RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road

Bengaluru – 560 059

Bachelor of Engineering (B.E.)
Scheme and Syllabus of VII & VIII Semesters

2016 SCHEME

CIVIL ENGINEERING

(Autonomous Institution Affiliated to VTU, Belagavi)
R.V. Vidyaniketan Post, Mysore Road
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2016 SCHEME

DEPARTMENT OF
CIVIL ENGINEERING

DEPARTMENT VISION

Excel in Education, Research and Consultancy in Civil Engineering with emphasis on Sustainable Development

DEPARTMENT MISSION

- Disseminating and integrating the knowledge of civil engineering and allied fields.
- Enhancing industry-institute interaction leading to interdisciplinary research.
- Imbibing wide-range of skills in cutting-edge technology for sustainable development.
- Motivate entrepreneurship and professional ethics to serve the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. Successfully address technological and managerial challenges.

PEO2. Professionally design and execute Civil Engineering projects.

PEO3. Pursue advanced education, research and continue life-long learning process to remain active professionals.

PEO4. Play key roles in addressing societal needs through interdisciplinary approach

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Apply knowledge of fundamental aspects to analyze and design civil engineering structures
PSO2	Provide sustainable solutions to civil engineering problems
PSO3	Employ codal provisions to arrive at comprehensive solutions to address societal needs
PSO4	Exhibit communication and teamwork skills

Lead Society: American Society of Civil Engineers (ASCE)

ABBREVIATIONS

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

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CIVIL ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME								
Sl. No	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS**	
1	16CV71	Design and Drawing of Steel Structures	CV	3	0	1	0	4
2	16CV72	Foundation Engineering	CV	3	0	0	0	3
3	16CV73	Estimation and Costing	CV	3	0	0	0	3
4	16CV74	Extensive Survey Camp*	CV	0	0	3	0	3
5	16CV7FX	Elective F (PE)	CV	4	0	0	0	4
6	16CV7GX	Elective G(PE)	CV	4	0	0	0	4
7	16GH7XX	Elective H (GE)	CV	3	0	0	0	3
Total No. of Credits				**20**	**0**	**4**	**0**	**24**
No. Of Hrs.				**20**	**0**	**8**	**0**	**28**

* Extensive Survey Camp during VI to VII Semester vacation for 11 days.

EIGTH SEMESTER CREDIT SCHEME								
Sl. No.	**Course Code**	**Course Title**	**BOS**	**Credit Allocation**				**Total Credits**
				Lecture	**Tutorial**	**Practical**	**SS**	
1.	16CV81	Major Project	CV	0	0	16	0	16
2.	16CV82	Technical Seminar	CV	0	0	2	0	2
3.	16HS83	Innovation and Social Skills	HSS	0	0	2	0	2
Total No. of Credits				**0**	**0**	**20**	**0**	**20**
No. of Hrs.				**0**	**0**	**40**	**0**	**40**

VII Semester		
GROUP F: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16CV7F1	Bridge Engineering
2.	16CV7F2	Solid waste Engineering
3.	16CV7F3	Ground Improvement Techniques
4.	16CV7F4	Urban Water Engineering and Management
VII Semester		
GROUP G: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	16CV7G1	Advanced Design of RCC Structures
2.	16CV7G2	Pavement Analysis and Design
3.	16CV7G3	Rock Mechanics
4.	16CV7G4	Valuation Engineering

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

Semester: VII						
DESIGN AND DRAWING OF STEEL STRUCTURES (Theory & Practice)						
Course Code	**:**	**16CV71**		**CIE**	**:**	**100+50**
Credits: L:T:P:S	**:**	**3:0:1:0**		**SEE**	**:**	**100+50**
Total Hours	**:**	**36L**		**SEE Duration**	**:**	**3 Hrs + 3 Hrs**

Course Learning Objectives: The students will be able to

1	Understand the behavior of elements in steel structures using current design specifications.(IS 800:2007 is the code of practice used in the course)
2	Apply their knowledge from statics, and structural analysis understanding in the relationship between analysis and design of steel structures
3	Design of steel structural elements of different forms, connections under different states of loading and to prepare structural steel drawings

PART A

UNIT-I	**08 Hrs**

Introduction: Advantages and disadvantages of steel structures load and load combinations, design philosophies, structural forms.

Bolted connections: Advantages, Types, Modes of failures, Introduction to simple , semi rigid and rigid connections, Eccentric connections(plane of connection parallel and perpendicular to the plane of moment),

Welded connections: Advantages, disadvantages. Types of joints, weld symbols, Design of simple joints, eccentric connections, (plane of connection parallel and perpendicular to the plane of moment).

UNIT-II	**07 Hrs**

Simple beam to beam and beam to column connections: Framed, stiffened, unstiffened seated connections with problems on welded and bolted connections.

UNIT-III	**07 Hrs**

Design of tension members: modes of failures, Analysis and design of tension members- angles, Lug angles.

UNIT-IV	**07 Hrs**

Design of compression members: Failure modes, section used for compression member, member classification, analysis and design of simple axially loaded members. Design of lacing, battens, slab base and gusseted column base with axial load on column.

UNIT-V	**07 Hrs**

Design of beams: Beam types, section classification, design of laterally supported beams, Design procedure for laterally unsupported beams.

PART-B (LABORATORY)	**36 Hrs**

Part - B1

a) Data given drawing using drafting software of the following

i) Beam to beam connections - Framed connections- bolted and welded
Beam to column connections – unstiffened and stiffened connections - bolted and welded.

ii) Laced and battened column.

Part - B2

b) Design and drawing

Roof truss including bolted and welded connection, supports

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

CO1:	Explain the engineering properties and behavior of structural steel
CO2:	Apply the behavior of steel members and connections to analyze structural components
CO3:	Analyze and evaluate critical capacity of structural steel sections
CO4:	Design and detail steel members and connections

Reference Books	
1.	Design of Steel structures, Subramanian N, Oxford University press, 1st Edition, 2008, ISBN 978019567681
2.	Limit state design of steel structures, S K Duggal, Tata McGraw Hill Education Private Limited, 2017, ISBN-10 9351343499, ISBN-13 978-9351343493
3.	Design of Steel structures, Bhavikatti S S, Interline Publications, 2009, ISBN 978938002661
4.	BIS Codes: i) IS-800-2007, General construction in steel-code of practice. ii) IS 875-1987, Code of practice for design loads, iii) SP6(6)- 1972, ISI handbook for structural engineers-application of plastic theory in design of steel structures. iv) SP6(1)-1964,Reaffirmed in 2003 Handbook for structural engineers- Structural steel sections

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.
Total CIE is 30(Q) +60(T) +10(A) =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 are considered for 40 marks. At the end of the semester a test (T) is conducted for 10 marks. Total marks for the laboratory is 50.
Total CIE is 40(AM) +10 (T) =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 practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and viva is for 10marks.The laboratory consists of Part B1 and Part B2. Out of 40 marks, Part-B1 is to be evaluated for 15 marks and Part-B2 is to be evaluated for 25 marks (Design-15M, Drawing-10M).

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

Low-1 Medium-2 High-3

Semester: VII						
FOUNDATION ENGINEERING (Theory)						
Course Code	**:**	**16CV72**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the Stratification of soils and soil investigation
2	Predict the behavior of soil beneath the substructures
3	Interpret the soil condition at a given location and suggest suitable foundation
4	Summarize the various methods of soil investigation and foundations for Civil Engineering applications

UNIT-I	**07 Hrs**
Site Investigation: Introduction, site reconnaissance, objective of site exploration, methods of site exploration, soil samples and samplers, methods of sampling, penetration and sounding tests, geophysical methods.	
UNIT-II	**07 Hrs**
Stress Distribution in Soil Mass: Introduction, Boussinesq's analysis, isobar and pressure bulb, vertical stress distribution on horizontal plane and on vertical line, vertical stress under uniformly loaded circular area and under strip load, vertical stress due to line load, uniformly loaded rectangular area, equivalent point load method, Newmark's influence chart, Westergaard analysis, comparison of Boussinesq and Westergaard theories.	
UNIT-III	**08 Hrs**
Bearing Capacity: Introduction, Terzaghi's analysis, Meyerhof's analysis and effect of water table on bearing capacity, effect of eccentricity of loading, I.S. Code method for computing bearing capacity, plate load test, penetration tests.	
UNIT-IV	**07Hrs**
Pile Foundations: Introduction, Classification of piles, pile driving, load carrying capacity of piles, dynamic formulae, static formulae, pile load tests, group action in piles, negative skin friction, under-reamed pile foundations.	
UNIT-V	**07Hrs**
Earth Pressure: Introduction, earth pressure at rest, active earth pressure: Rankine's theory, active earth pressure of cohesive soils, passive earth pressure: Rankine's and Coulomb's wedge theory, Rebhann's and Culmann's graphical method for active and passive pressure.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the soil behaviour under different subsoil conditions and methods of soil investigation
CO2:	Interpret the investigated soil data and design suitable foundation system
CO3:	Analyse the sub soil conditions at a given location and evaluate bearing capacity
CO4:	Apply the principles of soil behaviour and concepts of substructure to solve Civil engineering problems

Reference Books	
1.	Foundation Analysis and Designs, Bowles. J.E, McGraw Hill Publishing Co., New York. .1996, 5th Edition. ISBN 978-0071188449
2.	Soil Mechanics in Engineering practice, Terzaghi, Peck and Mesri, 3rd Edition, Wiley publication.
3.	Basic and Applied Soil Mechanics, Gopal Ranjan and Rao ASR ,New Age International (P) ltd, New Delhi, 2000, ISBN 788122412239
4.	Soil Mechanics and Foundation Engineering, VNS Murthy, First Edition, UBS Publishers and Distributors, New Delhi,2007, ISBN 9788174763228

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

Low-1 Medium-2 High-3

Semester: VII						
ESTIMATION AND COSTING (Theory)						
Course Code	**:**	**16CV73**		**CIE**	**:**	**100**
Credits: L: T:P:S	**:**	**3:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Estimator learns to read the construction drawings and extract quantities of items of different items involved in the construction project and prepare estimates for the proposed project
2	Imparting the knowledge of different types of estimates-Item wise, area basis, contract documents, departmental procedures etc
3	Calculations and earthwork quantities for construction, earthen embankments, canals etc. Preparation of detailed specification for the items of constructions
4	Preparation of construction estimates using available software for accuracy and faster preparation
5	Retrieval of data, Rate analysis, perform calculations in shorter time enabling the estimator to give more attention to alternative construction methods, to assess labour and equipment utilization

UNIT-I	**08 Hrs**
Estimation: Different type of estimates, study of various drawing attached with estimates, important terms, units of measurement, abstract, approximate methods of estimating buildings, cost from materials and labour coefficients recommended. **Measurement of Earth Work for Roads** **Estimation:** Methods of taking out quantities and cost-center line method, long and short wall method or crossing method, long and short wall method or crossing method. Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – Masonry structures, framed structures with flat, slopped RCC roofs with all building components, RCC slab culverts.. **Estimates:** Steel truss (north light and fink roof truss), manhole and septic tanks.	
UNIT-II	**07 Hrs**
Specifications: Definition of specifications, objectives of writing specifications, essentials in specifications, general and detailed specifications of item of works in buildings, specifications of aluminum and wooden partitions, false ceiling, aluminum and fiber doors and windows. Various types of claddings.	
UNIT-III	**07 Hrs**
Rate analysis: Definition and purpose. Working out quantities and rates for the following standard items of works – earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works or doors, windows and ventilators.	
UNIT-IV	**07 Hrs**
Measurement of Earth Work for Roads: Methods for computation of earthwork-cross sections-med section formula, trapezoidal or average end area or mean sectional area formula, prismoidal formula.**Project Preparation /Preliminary report (PSR) / DPR**	
UNIT-V	**07 Hrs**
Contracts: Types of contract-essential of contract –legal aspects, penal provision on breach of contract. Definition of the terms-Tender, Earnest money deposit, tender forms, documents and types. Comparative statements, acceptance of contract documents and issue of work orders, duties and liabilities, termination of contract, completion certificate, quality control, right of contractor refund of deposit. Administrative approval - Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements – preparation of bills.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Extract quantities of construction items by reading engineering / construction drawings and specifications followed in executing projects
CO2:	Prepare of estimates using different methods for building projects (RCC, Steel Structures, Masonry, Road and Hydraulic Structures)
CO3:	Apply the method of working out unit rate analysis of different construction items for finally prepared tendered documents
CO4:	Create tender document, billing of qualities of works and other financial related issues

Reference Books	
1.	Estimating, costing, specification and Valuation in Civil Engg., N. Chakraborti, , N. Chakraborti, Published by author, Culcutta, 20th Edition, 2007
2.	Estimating & Specification, B.N. Dutta, USB Publishers and Distributors, New Delhi, 25th Revised Edition, 2006, ISBN 817476383X, ISBN 9788174763839
3.	Estimating and Specification, S.C. Rangawala, Charotar Publishing House, Anand, 2008
4.	Text book of Estimating and Costing, G.S. Birdie, Dhanpath Rai and Sons, New Delhi, 1st Edition, 2008

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10. **Total CIE is 30(Q) +60(T) +10(A) =100 Marks.**

Semester End Evaluation (SEE); Theory (100 Marks)
SEE The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of four questions (descriptive, analytical, problems and / or design). Question from Unit 1 shall be for 35 marks and remaining three questions for 15 marks. All four questions from part B will have internal choice and one of the two have to be answered compulsorily.

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

Low-1 Medium-2 High-3

Semester: VII						
EXTENSIVE SURVEY CAMP (Practice)						
Course Code	**:**	**16CV74**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**0:0:3:0**		**SEE**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Describe the types of surveys and use of surveying tools and equipments required for civil engineering projects.
2	Address the field problems and challenges in surveying.
3	Evaluation, interpretation and communication the field data.
4	Design and develop solutions to meet societal needs.

36 Hrs

New Tank Project ;

1. Survey and preparation of drawing for longitudinal and Cross section of bund
2. Survey and preparation of drawing for Block levels at waste Weir Site.
3. Survey and preparation of drawing for Capacity Contours.
4. Survey and preparation of drawing for Initial Alignment of Channel.
5. Survey and preparation of drawing for Final Alignment of Channel.

Water Supply & Sanitary Project - conduction of survey, preparation of drawings ;

1. Water Supply Project.
   a. Survey and preparation of maps for water supply to the village
   b. Longitudinal and cross sections along the alignment of pipeline
   c. Calculation of cutting and filling along the alignment of pipeline
2. Sanitary Project.

Village survey & preparation of drawings for waste water drainage

Highway Project ;

1. Initial Alignment of Highway.
2. Final Alignment of Highway.

Preparation of finalized drawings and related calculations of cutting and filling for the following projects

1. New Tank Project
2. Water Supply & Sanitary Project
3. Highway Project

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the different surveys required for various Civil Engineering projects
CO2:	Apply the various equipments and methods of survey for different civil engineering projects
CO3:	Analyze the field data and prepare the drawings based on the survey field work
CO4:	Evaluate and calculate the bill of quantities for various works based on the survey and drawings prepared

Continuous Internal Examination (CIE):

Evaluation will be carried out under three Phases .CIE consists of preliminary survey, survey field work and preparation of preliminary drawings. The total marks for CIE shall be **100** out of which 20% for preliminary survey, 50% for field work and 30% for preparation and submission of drawings.

Scheme of Evaluation for SEE:

Based on performance in the viva voce examination out of **100**

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

Low-1 Medium-2 High-3

Semester: VII						
BRIDGE ENGINEERING (Theory)						
Course Code	**:**	**16CV7F1**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to

1	Describe history, classification and component of bridges
2	Illustrate the limit state design method
3	Know various types of bridges its components and their specific uses
4	Discuss design philosophy and codal requirements

UNIT-I	**09 Hrs**
Introduction: Historical Developments, Site Selection for Bridges, Necessary investigations & collection of essential bridge design data, definition of bridge, Components of bridge, Classification of Bridges, Requirements of an ideal bridge, Forces on Bridges. Hydraulic Design: Methods of finding design discharge, Natural artificial and linear water ways, afflux, economic span of bridge, Scour dept	
UNIT-II	**10 Hrs**
Bridge substructures: General, Design and construction of Bridge piers, Abutments, Wing walls, Approaches Bearings for bridges, Rocker and roller bearings, sliding bearings, Neoprene Bridge bearing Superstructures: Components-Parapets and Railings for Highway Bridges, Classification of Highway Bridge parapets, Cross barriers and its Details	
UNIT-III	**10 Hrs**
Low cost bridges- Introduction, types of low cost bridges, Cause-ways, suspension bridges, Culverts Bridge Loading: Standard Specifications for Roads and Railways Bridges, General, Indian Road Congress Bridge Code, Detailed explanation of IRC standard live loads, Loading for road bridges: Dead load, Live load, Impact factor, Centrifugal force, wind loads, hydraulic forces, longitudinal forces, Seismic forces; Earth pressure. Buoyancy; Lane concept, Equivalent loads, traffic load; Width of Roadway and Footway	
UNIT-IV	**10Hrs**
Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, Reinforcement Detailing.	
UNIT-V	**09 Hrs**
RCC deck Slab Bridge: Introduction to RCC deck slab bridge, Loading calculations and analysis, Calculation of BM & SF , Structural design of deck slab bridge for class AA loading and class A loading, Reinforcement detailing.	

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

CO1:	Describe the principle of bridge site investigation, bridge hydrology and standard specifications
CO2:	Apply the concepts of IRC 6 and IRC 21 in design of Bridges
CO3:	Analysis of bridges subjected to various loads
CO4:	Design of RCC Deck slab bridge for Class AA tracked vehicle loading

Reference Books

1.	Bridge Engineering, S. P. Bindra, Dhanpat Rai & sons publication, New Delhi, 1990, ISBN 9788189928841
2.	Design of Bridge Structures, M. A. Jayaram, PHI Pvt Ltd., 2nd Edition, 2012, ISBN 9788120338524
3.	Essentials of Bridge Engineering, D. Johnson and Victor, Oxford and IBH publications, 1980, ISBN 9788120417175
4.	Design of Bridges, Krishnaraju N, Oxford; ISBN : 8120403444, 918812040344

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.
Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

Low-1 Medium-2 High-3

Semester: VII						
SOLID WASTE ENGINEERING (Theory)						
Course Code	**:**	**16CV7F2**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to

1	Study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules.
2	Understand different elements of solid waste management from generation of solid waste to disposal.
3	Analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas.
4	Evaluate landfill site and to study the sanitary landfill reactions.

UNIT-I	**09 Hrs**
Introduction: Land Pollution. Scope and importance of solid waste management. Present solid waste disposal methods. Merits and demerits of open dumping, feeding to hogs, incineration, pyrolysis, composting, sanitary landfill. Definition and functional elements of solid waste management. **Sources**: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Generation rate, Numerical Problems.	
UNIT-II	**09 Hrs**
Collection: Collection of solid waste- services and systems, equipments, Problems. **Transportation**: Need of transfer operation, transfer station, transport means and methods, route optimization. Solid waste management 2000 rules with, 2016 amendments.	
UNIT-III	**10 Hrs**
Processing techniques: Purpose of processing. Chemical volume reduction (incineration) – Process description, 3T's, principal components in the design of municipal incinerators, Air pollution control Mechanical volume reduction (compaction), Mechanical size reduction (shredding), component separation (manual and mechanical methods).	
UNIT-IV	**10 Hrs**
Composting Aerobic and anaerobic method - process description, process microbiology, design consideration, Mechanical composting, Vermicomposting, Numerical Problems.	
UNIT-V	**10 Hrs**
Sanitary landfilling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Design of sanitary landfill. Numerical Problems	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyse existing solid waste management system and to identify their drawbacks.
CO2:	Evaluate different elements of solid waste management system.
CO3:	Suggest suitable scientific methods for solid waste management elements.
CO4:	Design suitable processing system and evaluate disposal sites.

Reference Books	
1.	Integrated Solid Waste Management: Engineering principles and management issues, George Tchobanoglous, Hilary Theisen , Samuel A Vigil, published by M/c Graw hill Education . Indian Edition 2014. ISBN – 13: 978- 9339205249, ISBN-10 : 9339205243
2.	Environmental Engineering, Howard S Peavy, Donald R Rowe and George Tchobanoglous, Tata Mcgraw Hill Publishing Co ltd., 2013, ISBN-13 9789351340263.
3.	Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016

4.	Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health And Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
5.	Handbook of Solidwaste management, Second Edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -10 0071356231

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

High-3: Medium-2: Low-1

Semester: VII						
GROUND IMPROVEMENT TECHNIQUES (Theory)						
Course Code	**:**	**16CV7F3**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the various methods of soil stabilization for problematic soils
2	Discuss the concepts of ground improvement methods for various soil conditions
3	Illustrate the various techniques of soil modification
4	Summarize the methods of improvement of difficult ground

UNIT-I	**10 Hrs**
Ground Improvement: Definition, Objectives of soil improvement. Classification of ground improvement techniques, Factors to be considered in the selection of the best soil improvement technique. **Grouting:** Introduction, Effects of grouting, Chemicals and materials used, Types of grouting, Grouting procedure, Applications of grouting.	
UNIT-II	**10 Hrs**
Mechanical Modification: Type of mechanical -modification, Aim of modification, compaction, Principle of modification for various types of soils, Effect of grain size distribution on compaction for various soil types like BC soil. Lateritic soil, coarse-grained soil, micaceous soil, Field compaction - static, dynamic, impact and vibratory type, Specification of compaction.	
UNIT-III	**10 Hrs**
Hydraulic Modification: Definition, aim, principle, techniques, gravity drain, lowering of water table, multistage well point, vacuum dewatering, discharge equations, design of dewatering system including pipe line effects of dewatering. Drainage of slopes, preloading, vertical drains, sand drains.	
UNIT-IV	**08 Hrs**
Chemical Modification: Definition, aim, special effects, and methods. Techniques -sandwich technique, admixtures, cement stabilization. hydration -effect of cement stabilization on permeability, Swelling and shrinkage. Criteria for cement stabilization, Assessment of ground condition for preloading, Electro kinetic dewatering).	
UNIT-V	**10 Hrs**
Stabilization: Suitability, process, special effects, criteria for lime stabilization, Other chemicals, chlorides, hydroxides, lignin, hydrofluoric acid , Fly ash in cement stabilization, Properties of chemical components, reactions and effects, Bitumen, tar or asphalt in stabilization.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the in-situ methods of soil improvement projects
CO2:	Acquire knowledge of ground improvement methods and its application
CO3:	Analyse the behaviour of soil with the addition of admixtures
CO4:	Summarize the methods of stabilization using admixtures

Reference Books	
1.	Ground Improvement Techniques, Purushothama Raj. P. Firewall Media Publisher, 2004 ISBN8170088372
2.	Construction and Geotechnical Methods in Foundation Engineering, Koerner. R.M, Mc Graw Hill Pub. Co., New York. 2007 ISBN0070352453
3.	Engineering principles of ground modification, Manfied Hausmann, McGraw Hill Pub. Co., New York.,2008 ISBN0070272794
4.	Methods of treatment of unstable ground, Bell, F.G., Butterworths, London. 2007 ISBN0408001666

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.
Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Low-1 Medium-2 High-3

Semester: VII						
URBAN WATER ENGINEERING AND MANAGEMENT (Theory)						
Course Code	**:**	**16CV7F4**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to

1	Study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules.
2	Understand different elements of solid waste management from generation of solid waste to disposal.
3	Analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas.
4	Evaluate landfill site and to study the sanitary landfill reactions.

UNIT-I	**09 Hrs**
URBAN HYDROLOGIC CYCLE: Water in the urban eco-system – Urban Water Resources – Major problems – Urban hydrological cycle – Storm water management objectives and limitations – Storm water policies – Feasibility consideration.	
UNIT-II	**09 Hrs**
URBAN WATER RESOURCES MANAGEMENT: Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff – Management of flow rate and volume control rate.	
UNIT-III	**10 Hrs**
URBAN STORM WATER MANAGEMENT: Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts – Types of storage – Magnitude of storage – Flow and storage capacity of urban components – Lake restorations.	
UNIT-IV	**10 Hrs**
REMOTE SENSING AND GIS FOR WATER RESOURCES MANAGEMENT: Thematic mapping –Digital elevation model. Web Based GIS Spatial data sources – GIS approach water resources system –Rainfall runoff – Groundwater mapping– Water quality mapping -– Drought monitoring – Cropping pattern change analysis –Performance evaluation of irrigation commands. Site selection for artificial recharge..	
UNIT-V	**10 Hrs**
CASE STUDIES: Water resources assessment case studies – Ganga Damodar Project, Himalayan glacier studies, Ganga valley project Operation policies for water resources projects - Drought management strategies - Temporal & spatial assessment of water.	

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

CO1:	Describe fundamental concepts of hydrology cycle, urban water management and application of remote sensing and GIS.
CO2:	Discuss components of hydrology cycle and urban water management.
CO3:	Apply the concepts of hydrology cycle and management practices in engineering problems.
CO4:	Demonstrate the applications of remote sensing and GIS for solving engineering problems.

Text books:

1.	Urban Water Engineering and Management, Mohammad Karamouz, Ali Moridi, Sara Nazif , CRC Press, 2010
2.	Storm Water Management, Martin, P. Wanelista and Yousef, A. Yousef., John Wiley and sons, 1993
3.	Principles of Geographical Information Systems, Burrough P.A. and McDonnell R.A,Oxford University Press. New York. 1998

Reference Books	
1.	Storm Water Management, Martin, P. Wanelista and Yousef, A. Yousef., John Wiley and sons, 1993.
2.	Urban Water Infrastructure Planning, Management and Operations, Neil S. Grigg., John Wiley and Sons, 1986.

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

Low-1 Medium-2 High-3

Semester: VII						
ADVANCED DESIGN OF RCC STRUCTURES (Theory)						
Course Code	**:**	**16CV7G1**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Apply the methods of designing RCC structures
2	Design basic RCC structures such as slabs, beams, columns, footings using SP-16
3	Design advanced RCC structures using SP-16
4	Create bar bending schedule and detailing of reinforcement in various structures

UNIT-I	**09 Hrs**
Analysis and design of singly and doubly reinforced beam, T beam, slabs with different end conditions using SP16 only. Detailing of reinforcement for singly and doubly reinforced beam, T beam, slabs.	
UNIT-II	**09 Hrs**
Importance of slenderness ratio in the design of **columns**, Analysis and design of long columns with axial load, uni-axial and bi- axial bending. Analysis and design of **footings** using SP16. Detailing of reinforcement for different columns and footings.	
UNIT-III	**10Hrs**
Analysis and design of Single storey-singly bay **portal frame** using SP16 with hinged and fixed end conditions. Detailing of reinforcement for single bay RCC frame with hinged and fixed end conditions.	
UNIT-IV	**10Hrs**
Necessity and proportioning of **combined footing**. Analysis and design of Combined footing with strap beam using SP16. Detailing of reinforcement for combined footing with strap beam.	
UNIT-V	**10Hrs**
Necessity of retaining walls. Types of RCC **retaining walls**. Analysis and design of Cantilever and counter fort retaining walls using SP16. Detailing of reinforcement for RCC retaining walls.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyze various forces in RC structures
CO2:	Design various RCC structures
CO3:	Demonstrate the Use of SP-16 in designing of RC structures
CO4:	Apply the principles of detailing of the reinforcements for RC structures

Reference Books	
1.	Reinforced Concrete Structures, Punmia B C, Volume 2, Standard Publishers and Distributors, 2004. ISBN :978-81-318-0644-9
2.	Limit State Design of Reinforced concrete, Varghese P C Eastern Economy Edition, Pentice Hall of India Pvt Ltd, New Delhi, 2nd Edition, 2004. ISBN: 8120320395
3.	Design of Reinforced Concrete Structures, Unnikrishnan Pillai and Devadas Menon PHI New Delhi, 4th Edition, 2003, ISBN: 0070495041
4.	Advanced Reinforced concrete Design, Krishna Raju N, CBS Publishers and Distributors, 4th Edition, 2012.ISBN : 1259003361

Codes:	
1	IS 456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards
2	SP 24-1983,Explanatory hand book on IS code of practice for plain and Reinforced concrete
3	SP 16-1980, Design Aids for IS code of practice for Plain and reinforced concrete, Bureau of Indian Standards
4	SP 34 : 1987, handbook on reinforcement and detailing, bureau of Indian standards, New Delhi

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.
Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

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

Low-1 Medium-2 High-3

Semester: VII						
PAVEMENT ANALYSIS AND DESIGN (Theory)						
Course Code	**:**	**16CV7G2**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand types ,components and factors affecting design of pavements
2	Analyze stresses in flexible pavements using layered system
3	Analyze stresses in rigid pavements
4	Design flexible and rigid pavements using IRC method

UNIT-I	
Types of pavement – types of pavements, advantages and limitations, composition and function, Factors affecting design of pavements.	**09 Hrs**
UNIT-II	
Stresses and Deflections in flexible pavement – layered systems concept, determination of stresses, homogeneous system, two layer, three layer elastic pavement system Various approaches to design of flexible pavements, Design of Flexible Pavement as per IRC 37 (2002 and 2012)	**09 Hrs**
UNIT-III	
Flexible Pavement design: Various approaches to design of flexible pavements, Design of flexible pavements as per IRC -37-2002 and 2012, overview of AASHTO method, overview of airfield pavement design	**10 Hrs**
UNIT-IV	
Stresses in rigid pavements – radius of relative stiffness of slab, modulus of sub-grade reaction, stress due wheel load and temperature, critical combination of stresses.	**10 Hrs**
UNIT-V	
Rigid Pavement design: IRC: 58 - 2015 method of Rigid pavement design – Importance of Joints in Rigid Pavements- Design of Joints – Design of Tie Bars and Dowel Bars.	**10Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the pavement components and its function
CO2:	Calculate stresses and deflection in flexible and rigid pavements
CO3:	Design and evaluate flexible pavement using IRC method
CO4:	Design and evaluate rigid pavements by IRC method

Reference Books	
1.	Principles of Pavement Design, Yoder and Witczak, -John Wiley and sons Inc ,Second Edition ,1975, ISBN : 978-81- 265-3072- 4.
2.	Pavement Design, R Srinivasa Kumar, University Press –,2013, ISBN 108173718857, ISBN – 13978-8173718854.
3.	Pavement Engineering: Principles and Practice, Rajib B. Mallick, Tahar El-Korchi, Second Edition, CRC Press, March 27, 2013, ISBN 9781439870358
4.	IRC 37-2001, 2012, IRC 81-1997, IRC 58 – 2002, 2015. IRC 59 – 1976, IRC 101-1988,Indian Roads Congress, New Delhi
5.	Highway Engineering, Khanna, Justo CEG, A Veeraraghavan, Enchant Publisher – 10th Edition.

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

Low-1 Medium-2 High-3

Semester: VII						
ROCK MECHANICS (Theory)						
Course Code	**:**	**16CV7G3**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	Understand the importance of Rock Mechanics.
2	Identify the rocks as materials used for civil engineering projects.
3	Interpret the behaviour of rocks to solve engineering problems.
4	Apply principles of rock mechanics for solving Civil Engineering problems.

UNIT-I	**09 Hrs**
Rock as a Material: Introduction, Fields of application of rock mechanics, rock forming minerals, classification of rocks-geological, petrographic and engineering. Index properties of rocks-porosity, density, permeability, strength and durability, logging of cores, core recovery, rock quality designation and its engineering importance.	
UNIT-II	**10 Hrs**
Defects in Rock masses: Discontinuities, Causes, strike and dip, bedding planes, stratification, joints, faults, types and importance of folds **Physical and mechanical properties of rocks**: Porosity, density, moisture content, degree of saturation, permeability, electrical properties, thermal properties, swelling, anisotropy, durability, mechanical properties, strength, tensile and compression strength	
UNIT-III	**10 Hrs**
Testing of Rocks : Laboratory testing- Uniaxial compression test, tension test, torsion test, hollow cylinder test, diametrical compression test, permeability tests, field tests- flat jack test, plate bearing tests. Insitu test for strength assessment in compression and shearing.	
UNIT-IV	**10 Hrs**
Strength of rocks: Stress- strain behaviour, factors influencing the strength of rocks- temperature, confining pressure, strain rates, modes of failures of rocks, failure theories of rocks, Mohr 'hypothesis, Griffith's criteria, Murrel's extension of Griffith's theory, elementary theory of crack propagation, failure of rock by crack propagation, effects of cracks on elastic properties.	
UNIT-V	**09 Hrs**
Rock foundations: Introduction, types of shallow and deep investigations for foundation design and construction aspect. **Rock slope Stability:** Modes of slope failures in rocks, Engineered slopes, slope design aspect, excavations in rocks and stabilization concepts.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe fundamental concepts of rock mechanics applied to Civil Engineering structures, mechanics and materials.
CO2:	Discuss engineering properties of rocks and behaviour of rocks.
CO3:	Apply the concepts of rock mechanics and rock as materials used in Construction for engineering problems.
CO4:	Demonstrate the applications of fundamentals for solving engineering problems.

Text books:	
1.	Fundamentals of Rock Mechanics , J. C. Jaeger, N. G.W. Cook, and R. W. Zimmerman , Blackwell Publishing Company, 4th Edition, 2007, ISBN-13: 978-0-632-05759-7
2.	Introduction to Rock mechanics , Richard E Goodman, John Wiley and Sons Inc., U.S.A, 2nd Edition, 2009, ISBN- 0-471-81200-5
3.	Engineering Rock Mechanics Introduction to the Principles, John A Hudson and John P Harrison, Pergamon Press, First Edition, 2000, ISBN:0 08 04 19 12 **7**

Reference books:	
1	Engineering in Rocks for Slopes, Foundations and Tunnels, T Ramamurthy PHI 2nd Edition, 2010, ISBN-971-81-203-4168-5
2	Geotechnology – An Introductory Text for Students and Engineers, A Roberts, 1st Edition 1977, ISBN 0-08-019602-0
3	Rock Mechanics in Engineering Practice', Stagg, K.G. and Zienkiewicz ,John Wiley and Sons, London, 1968, 1st Edition, ISBN 10: 0471819654 ISBN 13: 9780471819653.

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

Low-1 Medium-2 High-3

Semester: VII						
VALUATION ENGINEERING (Theory)						
Course Code	**:**	**16CV7G4**		**CIE**	**:**	**100**
Credits: L:T:P:S	**:**	**4:0:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**48**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives: The students will be able to	
1	To understand different types of outgoings
2	To analyze different methods of calculation of depreciation
3	To know the methods of valuations of different form of properties
4	To understand the methods of calculation of rent of the properties

UNIT-I	**09 Hrs**
Introduction: Purpose of valuation, Different forms of values. **Outgoings**: Municipal & Govt. Taxes, insurance, Loss of rent, collection charges, sinking fund, Annual repairs & maintenance. Depreciation. **Methods of calculation of depreciation**: Year's Purchase, Capitalized value, Obsolescence, Amortization.	
UNIT-II	**10 Hrs**
Methods of valuation: Open land valuation, Factors affecting intrinsic values of land, Comparative method, Abstractive method, Belting method. **Rent**: Definition, Forms of rents. Cost of structure, BIS rules for measuring plinth area and cubical contents. Rights and Liabilities of Lessor & Lessee, Leasehold properties, freehold Properties.	
UNIT-III	**10 Hrs**
Valuation of land with buildings: Rental method, Land and building method, Valuation on profit basis, Direct comparison of capital value, Residual or Development method. Valuation of agricultural/farm lands.	
UNIT-IV	**10 Hrs**
Easements: Self-imposed, Legally created, Dominant and Servient heritage. Effect of easements on valuation. **Market**: Real Estate market and market value, fair market value, open market value, affecting parameters. **Investments**: Bonds, debentures, capital gains, Wealth Tax and Income Tax.	
UNIT-V	**09 Hrs**
Case Studies: Valuation of immovable properties. Preparation of valuation reports for various types of buildings, land with buildings.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the different types of properties, outgoings, depreciations, Investments, valuation etc
CO2:	Apply the different methods of calculation of depreciation, valuation of buildings, open lands
CO3:	Analyze and evaluate the rent and value of the property scientifically
CO4:	Develop the valuation reports of the real properties

Reference Books	
1.	Principles and Practice of Valuation, John A Parks., Banerjee D.N., Eastern law house, 1998 ISBN:8171770940 9788171770946
2.	Professional Practice, Roshan H. Namavathi,.Lakhani Book Depot., 2001, ISBN : 9382472665 9789382472667
3.	Theory and Practice of Valuation, Mitra A.K., Eastern law house , 1986, ISBN : 087094-917-9
4.	Valuation Practices of Immovable Properties, Rao Gopinath C H, 2002. ISBN: 336.2220954 G 647

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10.

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

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

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

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

Low-1 Medium-2 High-3

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

Course Learning Objectives: The students will be able to

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

Unit-I	**06 Hrs**
Introduction to Nanomaterials: History of Nanotechnology, structures and properties of carbon based: Fullerenes (Bucky Ball, Nanotubes), metal based: Nano Shells, Quantum Dots, Dendrimers, Diamond like carbon(DLC) Nanocarriers, bionanomaterails: protein & DNA based nanostructures, Hybrids: hybrid biological/inorganic, Nanosafety Issues: Toxicology health effects caused by nanoparticles.	
Unit – II	**08 Hrs**
Characterization of Nanostructures: Spectroscopy: UV-Visible spectroscopy, Fourier Transform infrared spectroscopy (FTIR), Raman Spectroscopy, X-ray spectroscopy. **Electron microscopy**: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM).**Scanning probe microscopy**: Atomic Force microscopy (AFM), Scanning tunnel microscopy (STM). **Nano Synthesis and Fabrication**: Introduction & overview of Nanofabrication: Bottom up and Top down approaches using processes like Ball milling, Sol-gel Process, Chemical Vapour deposition (CVD), plsma arching and various lithography techniques (Hard & Soft lithography).	
Unit –III	**09 Hrs**
Nanosensors: Overview of nanosensors, prospects and market. Types of Nanosensors and their applications. Electromagnetic nanosensors: Electronic nose and electronic tongue, Magnetic nanosensors. Mechanical nanosensors: Cantilever Nanosensors, Mechanics of CNTs, Biosensors: Biosensors in modern medicine.	
Unit –IV	**06 Hrs**
Micro & Nano-Electromechanical systems and Microfluidics: MEMS/NEMS: Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators. Microfludics: Laminar flow, Hagen-Peouiselle equation, basic fluid ideas, Special considerations of flow in small channels, mixing, microvalves & micropumps.	
Unit –V	**07 Hrs**
Applications of Nanotechnology: Molecular electronics, molecular switches, mechanical cutting tools, machine components, DLC coated grinding wheels. solar cells, Batteries, fuel cells, Nanofilters. Medical nanotechnology: in Diagnostics, Therapeutics, Drug delivery and Nanosurgery.	

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

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

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

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

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

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

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

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

Course Learning Objectives: The students will be able to

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

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

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

Reference Books	
1	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, North corolina, Lulu publication, 2012, ISBN:1291187235
2	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M. , Pensulvania ISA publication,2005,ISBN:155617909X
3	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutcheon. , The University of Alberta press, Canada, 1st Edition,2003,ISBN: 0888643942.
4	Environmental Engineering – A Design Approach, Sincero A P and Sincero G A , Prentice

	Hall of India, New Delhi,1996, ISBN: 0024105643
5	Risks in Chemical units, Pandya C G, Oxford and IBH publications, New Delhi, 1992,ISBN: 8120406907

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

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

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

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

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

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

Course Learning Objectives: The students will be able to

1	Understand basic traffic flow and control for ITS
2	Understand user services for application in transportation system
3	Understand ITS architecture and its planning at various levels
4	Evaluate user services at various levels

Unit – I	**8 Hrs**
Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs. **Fundamentals of Traffic Flow and Control**- Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation	
Unit – II	**6 Hrs**
ITS User services-User services bundles, Travel and Traffic management, Public Transportation Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Management, Advanced Vehicle Control and safety systems, Information Management, Maintenance and construction Management	
Unit –III	**7 Hrs**
ITS Applications and their benefits-Freeway and incident management systems-objectives, functions, traffic Surveillance and incident detection, Ramp control, incident management, Advanced arterial traffic control systems- historical development, Adaptive traffic control algorithms, Advanced Public Transportation Systems-Automatic vehicle location systems, Transit Operations software and information systems, Electronic fare payment systems, Multimodal Traveler Information systems	
Unit –IV	**7 Hrs**
ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool. **ITS Planning**-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies.	
Unit –V	**8 Hrs**
ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing. **ITS Evaluation** – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify various applications of ITS
CO2:	Apply ITS applications at different levels.
CO3:	Examine ITS architecture for planning process.
CO4:	Define the significance of ITS for various levels

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

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10. The total marks of CIE are 100.

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

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

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

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

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

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

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

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

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

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

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

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

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

Semester: VII						
IMAGE PROCESSING AND MACHINE LEARNING (Group H: Global Elective)						
Course Code	**:**	**16G7H05**		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	100 Marks
Total Hours	**:**	**36**		**SEE Duration**	**:**	03 Hours

Course Learning Objectives: The students will be able to

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

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

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

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

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

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

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

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

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

SEMESTER: VII						
DESIGN OF RENEWABLE ENERGY SYSTEMS (GROUP H: GLOBAL ELECTIVE)						
Course Code	**:**	**16G7H06**		**CIE Marks**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

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

UNIT – I	**07 Hrs**
An introduction to energy sources: Industry overview, incentives for renewable, utility perspective, Relevant problems discussion, current positions of renewable energy conditions	
UNIT – II	**09 Hrs**
PV Technology: photovoltaic power, PV projects, Building-integrated PV system, PV cell technologies, solar energy maps, Technology trends, **Photovoltaic Power Systems**: PV cell, Module and Array, Equivalent electrical circuit, open-circuit voltage and short-circuit current, I-V and P-V curves, Array design (different methodologies), peak-power operation, system components.	
UNIT – III	**09 Hrs**
Wind Speed and Energy: Speed and power relations, power extracted from the wind, Air density, Global wind patterns, wind speed distribution (parameters calculations) , wind speed prediction, **Wind Power Systems :** system components , turbine rating , power vs. speed and TSR, maximum energy capture, maximum power operation, system-design trade-offs , system control requirements, environmental aspects.	
UNIT – IV	**07 Hrs**
Geothermal and ocean energy: Geothermal power, geo pressured sources, Geothermal well drilling, advantages and disadvantages, Comparison of flashed steam and total flow concept **Energy from ocean**: OTEC power generation, OPEN and CLOSED cycle OTEC. Estimate of Energy and power in simple single basin tidal and double basin tidal system	
UNIT – V	**08 Hrs**
Stand alone system: PV stand-alone, Electric vehicle, wind standalone, hybrid systems (case study), system sizing, wind farm sizing. **Grid-Connected Systems: i**ntroduction**,** interface requirements, synchronizing with the grid, operating limit, Energy storage and load scheduling**,** Grid stability issues**,** distributed power generation.	

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

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

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

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

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

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

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

VII Semester						
SYSTEMS ENGINEERING (Group H: Global Elective)						
Course Code	**:**	**16G7H07**		**CIE Marks**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**03 Hours**

Course Learning Objectives:

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

Unit-I	**07 Hrs**
System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems. **Structure of Complex Systems:** System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions. **The System Development Process:** Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.	
Unit – II	**07 Hrs**
Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **Needs Analysis:** Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, and problems. **Concept Exploration:** Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.	
Unit – III	**07 Hrs**
Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems **Advanced Development:** Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.	
Unit – IV	**06 Hrs**
Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. **Integration and Evaluation:** Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.	
Unit – V	**06 Hrs**
Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. **Operations and support**: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.	

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

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

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

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

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

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

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

Semester: VII						
MEMS AND APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	**16G7H08**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the rudiments of Micro fabrication techniques.
2	Identify and associate the various sensors and actuators to applications.
3	Analyze different materials used for MEMS.
4	Design applications of MEMS to disciplines.

Unit - I	**06 Hrs**
Overview of MEMS & Microsystems: MEMS and Microsystems, Typical MEMS and micro system products, Evolution of micro fabrication, Microsystems and microelectronics, Multidisciplinary nature of Microsystems, Design and manufacture, Applications of Microsystems in automotive, healthcare, aerospace and other industries. **Working Principle of Microsystems**: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal.	
Unit – II	**08 Hrs**
Micro actuation: Using thermal forces, shape memory alloys, Piezoelectric crystals and electrostatic forces. MEMS with micro actuators: Microgrippers, micromotors, microvalves and micropumps, microaccelerometers, microfluidics**.** **Introduction to Scaling:** Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics.	
Unit – III	**08 Hrs**
Materials for MEMS and Microsystems: Substrates and wafers, Active substrate materials, Silicon as substrate material, Silicon Compounds, Si-Piezoresistors, GaAs, Quartz, Piezoelectric Crystals, Polymers and packaging materials. Three level of Microsystem packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem packaging. Essential packaging technologies: die preparation, Surface bonding, Wire bonding, Sealing, 3D packaging.	
Unit – IV	**06 Hrs**
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD,PVD-Sputtering, Deposition of Epiaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	
Unit – V	**07 Hrs**
Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors. **Overview, Application, Fabrication Process in Applications:** Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Electrostatic Comb drive, Portable blood analyzer, Piezo electric Inkjet Print head, Micromirror array for Video projection.	

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

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

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

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

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

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

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

Semester: VII						
INTRODUCTION TO INTERNET OF THINGS (Group H: Global Elective)						
Course Code	**:**	**16G7H09**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Learn the fundamentals of IoT
2	Understands the hardware, networks & protocols used in IoT development
3	Illustrate smart applications using IoT devices and building applications
4	Know more advanced concepts like cloud connectivity in IoT
5	Learn the fundamentals of IoT

Unit-I	**06 Hrs**
Fundamentals Of IOT: Introduction, Physical design of IoT, Logical design of IoT, IoT Enabling technologies, IoT Levels and Deployment Templates, , IoTvs M2M	
Unit – II	**06 Hrs**
IOT Design Methodology: Need for IoT systems management, IoT Design Methodology **Internet of Things Strategic Research and Innovation Agenda:** Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Smart-X Applications, Internet of Things and Related Future Internet Technologies.	
Unit –III	**11 Hrs**
IOT Systems - Logical Design using Python: Provides an introduction to Python, installing Python, Python data types & data structures, control flow, functions, modules, packages, file input/output, data/time operations and classes.	
Unit –IV	**09 Hrs**
IOT Physical Devices & Endpoints: What is an IoT device, Raspberry Pi device, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.	
Unit –V	**07 Hrs**
IOT Physical Servers & Cloud Offerings: Provides an introduction to the use of cloud platforms and frameworks such as Xively and AWS for developing IoT applications.	

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

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

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

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

Semester: VII						
INDUSTRY 4.0– SMART MANUFACTURING FOR THE FUTURE (Group H: Global Elective)						
Course Code	**:**	**16G7H10**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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

Unit-I	**06 Hrs**
Smart Manufacturing and Industry 4.0 Need for Smart Manufacturing, Advantages, Emerging technologies in Smart manufacturing, CAD Architecture surrounding 3D Models (B-rep and CSG), MEMS, Industry 4.0–Interoperability, Information transparency, Technical assistance, Decentralized decision-making, Internet of Things(IoT), Industry Internet of Things (IIoT), Future of Manufacturing industries	
Unit – II	**09 Hrs**
Manufacturing Automation Technology intensive manufacturing and cyber-physical systems, Automation using Robotics, Data storage, retrieval, manipulation and presentation; Mechanisms for sensing state and modifying processes, Material handling systems, controlling material movement and machine flow, Mechatronics, Transducers and sensors, Proximity sensors, Biosensors, Acceleration Machine Vision–Flaw detection, Positioning, Identification, Verification and Measurement–Application of Machine Vision in industries	
Unit –III	**09 Hrs**
Data handling using Embedded Systems Data transformation–Mathematical functions, Regression, Need for different functions, Data merging–Discrete and Random variables, Transformation languages, Interfacing systems-Microprocessors, Direct memory access, Data transfer schemes and systems, Communication systems–Modulation, Time domain and frequency domain, Industrial Network Data Communications, Data Security Artificial Intelligence – Intelligent systems, Fuzzy logics, Neural networks – Supervised, Unsupervised and Reinforced learning	
Unit –IV	**06 Hrs**
Simulation, Modeling and Analysis Simulation - system entities, input variables, performance measures, and Functional relationships, types of simulation. Predictive modeling and simulation tools, Knowledge Modeling –types and technology options, Functional analysis of control systems – Linear and Non-linear, Functional decomposition, Functional sequencing, Information / dataflow, Interface	
Unit –V	**09 Hrs**
Performance Measures of Smart Manufacturing Systems- Smart manufacturing- Sensing and Perception, Manipulation, Mobility and Autonomy, Factory Networks, Information Modeling and Testing, Performance Measurement and Optimization, Engineering System integration, Production Network integration, Production network data quality, Sustainable Processes and Resources, Integration Infrastructure for Sustainable Manufacturing	

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

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

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

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

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS (Group H: Global Elective)						
Course Code	**:**	**16G7H11**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3 : 0 : 0**		**SEE**	**:**	**100 Marks**
Hrs/Week	**:**	**36**		**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	Analyze satellites in terms of technology, structure and communications.
3	Use satellites for space applications, remote sensing and metrology.
4	Apply the space technology, technology mission and advanced space systems to nation's growth.

UNIT-I	**07 Hrs**
Earth's environment: Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. **Launch Vehicles:** Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.	
UNIT-II	**07 Hrs**
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability, Payloads, Space simulation. **Satellite structure:** Satellite Communications, Transponders, Satellite antennas.	
UNIT-III	**07 Hrs**
Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques. **Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Tele-medicine, Satellite navigation, GPS.	
UNIT-IV	**07 Hrs**
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. **Metrology:** Weather forecast (Long term and Short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.	
UNIT-V	**07Hrs**
Satellite payloads: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and International space Missions. **Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Inter-space communication systems.	

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

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

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

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

Semester: VII						
ADVANCED LINEAR ALGEBRA (Group G: Global Elective)						
Course Code	**:**	**16G7H12**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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

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

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

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

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 60 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project 10.
Total CIE is 30(Q) +60(T) +10(A) =100 Marks.

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

Semester: VII						
THIN FILM NANOTECHNOLOGY (Group G: Global Elective)						
Course Code	**:**	**16G7H13**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

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

Unit-I	**08 Hrs**

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

Unit – II	**08 Hrs**

Methods of thin film preparation

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

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

Chemical Vapor Deposition (CVD) Techniques**:** Conventional CVD, Plasma Enhance CVD (PECVD) and Atomic layer deposition (ALD).Other Methods: Spin coating and Spray Pyrolysis.

Unit –III	**07 Hrs**

Surface Modification and Growth of Thin Films:

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

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

Unit –IV	**08 Hrs**

Properties and Characterization of Thin Films

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

Unit –V	**08 Hrs**

Thin Film Applications:

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

Thin Film Devices:

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

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

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

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

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

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

Semester: VII						
ENGINEERING MATERIALS FOR ADVANCED TECHNOLOGY (Group H: Global Elective)						
Course Code:	**:**	**16G7H14**		**CIE**	**:**	100 **Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	100 **Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	3.00 **Hours**

Course Learning Objectives: The students will be able to

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

UNIT-I — **08 Hrs**

Coating and packaging materials

Surface Coating materials:

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

Properties required in a pigment and extenders.

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

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

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

Packaging materials:

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

Pharmaceutical products: Injectibles and tablet packaging materials.

UNIT-II — **07 Hrs**

Adhesives

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

UNIT-III — **08 Hrs**

Optical fibre materials

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

Ion exchange resins and membranes

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

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

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

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

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

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

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

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

Semester: VII (Global elective)						
APPLIED PSYCHOLOGY FOR ENGINEERS						
Course Code	**:**	**16G7H15**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives: The students will be able to

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

Unit – I	**7 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit - II	**7 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit – III	**7 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio- Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment. Psychological Stress: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress. Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control.	
Unit – IV	**7 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. Distance learning, Psychological consequences of recent developments in Information Technology. Type A and Type B Psychological Counseling - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	
Unit – V	**7 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	
Experimental Psychology (Practicals)- Self Study 2 Hrs /Week	
1.Bhatia's Battery of Performance and intelligence test 2.Multidimensional Assessment of Personality 3.David's Battery of Differential Abilities (Aptitude test) 4.Bilateral Transfer of Training Mirror drawing apparatus with Electronic Digital Reset Error Counter (Performance) 5. Student Stress Scale.	

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

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

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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.

VII Semester						
FOUNDATIONAL COURSE ON ENTREPRENEURSHIP (Group H: Global Elective)						
Course Code	**:**	**16G7H16**		**CIE Marks**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE Marks**	**:**	**100**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**03 Hours**

Course Learning Objectives:

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

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

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

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

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

CIE is executed by way of Quizzes (Q), Tests (T) and Assignment (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 is 10. The total marks of CIE are 100.

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

Semester End Evaluation (SEE); Theory (100 Marks)- (Needs to be discussed)

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

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

Course Learning Objectives: The students will be able to

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

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

Course Outcomes: 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	Assess the performance and airworthiness of the designed UAV

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

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

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

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

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

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

Semester: VIII						
MAJOR PROJECT (Common to all Programs)						
Course Code	**:**	**16CV81**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**0:0:16:0**		**SEE**	**:**	**100 Marks**
Hours / Week	**:**	**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.

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 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 weightages 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

Semester: VIII						
TECHNICAL SEMINAR (Common to all Programs)						
Course Code	**:**	**16CV82**		**CIE**	**:**	**100 Marks**
Credits: L:T:P:S	**:**	**0:0:2:0**		**SEE**	**:**	**100 Marks**
Hours / Week	**:**	**04**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Recognize recent developments in specific program and in multidisciplinary fields.
2	Summarize the recent technologies and inculcate the skills for literature survey.
3	Demonstrate good presentation skills.
4	Plan and improve the Technical Report writing skills.
5	Support Group discussion and Team work.

General Guidelines for the Seminar

1. The seminar has to be presented by individual student.
2. The topic of the seminar should be from current thrust area along with consultation with the guide.
3. The topic can be based on standard papers (like ASCE/IEEE etc.) in the thrust area for the selected topic.
4. Presenting/publishing this paper in conference/ Journal will be given weightage in CIE.
5. The student needs to submit both hard & soft copy of the seminar report.
6. **As an outcome of Technical Seminar, each student has to prepare a technical paper out of seminar topic.**

Course Outcomes of Technical Seminar:	
1	Communicate effectively on complex engineering problems and demonstrate contextual knowledge to assess societal and environmental contexts.
2	Identify, formulate, review research literature, analyze and Design solutions for complex engineering problems using appropriate techniques with effective documentation.
3	Analyze, interpret and synthesize the information to provide valid conclusions with innovative ideas and ethical principles.
4	Apply the knowledge of engineering specialization to suggest solutions to complex engineering problems and recognize the need for technological changes.

Evaluation of CIE Marks:

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

Semester: VIII						
INNOVATION & SOCIAL SKILLS (Common to all Programs)						
Course Code	**:**	**16HS83**		**CIE**	**:**	**NA**
Credits: L: T:P:S	**:**	**0:0:2:0**		**SEE**	**:**	**NA**
Hours / Week	**:**	**02**		**SEE Duration**	**:**	**NA**

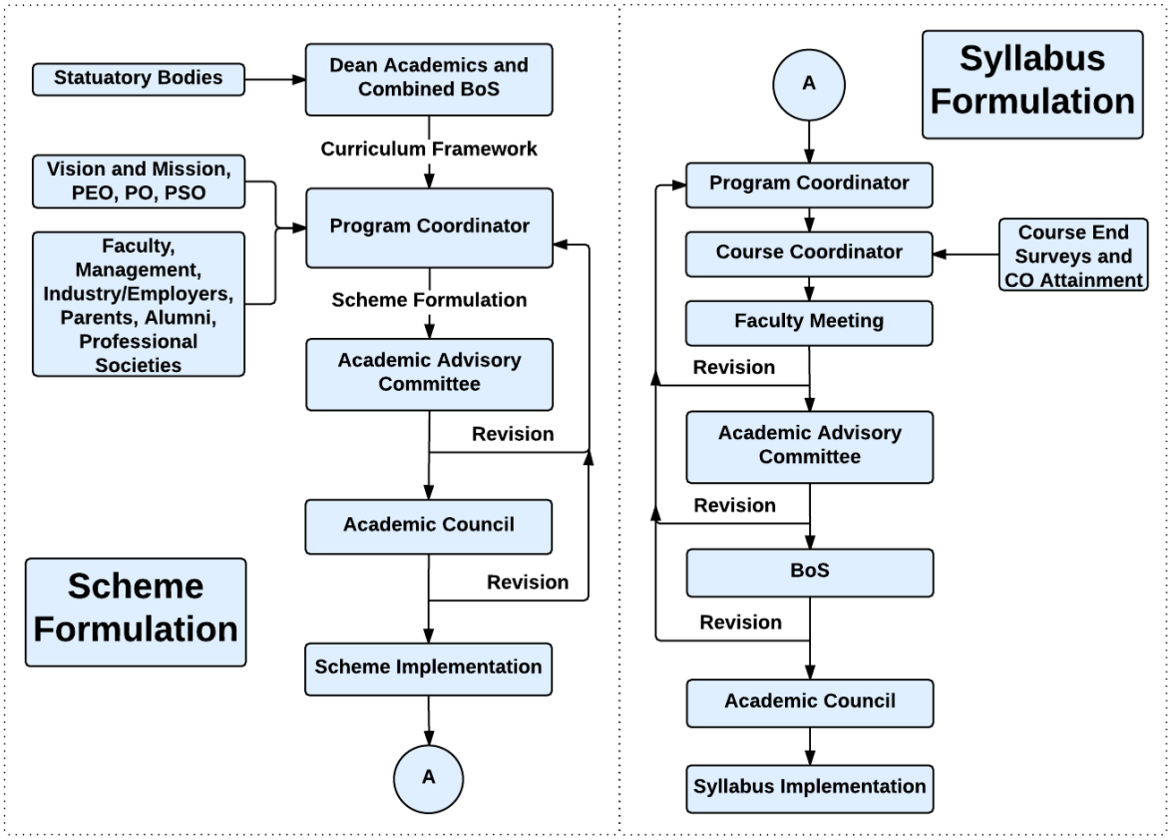
Course Learning Objectives: The students will be able to	
1	To provide a platform for the students to exhibit their organizational capabilities, team building, ethical values and extra mural abilities.
2	To encourage to carryout innovative ideas and projects.
3	Take part in societal and community building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

Guidelines

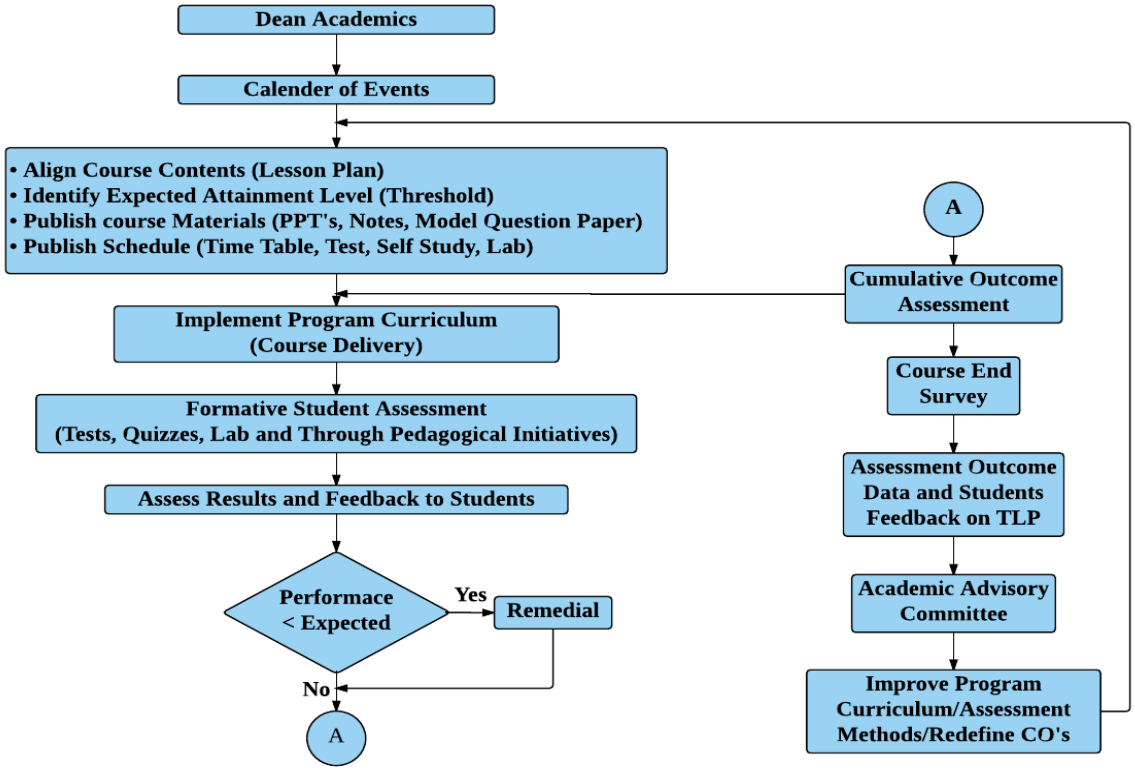
1. The HSS will be evaluated individually based on the broad parameters which include the progress made by student during 3rd& 4th year in innovative projects, Seminar, Paper Presentation, Field activity & other Co-curricular activities.
2. Students shall submit a report and documents as a proof his/her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

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

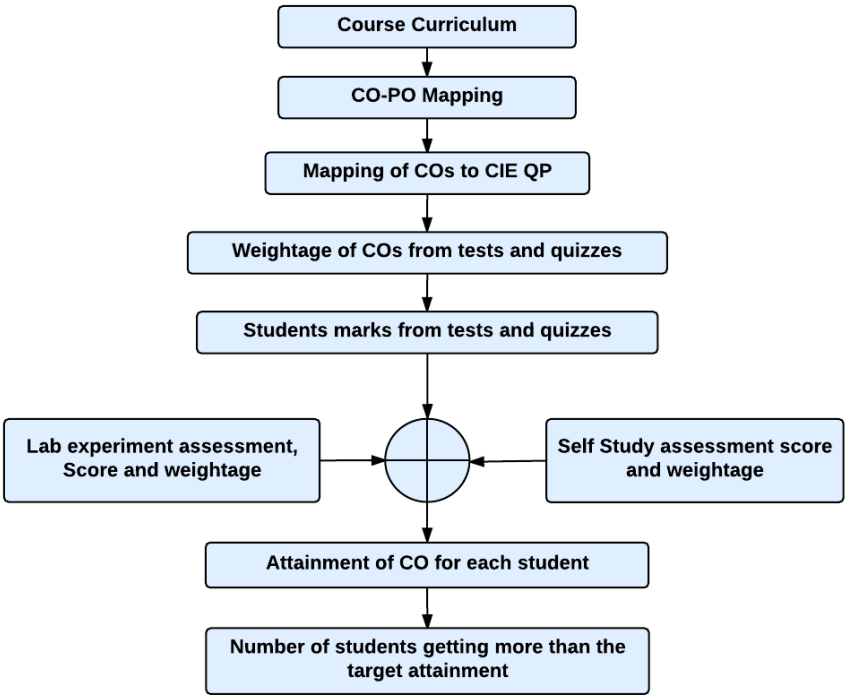
Curriculum Design Process



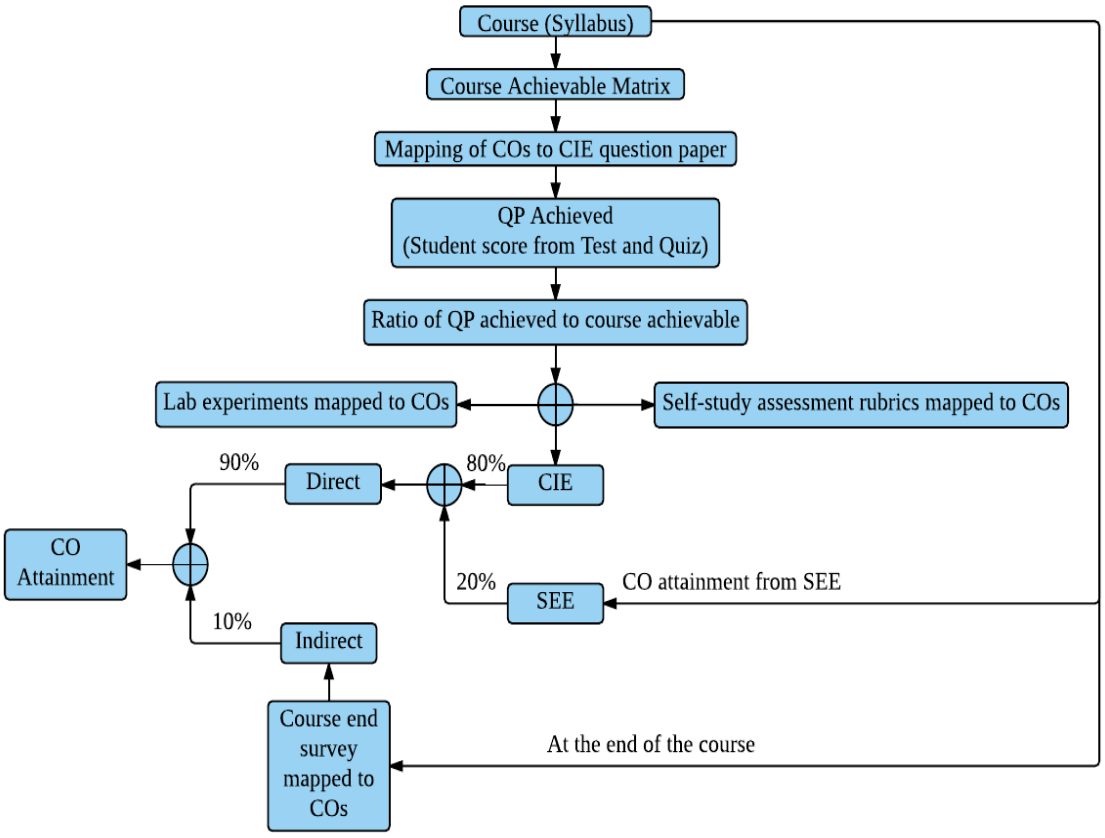
Academic Planning and Implementation



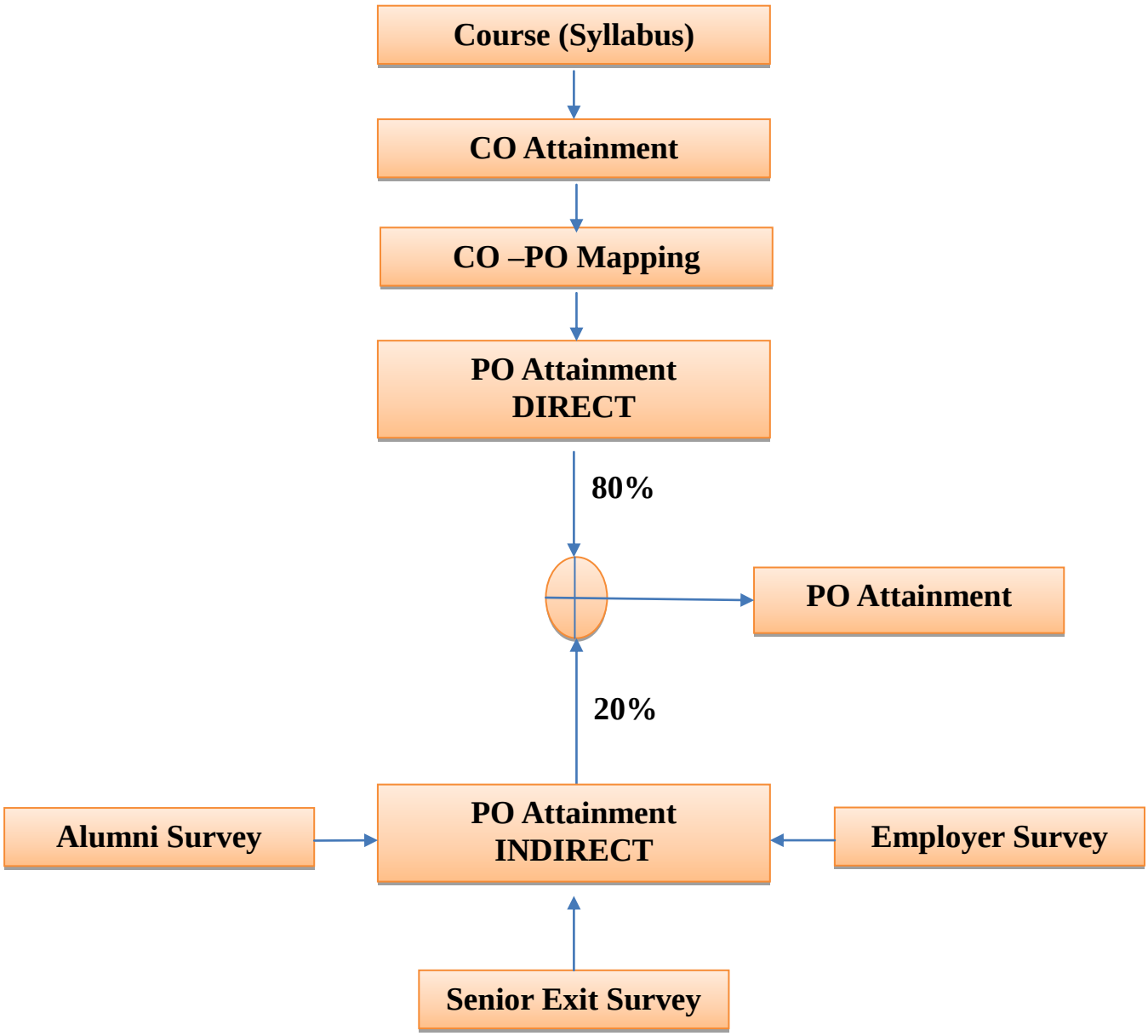
PROCESS FOR COURSE OUTCOME ATTAINMENT



Final CO Attainment Process



Program Outcome Attainment Process



Guidelines for Fixing Targets

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

PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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