RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

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

TELECOMMUNICATION 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
TELECOMMUNICATION ENGINEERING

Department Vision

Imparting quality education in Electronics and Telecommunication Engineering through focus on fundamentals, research and innovation for sustainable development

Department Mission

- Provide comprehensive education that prepares students to contribute effectively to the profession and society in the field of Telecommunication.
- Create state-of-the–art infrastructure to integrate a culture of research with a focus on Telecommunication Engineering Education
- Encourage students to be innovators to meet local and global needs with ethical practice
- Create an environment for faculty to carry out research and contribute in their field of specialization, leading to Centre of Excellence with focus on affordable innovation.
- Establish a strong and wide base linkage with industries, R&D organization and academic Institutions.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO	Description
PEO1	Acquire appropriate knowledge of the fundamentals of basic sciences, mathematics, engineering sciences, Electronics & Telecommunication engineering so as to adapt to rapidly changing technology
PEO2	Think critically to analyze, evaluate, design and solve complex technical and managerial problems through research and innovation.
PEO3	Function and communicate effectively demonstrating team spirit, ethics, respectful and professional behavior.
PEO4	To face challenges through lifelong learning for global acceptance.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Analyze, design and implement emerging Telecommunications systems using devices, sub-systems, propagation models, networking of Wireless and Wire line communication systems.
PSO2	Exhibit Technical skills necessary to choose careers in the design, installation, testing, management and operation of Telecommunication systems.

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.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics

INDEX

VII Semester			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	18HS71	Constitution of India and Professional Ethics	1
2.	18TE72	Wireless Communication	3
3.	18TE73	Optical Fiber Communication	6
4.	18TE74	Internship (6 weeks)	9
5.	18TE7FX	Group F: Professional Electives	11-21
6.	18TE7GX	Group G: Professional Electives	22-31
7.	18G7HXX	Group H: Global Electives	32-64

VIIISemester			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	18TEP81	Major Project	65

VII Semester			
PROFESSIONAL ELECTIVES (GROUP F)			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	18TE7F1	Application Specific Integrated Circuits	11
2.	18TE7F2	MIMO systems	13
3.	18TE7F3	Deep Learning and Artificial Intelligence	15
4.	18TE7F4	Wireless Networks and Standards	18
5.	18TE7F5	RF Circuits and Systems	20

VII Semester			
PROFESSIONAL ELECTIVES (GROUP G)			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	18TE7G1	5G Mobile Networks	22
2.	18TE7G2	Multimedia communication	24
3.	18TE7G3	Cryptography and Network Security	26
4.	18TE7G4	Satellite and Navigation Systems	28
5.	18TE7G5	Wireless Sensor Networks	30

VII Semester				
OPEN ELECTIVES (GROUP H)				
Sl. No.	**Course Code**	**Host**	**Course Title**	**Page No.**
1.	18G7H01	AS	Unmanned Aerial Vehicles	32
2.	18G7H02	BT	Bioinformatics	34
3.	18G7H03	CH	Industrial Safety and Risk Management	36
4.	18G7H04	CS	Web Programming	38
5.	18G7H05	CV	Solid Waste Management and Statutory Rules	40
6.	18G7H06	EC	Image Processing and Machine Learning	42
7.	18G7H07	EE	Renewable Energy Sources and Storage System	44
8.	18G7H08	EI	MEMS& Applications	46
9.	18G7H09	IM	Project Management	48
10.	18G7H10	IS	Cyber Forensics and Digital Investigations	50
11.	18G7H11	ME	Robotics and Automation	52
12.	18G7H12	TE	Space Technology and Applications	54
13.	18G7H13	PY	Introduction to Astrophysics	56
14.	18G7H14	CY	Materials for Advanced Technology and Spectroscopic Characterization	58
15.	18G7H15	HSS	Applied Psychology for Engineers	61
16.	18G7H16	HSS	Advanced Course in Entrepreneurship	63

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

TELECOMMUNICATION ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18HSC71	Constitution of India & Professional Ethics	HSS	3	0	0	3
2.	18TE72	Wireless Communication	TE	3	1	1	5
3.	18TE73	Optical Fiber Communication	TE	3	0	1	4
4.	18TE74	Internship *	TE	0	0	2	2
5.	18TE7FX	Elective F (PE)	TE	3	0	0	3
6.	18TE7GX	Elective G (PE)	TE	3	0	0	3
7.	18G7HXX	Elective H (GE)**	Res. BoS	3	0	0	3
Total Number of Credits				**18**	**1**	**4**	**23**
Total number of Hours/Week				**18**	**2**	**10**	

Note: * Internship (6 weeks) is to be carried during the vacation after 6th semester and evaluation shall be conducted during 7th semester for 2 credits.

** Students should take other department Global Elective courses.

EIGHTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18TEP81	Major Project	TE	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**
6.	18TE7F1	Application Specific Integrated Circuits	3
7.	18TE7F2	MIMO systems	3
8.	18TE7F3	Deep Learning and Artificial Intelligence	3
9.	18TE7F4	Wireless Networks and Standards	3
10.	18TE7F5	RF Circuits and Systems	3

VII Semester			
PROFESSIONAL ELECTIVES (GROUP G)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	18TE7G1	5G Mobile Networks	3
2.	18TE7G2	Multimedia communication	3
3.	18TE7G3	Cryptography and Network Security	3
4.	18TE7G4	Satellite and Navigation Systems	3
5.	18TE7G5	Wireless Sensor Networks	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 and Machine Learning	3
7	EE	18G7H07	Renewable Energy Sources and Storage System	3
8	EI	18G7H08	Mems & 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 (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 ofIndian Constitution ,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	**06 Hrs**
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	**06 Hrs**
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	**07 Hrs**
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 edition
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 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3: Medium-2 : Low-1

Semester: VII						
WIRELESS COMMUNICATION (Theory & Practice)						
Course Code	**:**	**18TE72**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:1:1**		**SEE**	**:**	**100+50 Marks**
Hrs/week	**:**	**40L+26T+33P**		**SEE Duration**	**:**	**3.00+3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Describe cellular concepts, fading, Wireless Network and standards.					
2	Analyze the concepts of propagation model and differentiate different Wireless networks.					
3	To understand the concept of fading, equalisation & diversity techniques					
4	Demonstrate path loss models and wireless networks for various applications.					
5	Analyze the architectures of 4G technologies.					

UNIT-I	**07 Hrs**
Cellular concept: Introduction Frequency reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving coverage and capacity in cellular systems-Cell splitting & Cell Sectoring, Problems.	
UNIT-II	**09 Hrs**
Propagation models for Large scale: Introduction to radio wave Propagation, Free Space Propagation Model, Relating Power to Electric field, The Three basic propagation Mechanisms, Reflection, Diffraction, Scattering, Practical link budget design using path loss models, Outdoor Propagation models: Okumura, Hata, Indoor Propagation models, problems. **Small scale fading:** Small scale fading Multipath Propagation, Impulse response model of a multipath channel, Small scale multipath measurements, problems.	
UNIT-III	**09Hrs**
Parameters of Mobile Multipath Channels, Types of Small scale fading, Rayleign & Ricean distributions, Examples of fading behaviour, Problems. **Equalisation techniques:** Introduction, Fundamentals of equalisation, Training a generic adaptive equaliser, Equaliser in communication receiver, Linear equaliser, problems.	
UNIT-IV	**07Hrs**
Nonlinear Equalisation, Algorithms for adaptive equalisation. **Diversity techniques:** Introduction, Derivation of Selection Diversity Improvement, Derivation of Maximal ratio combining, Practical space diversity considerations, Polarisation diversity, frequency diversity, Time diversity, Rake receiver, Interleaving, problems.	
UNIT-V	**08 Hrs**
4G LTE: Introduction, History of mobile telecommunication systems, Need for LTE, From UMTS to LTE and From LTE to LTE - advanced, The 3GPP specifications for LTE, Architecture of LTE. **Communication protocols:** Protocol model, Air interface transport protocols, Fixed network transport protocols, User plane protocols, Signalling protocols, Data transport, Bearer Management, State diagram, Spectrum allocation.	

Laboratory Experiments
1.Simulation of Okumura path loss model using MATLab simulation. 2. Realization of the HATA model using MATLab. 3. Realization of Indoor propagation model using MATLab. 4. Realisation of ZFE technique using Matlab. 5. Realisation of MRC technique using Matlab 5. Demonstrate operation of BPSK, QPSK & QAM modulation using **VSA/system vieu.** 6. Configure a WiMax N/W, UMTS N/W, wireless sensor networks, 2G network, VoIP using **Qualnet**.

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain cellular concepts, fading, equalisation& diversity techniques.
CO2	Analyze path loss models, fading types and equalisation & diversity techniques.
CO3	To implement various improvement techniques with respect to performance & user access.
CO4	Discuss the requirements of 4G, architecture & communication protocols.
Reference Books	
1	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4.
2	Wireless and Mobile Networks Concepts and Protocols, Dr. Sunil Kumar S Manvi, 2010 Edition, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3	An Introduction to LTE:LTE, LTE- advanced, Sae and 4G mobile Communications, Christopher Cox, 1st Edition, 2012, John Wiley & Sons Ltd., ISBN: 978-1-119-97038-5.
4	Wireless Communication, T L Singal, 3rd Edition, 2011, McGraw Hill, ISBN: 9780070681781.

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.

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

High-3: Medium-2: Low-1

Semester: VII						
OPTICAL FIBER COMMUNICATION (Theory & Practice)						
Course Code	**:**	**18TE73**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100Marks**
Total Hours	**:**	**39L+33P**		**SEE Duration**	**:**	**03Hrs**
Course Learning Objectives: The students will be able to						
1	Understand the overview and generations of Optical communication & Networks.					
2	Design analog and digital link and their characterization					
3	Analyze WDM concepts, components and their selection					
4	Analyze network standards such as SONET/SDH & topologies.					

UNIT-I	**08Hrs**
Overview of Optical Fiber Communications: Motivations for Light wave Communications, Optical Spectral Bands, Fundamental Data Communication Concepts, Network Information Rates, Key elements of Optical Fiber Systems. **Optical Fibers: Structures, Wave guiding:** The Nature of Light, Basic Optical Laws and Definitions, Optical Fiber Modes and Configurations, Single-mode Fibers, Graded-index Fiber Structure**.**	
UNIT-II	**08 Hrs**
Signal Degradation in Optical Fibers: Attenuation, Signal Distortion in Fibers: Intermodal dispersion, Group delay, Material dispersion, Waveguide dispersion, Polarization Mode Dispersion, Signal distortion Single Mode Fibers, Characteristics of Single-Mode Fibers. **Optical Sources:** Light-Emitting Diodes (LEDs), Laser Diodes, Line Coding.	
UNIT-III	**09Hrs**
Power Launching and Coupling: Source-to-Fiber Power Launching, Lensing Schemes for Coupling Improvement, Fiber-to-Fiber Joints, LED Coupling to Single-Mode Fibers, Fiber Splicing, Optical Fiber Connectors: Connector Types **Photo detectors:** Physical Principles of Photodiodes, Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise, Structures for InGaAs APDs	
UNIT-IV	**07 Hrs**
Optical Receiver Operation: Fundamental Receiver Operation, Front End Amplifiers, Digital Receiver Performance, Eye Diagrams, Burst-Mode Receivers, Analog Receivers**.** **Analog Links &**Overview of Analog Links, Carrier-to-Noise Ratio, Multichannel Transmission Techniques.	
UNIT-V	**07 Hrs**
Digital Links: Point-to-Point Links, Coherent Detection, Optical Link Design: Link power budget analysis, Rise time budget analysis, Power Penalties. **WDM Concepts:** Overview of WDM**:** Operational principles of WDM, WDM Standards, SONET/SDH : Transmission Formats & Speeds, SONET/SDH Rings, SONET/SDH Networks.	

Laboratory Experiments	
• Attenuation, bending losses and Numerical Aperture of optical fiber. • Characterization of an optical source and optical detector. • Characterization of analog link, digital link and BER measurement. • Realization of voice link and TDM. • Simulation of WDM system using Optisystem. • Link power budget analysis using Optisystem.	
Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the characterization of fibers, optical sources, detectors & their selection
CO2	Apply the design methodology for analog& digital optical links
CO3	Analyze the concepts of WDM in optical networks with standards.
CO4	Evaluate the selection of network topology and network standards.

Reference Books	
1	Optical Fiber Communication, Gerd Keiser, 5th Edition, 2009, Tata MGH, ISBN: 0-07-064810-7.
2	Optical Fiber Communication, John M Senior PHI, 2nd Edition, 2009, ISBN-0324359810.
3	Fiber Optics Communication Systems, G.P. Agarwal, 3rd Edition, 2004, John Wiley New York, ISBN: 9-8141-2660-8.

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.

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 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.

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

High-3: Medium-2: Low-1

Semester: VII						
INTERNSHIP						
Course Code	**:**	**18TE74**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
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 completing the course, the students 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						
APPLICATION SPECIFIC INTEGRATED CIRCUITS (GROUP F: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7F1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hrs/Week	**:**	**40 Hrs**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	Explain ASIC methodologies and programmable logic cells to implement a function.
2	Analyse datapath elements and physical design flow, including partitioning, floor-planning, placement, and routing.
3	Develop using CAD algorithms and to apply these concepts in ASIC design.
4	Evaluate various design alternatives and make comparative study.

Unit-I	**08 Hrs**
Introduction to ASICs, Full-custom, Standard-cell based, Gate-array based, and Programmable ASICs, ASIC Design flow, ASIC cell Libraries. **Datapath Logic Cells:** Data Path Elements, Adders: RCA, Carry save, Carry bypass, and Brent-Kung.	
Unit – II	**09 Hrs**
Datapath Logic Cells: Adders: Carry select and Conditional sum adder. Multiplier (Booth encoding). **ASIC Library Design:** Logical effort: Cell delay, Logical effort of Inverter, NAND and NOR gates, Predicting delay, Logical paths, Logical area and logical efficiency, Multi-stage cells, Optimum delay, and Optimum number of stages.	
Unit –III	**09 Hrs**
Programmable ASIC Logic Cells: Actel ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Timing model and critical path for ACT 2 and ACT 3 Logic Modules. Xilinx LCA: XC3000 CLB, Altera: FLEX architecture and MAX architecture. **Programmable ASIC I/O Cells:** Xilinx XC4000 IOB, Altera IOC and Altera IOB. Schematic entry for ASICs, Hierarchical design with an example, Net-list screener.	
Unit –IV	**07 Hrs**
ASIC Construction-I: Physical Design, CAD Tools. **Partitioning:** Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement: KL, FM and Look-ahead algorithms. **Floor planning:** Goals and objectives, Floor planning tools, Channel definition.	
Unit –V	**07 Hrs**
ASIC Construction-II: Placement: Goals and objectives, Min-cut Placement algorithm, Iterative Placement Improvement algorithms, Physical Design flow. **Global Routing:** Goals and objectives, Global Routing Methods, Back-annotation. **Detailed Routing:** Goals and objectives, Measurement of Channel Density, Left-Edge and Area-Routing Algorithms, Design checks.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the concepts of ASIC design methodology, data path elements, FPGA architectures and goals and objectives of Physical design.
CO2	Analyse the design of FPGAs and ASICs suitable for specific tasks, perform design entry and explain the physical design flow.
CO3	Design data path elements for ASIC cell libraries and compute optimum path delay.
CO4	Evaluate CAD algorithms for system partitioning, floorplan, placement and routing.

Reference Books	
1	Application Specific Integrated Circuits, Michael John Sebastian Smith, 1st Edition, 1997, Addison-Wesley Professional, ISBN: 0-201-50022-1.
2	CMOS VLSI Design: A Circuits and Systems Perspective, Neil H.E. Weste, David Harris, and Ayan Banerjee, 3rd Edition, 2006, Pearson education, ISBN: 108177585681.
3	VLSI Design: A Practical Guide for FPGA and ASIC Implementations, VikramArkalgudChandrasetty, 2011, Springer, ISBN: 978-1-4614-1119-2.

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

High-3: Medium-2: Low-1

Semester: VI						
MIMO SYSTEMS (GROUP F: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7F2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	To appreciate the need to learn AWGN channel behavior, signal detection, filtering and noise equalization.
2	To differentiate and compare different modulation and multiplexing techniques in Wireless communication.
3	To learn different coding techniques and design of universal coding.
4	To analyze fast, slow fading, receiver architecture and diversity techniques.
5	To design a MIMO system for wireless communication based applications.

Unit-I	**08 Hrs**
Channel Models: Introduction to channel modeling, Representation of discrete channel by filters, Stochastic/Statistical channel modeling considerations, Rayleigh, Rician&Nakagami fading models, Diversity techniques, Diversity combining techniques & Equalization techniques.	
Unit – II	**10 Hrs**
Wideband modulation techniques: Principles of Orthogonality, Single Vs Multicarrier systems, OFDM block diagram, Mathematical representation, Selection parameters for modulation, Pulse shaping and spectral efficiency, Synchronization in OFDM, Pilot Insertion in OFDM, Transmission and channel estimation, Amplitude limitation, FFT selection point constraints, Hybrid OFDM and other variants of OFDM.	
Unit –III	**08 Hrs**
Multiplexing and Multiple user access techniques: Introduction, Fixed Assignment type of multiple access schemes, Multiple access for packet radio system (Random access), Reservation-Based multiple access schemes. **Broadcast Networks:** Introduction, DAB, DRM,HD radio technology, DVB, DTH.	
Unit –IV	**07 Hrs**
MIMO systems: Introduction, Space diversity & systems based on space diversity, Architecture, MIMO exploits multipath, Space-time processing, MIMO channel modeling, measurements & capacity, Space-Time coding, Advantages & Applications of MIMO, MIMO-OFDM.	
Unit –V	**07 Hrs**
Massive MIMO: Massive multiple-input multiple-output (MIMO) systems: Introduction, Theoretical background, Pilot design for massive MIMO, Resource allocation and transceiver algorithms for massive MIMO, Fundamentals of baseband and RF implementations in massive MIMO, Channel models.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain AWGN channel behavior, signal detection, filtering and describe noise equalization.
CO2	Design and evaluate OFDM MIMO system for wireless communication based applications.
CO3	Compare and Apply the knowledge of channel behavior and use effectively multiplexing, modulation, bandwidth utilization, transmission rate and access in various Wireless applications.
CO4	Demonstrate the different coding techniques and explain diversity techniques.

Reference Books	
1	Wireless Communication, UpenaDalal, 1st Edition , 2010, Oxford higher Education, ISBN: 13:978-0-19-806066-6.
2	5G Mobile and Wireless Communication Technology, AfifOsseran, Jose F Monserrat, Patrick Marsch, Cambridge University Press, 2016.
3	Fundamentals of Wireless Communication, David Tse, 2005, Cambridge University Press, , ISBN: 0-521-68749-7.
4	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN: 97881-317-3186-4.
5	Wireless Communication, T L Singal, 6th Edition, 2013, McGraw hill education private limited, ISBN: 978-0-07-068178-1.

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

High-3: Medium-2: Low-1

Semester: VII						
Deep Learning and Artificial Intelligence (GROUP F: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7F3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to

1	Understand the basic deep learning tasks and building blocks of neural networks
2	Know the basics of CNN, RNN, auto encoders and apply in real-time applications.
3	Understand the working of reinforcement learning and its usage in real word
4	Understand the importance, features and usage of deep learning frameworks for various applications.

Unit-I	**06 Hrs**
Fundamentals of Deep Learning and Neural Networks: The neural networks,Building Intelligent Machines, Limits of Traditional Computer Programs, Mechanics of Machine Learning, Neuron, Expressing Linear Perceptrons as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, Softmax Output Layers. **Training Feed-Forward Neural Networks:** The Fast-Food Problem, Gradient Descent, Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, Backpropagation Algorithm, Stochastic and Minibatch Gradient Descent, Test Sets, Validation Sets, Overfitting, Preventing Overfitting in Deep Neural Networks.	
Unit-II	**10 Hrs**
Implementing Neural Networks in TensorFlow: Introduction to TensorFlow, How does TensorFlow compare to alternatives, installing TensorFlow, creating and manipulating TensorFlow variables, TensorFlow operations, placeholder tensor, sessions in TensorFlow, Navigating variable scopes and sharing variables, Managing models over the CPU and GPU. Leveraging Tensor board to visualize computation graphs and learning. **Beyond Gradient Descent:** Challenges with gradient descent, Local minima in the error surfaces of deep networks, Model Identifiability, spurious local minima in deep networks, Flat regions in error surface, gradient points in the wrong direction, Momentum based optimization, second order methods, Learning rate Adaptation (AdaGrad, RMSProp, Adam) **Multilayer Perceptron:** single layer perceptron, multilayer perceptron, Linear regression in TensorFlow, Logistic regression Model, multilayer perceptron in TensorFlow**.**	
Unit –III	**10 Hrs**

Convolutional Neural Networks (CNN): Introduction to CNN, Components of CNN: Convolution layer, Pooling layer, Flattening layer, Fully connected layer, ReLU layer, Exponential linear unit, Properties of CNN, Architectures of CNN-LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, DenseNet, Applications of CNN.

Recurrent Neural Networks (RNN): Introduction to RNN, Training of RNN, Back propagation through time (BPTT) illustration, RNN Topology, Challenges with Vanishing gradients, Bidirectional RNNs, Long Short term Memory (LSTM), Gated Recurrent unit (GRU), Deep Recurrent Neural Networks, Applications of RNN.

Auto Encoders: Introduction to auto encoders Features of auto encoders, Types of Auto encoders, Vanilla auto encoder, Multilayer auto encoder, stacked auto encoder, Deep Auto encoder, denoisingautoencoder, convolutional autoencoder, Regularization in autoencoder (regularized autoencoder). Applications of Auto encoders.

Unit –IV	**06 Hrs**

Memory Augmented Neural Networks: Neural Turing Machines (NTM), Attention based memory access, NTM memory addressing mechanisms, Differentiable Neural Computers(DNC), Interference-Free writing in DNCs, DNC memory Reuse, Temporal Linking of DNC Writes, DNC Read Head, DNC controller network, Visualizing DNC in action.

Deep Reinforcement Learning: Introduction, Deep Reinforcement Learning Masters Atari Games, Markov Decision Processes (MDP), Explore Versus Exploit, Policy Versus Value Learning.

Unit –V	**08 Hrs**

Open source framework for Deep Learning: Deep learning with python, scientific python (SciPy, NumPy, Matplotlib, Pandas), Frameworks (Tensorflow, Keras, PyTorch), Hardware support for deep Learning (CPU, GPU, VPU, NCS, TPU).

Applications of Deep learning and AI: Role of AI in Telecommunication and ITU standards, Visual recognition, Self Driving cars, Language Translations, Machine Translation, Game Playing, Entertainment, Health care, Applications of AI in wireless communication.

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the concepts of deep learning and Artificial intelligence
CO2	Analyze, Design and apply neural networks in real-time applications.
CO3	Analyze the role of un supervised deep learning architectures and its usage in real world.
CO4	Analyze the open source frameworks, Hardware support and challenges of AI in various applications.

Reference Books	
1	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithmsm,Nikhil Buduma,1st Edition,O'Reilly Media Inc, USA, 2017, ISBN: 978-1-491-92561-4.
2	Deep Learning with Applications Using Python,Navin Kumar Manaswi1st Edition, 2018, APress, Springer Science Business Media New York, ISBN:978-1-4842-3516-4.
3	Deep Learning using Python,Lovelyn Rose, L Ashok Kumar, 2020, Wiley, ISBN: 9788126579914.
4	Deep Learning,Goodfellow, Y, Bengio, A. Courville, 2016, MIT Press.
5	Neural Networks and Learning Machines,S. Haykin,3rd Edition, 2008, Pearson,ISBN-10: 0-13-147139-2.
6	Artificial Intelligence in Wireless Communications, CharlesBostian, Thomas Rondeau Artech House Publishers, Unabridged edition, 2009, ISBN: 0415012287.

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

High-3: Medium-2: Low-1

Semester: VII						
WIRELESS NETWORKS AND STANDARDS (GROUP F: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7F4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand wireless networks & to know the access technologies used in wireless networks.
2	Analyse the architecture & protocols of various standards.
3	Compare the concepts of WBAN, WPAN, WLAN and WMAN standards and their Architecture.
4	Apply the various standards for different applications.

UNIT-I	**08 Hrs**
Basics of Wireless Networks: Wireless Network architecture, Wireless Communication Problems, Wireless Network reference model, Wireless Networking issues, Wireless Networking standards. **Wireless Body area Network:** Network Architecture, Network Components, Design issues, Network Protocols, WBAN Applications, Problems.	
UNIT-II	**08 Hrs**
Wireless Personal Area Networks: WPAN and its Network architecture, WPAN components, WPAN technologies and protocols: IEEE 802.15.1, IEEE 802.15.2, IEEE 802.15.3, IEEE 802.15.4, WPAN Applications, Problems. **Wireless local Area networks:** Network components, Design requirements of WLAN, Network Architecture.	
UNIT-III	**08 Hrs**
WLAN Standards, WLAN protocols, IEEE 802.11p, WLAN Applications, Problems. **Wireless Metropolitan Area Networks:** IEEE 802.16 standards, advantages, IEEE 802.11 Vs IEEE 802.16, WMAN Network architecture, Network protocols, WMAN Applications, Problems.	
UNIT-IV	**08 Hrs**
Wireless Ad Hoc Networks: Introduction, Features, Advantages, Applications,Ad Hoc Networks Vs Cellular Networks, Mobile Ad Hoc networks-Network Architecture, Protocols, Technologies, Applications. **Vehicular Ad Hoc Networks (VANETS):** Network architecture, Protocols, Technologies, Applications, Problems.	
UNIT-V	**08 Hrs**
Research issues in Wireless Networks: Radio Resource Management,Routing, Addressing, Network access control, Mobility control, Flow control, QoS management, Power management, Simulation Modeling.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the concepts of wireless networks & access technologies used in wireless networks
CO2	Analyze and Compare the architectures of various Wireless technologies and standards
CO3	Apply the WBAN, WPAN, WLAN and WMAN standards for a given network application
CO4	Evaluate the performance of various wireless network standards.

Reference Books	
1	Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar SManvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
2	Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1
3	Wireless Communication, UpenaDalal, 1st Edition , 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.

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

High-3: Medium-2: Low-1

Semester: VII						
RF CIRCUITS AND SYSTEMS (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7F5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to

1	Understand the basics of RF components and circuits.
2	Analyze the RF circuits using S-parameters and Smith charts.
3	Design the RF Passive and active circuits.
4	Evaluate the performance of designed RF circuits.
5	esign RF circuits using EDA tools.

Unit-I	**07 Hrs**
Introduction: Review: Formulation and properties of S-parameters, Smith chart Concepts, Type, Applications of Smith chart. Radio frequency and Microwave circuit applications, Radio frequency waves, RF and Microwave circuit design considerations, Introduction to component basics, RF behavior of Resistors, Capacitors and Inductors, Microstripline, Impedance transformation, RF impedance matching by Resonance method.	
Unit – II	**08 Hrs**
Impedance Matching networks: Goal of impedance matching, Components for matching, Design of Matching Networks - Matching network design using Lumped elements- RC, RL circuits, Design of Matching Networks using Distributed Elements- Transmission lines, Microstrip lines, Stubs.	
Unit –III	**08 Hrs**
Couplers and Power dividers - Basic properties, Types, Power combining efficiency, Wilkinson Power divider equal and unequal types, 90° Hybrids, Branch line couplers, N-way combiners, Phase shifters - Types, Transmission line type, Reflection types phase shifters. RF Filters: Basic filter configurations, Special Filter Realizations, Filter Implementation.	
Unit –IV	**08 Hrs**
RF Transistors: Bipolar junction transistor , RF field effect transistors:- metal oxide semiconductor transistors, High electron mobility transistors- construction, Small signal Equivalent circuit, Figure of merit, High frequency Noise performance response, **Microwave Amplifiers**-: Amplifier classes of operation and biasing networks, characteristic of amplifiers, amplifier power relations, stability considerations, and constant gain.Low noise amplifiers	
Unit –V	**08 Hrs**
Oscillators: Basic oscillator models - Feedback oscillator, Negative Resistance oscillator, oscillator phase noise, Dielectric Resonator oscillators,Gunn element oscillator **Mixers**: Basic consideration of Mixers- basic concepts, frequency domain considerations, single ended mixer design,double balanced mixers Radio Receiver architectures, Parameters of Radio receivers	

Course Outcomes: After completing the course, the students will be able to	
CO1	Review and understand the S-parameters, Smithchart applications, Active RF semiconductor components.
CO2	Design and analyze the matching networks for the RF circuits
CO3	Design RF active circuits for given specifications
CO4	Evaluate the Performance of RF active circuits through EDA tools.

Reference Books	
1	RF and Microwave Electronics Illustrated, Matthew M. Radmanesh, 1st edition, 2004, Pearson Education, ISBN-978-81-775-8401-1
2	Fundamentals of RF and Microwave Transistor Amplifiers, Inder J Bahl, 2009, John Wiley & Sons Inc, ISBN: 9780470391662
3	Microwave Engineering, D. Pozar, 2005, John Wiley & Sons, New York.: ISBN: 978-0-470-63155-3..

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

High-3: Medium-2: Low-1

Semester: VI						
5G MOBILE NETWORK (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7G1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the essential principles of 5G communications.
2	Describe the 5G architecture and 5G Internet.
3	Analyze the cognitive radio networks for 5G.
4	Analyze the 5G spectrum crunch and security issues.

Unit-I	**08 Hrs**
History of 5G: Historical background, 5G use cases and system concept: Use case requirements, 5G system concept. **The 5G Architecture:** Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment.	
Unit-II	**07 Hrs**
Machine-type communications: Introduction, Fundamental techniques for MTC, Massive MTC, Massive MTC, Summary of uMTC features. **Device to Device (D2D) communications:** From 4G to 5G, Radio resource management for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi operator D2D communication.	
Unit –III	**09 Hrs**
The 5G radio-access technologies: Access design principles for multi-user communications, Multi-carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication, Radio access for massive machine-type communication.	
Unit –IV	**09 Hrs**
Relaying and wireless network coding: The role of relaying and network coding in 5G wireless networks, Multi-flow wireless backhauling, Highly flexible multi-flow relaying,Buffer-aided relaying. **Interference management, mobility management and dynamic:** Network deployment types, Interference management in 5G.	
Unit –V	**09 Hrs**
Mobility management in 5G, Dynamic network reconfiguration in 5G **Spectrum:** Introduction, 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies, Value of spectrum for 5G: a techno-economic perspective.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the concepts of 5G networks and its architecture.
CO2	Analyze the spectrum optimization using cognitive radio in 5G network.
CO3	Analyze the white space spectrum opportunities and challenges.
CO4	Analyze the security issues and challenges in 5G communication systems.

Reference Books	
1	5G Mobile and Wireless Communication Technology, AfifOsseran, Jose F Monserrat, Patrick Marsch, Cambridge University Press, 2016.
2	Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, John Wiley & Sons 2015, ISBN: 9781118867525
3	5G Core Networks Powering Digitization, Stephen Rommer, Academic Press,2019 ISBN: 978-0-08-1030009-7.

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

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

High-3: Medium-2: Low-1

Semester: VI						
MULTIMEDIA COMMUNICATION (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7G2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	Explain different types of data - such as image data, video data and audio data for processing.
2	Describe data compression algorithms for multimedia compression techniques.
3	Analyze lossless compression techniques applied in libraries, museums, film studios for converting data and archives into Digital form.
4	Analyze and Apply quantizer and transform coding for data compression.
5	Apply multimedia system standards such as JPEG and MPEG applications

Unit-I	**07 Hrs**
Introduction: Multimedia information representation, multimedia networks, multimedia applications, **QoS -**Network QoS and application QoS.	
Unit – II	**08 Hrs**
Multimedia Information Representation: Text formats–Unformatted, formatted and hypertext; Images- Graphics, Digitized documents& pictures, Audio-PCM speech, CD-quality audio, Synthesized audio and Video – Broadcast television, Digital video, PC video, Video content.	
Unit –III	**08 Hrs**
Text and image compression: Compression principles, Text compression- Huffman coding, Arithmetic Coding, LZ, LZW coding; Image compression- GIF, TIFF, Digitized documents and pictures, JPEG 2000: Development Process, Significant features, Architecture, Bit stream, Compression efficiency comparisons.	
Unit –IV	**08 Hrs**
Audio and video compression: Audio compression - DPCM, Adaptive DPCM, Adaptive and Linear predictive coding, CELP, MPEG and Dolby audio coders. **Video compression** -video compression principles; Standards - H.261, H.263, MPEG, MPEG-1, MPEG-2, MPEG-4.	
Unit –V	**08 Hrs**
Multimedia Network Communications and Applications: Quality of Multimedia Data Transmission: QoS, QoS for IP protocols, Prioritized Delivery. **Multimedia over IP:**IP Multicast, RTP, RTCP, RSVP, RTSP, Internet Telephony. **Multimedia over ATM Networks:** Video Bitrates over ATM, ATM adaptation layer, MPEG – 2 Convergence to ATM, Multicast over ATM.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and explain Multimedia information representation, networks, coding, image processing and compression techniques.
CO2	Apply the knowledge learnt about the various coding, image processing and compression techniques.
CO3	Analyze and Justify the impact of multimedia communication on society through various applications like interpersonal communication, interactive applications over the internet and
CO4	Design and Evaluate various coding, processing and compression techniques.

Reference Books	
1	Fred Halsall, " Multimedia Communications", Pearson Education, 2013, ISBN: 978-81-317-0994-8.
2	K.R. Rao, Zoran S.Bojkovic, D.A.Milovanovic, "Multimedia Communication Systems", PHI, 2014.
3	Ze-NianLi and Marks S Drew, "Fundamentals of Multimedia", PHI, 2006.

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

High-3: Medium-2: Low-1

Semester: VII						
CRYPTOGRAPHY AND NETWORK SECURITY (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7G3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3 : 0 : 0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Define the fundamentals of Security and cryptography for data transmission.
2	Explain the principles of cryptography and encryption.
3	Acquire knowledge on hash functions, authentication and digital signature.
4	Understand well known network security protocols at Network layer. Transport layer and Application layer.

UNIT-I	**07 Hrs**
Computer and Network Security Concepts: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, A Model for Network Security, Standards. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.	
UNIT-II	**08 Hrs**
Block Ciphers and Data Encryption Standards (DES): Traditional Block Cipher Structure,The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles. **Public-Key Cryptography and RSA:** Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman key exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	
UNIT-III	**08 Hrs**
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining. **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes (MAC), Security of MACs, MACs Based on Hash Functions: HMAC. Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, NIST Digital Signature Algorithm.	
UNIT-IV	**08 Hrs**
Network Access Control and Cloud Security : Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computing Security Concerns. **Transport-Level Security**: Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH).	
UNIT-V	**08 Hrs**
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security. **IP Security**: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamental concepts, issues and principles of cryptography for data transmission.
CO2	Apply cryptographic techniques and algorithms to provide security to the transmitted information.
CO3	Analyze the concepts of Authentication, Hash functions and Digital signature.
CO4	Understand and analyze System level security issues and protocols.

Reference Books	
1	Cryptography and Network Security, Williams Stallings, Seventh Edition, 2017, Pearson India Education Services, ISBN 978-0-13-444428-4.
2	Network Security, Perlman - Kaufman Spenciner, 2002, Pearson Education/PHI, ISBN: 9971–51–345–5.
3	Cryptography & Network Security, AtulKahate, 2003, TMH, ISBN-81-203-2186-3.

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

High-3: Medium-2: Low-1

Semester: VII						
SATELLITE AND NAVIGATION SYSTEMS (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7G4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand basic principles of satellite and navigation systems and Classification of satellites, orbital parameters, Launch vehicles.
2	Explain the various subsystems of Satellite and Earth Station.
3	Analyse positioning system based on measured variables.
4	Analyze and design satellite links.

UNIT-I	**08 Hrs**
Introduction to Satellites and their Applications: Ever-expanding application spectrum, What is a Satellite? History of the Evolution of Satellites, Evolution of Launch Vehicles, Future Trends. **Satellite Orbits and Trajectories :**Definition of an Orbit and a Trajectory, Orbiting Satellites – Basic Principles, Orbital Parameters, Injection Velocity and Resulting Satellite Trajectories, Types of Satellite Orbits.	
UNIT-II	**08 Hrs**
Satellite Launch and In-orbit Operations: Acquiring the Desired Orbit, Launch Sequence, Orbital Perturbations, Satellite Stabilization, Orbital Effects on Satellite's Performance, Look Angles of a Satellite, Earth Coverage and Ground Tracks.	
UNIT-III	**08 Hrs**
Satellite Hardware: Satellite Subsystems, Mechanical Structure, Propulsion Subsystem, Thermal Control Subsystem, Power Supply Subsystem, Attitude and Orbit Control, Tracking, Telemetry and Command Subsystem, Payload, Antenna Subsystem, Space Qualification and Equipment Reliability. **Earth Station**: Types of Earth Station, Earth Station Architecture, Earth Station Design Considerations, Earth Station Testing, Earth Station Hardware, Satellite Tracking.	
UNIT-IV	**08 Hrs**
Satellite Link Design Fundamentals : Transmission Equation, Satellite link parameters, Frequency Considerations, Propagation Considerations, Techniques to Counter Propagation Effects, Noise Considerations, Interference-related Problems, Antenna Gain-to-Noise Temperature (G/T) Ratio, Link Design.	
UNIT-V	**08 Hrs**
An Introduction to Radar: Basic Radar, Radar Block Diagram, The simple form of the Radar Equation, Radar Frequencies, Application of radar, Types of Radars, Probability of Detection and False alarm. **Introduction to Navigation systems:** Introduction**and** Classification of Wireless Positioning Systems, positioning and navigation systems.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain various Orbital Parameters, Satellite Link Parameters and Propagation considerations.
CO2	Apply the concepts of radars, WLAN and satellites in determining the user position and navigation
CO3	Analyze Orbital Mechanics, TT&C and other design issues
CO4	Design basic satellite link system for Uplink and Downlink and evaluate C/N overall for the link.

Reference Books	
1	Satellite Technology - Principles and Applications, Anil K Maini, Varsha Agarwal, 2nd Edition, 2011, John Wiley and Sons, ISBN: 9780470660249.
2	Satellite Communication Concepts and applications, K N Raja Rao, 2013, 2nd Edition, PHI, ISBN: 978-81-203-4725-0.
3	Satellite Communication, Timothy Pratt, Charles W. Bostian, 2nd Edition, 2012, John Wiley & Sons, ISBN: 9814126845.
4	Introduction to RADAR Systems, M. L Skolnik,2001,TATA Mcgraw-Hill, ISBN: 0-07-044533-8
5	Satellite and Terrestrial Radio Positioning techniques- A signal processing perspective, Davidedardari, EmanuelaFalletti, Marco Luise, 1st Edition, 2012, Elsevier Academic Press, ISBN: 978-0-12-382084-6

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

High-3: Medium-2: Low-1

Semester: VII						
WIRELESS SENSOR NETWORKS (GROUP G: PROFESSIONAL ELECTIVE) (Theory)						
Course Code	**:**	**18TE7G5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hrs**

Course Learning Objectives: The students will be able to	
1	Explain the architecture and applications of wireless sensor networks.
2	Appreciate the specifications of standards for WSN.
3	Analyze the need and structure of MAC protocol for WSN.
4	Develop a routing protocol and performance analysis for WSN.
5	Design Transport Control Protocols and Middle wares and operating system for Wireless Sensor Networks.

Unit-I	**08 Hrs**
Introduction, Overview and Applications of Wireless Sensor Networks: Introduction: Background of Sensor Network Technology, Basic overview of the Technology: Basic Sensor Network Architectural Elements, Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology.	
Unit – II	**08 Hrs**
Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends. **MAC and Routing Protocols for Wireless Sensor Networks:**Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study.	
Unit –III	**08 Hrs**
Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs.	
Unit –IV	**08 Hrs**
Transport Control and Middleware for Wireless Sensor Networks:Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. **Middleware for Wireless Sensor Networks**: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware: MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services).	
Unit –V	**08 Hrs**
Network Management and Operating System for Wireless Sensor Networks:Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. **Operating Systems for Wireless Sensor Networks:** Introduction, Operating System Design Issues, Examples of Operating Systems:TinyOS, Mate.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the type of sensor networks, protocols and applications of WSN.
CO2	Analyze the design issues of Transport,Network, MAC and Physical layers of WSN.
CO3	Analyze architecture and Identify need and selection of protocols for WSN.
CO4	Explore various software platforms that exist for sensor networks.

Reference Books	
1	KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocols and Applications: WILEY, Second Edition (Indian), 2014.
2	Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010.
3	Feng Zhao & Leonidas J. Guibas, "Wireless SensorNetworks- An Information Processing Approach", Elsevier, 2007.

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

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:S	**:**	**3:0:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**39L**		**SEE Duration:**	**:**	**3.00 Hrs**

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

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

High-3 : Medium-2 : Low-1

Semester: VII						
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 corolina, 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 alberta press,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 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	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	**:**	**39L**		**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 Rules 2016 , 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 28th March, 2016.
6	E-waste (Management) Rules 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 23rd March , 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 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**	**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, 1st Edition 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. The total marks of CIE are 100.

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

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

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**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	**:**	**39L**		**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, third 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 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**	**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 60. The marks component for Assignment/Presentation/Project 10.

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

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

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

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 Procurement Management**: Project Procurement Management, conduct procurements, 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 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**											
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 fundamentals and comprehend the impact of cybercrime and forensics.
2	Describe the motive and remedial measures for cybercrime, detection and handling.
3	Demonstrate and investigate the use of Tools used in cyber forensics.
4	Analyse areas affected by cybercrime and identify Legal Perspectives in cyber security.

Unit-I	**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 Cyberlaws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment.	

Course Outcomes: After 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 PrakashTripathi, RitendraGoyal, Praveen Kumar Shukla, KLSI. Dreamtech Press, ISBN: 9789351194736, 2015.
3	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions,Thomas J. Mowbray, Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 84965 -1
4	Cyber Forensics, Technical Publications, I. A. Dhotre, 1st Edition, 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 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**	**-**	**-**	**-**	**-**	**-**	**-**	**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	Mohsen Shahinpoor, "A Robot Engineering Textbook", Harper & Row Publishers, 3rd Edition, New York, ISBN:006045931X
2	John J. Craig, "Introduction to Robotics", Pearson Education International, 3rd Edition, ISBN:109876543, 1-13-123629-6
3	Mikell P Groover, "Automation, Production Systems, and Computer-integrated Manufacturing", Pearson Publishing, 3rd Edition, 2014, ISBN 978 81 203 3418 2
4	Joseph Talavage, "Flexible Manufacturing Systems in Practice Design: Analysis and Simulation", 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 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**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	**:**	**39L**		**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, Routledge publications, 2009, ISBN- 10 :0415465702.
2	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN:9788120324015.
3	Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9, ISBN 10: 047137007X.
4	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.

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

CIE is executed by 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 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												
	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.
CO5:	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. 38th Edtion, 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 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**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
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 s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control	
Unit –IV	**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 and contrast the factors that cognitive, behavioral, and Humanistic theorists believe influence the learning process.
CO3:	Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4:	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.

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	3. Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4	4. Organisational Behaviour : Human Behaviour at Work ,John W.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 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

High-3: Medium-2 : Low-1

Semester: VII						
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: Targeting Blogs, Unconventional PR, Search Engine Marketing, Search Engine Optimization, Social ads, display ads and existing platforms, Emai Marketing, Viral Marketing, Affiliate programs, Magazines, Newspaper, Radio and TV ads, Offline Ads, Trade Shows	
Unit –IV	**10 Hrs**
Business model: Reiterate and Refine your Business Model Canvas, Choose the right business model for your start-up **Financial Planning**: Forecasting sales and revenue projections, Cash-flow statement	
Unit –V	**09 Hrs**
Pitching: Create your funding plan, Build your pitch deck and compose your pitch.	

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

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

High-3: Medium-2: Low-1

Semester VIII						
MAJOR PROJECT						
Course Code	**:**	**18TEP81**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**0:0:16:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**32**		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1.	Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.					
2.	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a specific audience in both written and oral forms.					
3.	Acquire collaborative skills through working in a team to achieve common goals.					
4.	Self-learn, reflect on their learning and take appropriate action to improve it.					
5.	Prepare schedules and budgets and keep track of the progress and expenditure.					

Major Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
2. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the 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%

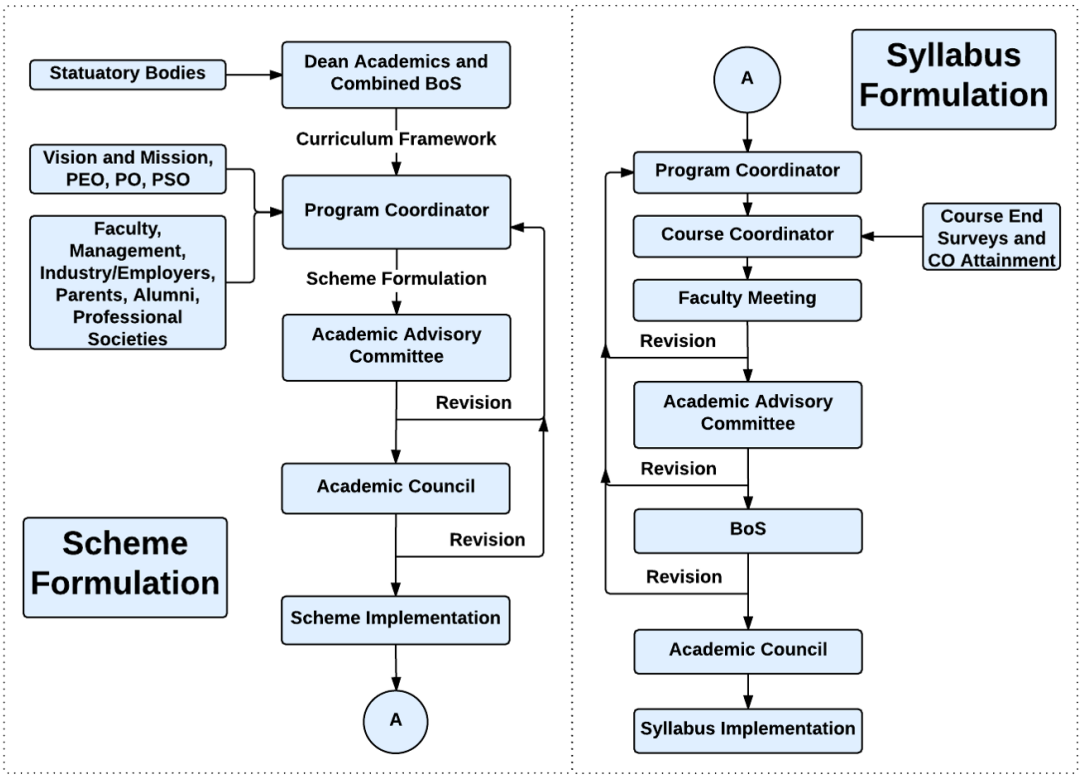
Calendar of Events for the Project Work:

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.

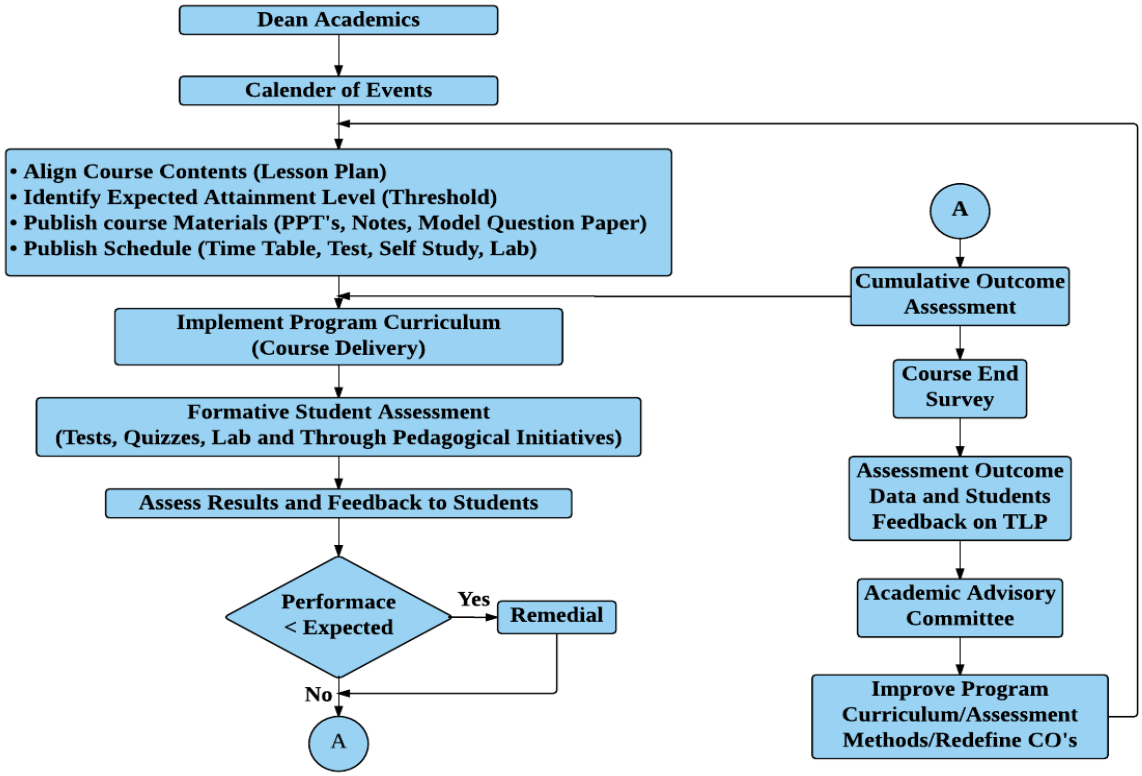
Evaluation Scheme for CIE and SEE

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

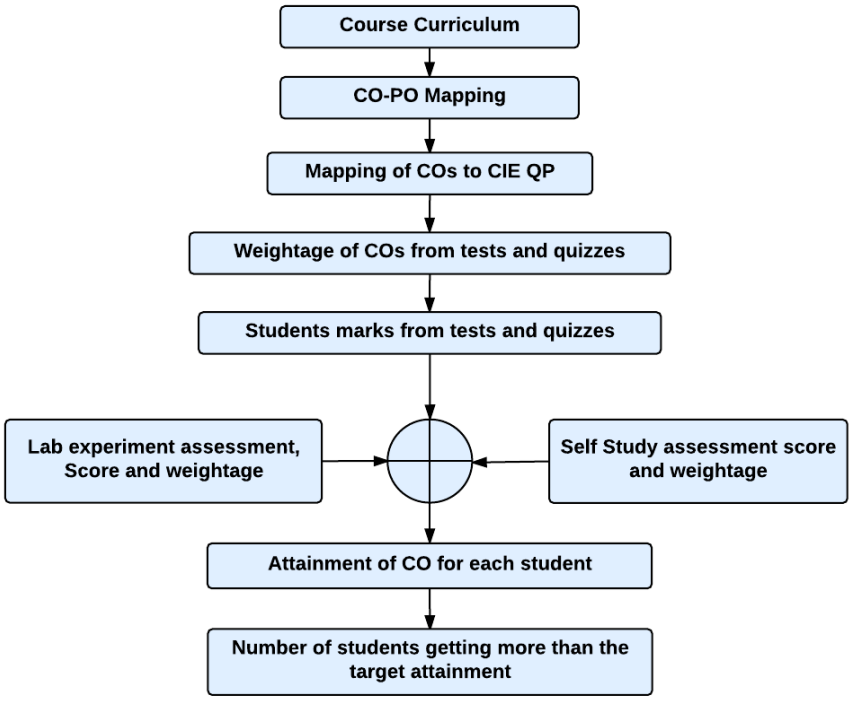
Curriculum Design Process



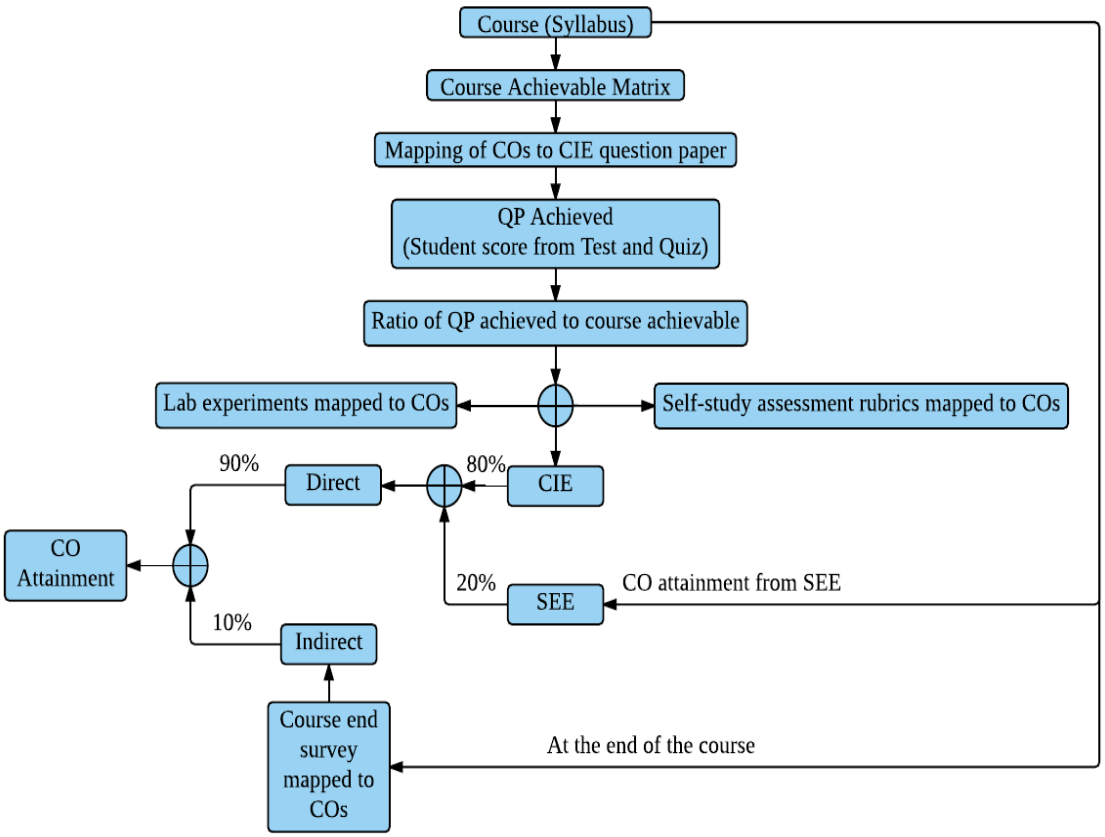
Academic Planning and Implementation



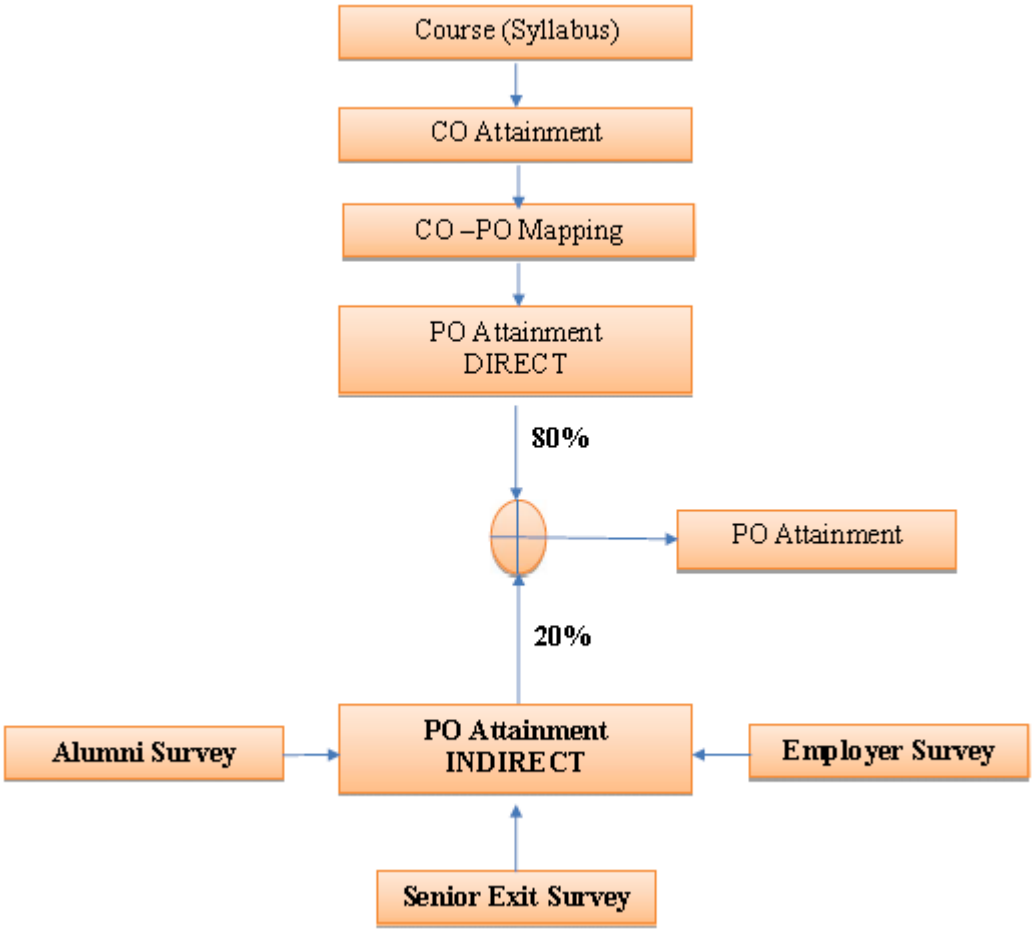
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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