field of Electronics & Communication Engineering with industrial and university collaborations.
- To develop entrepreneurial skills among the graduates to create new employment opportunities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. To apply concepts of mathematics, science and computing to Electronics and Communication Engineering

PEO2. To design and develop interdisciplinary and innovative systems.

PEO3. To inculcate effective communication skills, team work, ethics, leadership in preparation for a successful career in industry and R & D organizations.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO	Description
PSO1	Should be able to clearly understand the concepts and applications in the field of Communication/networking, signal processing, embedded systems and semiconductor technology.
PSO2	Should be able to associate the learning from the courses related to Microelectronics, Signal processing, Microcomputers, Embedded and Communication Systems to arrive at solutions to real world problems.
PSO3	Should have the capability to comprehend the technological advancements in the usage of modern design tools to analyze and design subsystems/processes for a variety of applications.
PSO4	Should possess the skills to communicate in both oral and written forms, the work already done and the future plans with necessary road maps, demonstrating the practice of professional ethics and the concerns for societal and environmental wellbeing.

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

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 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

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

ELECTRONICS AND COMMUNICATION ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME							
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18HS71	Constitution of India and Professional Ethics	HSS	3	0	0	3
2.	18EC72	Microwave and Radiating Systems	EC	4	0	1	5
3.	18EC73	Broadband Wireless -LTE 4G	EC	3	1	0	4
4.	18EC74	Internship	EC	0	0	2	2
5.	18EC7FX	Elective F (PE)	EC	3	0	0	3
6.	18EC7GX	Elective G (PE)	EC	3	0	0	3
7.	18G7HXX	Elective H (GE)*	Respective BOS	3	0	0	3
Total Number of Credits				**19**	**1**	**3**	**23**
Total Number of Hours/Week				**19**	**2**	**7.5**	

*Students should take other department global elective courses.

EIGTHSEMESTER CREDIT SCHEME							
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18ECP81	Major Project	EC	0	0	16	16
Total Number of Credits				0	0	16	16
Total Number of Hours/Week						**32**	

VII Semester			
PROFESSIONAL ELECTIVES (GROUP F)			
Sl No	**Course code**	**Course Title**	**Credits**
1	18EC7F1	High Performance Computing	3
2	18EC7F2	Mixed Signal Integrated Circuit Design	3
3	18EC7F3	Design of Testing and Testability	3
4	18EC7F4	Nanoelectronics	3
5	18EC7F5	Speech Processing	3
6	18EC7F6	Radar Systems Engineering	3

VII Semester			
PROFESSIONAL ELECTIVES (GROUP G)			
Sl No	**Course code**	**Course Title**	**Credits**
1	18EC7G1	Automotive Electronics	3
2	18EC7G2	Optoelectronics and Networks	3
3	18EC7G3	System on Chip Design	3
4	18EC7G4	Multimedia Communication	3
5	18EC7G5	ASIC Design	3
6	18EC7G6	ARM Programming & Optimization	3

VII Semester				
GLOBAL ELECTIVES (GROUP H)				
Sl No	**Host Dept.**	**Course code**	**Course Title**	**Credits**
1	AS	18G7H01	Unmanned Aerial Vehicles	3
2	BT	18G7H02	Bioinformatics	3
3	CH	18G7H03	Industrial Safety and Risk Management	3
4	CS	18G7H04	Web Programming	3
5	CV	18G7H05	Solid Waste Management and Statutory Rules	3
6	EC	18G7H06	Image Processing with Machine Learning	3
7	EE	18G7H07	Renewable Energy Sources and Storage System	3
8	EI	18G7H08	MEMS and Applications	3
9	IM	18G7H09	Project Management	3
10	IS	18G7H10	Cyber Forensics and Digital Investigations	3
11	ME	18G7H11	Robotics and Automation	3
12	TE	18G7H12	Space Technology and Applications	3
13	PY	18G7H13	Introduction to Astrophysics	3
14	CY	18G7H14	Materials for Advanced Technology and Spectroscopic Characterization	3
15	HSS	18G7H15	Applied psychology for Engineers	3
16	HSS	18G7H16	Advanced Course in Entrepreneurship	3

Semester: VII						
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS (Theory) (Common to All Programs)						
Course Code	**:**	**18HS71**		**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 knowledge of the constitutional literacy to become aware of the fundamental rights and duties in their role as Engineers.
2	Understanding of ethical and legal aspects of advertising, consumer problems and their redressal mechanism related to product and service standards.
3	Discuss the knowledge of substantive Labor law and to develop skills for legal reasoning and statutory interpretations.
4	Evaluate individual role, responsibilities and emphasize on professional/ engineering ethics in shaping professions.

Unit – I	**10 Hrs**
Indian Constitution- Salient features of IndianConstitution, Preamble to the Constitution of India; Provisions Relating to Citizenship in India- at the Commencement of the Constitution and Later with latest amendments, Modes of Acquisition and Termination of Citizenship of India. Scope & Extent of Fundamental Rights-Articles 14-32 with case studies; Right to Information Act, 2005 with Case studies.	
Unit – II	**10 Hrs**
Directive Principles of State Policy- Significance of Directive Principles of State Policy, Fundamental Duties in the Constitution of India; Union Executive- President and State Executive-Governor; Parliament & State Legislature; Council of Ministers; Anti-defection law; Union and State Judiciary; Emergency provisions; Elections, Administrative tribunals. Human Rights & Human Rights Commission.	
Unit –III	**06Hrs**
Consumer Protection Law - Definition and Need of Consumer Protection; Consumer Rights under the Consumer Protection Act, 2019; Unfair Trade Practice, Defect in goods, Deficiency in services; Product liability and Penal Consequences, False and Misleading Advertisement, E-Commerce**,** Alternate dispute Redress mechanism**;** Redresses Mechanisms under the Consumer Protection Act, 2019. **An overview of Indian Penal Code 1860 (Law of Crimes)**	
Unit – IV	**06Hrs**
Introduction to Labour Legislations - Industrial Relation, Labour Problem and Labour Policy in India; Labour Welfare and Social Security- Factories Act, 1948, Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013; the Child Labour (Prohibition and Regulation) Act, 1986, Maternity Benefit (Amendment) Act, 2017; Industrial Dispute Act, 1947, Reference of Disputes toBoards, Courts or Tribunals.	
Unit –V	**07Hrs**
Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering. Corporate Social Responsibility. Statutory Provision regarding prohibition and prevention of Ragging.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the citizen's fundamental Rights, duties & consumer responsibility capability and to take affirmative action as a responsible citizen.
CO2:	Identify the conflict management in legal perspective and judicial systems pertaining to professional environment, strengthen the ability to contribute to the resolve of human rights & Ragging issues and problems through investigative and analytical skills.
CO3:	Understanding process of ethical and moral analysis in decision making scenarios and inculcate ethical behavior as a trait for professional development.
CO4:	Apply the knowledge to solve practical problems with regard to personal issues & business Enterprises.

Reference Books	
1	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2020.
2	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN -13:978-9351452461
3	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400
4	Jr. Charles E Harris, Michael. S. Pritchard and Michael J Rabins, Engineering Ethics, Wadsworth Cengage Learning, 5th Edition, 2009, ISBN-978-0495502791

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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						
MICROWAVE & RADIATING SYSTEMS (Theory & Practice)						
Course Code	**:**	**18EC72**		**CIE**	**:**	**150 Marks**
Credits: L:T:P	**:**	**4:0:1**		**SEE**	**:**	**150 Marks**
Total Hours	**:**	**48 L+30 P**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Apply the knowledge of fields and waves to develop concepts of transmission line theory.
2	Describe the basic operation of microwave devices.
3	Describe the radiation from isolated, linear wire antennas and from linear elements near or on a conducting surface.
4	Calculate the fundamental parameters for antennas and the radiation field from an antenna using potential functions.

Unit-I	**09Hrs**
Transmission Lines Introduction, transmission lines equations and solutions, termination of line by infinite line, by characteristic impedance, short circuit line, open circuit line and any load resistive impedance, input impedance reflection and transmission coefficients, standing waves and SWR(at both load end and generator end), Quarter wave transforms, Smith chart construction and properties, Single stub matching	
Unit – II	**10 Hrs**
Microwave Waveguides Introduction, TE, TM waves Rectangular waveguides (quantitative analysis TE, TM modes), dominant modes, group velocity phase velocity, and wave impedance, Microwave cavities (qualitative analysis), resonant frequency. **S-parameters:** Introduction, properties of S matrix (qualitative analysis) **Microwave Passive Devices** Waveguide Tee's, Directional couplers, circulators, power divider, Isolators (Faraday isolator), phase shifters (Rotatory type), Attenuators (Rotatory type), (s-parameters of all devices) **Microwave Sources:** Klystron Oscillator, Magnetron, TWT amplifiers.	
Unit – III	**10 Hrs**
Antenna Basics Introduction, antenna radiation mechanism, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna field zones. **Wire Antennas** Electric dipoles: Introduction, short electric dipole (fields, power density, power radiated, directivity, radiation resistance), Half wave dipoles(field: qualitative analysis power density, power radiated, directivity, radiation resistance).	
Unit – IV	**09 Hrs**
Antenna Types Folded dipole, Yagi-Uda array, parabolic reflectors, log periodic antenna, Rectangular patch antenna, horn antenna (Qualitative Analysis only: Construction, working). **Antenna Arrays** Introduction, pattern multiplication, Array of two isotropic point sources, N element linear array with uniform spacing and phase(Array factor), Broadside and end fire array(Directivity, location of beam with, Beam width, etc).	

Unit – V	10 Hrs
Introduction to Computational Electromagnetics Classification of CEM, Classification of EMProblems: Classification of Solution Region. Finite Element Method Introduction, Solution of Laplace's Equation, Finite Element Discretization, Element Governing Equations, Assembling of All Elements, Solving the Resulting Equations, Solution of Poisson's Equation, Deriving Element-Governing Equation, Solving the Resulting Equations.	

Practical's: Microwave and Radiating Systems Lab	
Sl No	**Experiment Name**
1.	Study of Mode Curves of Reflex Klystron Source(X-band)
2.	Radiation Characteristics of Pyramidal Horn Antenna and Microstrip Patch (X-band)
3.	Characterization of Microwave Directional Coupler, Power divider, Hybrid coupler and Ring resonator (Strip line type, C-band)
4.	Design and Simulation of Waveguide Magic-Tee and Hybrid Ring using HFSS
5.	Characterization of Microwave Magic Tee, Directional Coupler, Circulator, Tunable Attenuator and Isolator (Waveguide type, X-band)
6.	Characterization of Lowpass, bandpass and band stop filters (C-Band)
7.	Illustration of RADAR Range / Target Detection
8.	Performance Analysis of Rayleigh and Rician Fading Channel Models
9.	Time and frequency diversity techniques
10.	Simulation of OFDM Transmission and Reception

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain and summarize the working of transmission line, Waveguides, Microwave Passive Devices and Antennas.
CO2:	Analyze wave propagation in transmission line, Waveguides and characterize the passive microwave components and Antennas.
CO3:	Design the transmission lines, passive microwave components and Antennas for given specification and also match the impedance.
CO4:	Evaluate S-Parameter, VSWR for transmission lines, Microwave components and radiation pattern for Antennas.

Reference Books	
1.	Microwave Engineering, David M Pozar,4thEdition, 2011, John Wiley, ISBN: 978-0-470-63155-3
2.	Antenna Theory and Design, C A Balanis, 3rd Edition,2005, John Wiley & sons, Inc. publication, ISBN-13: 978-0471667827
3.	Foundations of Microwave Engineering, R E Collin, 2009, 2nd Edition, IEEE Press on Electromagnetic and Wave Theory, ISBN-13: 978-0-7803-6031-0
4.	Computational Electromagnetics with MATLAB, Matthew N.O. Sadiku, 2019, Taylor & Francis Group, ISBN: 13: 978-1-138-55815-1

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

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

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 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 marks (AM) over number of weeks is considered for 30 marks. At the end of the semester a test (T) is conducted for 10 marks. The students are encouraged to implement additional innovative experiments (IE) in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.

Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

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

SEE for 100 marksis 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.

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks

SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

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

Low-1 Medium-2 High-3

Semester: VII						
BROADBAND WIRELESS -LTE 4G (Theory)						
Course Code	**:**	**18EC73**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L+26T**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basics of LTE standardization phases, specifications and its architecture
2	Identify the layer of LTE, based on the use of OFDMA and SC-FDMA principles
3	Analyze the role of LTE radio interface protocols to set up, reconfigure and release the Radio Bearer, for transferring the EPS bearer.
4	Explain the role of Radio Resource Management (RRM) to ensure that the radio resources are efficiently used.

UNIT-I	**08 Hrs**
Review of Legacy Systems **Key Enablers for LTE features:** OFDM, Single carrier FDMA, Single carrier FDE, Channel Dependent Multiuser Resource Scheduling, Multi antenna Techniques, IP based Flat network Architecture, LTE Network Architecture. **Wireless Fundamentals:** Cellular concept, Broadband wireless channel (BWC), Fading in BWC, Modeling BWC – Empirical and Statistical models, Mitigation of Narrow band and Broadband Fading.	
UNIT-II	**08 Hrs**
Multicarrier Modulation OFDM basics, OFDM in LTE, PAR, SC-FDE. **(Non-Mathematical treatment only**). **OFDMA and SC-FDMA:** OFDM with FDMA, TDMA, CDMA, OFDMA, SC-FDMA, OFDMA and SC-FDMA in LTE. **Overview and Channel Structure of LTE:** Introduction to LTE, Channel Structure of LTE, Downlink OFDMA Radio Resource, Uplink SC-FDMA Radio Resource.	
UNIT-III	**08 Hrs**
Downlink Transport Channel Processing Overview, Downlink shared channels, Downlink Control Channels, Broadcast channels, Multicast channels, Downlink physical channels, H-ARQ on Downlink **Uplink Channel Transport Processing:** Overview, Uplink shared channels, Uplink Control Information, Uplink Reference signals, Random Access Channels, H-ARQ on uplink	
UNIT-IV	**08 Hrs**
Physical Layer Procedures Hybrid – ARQ procedures, Channel Quality Indicator CQI feedback, Precoder for closed loop MIMO Operations, Uplink channel sounding, Buffer status Reporting in uplink, Scheduling and Resource Allocation, Cell Search, Random Access Procedures, Power Control in uplink.	
UNIT-V	**07Hrs**
Radio Resource Management and Mobility Management PDCP overview, MAC/RLC overview, RRC overview, Mobility Management, Inter-cell Interference Coordination. **Case study:** Intra-LTE Handovers and Inter-system Handovers, MIMO benefits.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Associate terms in the system architecture to the functional standard specified in LTE 4G.
CO2:	Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.
CO3:	Demonstrate the UTRAN and EPS handling processes from set up to release including mobility management for a variety of data call scenarios.
CO4:	Test and Evaluate the Performance of resource management and packet data processing and transport algorithms.

Reference Books	
1.	Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, 1st Edition, 2018, Prentice Hall, Communications Engg and Emerging Technologies, ISBN: 9780137033638.
2.	LTE for UMTS Evolution to LTE-Advanced, HarriHolma and Antti Toskala, 2nd Edition, 2011, John Wiley & Sons Ltd. ISBN: 9780470660003.
3.	Evolved Packet System (EPS) - The LTE And SAE Evolution of 3G UMT, Pierre Lescuyer and Thierry Lucidarme, 2008, John Wiley & Sons, Ltd. Print ISBN: 978-0-470-05976-0.
4	LTE-The UMTS Long term Evolution; From Theory to Practice' by Stefania Sesia, IssamToufik, and Mathew Baler, 2009, John Wiley and Solns Ltd, ISBN 978-0-470-69716-0.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =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	-	-	2	3	2	2	1	2	2	2
CO2	3	2	2	1	1	1	2	2	2	2	1	3
CO3	3	3	2	2	1	1	2	1	2	2	1	2
CO4	3	3	3	3	3	1	2	3	3	2	1	2

High-3: Medium-2: Low-1

SEMESTER: VII						
INTERNSHIP						
Course Code	**:**	**18EC74**		**CIE Marks**	**:**	**50**
Credit L:T:P	**:**	**0:0:2**		**SEE Marks**	**:**	**50**
Hours/week	**:**	**4**		**SEE Duration**	**:**	**3.00 Hours**

GUIDELINES

1) The duration of the internship shall be for a period of 6/8 weeks on full time basis after IV semester final exams and before the commencement of VII semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective UG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments,	45%
Review-II	Importance of resource management, environment and sustainability presentation skills and report writing	55%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

Semester: VII						
HIGH PERFORMANCE COMPUTING (Group F: Professional Elective)						
Course Code	**:**	**18EC7F1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To review the trends in parallel programming.
2	To demonstrate the basic ideas of multiprocessing and parallel operations with case studies.
3	To expose to basics of parallel programming.
4	To demonstrate parallel programming using MPI, OpenAcc and OpenMP.

Unit-I	**08 Hrs**
Multiprocessors and Thread level parallelism Introduction, Symmetric shared memory architectures; Performance of symmetric shared-memory multiprocessors, Distributed shared memory and directory-based coherence, Basics of synchronization, Models of memory consistency.	
Unit – II	**08 Hrs**
Data-Level Parallelism in Vector, SIMD, and GPU Architectures Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Mobile versus Server GPUs and Tesla versus Core i7	
Unit –III	**08 Hrs**
Introduction to Parallel Programming Motivation, Scope of Parallel Computing, Principles of Parallel Algorithm design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models.	
Unit –IV	**08Hrs**
Programming Using the Message Passing Paradigm Principles of Message Passing Programming, Building Blocks, MPI, Topologies and Embedding, Overlapping Communication with computation, Collective Communication and computation operations, Groups and Communicators.	
Unit –V	**07 Hrs**
GPU Programming using OpenACC Serial to parallel programming using OpenACC: A Simple Data-Parallel Loop, Task-Parallel Example, Amdahl's Law and Scaling, Parallel Execution and Race Conditions, Lock-Free Programming, Controlling Parallel Resources. **Pipelining data transfers with OpenACC** Introduction to Pipelining, Mandelbrot Generator, Pipelining Across Multiple Devices.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamentals of high-performance computing concepts.
CO2:	Analyze the performance of parallel programming.
CO3:	Design parallel computing constructs for different applications.
CO4:	Demonstrate Parallel computing concepts for suitable applications.

Reference Books	
1	Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, 2nd Edition, 2013, Pearson Education, ISBN 13: 9788131708071.
2	CUDA Programming: A Developers Guide to Parallel Computing with GPUs, Shane Cook, 1st Edition, 2013, Morgan Kaufmann, ISBN:9780124159334.
3	Parallel Programming with Open ACC, Rob Farber, 1st Edition, 2016, Morgan Kaufmann (MK) Publication, ISBN :9780124103979.
4	ARM System Developers Guide, Andrew N Sloss, Dominic Symes, Chris Wright, Elsevier, Morgan Kaufman publishers, 2008, ISBN-13:9788181476463

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 50. The marks component for experiential learning is 20.

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

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

SEE for 100 marksis 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	2	-	-	-	-	1	-	1
CO4	3	3	3	3	2	-	-	-	-	1	-	1

High-3: Medium-2: Low-1

Semester: VII						
MIXED SIGNAL INTEGRATED CIRCUIT DESIGN (Group F: Professional Elective)						
Course Code	**:**	**18EC7F2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Design Sample and Hold circuits.
2	AnalyzeSwitched Capacitor Amplifiers and its non-dualities.
3	Design various types of ADC/DAC for a given specification
4	Evaluate various performance parameters of ADC/ DAC.

Unit-I	**08 Hrs**
Basic Sampling Circuits NMOS, PMOS and Transmission Gate switch, Distortion due to switch, Speed and Precision considerations, Charge injection, Clock feedthrough, Thermal noise in sample and holds, Charge injection cancellation – Dummy switch, complementary switches, differential circuits, Bottom plate sampling, Gate bootstrapped switch, Nakagome charge pump.	
Unit – II	**08 Hrs**
Building Blocks of Data Conversion Systems – Operational Amplifiers Two stage Opamp, design of buffer stage, Operational Transconductance Amplifier, compensating the Opamp for stability, characterizing the Opamp open loop gain, common mode range, common mode rejection ratio, power supply rejection ratio. Common mode feedback (CMFB) – resistive CM detector, CMFB compensation. Switched Capacitor (SC) circuits– Parasitic Insensitive Switched Capacitor amplifiers.	
Unit –III	**08 Hrs**
Building Blocks of Data Conversion Systems – Comparators Basic comparator design – preamplification, decision circuit and output buffer. Characterizing the comparator – comparator dc performance, transient response, clocked comparators – case study. **Data Converter Specifications** – Static specifications - INL, DNL and Dynamic specifications - SNDR, DR, SFDR, linearity.	
Unit –IV	**07 Hrs**
Digital to Analog Converter Architectures - Static performance of DAC – DAC transfer characteristics, Ideal DAC transfer curve, offset, gain error, monotonicity. Digital Input code, Resistor String DAC, R-2R ladder DACs, Current steering DAC.	
Unit –V	**08 Hrs**
Analog to Digital Converter Architectures - Flash ADC, SAR ADC, Pipelined ADC, Delta Sigma ADCs (Introduction only) **CMOS Color and Image Sensor Circuit Design** – Introduction to design flow of CMOS image sensor. Concept of Transimpedance Amplifier topologies.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Design various Sample and Hold circuits.
CO2:	Analyze Switched Capacitor Amplifiers and its non idealities.
CO3:	Design various types of ADC/DAC for a given specification
CO4:	Evaluate the different performance parameters of ADC/ DAC

Reference Books	
1	CMOS Circuit Design, Layout and Simulation, R. Jacob Baker,4th edition, 2019, IEEE Press Wiley Series on Microelectronic Systems, ISBN: 978-1-119-48151-5
2	Design of Analog CMOS Integrated Circuits, Behzad Razavi,2nd Edition, 2016, Mc Graw Hill, ISBN 9780072380323
3	Data Converters, Franco Maloberti, 1st Edition,2007, Springer, ISBN 978-0-387-32486-9
4	CMOS Analog and Mixed-Signal Circuit Design- Practices and Innovations, Arjuna Marzuki,1st Edition, 2020, CRC Press, ISBN 978-0367430108

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

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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

SEE for 100 marksis 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	3	3	-	-	-	-	2	1	2
CO2	3	2	-	2	3	1	-	-	-	2	1	2
CO3	3	3	2	2	3	2	-	3	2	2	1	2
CO4	3	3	2	-	3	-	-	-	-	2	1	2

High-3: Medium-2: Low-1

Semester: VII						
DESIGN FOR TESTING AND TESTABILITY (Group F: Professional Elective)						
Course Code	**:**	**18EC7F3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Specify fabrication defects, errors and faults. Understand different types of faults associated with logic circuits and types of testing by employing fault models to the logic circuits.
2	Understand advanced methods of simulation and digital testing algorithms and use the appropriate methods for achieving fault coverage specifications in design.
3	Implement combinational and sequential circuit test generation algorithms
4	Identify & Recognize the significance of testable design, different techniques in Built In Self-Test (BIST) such as MBIST and LBIST.

Unit-I	**08 Hrs**
Introduction to Testing Introduction to Testing, Role of testing VLSI circuits, VLSI trends affecting testing, Faults in digital circuits. **Fault Modeling** Functional Testing, Structural Testing, Types of Fault Models, Stuck-at Faults, Bridging Faults, cross point faults, Fault Equivalence, Fault Dominance	
Unit – II	**08 Hrs**
Fault Simulation Fault Simulation algorithm- Serial, Parallel, Deductive and Concurrent Fault Simulation. **Testability Measure** - Controllability, Observability, SCOAP measures for combinational and sequential circuits. Probability-based Testability Analysis	
Unit –III	**07 Hrs**
ATPG for Combinational Circuits Path Sensitization Methods, Roth's D- Algorithm, Boolean Difference, Complexity of Sequential ATPG, Time Frame Expansion. **Design for Testability**- Ad-hoc, Structured DFT- Scan method, Scan Design Rules, Overheads of Scan Design, partial scan methods, multiple chain scan methods.	
Unit –IV	**08 Hrs**
Self-test And Test Algorithms Built-In self-Test, test pattern generation for BIST, response compaction - Parity checking, Ones counting, Transition Count, Signature analyser (SISR and MISR). Circular BIST, Logic BIST Architectures.	
Unit –V	**08 Hrs**
Memory Testing Testable Memory Design Test Algorithms, Reduced Functional Faults-MARCH and MAT+ algorithm. Test generation for Embedded RAMs. MBIST.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Attain knowledge about testing, fault modeling & collapsing. The difference between defects and faults
CO2:	Explore various fault simulation methods. Design methods/techniques to improve the testability of digital circuits.
CO3:	Evaluate the significance of ATPG, how patterns are generated for combinational, sequential, and scanned circuits

CO4:	Get complete knowledge about different methods of LBIST and MBIST associated with testing. Design Logic BIST circuits based on LFSRs.

Reference Books	
1	Essentials of Electronic Testing for Digital, Memoryand Mixed-Signal VLSI Circuits, M. L. Bushnell and V. D. Agrawal, Kluwer Academic Publishers, 2000, ISBN:0-7923-7991-8.
2	VLSI Test Principles and Architectures,L. T. Wang, C. W. Wu, and X. Wen, Morgan Kaufmann, 2006, ISBN-13: 978-0-12-370597-6
3	Digital Circuit Testing and Testability, Parag.K.Lala, Academic Press.
4	Digital Systems Testing andTestable Design, M. Abramovici, M. A. Breuer, and A. D. Friedman, Computer Science Press, 1990, ISBN: 0-7167-8179-4.

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 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

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

SEE for 100 marksis 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	2	2	-	2	-	-	-	-	1	-	1
CO2	2	2	2	1	2	-	-	-	-	1	-	1
CO3	2	3	2	2	2	-	-	-	-	1	-	1
CO4	2	3	2	3	2	-	-	-	-	1	-	1

High-3: Medium-2: Low-1

Semester: VII						
NANOELECTRONICS (Group F: Professional Elective)						
Course Code	**:**	**18EC7F4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to

1	Develop substantial understanding of contemporary relevance and potential of nanoelectronics.
2	Develop appreciation of how factors like scaling and dimension lead to novel behavior of nanoelectronics components.
3	Develop understanding of the importance of quantum ideas and their place in modeling of nanoelectronics phenomena and devices;
4	Expose to a variety of nanoelectronics phenomena, nanoelectronics components and their possible applications.

Unit-I	**08 Hrs**
Review of Electrons Quantum mechanics: Electrons wave particle duality**,** Wave equation, Wave packets and uncertainty, Schrodinger's Equation, The Time Independent Schrödinger Equation, Stationary States, The Infinite Square Well, Harmonic Oscillator-Algebraic method. (Ref 2: Chapter 1,2)	
Unit – II	**08 Hrs**
Free and confined electrons: Free electrons, Periodic boundary conditions, Electrons Confined to a Bounded Region of Space, and Quantum Numbers, Fermi level and Chemical potential, Partially Confined Electrons- Finite Potential Wells, Quantum Dots, Wires, and Wells, Simulation examples. (Ref 1: Chapter 4)	
Unit –III	**07 Hrs**
Electrons subject to a periodic potential: Electrons in periodic potential, Kronig-Penney of Band structure- Effective Mass, **Band theory of Solids:** Interacting system model, Band structure, electronic band transition, graphene and carbon nanotube, Simulation examples. (Ref 1: Chapter 5)	
Unit –IV	**08 Hrs**
Tunnel junctions and applications of tunneling: Tunneling Through a Potential Barrier, Potential Energy Profiles for Material Interfaces, Applications of Tunneling, Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in MOSFETs, Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode, Simulation examples.	
Unit –V	**08 Hrs**
Coulomb blockade and the single-electron transistor: Tunnel Junction Excited by a Current Source, Coulomb Blockade in a Quantum Dot Circuit, The Single-Electron Transistor, Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Molecular SETs and Molecular Electronics. (Ref 1: Chapter 7)	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define novel behavior of nanoelectronics devices and quantum behavior of matter at the nano scale & modelling of nanoelectronics devices.
CO2:	Comprehend principles of devices such as tunnelling diodes, single electron transistor, spintronic devices.
CO3:	Analysis fundamental concepts and methods of Analysis quantum tunnelling, resonant tunnelling, Coulomb blockade, density of quantum states, quantum statistics and quantum modelling.
CO4:	Evaluate nano scale effects in futuristic electron devices & quantum level computing

Reference Books	
1	Fundamentals of Nanoelectronics, George W. Hanson, Pearson, 1st edition, (2009), ISBN: 978-8131726792
2	Introduction to Quantum Mechanics, David J. Griffiths, Darrell F. Schroeter, 3rd Edition, 2018, Cambridge: Cambridge University, ISBN: 9781107189638
3	Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens, Wiley (15 January 2007), ISBN:978-8126510993
4	Nanoelectronics and Information Technology, Rainer Waser, Wiley VCH; 3rdRevised edition (2012), ISBN: 978-3527409273

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	2	-	-	-	-	2
CO2	3	2	1	-	-	1	2	-	-	-	-	2
CO3	3	3	2	-	2	1	2	-	-	-	-	2
CO4	3	3	3	2	2	1	2	-	-	-	-	2

High-3: Medium-2: Low-1

Semester: VII						
SPEECH PROCESSING **(Group F: Professional Elective)**						
Course Code	**:**	**18EC7F5**		**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	Develop the students mathematical, scientific, and computational skills relevant to the field of biomedical signal processing.
2	Enhance the student's ability in formulating problems and designing analysis tools for biological signals.
3	Increase the student's awareness of the complexity of various biological phenomena and cultivate an understanding of the same.
4	Foster effective interaction skills and teamwork communication.

Unit-I	**08 Hrs**
Introduction to Digital Speech Signal Processing Digitization and recording, Human speech production and source filter model, Place and manner at articulation, Articulatory and acoustic phonetics, Uniform tube modelling of speech processing, Human auditory system, Speech perception.	
Unit – II	**08 Hrs**
Time Domain Models for Speech Processing Time dependent representation of speech, Short time average zero crossing rate, Speech vs. silence discrimination using energy and zero crossing, pitch period estimation using parallel processing approach, short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function.	
Unit –III	**08 Hrs**
Short Time Fourier Analysis Introduction, Definitions and properties, Fourier transform interpretation, linear filtering interpretation, Sampling rates of $X(e^{jw})$ in time and frequency, Filter bank summation method of short time synthesis, Spectrographic displays.	
Unit –IV	**08 Hrs**
Feature Extraction Extraction of Fundamental frequency, Frequency domain fundamental frequency detection algorithm, Segmental and supra segmental features of speech signal, Cepstral transform coefficients parameters extraction, Mel-frequency Cepstral coefficients, MFCC features vector.	
Unit –V	**07 Hrs**
Speech based Applications Text to speech synthesis, Automatic speech recognition, Statistical modelling of automatic speech recognition, and Speech based technology development for e learning.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyze the basic signal processing techniques in biological signals
CO2:	Apply basic mathematical, scientific and computational skills necessary to analyze biomedical signals.
CO3:	Formulate and solve basic problems in biomedical signal analysis.
CO4:	Design of Signal processing algorithm to be used in DSP Processor

Reference Books	
1	Digital Processing of Speech Signals, L R Rabiner and R W Schafer, 1st Edition, 2004, Pearson Education, ISBN: 0-13-213603-1
2	Digital Speech Processing, Synthesis and Recognition, SadoakiFurui, 2nd Edition, 2002 MercelDekk er, ISBN-13: 978-0824704520
3	Fundamentals of Speech Recognition, Rabiner and B.Juang, 2004, Pearson Education, ISBN-13: 978-0130151575
4	Discrete-Time Speech Signal Processing: Principles and Practice, Thomas F. Quatieri, 1stedition, (10 November 2008), Prentice Hall, ISBN:0-13-242942-X
5	Theory and Applications of Digital Speech Processing, L. R. Rabiner and R. W. Schafer, 1st edition, (3 March 2010), Pearson, ISBN: 978-0136034285

Continuous Internal Evaluation (CIE); Theory (100 Marks)
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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	2	2					2	-	2
CO2	2	2	2	1	2	1				2	-	3
CO3	3	2	3	2	1	2					-	3
CO4	3	2	3	3	2	1				2	-	2

High-3: Medium-2: Low-1

Semester: VII						
RADAR SYSTEMS ENGINEERING (Group F: Professional Elective)						
Course Code	**:**	18EC7F6		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	36L		**SEE Duration**	**:**	03 Hours

Course Learning Objectives: The students will be able to	
1	To develop the knowledge on fundamentals of radar and parameters of general radar equation
2	To enable the students to demonstrate the Doppler Effect and the concepts of continuous wave radars and the FM-CW Altimeter.
3	Able to know operation of MTI radar and delay line cancellers. Understanding of blind speeds, range gated Doppler filters and compare MTI radar with Pulse Doppler radar.
4	To enable the students to analyze the detection of radar signals in noise and demonstrate the noise figure and radar receiver, Beam steering

Unit-I	**07Hrs**
Basic of Radar Introduction, Maximum Unambiguous Range, Simple form of RadarEquation, Radar Block Diagram and Operation, Radar Frequencies and Applications.Predication of range performance, Minimum Detectable Single, Receiver Noise, ModifiedRange Equation, Illustrative Problems.Radar Equation: Signal to Noise Ratio, Integration of Radar Pulses, Radar Cross Section ofTargets, Transmitter Power, Pulse Repetition Frequency and Range Ambiguities, SystemLosses, Illustrative Problems.	
Unit – II	**08Hrs**
CW and Frequency Modulated Radar Doppler Effect, CW Radar – Block Diagram, Isolationbetween Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements,Applications of CW radar, Illustrative Problems.FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics(Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.	
Unit –III	**07Hrs**
MTI AND Pulse Doppler Radar Introduction, Principle, MTI Radar with - Power AmplifierTransmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics,Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters, MTIRadar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.	
Unit –IV	**07Hrs**
Tracking Radar Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar– Amplitude Comparison Monopulse (one- and two coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.	
Unit –V	**07Hrs**
Detection of Radar Signals in Noise Introduction, Matched Filter Receiver – ResponseCharacteristics and Derivation, Correlation Function and Cross correlation ReceiverRadar Receivers – Noise Figure and Noise Temperature. Displays – types. Duplexers –Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased ArrayAntennas – Basic Concepts. Radiation Pattern, Beam Steering and Beam Width changes.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand about radar fundamentals and remember the radar ranges and parameters of general radar equation
CO2:	Understand the operation of MTI radar and delay line cancellers

CO3:	Demonstrate the Doppler Effect and the concepts of continuous wave radars and the FM-CW Altimeter
CO4:	Analyze the detection of radar signals in noise and demonstrate the noise figure and radar receiver, Beam steering

Reference Books	
1	Introduction to radar systems, Skolnik, 2nd Edition, 2007, McGraw Hill, ISBN 9780070634411
2	Radar Principles, Technology,Byron Edde, 1stEdition,2012,Pearson Education Limited, ISBN:139788131713839
3	Introduction to Radar Systems-Merill I Skolnik, 3rdEdition,2001, MCGraw-Hill ISBN 13: 9780072909807
4	Radar Principles,Peyton Z Peebles,1stEdition,2007,Wiley India, ISBN 13: 9788126515271

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

Low-1 : Medium-2: High-3

Semester: VII						
AUTOMOTIVE ELECTRONICS (Group G: Professional Elective)						
Course Code	**:**	**18EC7G1**		**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	Acquire the knowledge of automotive domain fundamentals, need of Electronics and communication interfaces in Automotive systems.
2	Apply various types of sensors, actuators and Motion Control techniques in Automotive systems
3	Understand digital engine control systems and Embedded Software's and ECUsused in automotive systems.
4	Analyse the concepts of Diagnostics, safety and advances in Automotive electronic Systems.

Unit-I	**08 Hrs**
Fundamentals of Automotive: Evolution and Use of Electronics in Automotive, Automotive Systems, The Engine, Engine Control, Internal Combustion Engines, Spark Ignition Engines and Alternative Engines. Ignition System, Ignition Timing, Drivetrain, Suspensions, Brakes and Steering Systems. **Basics of Electronic Engine Control:** Motivation for Electronic Engine Control, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.	
Unit – II	**08 Hrs**
Automotive Sensors and Actuators: Automotive Control System Applications of Sensors and Actuators, **Sensors:** Air Flow Sensor, Engine Crankshaft Angular Position Sensor, Throttle Angle Sensor, Temperature Sensor, Sensors for Feedback Control, Sensors for Driver Assistance System: Radar, Lidar, Video Technology. **Actuators:** Solenoids, Piezo Electric Force Generators, Fluid mechanical Actuators**,** Electric Motors and Switches.	
Unit –III	**07 Hrs**
Digital Engine Control Systems: Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed Loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System. **Vehicle Motion Control:** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS), Electronic Suspension System, Electronic Steering Control.	
Unit –IV	**08 Hrs**
Automotive Communication Systems: Automotive networking: Bus systems, Technical principles, network topology. Buses in motor vehicles: CAN, Flex Ray, LIN, Ethernet, IP, PSI5, MOST, D2B and DSI. **Automotive Embedded Software Development** Fundamentals of Software and software development lifecycles. Overview of AUTOSAR methodology and principles of AUTOSAR Architecture.	
Unit –V	**08 Hrs**
Diagnostics and Safety in Automotive:	

Timing Light, Engine Analyzer, Electronic Control System Diagnostics: Onboard diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer based Air Bag systems, Case study on ON-BOARD, OFF-BOARD diagnostics. **Advances in Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Navigation: Navigation Sensors, Radio Navigation, dead reckoning navigation, Video based driver assistance systems, Night vision Systems.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Acquire the knowledge of automotive domain fundamentals, need of Electronics and communication interfaces in Automotive systems.
CO2:	Apply various types of sensors, actuators and Motion Control techniques in Automotive systems
CO3:	Analyze digital engine control systems and Embedded Software'sand ECUsused in automotive systems.
CO4:	Illustrate the concepts of Diagnostics, safety and advances in Automotive electronic Systems.

Reference Books	
1	Understanding Automotive Electronics, Williams. B. Ribbens, 6th Edition, 2003, Elsevier science, Newness publication, ISBN-9780080481494.
2	Automotive Electronics Handbook, Robert Bosch, 2004, John Wiley and Sons, ISBN-0471288357
3	Automobile Electrical and Electronic Systems, Tom Denton, Third edition, Elsevier Butterworth-Heinemann. ISBN 0-7506-62190.
4	Advanced Automotive Fault Diagnosis, Tom Denton, Second edition, Elsevier Butterworth-Heinemann. ISBN 0-75-066991-8.

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 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	2	-	-	-	-	2
CO2	3	2	1	-	-	1	2	-	-	-	-	2
CO3	3	3	2	-	2	1	2	-	-	-	-	2
CO4	3	3	3	2	2	1	2	-	-	-	-	2

High-3: Medium-2: Low-1

Semester: VII						
OPTOELECTRONICS AND NETWORKS (Group G: Professional Elective)						
Course Code	**:**	**18EC7G2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**03 Hours**

Course Learning Objectives: The students will be able to	
1	Understand processes that help to manipulate the fundamental properties of light.
2	Learn the fundamental principles of photonics and light-matter interactions.
3	Develop the ability to formulate problems related to photonic structures/processes and analyse them.
4	Describe basic fiber networks, protection schemes and passive optical networks.

Unit-I	**09 Hrs**
Ray Optics Postulates, Simple optical components: Mirrors, Planar Boundaries, Spherical Boundaries and Lenses, Matrix Optics: The-Ray Transfer Matrix, Matrices of Simple and Cascaded Optical Components. **Wave Optics** Postulates, Monochromatic Waves: Complex Representation and Helmholtz equation, Elementary Waves, Paraxial Waves, Simple Optical Components: Reflection and Refraction, Transmission through Optical Components, Interference: Two Waves and Multiple-Wave Interference.	
Unit – II	**08 Hrs**
Beam Optics The Gaussian beam: Complex Amplitude, Properties, Power, Beam Width, Beam Divergence, Depth of focus, Beam Quality. **Statistical Optics** Statistical Properties of Random Light: Optical Intensity, Temporal Coherence and Spectrum, Spatial and Longitudinal Coherence, Interference of Partially Coherent Light.	
Unit –III	**07 Hrs**
Photon Optics The Photon, Photon Streams, Interactions of Photons with Atoms. **LASER Amplifiers** Theory, Amplifier Pumping, Common LASER amplifiers, Theory of LASER oscillation, Characteristics of LASER Output.	
Unit –IV	**08 Hrs**
Semiconductor Photon Sources Light-Emitting Diodes, Semiconductor Optical Amplifiers, Laser Diodes. **Semiconductor Photon Detectors** Photodetectors, Photoconductors, Photodiodes, Avalanche Photodiodes, Noise in Photodetectors.	
Unit –V	**08 Hrs**
Optical Networks Basic Networks, SONET/SDH, Broadcast and select WDM Networks, Wavelength Routed Networks, Nonlinear effects on Network performance, Performance of WDM + EDFA systems, Solitons, Isolators, Circulators, Optical CDMA, Ultra High Capacity Networks.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply mathematical principles to various optical components and analyze their performance.
CO2:	Explain the basic properties of light: Reflection, Refraction, Interference, Diffraction and Coherence.
CO3:	Design circuits involving optical sources and detectors based on given design parameters.

CO4:	Illustrate the networking aspect of optical fiber and describe various standards associated with it.

Reference Books	
1	Fundamentals of Photonics, B.E.A. Saleh, M.C.Teich, Wiley, 2nd Edition, 2007, ISBN: 978-0-471-35832-9.
2	Optical Fiber Communications: Principles and Practice, John M. Senior, Pearson Prentice Hall, 3rd Edition, 2009, ISBN: 978-0-13-032681-2.
3	Optical Fiber Communications, Gerd Keiser, Pearson Education, 3rd Edition, 2010, ISBN: 978-8131732663.
4	Optical Networks: A Practical Perspective, Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki, 3rd Edition, 2010, ISBN: 978-0-12-374092-2.

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 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	3
CO2	3	3	2	-	2	-	-	-	2	2	-	3
CO3	3	3	3	2	-	-	-	-	2	2	-	3
CO4	2	3	3	2	1	-	1	-	2	2	-	3

High-3: Medium-2: Low-1

Semester: VII						
SYSTEM ON CHIP DESIGN (Group G: Professional Elective)						
Course Code	**:**	**18EC7G3**		**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	Understanding of SoC Design Flow, Design challenges, goals and motivation of SoC design.
2	Design approaches of Soc Design, specifications, types of specifications, The System design process.
3	System level design issues: IP verification and Integration, Hardware-Software codesign, Design for timing closure, Logic design issues.
4	Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh-based NoC. Routing in an NoC. Packet switching and wormhole routing, Concept of Multiprocessor – System on Chip

Unit-I	**08 Hrs**
Motivation for SoC Design Introduction to SoC, SoB, SiP, Benefits of system-on-chip integration in terms of cost, power, and performance. Comparison on System-on-Board, System-on-Chip, and System-in-Package. Typical goals in SoC design – cost reduction, power reduction, design effort reduction, performance maximization. Productivity gap issues and the ways to improve the gap. **System on Chip Design Process** **C**anonical SoC Design, SoC Design flow - waterfall vs spiral, Top-down vs Bottom-up, Specification requirement, Types of Specification, System Design process, System level design issues- Soft IP vs Hard IP, Design for timing closure,	
Unit – II	**08Hrs**
Macro Design Process Overview of IP Design, Key Features, Planning and Specification, Macro design and Verification. **Developing Hard Macros** Overview, Design Issues for Hard Macros, The Hard Macro Design Process, Productization of Hard Macros.	
Unit –III	**07 Hrs**
SoC Verification Verification technology options, Verification methodology, Verification languages, Verification IP Reuse, approaches. Verification and Device Test, Verification Plans. **VLSI Packaging** Introduction, Packaging, Power Distribution, Input/Output, Chip-Package Co-design.	
Unit –IV	**08 Hrs**
Interconnect Architectures for SoC Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh-based NoC. Routing in an NoC. Packet switching and wormhole routing.	
Unit –V	**08 Hrs**
MPSoCs What, Why, How MPSoCs, Techniques for designing MPSoCs, Performance and flexibility for MPSoCs design: The limitations of traditional ASIC design, General Purpose Processor,	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Learn about the system on chip design and macro design process
CO2:	Analyze the design flow, IP cores, routing used in system on chip
CO3:	Exposure the concepts of verification methodology and interconnection methods in SoC
CO4:	Design & Develop the algorithms required for the design of IP and SoC and Exposure to the concept of MPSoCs.

Reference Books	
1	Reuse Methodology manual for System-On-A-Chip Designs, Michael Keating, Pierre Bricaud, Kluwer Academic Publishers, 2nd edition,2001
2	SoC Verification-Methodology and Techniques, Prakash Rashinkar, Peter Paterson and Leena Singh, Kluwer Academic Publishers,2001.
3	On-Chip Communication Architectures: System on Chip Interconnect", Sudeep Pasricha and NikilDutt, Morgan Kaufmann Publishers © 2008
4	Introduction to system on package sop- Miniaturization of the Entire System, Rao R. Tummala, Madhavan Swaminathan, McGraw-Hill, 2008.
5	Multiprocessor Systems-on-chips, A.A.Jerraya, W.Wolf , 1stEdition,Morgan Kaufmann, 2004

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =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	2	2	-	-	-	-	-	-		-	-
CO2	2	2	2	3	-	-	-	2	2		-	-
CO3	2	2	2	2	2	1	-	2	2		-	-
CO4	2	2	3	3	2	2	2	2	3	2	2	2

High-3: Medium-2: Low-1

Semester: VII						
MULTIMEDIA COMMUNICATION (Group G: Professional Elective)						
CourseCode	**:**	**18EC7G4**		**CIE Marks**	**:**	**100 Marks**
Credits:L:T:P	**:**	**3:0:0**		**SEE Marks**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEEDuration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basics of analog and digital video: video representation and transmission
2	Analyze analog and digital video signals and systems
3	Analyze the fundamental video processing techniques & acquire the basic skill of designing video compression
4	Design video transmission systems: error control and rate control

Unit-I	**08 Hrs**
Multimedia Communications: multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.	
Unit-II	**08 Hrs**
Text and image compression, compression principles:lossless and lossy, Source encoders and destination decoders, Entropy encoding, Source encoding, Statistical encoding text compression-Runlength,static HuffmanCoding,Dynamic Huffman coding,Arithmetic coding,LZ, LZW, Image compression- GIF, TIFF and JPEG.	
Unit-III	**08 Hrs**
Audio and video compression: Introduction, audio compression, DPCM, ADPCM, APC, LPC, video compression principles.	
Unit-IV	**08 Hrs**
Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs.	
Unit-V	**08 Hrs**
The Internet: Introduction, IP datagrams, fragmentation, Internet protocol address, ARP and RARP, QoS. Transport Protocol: Introduction, TCP/IP, TCP, UDP, RTP and RTCP, RSVP.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe and describe various multimedia data.
CO2:	Analyze the representation of multimedia data.
CO3:	Describe the concept involved in MPEG4 standards.
CO4:	Develop algorithms for protocols like RTP,RTCP for multimedia communication over mobile networks.

Reference Books	
1.	Multimedia Communications, Fred Halsall, Pearson education, 2001. ISBN: 8131709949, 978-8131709948
2.	Multimedia Communication Systems, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Pearson education, 2004.ISBN: 013031398X978-0130313980
3.	Multimedia: Computing, Communications and Applications, Raifsteinmetz, Klara Nahrstedt, Pearson education, 2002, ISBN: 3540408673, 978-3540408673
4.	Multimedia: An Introduction, John Villamil, Louis Molina, PHI, 2002, ISBN: 1575765578, 978-1575765570

Continuous Internal Evaluation (CIE): Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	3	3	3	3	-	-	-	-	-	-	2
CO2	3	1	3	-	2	-	-	-	-	-	-	2
CO3	2	3	1	2	2	-	-	-	2	-	-	1
CO4	3	3	-	2	3	-	-	-	2	-	-	1

High-3: Medium-2: Low-1

Semester: VII						
ASIC DESIGN **(Group G: Professional Elective)**						
Course Code	**:**	**18EC7G5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the fundamentals of ASIC and its design methods
2	Differentiate between ASICs and FPGAs, standard cells, cell libraries, IPs.
3	Gain knowledge on programmable architectures for ASICs.
4	Analysing the steps involved in physical design of ASIC including floor planning, placement and Routing. Design a digital system from specifications to GDSII.

Unit-I	**07 Hrs**
Introduction to ASICs **Types of ASICs**: Full Custom ASIC, Semi-custom based ASICS, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channelless gate array, Structured gate array, Programmable logic devices, FPGA. **Design flow.**	
Unit – II	**08 Hrs**
CMOS Logic **Combinational logic cells Sequential logic cells:** Latch, flipflop, clocked inverter**.** **Data logic cells:** Data Path Elements, Adders, Multipliers, Arithmetic operator (Practical approach). **I/O Cell, Cell Compilers**	
Unit –III	**08 Hrs**
ASIC Library Design **Logical effort**: predicting delay, logical area and logical efficiency, logical paths, multi stage cells, optimum delay, optimum no. of stages, Library cell design. **Programmable ASICS**: The Antifuse, Static RAM, EPROM and EEPROM technology.	
Unit –IV	**08 Hrs**
Programmable ASICs logic cells **Actel ACT:** ACT1 logic module, Shannon's expansion theorem, Multiplexer logic as function generators, Timing models and critical path, speed gating, worst case timing. **Low-Level Design Entry:** Schematic Entry: Hierarchical design. The cell library, Names, Schematic, Icons & Symbols, Nets, schematic entry for ASIC'S, connections, vectored instances and buses, Edit in place attributes, Netlist, screener, Back annotation **ASIC Construction: Floor Planning and Power Planning** Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning	
Unit –V	**08 Hrs**
ASIC Construction: Placement, Routing Placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Learn the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test.
CO2:	Apply & analyze the design parameters for speed, area & power optimization.
CO3:	Develop the algorithms required for the design of ASIC

CO4:	Apply the back-end physical design flow, including floor planning, placement, and Routing techniques,

Reference Books	
1	Application - Specific Integrated Circuits, M.J. S. Smith, Pearson Education, 2003, ISBN:978-817758-408-0
2	Advanced ASIC Chip Synthesis Using Synopsys Design Compiler Physical Compiler and Prime Time, H. Bhatnagar, -2nd edition, 2001, ISBN:0792385373
3	Logic Synthesis Using Synopsys, P. Kurup, T. Abbasi, ISBN 0-7923-9582-4
4	Multiprocessor Systems-on-chips, A.A.Jerraya, W.Wolf , 1st Edition,Morgan Kaufmann, 2004

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =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	2	2	-	-	-	-	-	-		-	-
CO2	2	2	2	2	-	-	-	2	2		-	-
CO3	2	2	2	3	-	-	-	2	2		-	-
CO4	3	3	3	3	2	2	2	2	3	2	2	2

High-3: Medium-2: Low-1

Semester: VII						
ARM PROGRAMMING AND OPTIMIZATION (Group G: Professional Elective)						
Course Code	**:**	**18EC7G6**		**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	Discuss the basic principles of ARM system design.
2	Identify the major hardware components ARM data path architecture.
3	Identify the design issues ARM based
4	Analyze the execution of instructions/program knowing the basic principles of ARM architecture and assembly language.

Unit-I	**08 Hrs**
Introduction, ARM Family Overview, Data Path Architecture, Registers, Modes, Exceptions **ARM Instructions** Data processing instructions, Branch instructions, Load store instructions, software interrupt instructions, program status register instructions, loading constants, ARMv5E extension, and conditional execution. **Thumb Instructions:** Thumb register usage, ARM Thumb inter working, Other branch instructions, data processing instructions, single register load store instructions, multiple register load store instructions, stack instructions, software interrupt instruction.	
Unit-II	**08 Hrs**
Programming in C for ARM Overview of C Compilers and optimization, basic C data types, C looping structures, register allocation, function calls, pointer aliasing, structure arrangement, bit fields, unaligned Data and Endianess, division, floating point, inline functions and inline assembly, portability issues.	
Unit-III	**08 Hrs**
Writing and Optimizing ARM Assembly Code Writing assembly code, profiling and cycle counting, instruction scheduling, register allocation, conditional execution, looping constructs, Bit manipulation, efficient switches. Handling unaligned data	
Unit-IV	**08 Hrs**
Optimized Primitives Double Precision Integer Multiplication, Integer Normalization, Counting Trailing Zeros, Division: Unsigned Integer Newton Raphson Division, Signed Division, Square root by Newton Raphson Iteration, Transcendental Functions: Log, Sin	
Unit-V	**07 Hrs**
Exception and Interrupt Handling Exception Handling, Interrupts, Non-nested Interrupt handler, Re-entrant Interrupt handler Firmware & Boot loader **Embedded Operating Systems** Fundamental Components, Simple Operating System	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the programmer's model of ARM processor and analyse the instruction set architecture to realize complex operations.
CO2	Apply the optimization methods available for ARM architectures to design embedded software to meet given constraints with the help of modern engineering tools.
CO3	Write optimized code to perform primitives mathematical & OS operations on different ARM

	architectures by making use of software libraries.
CO4	Engage in self-study to formulate, design, implement, analyze and demonstrate an application realized on ARM development boards through assignments.

Reference Books	
1	ARM System Developer's Guide, Andrew N Sloss, Dominic Symes, Chris Wright, Elsevier, Morgan Kaufman publishers, 2008, ISBN-13:9788181476463
2	The Definitive Guide to the ARM Cortex-M3& M4 Processors, Joseph Yiu, 3rd Edition, 2014 Newnes (Elsevier), ISBN:978-93-5107-175-4
3	ARM Architecture Reference Manual, David seal, Addison-Wesley, 2nd Edition, 2009, ISBN-13:9780201737196
4	ARM System on Chip Architecture, Steve Furber, Pearson Education Limited,2nd Edition, ISBN-13:9780201675191
5	Technical reference manual for ARM processor cores including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
6	User guides and reference manuals for ARM software development tools.

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 50. The marks component for experiential learning is 20.

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

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

SEE for 100 marksis 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 the entire unit having the same complexity in terms of COs and Bloom's taxonomy level.

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

High-3: Medium-2: Low-1

Semester: VII						
UNMANNED AERIAL VEHICLES (Group H: Global Elective)						
Course Code	**:**	**18G7H01**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**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	Comprehend the importance of guidance and navigation of a UAV

Unit-I	**07 Hrs**
Overview of Unmanned Aerial Vehicles and Systems: History of UAVs, Need of unmanned aerial systems, Overview of UAV Systems-System Composition, Classification of UAVs based on size, range and endurance, Basic working of fixed, rotary and flapping UAVs, Applications of UAVs.	
Unit – II	**08 Hrs**
Aerodynamics of Unmanned Aerial Vehicles: Airfoil nomenclature and its characteristics, Basic aerodynamics equations, Aircraft polar, Types of drag, Aerodynamics of rotary and flapping wings, Airframe configurations-HTOL, VTOL and Hybrids.	
Unit -III	**08 Hrs**
Structures of UAV: Mechanic loading, Load calculation, Materials used for UAV (general introduction), Selection criteria for structure, Types of structural elements used in UAV their significance and characteristics. **UAV Propulsion Systems:** Thrust Generation, Powered Lift, Sources of Power for UAVs- Piston, Rotary, Gas turbine engines, electric or battery powered UAVs.	
Unit -IV	**08 Hrs**
Payloads of UAVs : Non-dispensable Payloads- Electro-optic Payload Systems, Radar Imaging Payloads, Electronic Warfare Payloads, Dispensable Payloads and other payloads. **Launch and Recovery Systems for UAVs:** UAV Launch Methods for Fixed-Wing Vehicles- Rail Launchers, Pneumatic Launchers, Hydraulic/Pneumatic Launchers, Zero Length RATO Launch of UAVs, UAV Recovery Systems-Conventional Landings, Vertical Net Systems, Parachute Recovery, VTOL UAVs, Mid-Air Retrieval, Shipboard Recovery.	
Unit -V	**08 Hrs**
UAV Navigation and Guidance Systems Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite–Way point Navigation, UAV Guidance, Types of guidance, UAV communication systems, Ground control station, Telemetry, UAS future.	

Course Outcomes:
At the end of thiscourse the student 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	Appreciate the guidance and navigation systems for enabling the versatility of UAV systems

Reference Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1st Edition, 2010, Wiley, ISBN 9780470058190.
2	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4
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	Flight Stability and Automatic Control, Robert C. Nelson, 2nd Edition, October 1, 1997, McGraw-Hill, Inc, ISBN 978-0070462731.
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 experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	3	1	1	3	2	2	-	-	-	1
CO2	2	3	3	3	1	1	1	1	-	-	-	2
CO3	1	-	3	3	-	-	-	-	-	-	-	2
CO4	3	3	3	3	-	2	1	2	-	-	-	2

High-3: Medium-2: Low-1

Semester: VII						
BIOINFORMATICS (Group H: Global Elective)						
Course Code	**:**	**18G7H02**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Acquire the knowledge of biological database and its role in insilico research
2	Understand the essential algorithms behind the biological data analysis such as Dynamic programming, Dot plotting, Evolutionary and Clustering algorithms along with their implementation.
3	Use various tools and techniques for the prediction of linear & non-linear structures of both macro and micro molecules and study the dynamics of macromolecules and High Throughput Virtual Studies.
4	Perform annotation of unknown DNA and Protein sequences and explore the principles of molecular modelling
5	Apply the knowledge towards analyzing the sequences using programming languages and Drug development

Unit-I	**08 Hrs**
Biomolecules and Introduction to Bioinformatics: Introduction to Biomolecules. Structure, Types and Functions of Carbohydrates, Lipids, Nucleic Acids and Proteins. Genetic code, Codon degeneracy, Genes and Genomes. Introduction to Bioinformatics, Goals, Scope, Applications in biological science and medicine. Biological databases – Sequence, structure, Special Databases and applications - Genome, Microarray.	
Unit – II	**08 Hrs**
Sequence analysis: Introduction, Types of sequence alignments, Pairwise sequence alignment, Multiple sequence alignment, Alignment algorithms Needleman & Wunch, Smith & Waterman and Progressive global alignment, Database Similarity Searching- Scoring matrices – BLOSSUM and PAM, Basic Local Alignment Search Tool (BLAST), and FASTA. Next Generation Sequencing – Alignment and Assembly. **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation	
Unit –III	**09 Hrs**
Predictive and structural bioinformatics: Gene prediction programs – ab initio and homology-based approaches. ORFs for gene prediction. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition. Structure prediction - Prediction of secondary structure.	
Unit –IV	**07 Hrs**
PERL: Introduction to Perl, writing and executing a Perl program, Operators, Variables and Special variables. Object Oriented Programming in Perl–Class and object, Polymorphism, inheritance and encapsulation. Data Types – Scalar, Array and Associative array. Regular Expressions (REGEX), Components of REGEX - Operators, Metacharacters and Modifiers.	
Unit –V	**07 Hrs**
BioPERL: Introduction to BioPerl, BioPerl Modules, Applications of BioPerl – Sequence retrieval from Database and submission of sequence to online Database, Indexing and accessing local databases, Sequence alignments BioPerl and Sequence Analysis - Pair wise and Multiple sequence alignment, Parsing BLAST and FASTA results.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Demonstrate the knowledge of retrieval of the biological data in the essential formats and its analysis.
CO2:	Analyse the gene, protein and RNA data to find the degree of similarities and identifying the patterns
CO3:	Apply the drug designing methods for screening and inventing the new targets and drugs
CO4:	Predict the structure of a compound and design the molecule.

Reference Books	
1.	Essential Bioinformatics, JinXiong, 2006, Cambridge University Press, ISBN: 978-05-216-00828.
2.	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins; D. Andreas Baxevanis and B. F; Francis Ouellette. 2009; Wiley-IEEE; 3rd edn; ISBN: 978-81-265-21920.
3	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
4	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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						
INDUSTRIAL SAFETY AND RISK MANAGEMENT (Group H: Global Elective)						
Course Code	**:**	**18G7H03**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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

Unit-I	**08 Hrs**
Introduction: Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, Hazard recognition.	
Unit – II	**08 Hrs**
Risk assessment and control: Individual and societal risks, Risk assessment, Risk perception, Acceptable risk, ALARP, Prevention through design. **Hazard Identification Methods:** Preliminary Hazard List (PHL): Overview, methodology, worksheets, case study. Preliminary Hazard Analysis (PHA): Overview, methodology, worksheets, risk index, example.	
Unit –III	**08 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Definition, Process parameters, Guide words, HAZOP matrix, Procedure, Example. Failure Modes and Effects Analysis (FMEA): Introduction, system breakdown concept, methodology, example.	
Unit –IV	**08 Hrs**
Application of Hazard Identification Techniques: Case of pressure tank, system breakdown structure, safety ontology, Accident paths, HAZOP application, risk adjusted discounted rate method, probability distribution, Hiller's model	
Unit –V	**07 Hrs**
Safety in process industries and case studies: Personnel Protection Equipment (PPE): Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire.	

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	Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North Carolina, Lulu publication, ISBN:1291187235
2	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X
3	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003, The University of Albertapress,Canada, ISBN: 0888643942.
4	Industrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th

	Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	3	-	1	-	1	1	1	-	-	1	-
CO2	2	3	1	-	1	1	-	-	-	-	-	-
CO3	3	2	1	1	2	-	1	-	-	1	1	-
CO4	3	-	1	-	-	-	-	-	1	-	1	-

High-3; Medium-2; Low-1

Semester: VII						
WEB PROGRAMMING (Group H: Global Elective)						
Course Code	**:**	**18G7H04**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the standard structure of HTML/XHTML and its differences.
2	Adapt HTML and CSS syntax & semantics to build web pages.
3	Learn the definitions and syntax of different web programming tools such as JavaScript, XML and Ajax to design web pages.
4	Design and develop interactive, client-side, server-side executable web applications using different techniques such as CSS, JavaScript, XML and Ajax.

Unit-I	**07 Hrs**
Introduction to Web, HTML and XHTML: Fundamentals of Web(Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox), XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames. **HTML 5:**Core HTML attributes, headings, paragraphs and breaks, quotations, preformatted text, lists, horizontal rules, block-level elements, text-level elements The audio Element; The video Element; Organization Elements; The time Element, Syntactic Differences between HTML and XHTML.	
Unit – II	**08 Hrs**
CSS (Cascading Style Sheet) Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **The Basics of JavaScript:** Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements.	
Unit –III	**09 Hrs**
JavaScript (continued): Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts. **JavaScript and HTML Documents:** The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object.	
Unit –IV	**08 Hrs**
Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. **Introduction to PHP:** Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling;Cookies; Session Tracking.	
Unit –V	**07 Hrs**

XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. **Ajax:** Overview of Ajax; Basics of Ajax: The Application; The Form Document; The Request Phase; The Response Document; The Receiver Phase.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic syntax and semantics of HTML/XHTML.
CO2:	Apply HTML/XHTML tags for designing static web pages and forms using Cascading Style Sheet.
CO3:	Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP and utilize the concepts of XML & Ajax to design dynamic web pages.
CO4:	Develop web-based applications using PHP, XML and Ajax.

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

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =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	-	2	-	1	1	1	-	-	-	-	1
CO2	-	-	2	-	1	1	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	2	-	-	2
CO4	-	-	3	-	2	-	-	-	2	-	-	2

High-3: Medium-2: Low-1

Semester: VII						
SOLID WASTE MANAGEMENT AND STATUTORY RULES (Group H: Global Elective)						
Course Code	**:**	**18G7H05**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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

Unit-I	**08 Hrs**
Introduction: Present solid waste disposal methods. Merits and demerits of open dumping, incineration, pyrolysis, composting, sanitary landfill. Scope and importance of solid waste management. Definition and functional elements of solid waste management. **Sources**: Sources of Solid waste, types of solid waste, composition of municipal solid waste, generation rate, Problems. **Collection and transportation of municipal solid waste:** Collection of solid waste- services and systems, Municipal Solid waste (Management and Handling) 2016 rules with amendments. Site visit to collection system.	
Unit – II	**08 Hrs**
Composting Aerobic and anaerobic composting - process description, process microbiology, Vermicomposting, Site visit to compost plant, Numerical problems. **Sanitary land filling**: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.	
Unit –III	**08 Hrs**
Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016 with amendments. Site visit to hazardous landfill site	
Unit –IV	**08 Hrs**
Bio medical waste management: Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Biomedical waste management (Management & Handling Rules) 2016 with amendments. Site visit to hospital to observe biomedical waste collection and transportation system and visit to biomedical waste incineration plant.	
Unit –V	**07 Hrs**
E-waste management: Definition, Components, Materials used in manufacturing electronic goads, Recycling and recovery integrated approach. e-waste (Management) Rules 2016 and amendments. Site visit to e- waste treatment plant. **Plastic waste management:** Manufacturing of plastic with norms. Plastic waste management. Plastic manufacture, sale & usage rules 2009 with amendments.	

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

Reference Books:	
1	Integrated Solid Waste Management, George.C. Tchobanoglous, International edition ,1993, McGraw hill publication. ISBN 978-0070632370
2	Electronic waste management, R.E. Hester, Roy M Harrison, Cambridge, UK, 2009, RSC Publication, ISBN 9780854041121
3	Solid Waste Management Rules2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 8th April 2016
4	Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 04th April 2016.
5	Biomedical waste management (Management & Handling Rules) 2016, Ministry of Environment & Forest Notification, New Delhi, amendment on 28thMarch 2016.
6	E-waste (Management) Rules 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 23rdMarch 2016.
7	Plastic Waste (Management and Handling) Rules, 2011 as amended in 2018, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 27th March 2018.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by the way of Tests (T), Quizzes (Q),) and Experiential Learning (EL). Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. 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 marks component for experiential learning is 20.
Total CIE is 50 (T) +30 (Q) +20 (EL) = 100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	-	-	-	2	2	1	-	1	-	2
CO2	2	2	2	2	-	1	2	1	-	-	-	-
CO3	1	-	2	2	-	1	2	1	-	1	-	-
CO4	2	-	-	3	-	1	2	1	-	-	-	1

High-3: Medium-2: Low-1

Semester: VII						
IMAGE PROCESSING AND MACHINE LEARNING (Group H: Global Elective)						
Course Code	**:**	**18G7H06**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40 L**		**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: Introduction to image processing, Applications of image processing, Components of an image processing system, Fundamental steps in image processing, Image formation and representation, Color imagery, basic definitions, Pixels, Image resolution, PPI and DPI, Bitmap images, Lossless and lossy compression, Image file formats, Color spaces, Bezier curve, Ellipsoid, Gamma correction, Examples of zooming and shrinking in image processing Advanced image concepts.	
Unit – II	**08 Hrs**
Basics of Python, Scikit image & Advanced Image Processing using Open CV: 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**
Image Processing using Machine Learning Feature mapping using SIFT algorithm, Image registration using the RANSAC algorithm, Image classification using Artificial Neural Networks, Image classification using CNNs, Image classification using machine learning Approaches.	
Unit –V	**08 Hrs**
Real time use CASES Exhaustive vs. Stochastic Search, Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models, finding palm lines, Face Detection / Recognition, Tracking movements.	

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	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Pearson Education, 3rd Edition, ISBN 978-81-317-2695-2.
2	Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python, Himanshu Singh, 1st Edition, Apress, ISBN:978-1-4842-4149-3
3	Pattern Recognition and Machine Learning, Christopher Bishop, 1stEdition Springer, 2008, ISBN: 978-0387-31073-2
4	Computer Vision: A modern Approach, David Forsyth and Jean Ponce, 2nd Edition, Prentice Hall India 2004, ISBN: 978-0136085928

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

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

Total CIE is 30(Q)+50(T)+20(EL)=100Marks

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

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

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

High-3; Medium-2; Low-1

Semester: VII						
RENEWABLE ENERGYSOURCES AND STORAGE SYSTEM (Group H: Global Elective)						
Course Code	**:**	**18G7H07**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Understand Concepts of nonconventional energy sources and allied technology required for energy conversion.					
2	Analyse the Basics of battery working and sizing of battery for a given application.					
3	Design aspects of solar and wind power systems.					
4	Energy storage techniques					

UNIT-I	**08 Hrs**
Basics of Renewable Energy: Energy balance of the earth, Solar radiation, wind energy, geothermal energy. **Geothermal Energy** – principles, technical description, heat supply by hydro-geothermal systems, heat supply by deep wells, geothermal generation, economic and environmental analysis. **Biomass Energy:** Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Updraft, Downdraft and Cross-draft Gasifiers, Applications of Biomass Gasifier. **Tidal Energy:** Introduction, Tidal Energy Resource, Tidal Power Basin, Advantages and Disadvantages of Tidal Power.	
Unit – II	**08 Hrs**
Photo Voltaic Systems: PV Cell, Module and array; Equivalent electrical circuit, Open –circuit voltage and short circuit current, I-V and P-V curves, Array design, Peak power Tracking, System Components, **Grid Connected Solar PV Power System:** Introduction to grid connected PV system, Configuration of Grid-connected solar PV system, Components of Grid –connected solar PV systems, Grid connected PV system Design for small power Applications, Grid- connected PV system design for power plants.	
Unit -III	**08 Hrs**
Wind Power: Introduction, site selection, Advantages and Disadvantages, Wind power installations in the world. **Wind Speed and Energy:**Speed and Power Relations,Power Extracted from the wind. Rotor-Swept Area, Air Density,Global Wind Patterns, Wind Speed Distribution,Weibull Probability, Distribution,Mode and Mean Speeds, Root Mean Cube Speed, Mode, Mean, and RMC Speeds, Energy Distribution, Digital Data Processing, Effect of Hub Height, Importance of Reliable Data, Wind Speed Prediction,Wind Energy Resource Maps. **Wind Power Systems:** System Components, Tower, Turbine, Blades, Speed Control, Turbine Rating, Power vs Speed and TSR.	
Unit –IV	**08 Hrs**
Wind Power Systems: Maximum Energy Capture, Maximum Power Operation Constant-TSR Scheme, Peak-Power-Tracking scheme, System-Design Trade-offs, Turbine Towers and Spacing, Number of Blades, Rotor Upwind or Downwind, Horizontal vs. Vertical Axis. **System Control Requirements**: Speed Control, Rate Control. **Environmental Aspects**: Audible Noise, Electromagnetic Interference (EMI), Effects on Birds.	
Unit –V	**07 Hrs**

Energy storage **Batteries:** Different types of batteries, Equivalent Electrical Circuit, Battery charging, Battery management **Flywheels**: Energy Relations, Components, Benefits over battery **Other Storage devices:** Superconducting magnetic energy storage, Compressed air, Pumped storage hydropower, Hydrogen Energy storage

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concepts of power generation from various renewable sources.
CO2:	Design the Size of the battery required for solar PV applications.
CO3:	Design main components of solar and wind power systems.
CO4:	Execute projects in renewable power generation.

Reference Books	
1	Renewable energy: Technology, Economics and Environment, Martin Kaltschmitt, Wolfgang Streicher Andreas Wiese, Springer Publication, 2007, ISBN 978-3-540-70947-3
2	Solar photo voltaic Technology and systems, Chetan Singh Solanki, 3rd edition (2013), PHI , Learning private limited New Delhi ISBN: 978-81-203-4711-3
3	Wind and solar power system design, Analysis and operation, Mukund R. Patel, 2nd Edition. CRC Group,Taylor and Francis group, New Delhi, ISBN 978-0-8493-1570-1
4	Power System Energy Storage Technologies, Paul Breeze, Academic Press, 2018, ISBN 978-0-12-812902-9

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	2	3	2	-	-	-	-	-	1	-	1
CO2	3	3	2	1	1	2	-	-	-	1	-	1
CO3	3	2	2	2	2	2	2	1	-	1	-	1
CO4	3	3	3	3	2	3	1	1	1	3	1	3

High-3: Medium-2: Low-1

Semester: VII						
MEMS AND APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	**18G7H08**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**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	**09 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	**09 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	**08 Hrs**
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD,PVD-Sputtering, Deposition by Epitaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	
Unit –V	**07 Hrs**
Micro Sensors, Actuators, Systems and Smart Materials: An Overview Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Fibre-optic sensors, Conductometric Gas Sensor, Electrostatic Comb drive, Magnetic Microrelay, Portable blood analyzer, Piezo electric Inkjet Print head, Micromirror array for Video projection, Micro-PCR Systems, Smart materials and systems.	

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	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.
3	Foundations of MEMS, Chang Liu, 2012, Pearson Education Inc., ISBN-13:978-0-13-249736-7.
4	Smart Material Systems and MEMS, Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, 2006, Wiley-INDIA, ISBN-978-81-265-3170-7.

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 50. The marks component for experiential learning is 20.

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

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	1
CO4	3	3	3	3	1	-	-		1	1	1	1

High-3; Medium-2; Low-1

Semester: VII						
PROJECT MANAGEMENT (Group H: Global Elective)						
Course Code	**:**	**18G7H09**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.0 Hours**

Course Learning Objectives: The students will be able to

1	To understand the principles and components of project management.
2	To appreciate the integrated approach to managing projects.
3	To explain different process groups and knowledge areas used to manage project.

Unit-I	**07 Hrs**
Introduction: What is project, what is project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.	
Unit – II	**09 Hrs**
Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle. **Project Integration Management**: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.	
Unit –III	**09 Hrs**
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Project Time Management**: Plan schedule management, define activities, sequence activities, estimate activity resources, estimate activity durations, develop schedule, control schedule.	
Unit –IV	**07 Hrs**
Project Cost management: Project Cost management, estimate cost, determine budget, control costs. **Project Quality management**: Plan quality management, perform quality assurance, control quality.	
Unit –V	**07 Hrs**
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Procure mentManagement**: Project procure ment Management, conductprocurements, control procurements, close procurement.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the concepts, tools and techniques for managing large projects.
CO2:	Explain various knowledge areas and process groups in the project management framework.
CO3:	Analyze and evaluate risks in large and complex project environments.
CO4:	Develop project plans for various types of organizations.

Reference Books	
1	A Guide to the Project Management Body of Knowledge(PMBOK Guide), Project Management Institute, 5th Edition, 2013, ISBN: 978-1-935589-67-9
2	Project Planning Analysis Selection Financing Implementation & Review, Prasanna Chandra, 7th Edition, 2010, Tata McGraw Hill Publication, ISBN 0-07-007793-2.
3	Project Management A System approach to Planning Scheduling & Controlling, Harold Kerzner, 10th Edition, 2009, CBS Publishers and Distributors, ISBN 047027806.

4	Strategic Project Management Made Simple: Practical Tools for Leaders and Teams, Terry Schmidt, 1st Edition, 2009, John Wiley & Sons, ISBN: 978-0470411582

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	1	1	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	-
CO4	2	-	3	-	1	-	-	-	-	-	-	-

High-3: Medium-2: Low-1

Semester: VII						
CYBER FORENSICS AND DIGITAL INVESTIGATIONS (Group H: Global Elective)						
Course Code	**:**	**18G7H10**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	To provide an understanding Computer forensics fundamental 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	**09 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	**08 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	**07 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	**08 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	**07 Hrs**
Cybercrime And Cyber Security: The Legal Perspectives-Introduction, Why Do We Need Cyber laws: 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 completing the course, the students 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 Prakash Tripathi, Ritendra Goyal, 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, 2016, ISBN-13: 978-9333211475

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by the way of Tests (T), Quizzes (Q),) and Experiential Learning (EL). Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. 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 marks component for experiential learning is 20.
Total CIE is 50 (T) +30 (Q) +20 (EL) = 100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	2	-	-	-	-	-	-	3	1	-	-
CO2	1	2	-	2	2	-	-	2	2	3	1	2
CO3	2	3	-	2	2	2	-	2	3	2	-	-
CO4	3	2	3	2	3	1	-	2	3	2	1	1

High-3: Medium-2: Low-1

Semester: VII						
ROBOTICS AND AUTOMATION (Group H: Global Elective)						
Course Code	**:**	**18G7H11**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Understand the concepts of robotics and automation.					
2	Impart the knowledge of robotic programming and robotic operation control					
3	Selection and analysis of robot configuration and kinematics					
4	Importance of automation manufacturing techniques and processing industries					
5	Development of automation system for manufacturing and processing industries					

Unit-I	**06 Hrs**
Introduction - Basics of kinematics, Anatomy of robot, Robot configuration, Robot joints, Sensors and drive system, Control modes, Specification of robots, Robot programming methods.	
Unit – II	**09 Hrs**
Robot Kinematics - Position and orientation of objects, Objects coordinate frame, Rotation matrix, Euler angles roll, pitch and yaw angles coordinate transformations, Joint variables and position of end effector, Homogeneous transformation. **D-H parameters** and conventions, D-H matrix, Direct kinematic and inverse analysis of planar and 3 DoF robots.	
Unit –III	**10 Hrs**
Trajectory planning - Introduction, Path versus trajectory, Joint-space versus Cartesian-space descriptions, Basics of trajectory planning, Joint-space trajectory planning, Third-order and Fifth-order polynomial trajectory planning. **Automation in Production Systems** - Manufacturing support systems, Automation principles and strategies, Levels of Automation, Production Concepts and Mathematical models, Numericals.	
Unit –IV	**08 Hrs**
Machine Vision - Object recognition by features, Basic features used for object identification, Moments, Template matching, Discrete Fourier descriptors, Computed Tomography (CT), Depth measurement with vision systems, Scene analysis versus mapping, Range detection and Depth analysis, Stereo imaging, Scene analysis with shading and sizes, Specialized lighting, Image data compression, Intraframe spatial domain techniques, Interframe coding, Compression techniques, Colour images, Heuristics, Applications of vision systems	
Unit –V	**06 Hrs**
Flexible Manufacturing Systems - Introduction to FMS - concepts, integration in the data processing systems, FMS scheduling. Case studies. Material Handling systems - Conveyors - AGVs – industrial robots in material handling – Automated Storage and retrieval system. Distributed data processing in FMS - Database Management System and their applications in CAD/CAM and FMS – distributed systems in FMS - Integration of CAD and CAM	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the characteristics and working principle of robots.
CO2:	Apply the related mathematical model to formulate the kinematics and trajectory planning of industrial robot.
CO3:	Analyse the machine vision for effective Flexible Manufacturing Systems.
CO4:	Develop model and integrate drives for industrial robots and automation systems.

Reference Books	
1	A Robot Engineering Textbook,Mohsen Shahinpoor, Harper& Row Publishers, 3rd Edition, New York, ISBN:006045931X
2	Introduction to Robotics,John J. Craig, Pearson Education International, 3rd Edition, ISBN:109876543, 1-13-123629-6
3	Automation, Production Systems, and Computer-integrated Manufacturing,Mikell P Groover, Pearson Publishing, 3rd Edition, 2014, ISBN 978 81 203 3418 2
4	Flexible Manufacturing Systems in Practice Design: Analysis and Simulation,Joseph Talavage CRC Press, 1987, ISBN 9780824777180

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	-	-	2	-	2
CO2	3	3	1	3	1	1	-	-	-	2	-	2
CO3	2	-	2	-	1	1	-	-	2	-	-	2
CO4	3	3	2	3	1	1	-	2	3	-	3	2

High-3: Medium-2: Low-1

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS (GROUP H: GLOBAL ELECTIVE)						
Course Code	**:**	**18G7H12**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3 : 0 : 0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Define the earth environment and its behaviour, launching vehicles for satellites and its associated concepts.
2	Analyse 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	**08 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, Classification of satellites. **Satellite structure:**Satellite Communications, Transponders, Satellite antennas.	
UNIT-III	**08 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	**08 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	**08Hrs**
Space Missions: 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, Routledgepublications, 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 the way of Tests (T), Quizzes (Q) and Experiential Learning (EL). Three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. 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 marks component for experiential learning is 20.
Total CIE is 50 (T) +30 (Q) +20 (EL) = 100 Marks.

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

SEE for 100 marksis 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	-
CO2	2	2	1	1	-	-	-	-	-	-	1	-
CO3	2	2	1	-	-	-	-	-	-	-	1	-
CO4	2	2	1	-	-	-	-	-	-	-	1	-

High-3: Medium-2: Low-1

Semester: VII						
INTRODUCTION TO ASTROPHYSICS (Group H: Global Elective)						
Course Code	**:**	**18G7H13**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Familiarize with the various celestial bodies and the laws governing their behavior					
2	Understand the fundamental concepts of relativity and establish the relation between light and matter					
3	Study the methods used to identify and investigate the nature of different stellar bodies					
4	Determine the characteristic features of any star by understanding its spectral properties					
5	Contemplate the complex system of the milky way galaxy and its components					

Unit-I	**07 Hrs**
Fundamental concepts in Astronomy: Origin of the Universe, Major constituents of the universe, Cosmic Microwave Radiation (CMR) background, Geocentric Universe, Retrograde Motion of planets, Brief introduction to the Copernican Revolution, Positions of the Celestial Sphere: Altitude-Azimuth Coordinate System, Equatorial Coordinate System, Solar System, Planets - laws of motion of planets, inner planets, outer planets,	
Unit – II	**08 Hrs**
Theory of Special Relativity: Galilean Transformations, Failure of Galilean Transformations, Lorentz Transformations, Derivation, Time & Space in Special Relativity, Momentum & Energy in Relativity, Doppler Effect for light (Red & Blue Shift), The equivalence principle, the principle of minimal gravitational coupling, Schwarzschild spacetime, Past-Present-Future (Light Cone diagram).	
Unit –III	**08 Hrs**
Stellar Astrophysics: Blackbody radiation, Connection between Color and Temperature, Stellar Parallax, Magnitude Scale, Life cycle of stars (Birth, Life & Death), Hertzsprung-Russel Diagram, Classification of Binary Stars, Mass Determination using Visual Binaries, Eclipsing Spectroscopic Binaries, Formation of Spectral Lines, Schrodinger's time-dependent and independent equations, Boltzmann-Saha Equation, Chandrashekar's Limit, black holes (qualitatively).	
Unit –IV	**08 Hrs**
Light and Matter: Dispersion of light (Prism & Grating), Spectral Lines, de-Broglie's Wavelength and Frequency, Heisenberg's Uncertainty Principle, Broadening of Spectral lines **Spectral Characterization of Stars:** Description of the Radiation Field, Stellar Opacity, Transfer Equation, Profile of Spectral Lines, Optical Telescopes, Radio Telescopes (Case Studies)	
Unit –V	**08 Hrs**
Galaxy Astronomy: The Milky way Galaxy, Counting the Stars, Historical Models, Differential & Integrated Star Counts, Extrasolar planets, Methods of detection of extrasolar planets, Distance to the Galactic Centre, Galactic Coordinate System, Classification of Galaxies, Introduction to Elliptical galaxies, Irregular galaxies, Dwarf galaxies.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Contemplate the nature of our universe by identifying and studying the behavior of celestial bodies.
CO2:	Explain the usefulness of the theory of relativity, light and matter in establishing the fundamental behavior of stellar bodies.
CO3:	Utilize various techniques to discover the components of our universe and conclude their celestial properties.
CO4:	Interpret the spectral properties of any astronomical body to illustrate its properties.Inspect the milky way galaxy to identify the proponents and their characteristic features.

Reference Books	
1	Carroll Bradley W, and Dale A Ostlie, An Introduction to Modern Astrophysics. Reading, 2nd Edition, 1995, MA: Addison-Wesley Pub, ISBN: 9780201547306.
2	Padmanabhan, T, Theoretical Astrophysics, Vols.1-3, 2005, Cambridge University Press, ISBN-9780521016278.
3	Shu F, The Physical Universe, New Edition, 1982, University of California, ISBN- 978-0935702057.
4	Harwit M, Astrophysical Concepts, 3rd Edition, 2000, Springer-verlag, ISBN- 978-0387949437.
5	Shapiro, Stuart L, and Saul A Teukolsky, Black Holes, White Dwarfs, and Neutron Stars, 1st Edition, 1983, Wiley, ISBN: 9780471873167.

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 50. The marks component for Assignment/Presentation/Project 20.
Total CIE is 30(Q) +50(T) +20(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	1	2	-	-	1	-	1	-	-	2
CO2	3	2	2	2	-	-	1	-	1	-	-	2
CO3	2	3	1	2	2	1	1	-	2	1	-	2
CO4	3	3	1	2	2	1	2	-	3	3	-	2

High-3, Medium-2, Low-1

Semester: VII						
MATERIALS FOR ADVANCED TECHNOLOGY AND SPECTROSCOPIC CHARACTERIZATION (Group H: Global Elective)						
Course Code	**:**	**18G7H14**		**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	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, molybdate orange, 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, biopolymers & biodegradable polymers. **Packaging materials:** Food products: Cellulosic and Polymeric packaging materials and their properties – including barrier properties, strength properties, optical properties. Glass, aluminum, tin, paper, plastics, composites. Pharmaceutical products: Injectables and tablet packaging materials.	
Unit – II	**08 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-cation and anion exchange resins, examples, 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-anion and cation exchange membranes. Classification of ion exchange membranes based on connection way between charged groups and polymeric matrix-homogeneous and heterogeneous ion exchange membranes, examples. 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, 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. Application of NMR in magnetic resonance imaging (MRI).

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 by G.K.Narula, K.S.Narula&V.K.Gupta. 38thEdtion, Tata McGraw-Hill Publishing Company Limited-2015, ISBN: 9780074517963
2	Solar Lighting by Ramachandra Pode and Boucar Diouf, Springer e-book, 2011, ISBN: 978-1-4471-2133-6 (Print) 978-1-4471-2134-3 (Online).
3	Spectroscopy of organic compounds by P.S.Kalsi, New Age International (P) ltd, Publisher, 2005, ISBN 13: 9788122415438
4	Food Packaging Materials. Mahadeviah M &Gowramma RV, Tata McGraw Hill Publishing Company Limited, 1996, ISBN :0074622382 9780074622384.

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	2	2	-	-	1	-	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	1	1	-	-	-	-	1

High-3: Medium-2: Low-1

Semester: VII						
APPLIED PSYCHOLOGY FOR ENGINEERS **(Group H: Global Elective)**						
Course Code	**:**	**18G7H15**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**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	**07 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	**09 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	**09 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 sBurnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stressthreshold,perceivedcontrol	
Unit –IV	**07 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	**07 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.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.
CO2:	Define learning and compare 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.

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	OrganisationalBehaviour: Human Behaviour at Work, JohnW.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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						
ADVANCED COURSE IN ENTREPRENEURSHIP (Group H: Global Elective)						
Course Code	**:**	**18G7H16**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Acquire additional knowledge and skills for developing early customer traction into a repeatable business.
2	Learn the tools and methods for achieving sustainable growth, such as by refining their product or service and business models, building brand strategy, making a sales and financial plan
3	Develop brand strategy and create digital presence, Develop channel strategy for customer outreach.
4	Leverage social media to reach new customers cost effectively, Develop strategies to increase revenues and expand markets

Unit-I	**07 Hrs**
Intro to building Products & Value Proposition: Diagnose: Where are you today on the Product Life Cycle? Assess your Start-up's attractiveness **Competition & testing**: Conduct a Competition Analysis Identify your Competitive Advantage	
Unit – II	**06 Hrs**
Market Validation: Market validation, Customer Usability Interviews, Analyzing Customer feedback **Delivering Value:** Enlist marketing channels, Identify partners for your venture, Create a Sales plan	
Unit –III	**07 Hrs**
Customer acquisition & growth channels: Types of Marketing Channels: TargetingBlogs, UnconventionalPR, Search EngineMarketing, Search EngineOptimization, Social ads,displayadsandexistingplatforms, EmailMarketing, ViralMarketing, Affiliateprograms, Magazines,Newspaper,RadioandTVads, OfflineAds, TradeShows	
Unit –IV	**10 Hrs**
Business model: ReiterateandRefineyourBusinessModelCanvas, Choosetherightbusinessmodelforyourstart-up **Financial Planning:** Forecastingsalesandrevenueprojections, Cash-flowstatement	
Unit –V	**09 Hrs**
Pitching: Create your funding plan, Build your pitch deck and compose your pitch. **Experiential Learning:** Studentteams will present their practice ventures: business model, business plan, growth achieved, and key learnings to their classmates, faculty, and other entrepreneurs	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Develop strategies to increase revenues and expand markets, Explore licensing and franchising for business expansion.
CO2:	Leverage technologies and platforms for growth stage companies, Develop key metrics to track progress.
CO3:	Basics of registering a company, Understanding business regulations and compliances.
CO4:	Advanced concepts of business finance, Financial planning.

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

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of tests (T) and Milestones (M). A minimum of four milestone submission have to be submitted and first three milestones (M1, M2, M3) are evaluated for 10 marks adding up to 30 marks and the final milestone (M4) is evaluated for 20 marks. All milestone submissions are online and as per format and portal prescribed by Wadhwani foundations. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(M1, M2 and M3) +50(T) +20(M4) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis 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 VIII						
MAJOR PROJECT						
Course Code	**:**	**18ECP81**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**0:0:16**		**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 program or any other program.
- 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.**

Students can select courses in ***NPTEL*** from the discipline of ***Humanities and Social Sciences, Management, Multidisciplinary and Design Engineering.*** The course chosen could be either of ***4w/8w/12w*** duration. The students need to enrol for a course, register for the exam and submit the e-certificate to the department, as and when it is released by NPTEL. ***The same will be considered as one of the components during project evaluation of phase 2 and phase 5.***

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:	
1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.
2	Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.
3	Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.
4	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%

Calendar of Events for the Project Work:

Week	Event
Beginning of 7th Semester	Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment

II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	First visit of the internal guides to industry (In case of project being carried out in industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Submission of draft copy of the project report
XI and XII Week	Second visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

Evaluation Scheme for CIE and SEE

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