RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

Scheme and Syllabus of V & VI Semesters of Bachelor of Engineering (B.E.)

(2021 Scheme)

(AS PER NEP-2020 GUIDELINES)

CIVIL ENGINEERING

ACADEMIC YEAR 2023-2024

Department of Civil Engineering

Vision

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

Mission

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

Program Educational Objectives

After successful completion of the program, the graduates will be able to

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

1. Apply knowledge of fundamental aspects to analyze and design civil engineering structures.

2. Provide sustainable solutions to civil engineering problems.

3. Employ codal provisions to arrive at comprehensive solutions to address societal needs

4. Exhibit communication and teamwork skills.

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.	PY	Physics
9.	CY	Chemistry
10.	MA	Mathematics
11.	AS	Aerospace Engineering
12.	AI & ML	Artificial Intelligence & Machine Learning
13.	BT	Biotechnology
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	CV	Civil Engineering
17.	EC	Electronics & Communication Engineering
18.	EE	Electrical & Electronics Engineering
19.	EI	Electronics & Instrumentation Engineering
20.	ET	Electronics & Telecommunication Engineering
21.	IM	Industrial Engineering & Management
22.	IS	Information Science & Engineering
23.	ME	Mechanical Engineering

INDEX

B.E. IN
CIVIL ENGINEERING

V SEMESTER													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**				**Theory**	**Lab**		**Theory**	**Lab**
1	21HS51B	Principles of Management & Economics	3	0	0	3	HSS	Theory	1.5	100	--	3	100	--
2	21CV52	Design and Drawing of RCC Structures	3	0	1	4	CV	Theory + Lab	1.5	100	50	3	100	50
3	21CV53	Highway Engineering	3	0	1	4	CV	Theory + Lab	1.5	100	50	3	100	50
4	21CV54	Hydrology and Irrigation	3	1	0	4	CV	Theory	1.5	100	--	3	100	--
5	21CV55BX	Professional Core Elective-I (Group-B)	3	0	0	3	CV	Theory	1.5	100	--	3	100	--
6	21CV56CX	Professional Core Elective-II (Group C)	2	0	0	2	CV	NPTEL	1.5	50	--	2	50	--
7	21CVI57	Summer Internship- II	0	0	2	2	CV	Internship	1		50	2		50
		Total				**22**								
Note: Summer Internship-II will be undertaken between IV & V semester for a period of 06 Weeks (this will have both CIE & SEE)														

GROUP-B		
S No	**Course Code**	**Course Title**
1.	21CV55B1	Traffic Engineering
2.	21CV55B2	Alternate Building Materials and Technologies
3.	21CV55B3	Remote sensing and GIS
4.	21CV55B4	Bridge Engineering

GROUP-C (NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1	21CV56C1	Laboratory Practices in Earth Sciences: Landscape Mapping
2	21CV56C2	Introduction to Civil Engineering Profession
3	21CV56C3	Earthquake Resistant Design of Foundations
4	21CV56C4	Introduction to Accounting and Finance for Civil Engineers
5	21CV56C5	Expansive Soil

Semester: V/VI						
Principles of Management & Economics **Category: Common to all Programs** **Stream: Theory**						
Course Code	**:**	**21HS51B / 61B**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45Hrs**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**06 Hrs**
Introduction to Management: Management Functions – POSDCORB – an overview, Management levels & Skills, Management History - Classical Approach: Scientific Management, Administrative Theory, Quantitative Approach: Operations Research, Behavioural Approach: Hawthorne Studies, Contemporary Approach: Systems Theory, Contingency Theory. Caselets / Case studies	
Unit – II	**10 Hrs**
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate strategies – types of corporate strategies, BCG matrix, Competitive Strategies – Porters Five force Model, types of Competitive Strategies. Caselets / Case studies Organizational Structure & Design: Overview of Designing Organizational Structure - Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures. Caselets / Case studies	
Unit –III	**10 Hrs**
Motivation: Early Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory. Contemporary Theories of Motivation: Adam's Equity theory, Vroom's Expectancy Theory. Caselets / Case studies Leadership: Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. Caselets / Case studies	
Unit –IV	**10 Hrs**
Introduction to Economics: Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems. **Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India. **Macroeconomic Indicators:** Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations.	
Unit –V	**09 Hrs**
Essentials of Microeconomics: Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Elucidate the principles of management theory & recognize the characteristics of an organization.
CO2	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO3	Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation.
CO4	Demonstrate an understanding on the usage and application of basic economic principles.
CO5	Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation.

Reference Books	
1.	Management, Stephen Robbins, Mary Coulter & Neharika Vohra, 15th Edition, 2021, Pearson Education Publications, ISBN: 13: 978-0-13-558185-8
2.	Management, James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 2009, PHI, ISBN: 81-203-0981-2.
3.	Principles of Microeconomics, Steven A. Greenlaw, David Shapiro, 2nd Edition, 2017, ISBN:978-1-947172-34-0
4.	Macroeconomics: Theory and Policy, Dwivedi D.N, 5th Edition, 2021, McGraw Hill Education; ISBN : 9789353163334

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
PART A		
1	Objective type questions covering entire syllabus	20
PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)		
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
DESIGN AND DRAWING OF RCC STRUCTURES **Category: Professional Core Course** **Stream: Theory& Practice**						
Course Code	**:**	**21CV52**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3.0 Hours + 3Hours**

Unit-I	**8 Hrs**
Principles of Limit State Design and Ultimate Strength of RC Sections Philosophy of limit state design, Principle of limit states, Factor of safety , Characteristic and design loads, Characteristic and design strength, General aspects of ultimate strength, Stress block parameters for limit state of collapse, Ultimate flexural strength of rectangular sections- singly reinforced and doubly reinforced, Ultimate flexural strength of flanged sections, Ultimate torsional strength of RC sections, Concept of development length and anchorage, Analysis problems using IS 456:2000	
Unit – II	**8 Hrs**
Design of beams Practical requirements of RCC beam; size, cover and spacing of bars, Design of rectangular and flanged RCC beams for flexure, shear, deflection, Anchorage, etc. (Simply supported and Cantilever beams only) using IS 456:2000 and SP16	
Unit –III	**8 Hrs**
Design of Slabs General considerations for design of slabs, Rectangular slabs spanning in one direction, Rectangular slabs spanning in two directions for various boundary conditions, Torsion reinforcement design for two way slabs, Design of simply supported and cantilever slabs as per IS 456:2000.	
Unit –IV	**8 Hrs**
Design of columns General aspects, effective length of column, loads on columns, slenderness ratio, Slender column, Minimum eccentricity, Design of short axially loaded columns, Design of columns subjected to axial load and uni-axial moment. Using IS 456:2000 and SP16.	
Unit –V	**8 Hrs**
Design of stairs Loading on stairs, Design of doglegged stairs, design of open-well stairs as per IS 456:2000. **Design of Footings** Introduction, Load on footing, Design of square and rectangular isolated footings for axial load and uni-axial moment as per IS 456:2000.	
Laboratory	
Preparation of salient drawings and schedule of bars adopting the given data: 1. Singly and Doubly reinforced beams - Simply supported and cantilever beams. 2. T- Beam and slab arrangement. 3. One-way and two-way slab with and without torsion reinforcement. 4. Dog legged and Open well staircase. 5. Square, rectangular and Circular Isolated column with footing.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply the philosophy and principles of limit state method and analyze RC sections
CO 2	Analyze and design RC beams and slabs by limit state method as per codal provisions
CO 3	Analyze and design RC columns, stairs and footings by limit state method as per codal provisions
CO 4	Sketch rebar details and calculate the quantity of steel for RC sections as per codal provisions

Reference Books	
1.	Reinforced Concrete Design (IS: 456-2000 Principles and Practice), R.N. Pranesh, N. Krishna Raju, New Age International (P) Limited, New Delhi, 1st Edition, 2014, ISBN13:9788122414608
2.	Limit State Design of Reinforced Concrete, Varghese P.C, Eastern Economy Edition, Prentice –Hall of India Pvt Ltd, New Delhi, 2nd Edition, 2004, ISBN 9788120320390
3.	Design of Reinforced Concrete Structures, Unnikrishnan and DevadasMenon, PHI, New Delhi, 4th Edition, 2003,ISBN 978-0070495043
4.	RCC Designs (Reinforced Concrete Structures), Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, New Delhi, 10th Edition, 2011, ISBN 978-81-318-0942-6
IS Codes	
1.	IS 456: 2000, Indian Standard,Plain and Reinforced Concrete – Code of Practice (Fourth Revision), BIS, New Delhi, 2000
2.	SP-16, Design Aids for Reinforced Concrete to IS: 456-1978, BIS, New Delhi, 1997

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE THEORY & LABORATORY	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	20
2	Conduction of the Experiments	20
3	Viva	10
	TOTAL	**50**

Semester: V						
HIGHWAY ENGINEERING **Category: Professional Core Course** **Stream: Theory and Practice**						
Course Code	**:**	**21CV53**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3.0Hours + 3.0Hours**

Unit-I	**8 Hrs**
Principles of Transportation Engineering: Overview of basic characteristics of Transportation systems, social factors and strategic consideration, Salient features of ongoing major road projects in the country, Classifications of Urban and rural roads. Engineering surveys for alignment, objectives, conventional and modern methods.	
Unit – II	**8 Hrs**
Highway Geometric Design: Design factors; Cross-section elements, Sight distances-Types, Factors affecting and measurements. Design of Horizontal alignment and vertical alignment. (Note: Derivation not required)	
Unit –III	**8 Hrs**
Pavement Design: Factors affecting design; Traffic volume and Axle load survey, Layers, design requirements, Flexible pavement design as per IRC: 37 – 2018. Design of rigid pavement as per IRC: 58 – 2015(Excluding design of joints)	
Unit –IV	**8 Hrs**
Highway Drainage System: Importance and requirements, Surface and Subsurface drainage system - methods. Highway Construction: Construction of Subgrade, Granular Sub Base, Wet Mix Macadam, Bituminous concrete course, Paving quality concrete course.	
Unit –V	**8 Hrs**
Highway Maintenance and Economics: Importance of highway maintenance, Distresses and remedial measures for Flexible and Rigid pavements. Importance of Highway Economics, user benefits and costs, Economic analysis, Highway financing in India.	
Laboratory	
Tests on Soil 1. California bearing ratio **Tests on aggregates** 2.Shape of aggregates 3.Ten percent fines 4.Los Angeles abrasion **Tests on Bitumen** 5. Kinematic Viscosity 6. Softening point 7.Ductility 8. Penetration 9. Specific Gravity **Tests on mixes** 10. Proportioning of aggregates **Innovative Experiments** Marshall method of mix design	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain suitable geometry, materials and drainage system for design and construction of pavements.
CO 2	Compute the design requirements for geometry, drainage and pavements.
CO 3	Select suitable geometry, materials and drainage for design and construction of pavements.
CO 4	Evaluate and recommend geometry materials and design for pavements.

Reference Books	
1.	Khanna, S.K. and Justo, C.E.G, Veeraragavan A, 'Highway Engineering', Nemechand and Bros. Roorkee, 10th Edition, 2014 ISBN: 9788185240633, 8185240639
2.	R Srinivasa Kumar, "Highway Engineering", Universities Press (India) Private Limited, Reprinted 2018, ISBN:978 81 7371 681 2
3.	L. R. Kadiyali, N.B. Lal , Principles And Practices Of Highway Engineering , Khanna Publishers, 2004, ISBN-13: 978-8174091659
4.	Khanna, Justo and Veeraragavan - 'Highway Material Testing' Nemechand Bros, Roorkee, 5th Edition, 2009,ISBN 9788185240213

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE THEORY AND LABORATORY	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	20
2	Conduction of the Experiments	20
3	Viva	10
	TOTAL	**50**

Semester: V						
HYDROLOGY AND IRRIGATION ENGINEERING **Category: Professional Core Course** **Stream: Theory**						
Course Code	**:**	**21CV54**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L+28T**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**9 Hrs**
Hydrology: Introduction, Hydrologic cycle (Horton's representation and Engineering Representation), water budget equation, Applications in engineering, sources of Data, numerical problems. **Precipitation:** Forms and types of precipitation, Measurement of rainfall using Symon's and Syphon type of rain gauges, Optimum number of rain gauge stations, Consistency of rainfall data (double mass curve method), Computation of mean rainfall, Estimation of missing data, presentation of precipitation data, numerical problems.	
Unit – II	**9 Hrs**
Losses: Evaporation: Introduction, Process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae (Meyer's and Rohwer's equations) Reservoir evaporation and control. **Evapo-transpiration:** Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation. **Infiltration:** Introduction, factors affecting infiltration, infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices, numerical problems.	
Unit –III	**8 Hrs**
Runoff: Factors affecting runoff, runoff measurement, Estimation of runoff using rational and empirical methods, numerical problems. **Hydrographs:** Components of hydrographs, unit hydrograph and its derivation from simple storm hydrograph, base flow separation, preparation of unit hydrographs – from isolated storms, method of superposition, numerical problems.	
Unit –IV	**8 Hrs**
Irrigation: Definition, Benefits and ill effects of irrigation, System of irrigation: surface and ground water, flow irrigation, lift irrigation, Bandhara irrigation. **Water Requirements of Crops:** Duty, delta and base period, relationship between them, factors affecting duty of water, crops and crop seasons in India, irrigation efficiency, and frequency of irrigation.	
Unit –V	**8 Hrs**
Canals: Types of canals. Alignment of canals. Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Unlined and lined canals. Standard sections. Design of canals by Lacey's and Kennedy's method.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Describe various hydrological parameters and irrigation practices in use for design of water resources projects.
CO 2	Understand the hydrological aspects of surface water and concepts of irrigation water management
CO 3	Determine various hydrological parameters over a catchment, crop water requirement and storage capacity of a reservoir.
CO 4	Analyse the hydrological data, stream flow data for design of conveyance system, canal works hydraulic structures.

Reference Books	
1.	Engineering Hydrology, Subramanya K., Tata McGraw Hill, New Delhi, 4th Edition, 2013, ISBN-10: 1259029972, ISBN-13: 978-1259029974.
2.	Irrigation Engineering and Hydraulic Structures, S.K.Garg, Khanna publications, New Delhi.2006, ISBN-10: 8174090479, ISBN-13: 978-8174090478.
3.	Irrigation water resources and water Power Engineering, P.N.Modi, Standard book house, 9th Edition, 2008, ISBN 8189401297, ISBN-13: 978-8189401290
4.	Applied Hydrology, VenTe Chow, Tata McGraw Hill Edition, 2010, ISBN-13:9780070702424, ISBN-10:007070242X.
5.	Irrigation Engineering, R.K. Sharma, S Chand & company; Revised Edition 2007, ISBN-10: 8121921287, ISBN-13: 978-8121921282.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
TRAFFIC ENGINEERING **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV55B1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction to traffic Engineering: Traffic engineering as a profession, elements, modern problems. Traffic Components and their characteristics: road user and vehicle characteristics, roadways and their geometric characteristics, introduction to road safety.	
Unit – II	**8 Hrs**
Traffic studies: Statistical applications in traffic engineering, objectives, methodologies, analysis and interpretation of traffic studies – volume studies, speed, travel time and delay studies, origin and destination studies, accident studies and parking studies.	
Unit –III	**8 Hrs**
Traffic flow and roadway capacity: Traffic stream parameters – headway, occupancy, density and capacity. Fundamental relationships between traffic flow parameters, Level of service, Equivalency factors, design service volume.	
Unit –IV	**8 Hrs**
Intersections design and control: Classification, factors considered in design, design principles, conflict points at intersection, signal timings for different colour indications. Introduction to control devices – markings, signs, signals, special controls.	
Unit –V	**8 Hrs**
Traffic control and management: Objectives, benefits, Low cost techniques – one way street, turn restrictions, tidal flow. Advanced methods – Computer controlled coordinated signal control system, ITS- design, Technology used in ITS, ITS architecture, subsystems of ITS. **Traffic and Environment**: Detrimental effects of Traffic on Environment; Air pollution; Noise Pollution; Measures to curtail environmental degradation due to traffic.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the various traffic characteristics and fundamental of traffic flow
CO 2	Understand traffic surveys and evaluate traffic data
CO 3	Analyze various traffic control measures and design traffic engineering facilities
CO 4	Evaluate the methods of traffic management and understand the role of Intelligent Transportation System

Reference Books	
1.	Roess, Roger P., Elena S. Prassas, and William R. McShane. Traffic engineering. Pearson/Prentice Hall, 2019, ISBN 978-93-325-0936-8.
2.	Garber N.J., and Hoel L.A., Traffic and Highway Engineering, 4th Edition, Cengage Learning, 2009,
3.	Kadiyali, L.R., 'Traffic Engineering', Khanna Publishers, 7th Edition, 2001, ISBN 8174091653, 97881740916.
4.	R Srinivasa Kumar., Introduction to traffic Engineering, University Press (India) private Limited 2018, ISBN 978-93-86235-47-3.
5.	Chandra, Satish, S. Gangopadhyay, S. Velmurugan, and Kayitha Ravinder. "Indian highway capacity manual (Indo-HCM)." (2017).

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
ALTERNATE BUILDING MATERIALS AND TECHNOLOGIES **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV55B2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42 Hrs**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction to Energy in building materials Energy in building materials, Environmental issues concerned to building materials, Global warming, Environmental friendly and cost effective building technologies, Buildings in different climatic region. Energy evaluation of building materials – building materials.	
Unit – II	**9 Hrs**
Introduction to alternative to cement and mortars, Masonry units: Alternatives to Cements and fine aggregates, Mortars, Types, Preparation, Properties, Masonry materials Classification and properties of mortars, selection of mortars. Manufacturing process and Characteristics of alternative masonry units - stabilized mud blocks, Geo polymer, FaL- G Blocks, Aerated concrete blocks, mud concrete blocks etc - strength, modulus of elasticity and water absorption. Polymer mortars.	
Unit –III	**9 Hrs**
Alternative Building Technologies Alternative Technology for wall construction, Ferro cement and ferro concrete building, components, Materials and specifications, Properties, Construction methods, Applications, Alternate form works. Alternative roofing systems-Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes. Bamboo application in housing and building construction.	
Unit –IV	**8 Hrs**
Fibre Reinforced composites (cementations and polymer): Types and Properties of constituent materials for Fibre Reinforced composites, Properties of Fibre Reinforced composites and Applications of Natural fibre reinforced composites, Glass fibre reinforced composites, Carbon fibre reinforced composites and Slurry Infiltrated Fiber Concrete.	
Unit –V	**8 Hrs**
Cost Effective Building Design: Concept of appropriate Cost Effective buildings and Cost saving techniques adopted in planning, design and construction and Factors governing Cost Effective buildings.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Process environmental appropriate and resource-efficient solutions throughout a building's life-cycle
CO 2	Innovate solutions using state-of-the-art technologies and building materials
CO 3	Minimize environmental impact by facilitating to use local and recycled materials to lessen energy in buildings
CO 4	Assess the behavior of materials and structures

Reference Books	
1.	Alternative building Materials and Technologies, K.S.Jagadish, B.V.Venkatarama Reddy and K.S.Nanjunda Rao, New Age International Private Limited; 2nd Edition (1 January 2017);ISBN 978-9385923876
2.	K.S .Jagadish, Building Alternatives for housing. Lecture notes on Alternative Building, Dept of Civil Engg, Indian Institute of Science ,1997
3.	Paul Graham McHenry, Adobe and Rammed Earth Buildings: Design and Construction, University of Arizona Press; New Edition (15 September 1989), ISBN-10: 0816511241, ISBN-13:978-0816511242
4.	Ferrocement & Laminated Cementitious Composites, Antoine E. Naaman, Techno Press 3000 (1January 2000), ISBN-13 : 978-0967493909
5.	Sustainable Building Technology, K.S. Jagadish, I K International Publishing House Pvt. Ltd (30 March 2019) ISBN-13: 978-9386768209.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
REMOTE SENSING AND GIS **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	:	**22CV55B3**		**CIE**	:	**100 Marks**
Credits: L:T:P	:	**3:0:0**		**SEE**	:	**100 Marks**
Total Hours	:	**40L**		**SEE Duration**	:	**3.0 Hours**

Unit-I	**8 Hrs**
Remote Sensing: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution (spatial, spectral, radiometric and temporal), image registration and Image and False color composite, elements of visual interpretation techniques.	
Unit – II	**8 Hrs**
Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms - IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor. Basics of digital image processing- introduction to digital data, systematic errors (Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity, Earth Rotation) and non-systematic [random] errors (Altitude, Attitude), Image enhancements (Gray Level Thresholding, level slicing, contrast stretching), image filtering.	
Unit –III	**8 Hrs**
Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.	
Unit –IV	**8 Hrs**
Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, and Data conversion.	
Unit –V	**8 Hrs**
Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services And Its Applications.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Describe the various principles of Remote sensing, energy interactions and visual interpretation techniques
CO 2	Explain distortion properties associated with platforms, sensors and capturing of remotely sensed data
CO 3	Explain the data models, coordinate systems and attribute data management with respect to GIS
CO 4	Apply the principles and techniques of Remote Sensing and GIS in the analysis of land use land cover, change detection, water resources management and planning, urban planning, natural resource management and traffic management.

Reference Books	
1.	Lillesand T, Kiefer R W, Chipman J, "Remote Sensing and Image Interpretation", 7th Edition, *Wiley Publishers* (2015), ISBN: 9781118919453
2.	Jensen R John, "Remote Sensing of the Environment: An Earth Resource Perspective", 2nd Edition, *PearsonEducation India* (2013), ISBN:9789332518940
3.	Chang K T, "Introduction to Geographic Information Systems", 4th Edition, *Mc Graw Hill Eduction* (2017), ISBN: 0070658986
4.	Bhatta B, "Remote Sensing and GIS", 3rd Edition, *Oxford University Press, India* (2021), ISBN: 0199496641

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
BRIDGE ENGINEERING **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV55B4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction: Historical Development of Bridges, Site Selection for Bridges, Necessary Investigations & collection of essential bridge design data, Different stages of planning, Classification of Bridges, Requirements of an ideal bridge. **Hydraulic Design**: Methods of finding design discharge, Natural artificial and linear water ways, afflux, economic span of bridge, Scour depth	
Unit – II	**9 Hrs**
Bridge substructures: General, Design and construction of Bridge piers, Abutments, Wing walls, Approaches, Bearings for bridges, Types of bearings. **Superstructures & Design Aspects**: Components - Parapets and Railings for Highway Bridges, Classification of Highway Bridge parapets, Cross barriers and its Details.	
Unit –III	**9 Hrs**
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. **Bridge Loading**: Standard Specifications for Roads and Railways Bridges, Railway Loading standards. IRC standard live loads.	
Unit –IV	**8 Hrs**
Low-cost bridges- Introduction, types of low-cost bridges, Cause-ways, suspension bridges, Culverts. **Box Culvert**: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, Structural Design of Slab Culvert.	
Unit –V	**8 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. **Introduction to structural health monitoring in integration with AI**: Simulation study and incorporation of different types of sensors. Inspection & Maintenance of bridges.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Describe the principle of bridge site investigation, bridge hydrology and standards.
CO 2	Apply the Codal provisions of IRC 6 and IRC 21 in the design of Bridges.
CO 3	Analysis of bridges subjected to various loads.
CO 4	Design of RCC Deck slab bridge for Class AA tracked vehicle loading.

Reference Books	
1.	S. P. Bindra —Principles & Practices of Bridge Engineering‖, Dhanpat Rai &Sons publication, New Delhi, 2012, ISBN 978-8189928841.
2.	M. A. Jayaram —Design of Bridge Structure, PHI Pvt Ltd., 2nd Edition, 2012, ISBN 9788120338524.
3.	D. Johnson and Victor —Essentials of Bridge Engineering, Oxford and IBH publications, 6th Edition, 2019, ISBN 978-8120417175.
4.	Krishnaraju N —Design of Bridge, Oxford & IBH Publications, 5th Edition, 2019 ISBN: 978-8120417984.
5.	S.Ponnuswamy- Bridge Engineering, McGraw Hill Education, 3rd Edition, 2017, ISBN: 978-9339221072.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
Laboratory Practices in Earth Sciences: Landscape Mapping (MOOC Course)						
Course Code	**:**	**21CV56C1**		**CIE**	**:**	**50 Marks**
Credits:L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
TotalHours	**:**	**30L**		**SEEDuration**	**:**	**3.0 Hours**

Content	**30 Hrs**
Laboratory Practices in Earth Sciences: Landscape Mapping is a thorough and practical course that explores remote sensing, fieldwork, and laboratory studies to better understand the surface and subsurface geological and geomorphological structures. The fundamental principles, techniques, and methodologies that have been used to investigate, analyze, and map landscapes across the world will be covered in this course. It is a comprehensive educational experience that incorporates theoretical ideas, real-world applications, and ethical problems. This course offers a strong basis for your career choice, irrespective of whether you want to pursue a career in the Earth Sciences or want to learn more about landform mapping techniques.	

Semester: V						
Introduction to Civil Engineering Profession (MOOC Course)						
Course Code	**:**	**21CV56C2**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**3.0 Hours**

Content	**30 Hrs**
Week 1: What is Civil Engineering? Different disciplines of civil engineering. Scope and prospects. Heritage structures, architecture **Week 2:**Environmental Engineering. Prevention of environmental impact. Pollution, waste and water treatment **Week 3:**Geotechnical Engineering. Soil mechanics and foundations. Hydraulics and water resources **Week 4 :**Construction Materials and Methods. Infrastructure Engineering. Sustainability **Week 5 :**Structural Engineering. Analysis, design and modelling **Week 6 :**Highway Engineering. Traffic Engineering and Planning **Week 7 :**Automation and Robotics in Construction. Water Security **Week 8:**Novel areas. Career Prospects	

Semester: V						
Earthquake Resistant Design of Foundations (MOOC Course)						
Course Code	**:**	**21CV56C3**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**3.0 Hours**

Content	**30 Hrs**
Week 1: Introduction: General requirements, types of shallow and deep foundations and their use; performance of various types of foundations during past earthquakes. Shallow Foundations: IS codes for bearing capacity and settlement of foundations, foundation design, modes of soil failure. **Week 2**: Shallow Foundations: Safe bearing capacity, differential & total settlements, increase in permissible stress under earthquake loads. Methods of analysis, experimental investigations, Combined footings for earthquake loads **Week 3**: Shallow Foundations: Raft foundation, modulus of sub grade reaction, Winkler model, beam on elastic foundation. Dynamic Bearing Capacity under Transient & Earthquake Type Loads: Types of dynamic loads; Footing requirements to account for settlements and earthquake induced forces; Pseudo-Static analysis of footings with eccentric & inclined loads. Effect of horizontal load and moment. Dynamic Analysis of shallow foundations for various modes of vibrations **Week 4**: Pile Foundations: Types of piles based on usage, material, construction etc. pile load capacity in compression, Bearing capacity of piles, group action of piles, settlement of a pile group; **Week 5**: Pile Foundations: Laterally loaded piles, elastic analysis; Reese and Matlock approach, fixity of pile heads, dimensionless factors; Pile with dynamic loads. **Week 6**: Pile Foundations: soil-pile analysis with spring-mass & FEM idealisation, elements for slip and separation, soil-pile interaction, IS code of practice for design of pile foundations, piles through liquefiable soils **Week 7**: Well Foundations & Caissons: Types; components; scour depth, depth & bearing capacity of wells, static forces considered in stability of wells; Lateral stability of well foundations. Pseudo-static analysis with earthquake induced loads, Lateral load resistance of well foundation; Terzahi's approach; IRC, IS and Indian Railway Codes, their limitations. **Week 8**: SSI for Deep Foundations: Soil-Structure Interaction, Modelling of Unbounded Soil Media for Dynamic Loads, Free Field Motion, Kinematic Interaction and Inertial Interaction.	

Semester: V						
Introduction to Accounting and Finance for Civil Engineers (MOOC Course)						
Course Code	:	**21CV56C4**		**CIE**	:	**50 Marks**
Credits: L:T:P	:	**2:0:0**		**SEE**	:	**50 Marks**
Total Hours	:	**30L**		**SEE Duration**	:	**3.0 Hours**

Content	**30 Hrs**
Week 1 : Basic Accounting and concepts in finance; Book keeping: definitions, objectives, elements, journal and ledger. **Week 2 :** Accounting & Concepts in Finance I: definitions, objectives, characteristics, limitations, basic terms; GAAP (Generally Accepted Accounting Principles) **Week 3 :** Accounting & Concepts in Finance II: Systems of accounting, cash book, bank book, depreciation; provisions, reserves, accounting equation, journal & ledger entries,trial balance, profit & loss; account,balance sheet, cash flow statement) **Week 4 :** Analysis of financial statements I: Financial leverage, financial ratios **Week 5 :** Analysis of financial statements II: Significance and applications **Week 6 :** Financial planning including capital budgeting I: Definition, financial planning options and objectives, time value of money **Week 7 :** Financial planning including capital budgeting II: simple and compound interest, rule of 72, methods of capital budgeting - payback period **Week 8 :** Financial planning including capital budgeting III: Accounting rate of return (ARR), net present value (NPV), internal rate of return (IRR)	

Semester: V						
Expansive Soil (MOOC Course)						
Course Code	**:**	**21CV56C5**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**3.0 Hours**

Content	**30 Hrs**
Week 1: Introduction to soil mechanics **Week 2:** Clay mineralogy, introduction to Expansive soils **Week 3:** Swelling behavior of expansive soil **Week 4:** Swelling-shrinkage characteristics of expansive soil **Week 5:** Behaviour of expansive soil **Week 6:** Treatment of expansive soil-1 **Week 7:** Treatment of expansive soil-2 **Week 8:** Foundation on expansive soil, Engineering application of expansive soil	

Semester: V						
SUMMER INTERNSHIP - II (Practical)						
Course Code	:	21XXI57		**CIE**	:	50 Marks
Credits: L: T: P	:	0:0:2		**SEE**	:	50 Marks
Total Hours	:	4 Weeks		**SEE Duration**	:	2.0 Hours
Students can opt the internship with the below options						4 Weeks

A. Within the respective department at RVCE (Inhouse) Departments may offer internship opportunities to the students through the available tools so that the students come out with the solutions to the relevant societal problems that could be completed within THREE WEEKS.

B. At RVCE Center of Excellence/Competence

RVCE hosts around 16 CENTER OP EXCELLENCE in various domains and around 05 CENTER OP COMPETENCE. The details of these could be obtained by visiting the website https:/ /rvce.edu.in / rvce-center-excellence. Each centre would be providing the students relevant training/internship that could be completed in three weeks.

C. At InternShala

Intern Shala is India's no.1 internship and training platform with 40000+ paid internships in Engineering. Students can opt any internship for the duration of three weeks by enrolling on to the platform through https: / /internshala.com

D. At Engineering Colleges nearby their hometown

Students who are residing out of Bangalore, should take permission from the nearing Engineering College of their hometown to do the internship. The nearby college should agree to give the certificate and the letter/email stating the name of the student along with the title of the internship held with the duration of the internship in their official letter head.

E. At Industry or Research Organizations

Students can opt for interning at the industry or research organizations like BEL, DRDO, ISRO, BHEL, etc.. through personal contacts. However, the institute/industry should provide the letter of acceptance through hard copy/email with clear mention of the title of the work assigned along with the duration and the name of the student.

Procedures for the Internship:

1. Request letter/Email from the office of respective departments should go to Places where internships are intended to be carried out with a clear mention of the duration of Three Weeks. Colleges/Industry/ CoEs/CoCs will confirm the training slots and the number of seats allotted for the internship via confirmation letter/ Email.
2. Students should submit a synopsis of the proposed work to be done during internship program. Internship synopsis should be assessed or evaluated by the concerned Colleges/Industry/CoEs/CoC. Students on joining internship at the concerned Colleges/Industry/ CoEs/CoCs submit the Daily log of student's dairy from the joining date.
3. Students will submit the digital poster of the training module/project after completion of internship.
4. Training certificate to be obtained from industry.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Develop interpersonal, critical skills, work habits and attitudes necessary for employment.
CO2	Assess interests, abilities in their field of study, integrate theory and practice and explore career opportunities prior to graduation.

CO3	Explore and use state of art modern engineering tools to solve the societal problems with affinity towards environment and involve in ethical professional practice.
CO4	Compile, document and communicate effectively on the internship activities with the engineering community.

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1	**REVIEW I:** Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments, exhibiting professional and ethical practice, communication skills (oral and body language).	**20**
2	**REVIEW II**: Presentation in the form digital poster, report writing, exhibiting ethics in report writing, oral presentation.	**30**
	MAXIMUM MARKS FOR THE CIE	**50**

RUBRICS FOR SEMESTER END EXAMINATION		
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner.		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	**20**
2	Conduction of the Experiments	**20**
3	Viva	**10**
	TOTAL	**50**

B.E. IN
CIVIL ENGINEERING

VI SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21HS61A	Intellectual Property Rights & Entrepreneurship	3	0	0	3	HSS	Theory	1.5	100	--	3	100	--
2	21CV62	Water and wastewater Engineering	3	0	1	4	CV	Theory + Lab	1.5	100	50	3	100	50
3	21CV63	Geotechnical Engineering	3	0	1	4	CV	Theory + Lab	1.5	100	50	3	100	50
4	21CV64DX	Professional Core Elective (Group – C)	3	0	0	3	CV	Theory	1.5	100	--	3	100	--
5	21CV65EX	Professional Core Elective (Cluster Elective) (Group- D) (TWO Courses under Each Program)	3	0	0	3	CV	Theory	1.5	100	--	3	100	--
6	21IE66FX	Institutional Electives – I (Group E)	3	0	0	3	XX	Theory	1.5	100	--	2	50	--
		Total				**20**								

GROUP-D		
Sl. No.	**Course Code**	**Course Title**
1.	21CV64D1	Advanced Concrete Technology
2.	21CV64D2	Transportation Engineering
3.	21CV64D3	Integrated Watershed Management
4.	21CV64D4	Structural Masonry

GROUP-E		
Sl. No.	**Course Code**	**Course Title**
1	21CV65E1	Disaster Management
2	21CV65E2	Solid Waste Management
3	21CH65E1	Bio-energy Technology
4	21CH65E2	Hydrogen Technology
5	21BT65E1	Nanobiotechnology
6	21BT65E2	Nature Impelled Technologies

GROUP-E			
Sl. No.	**Course Code**	**BoS**	**Course Title**
1	21IE6F1	CH	Industrial Safety and Risk Management
2	21IE6F2	EE	Renewable Energy Systems
3	21IE6F3	IM	Systems Engineering
4	21IE6F4	ME/EC	Mechatronics
5	21IE6F5	MA	Mathematical Modelling
6	21IE6F6	ME	Industry 4.0 – Smart Manufacturing for The Future
7	21IE6F7	HSS	Industrial Psychology for Engineers
8	21IE6F8	IM	Elements of Financial Management
9	21IE6F9	HSS	Universal Human Values-II
10	21IE6F10	EC	Human Machine Interface (Industry offered Elective)

Semester: VI

INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP
Category: Common to all Programs
Stream: Theory

Course Code	**:**	**21HS61A**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**09 Hrs**

Introduction: Types of Intellectual Property
Patents: Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; protection of traditional knowledge, Infringement of patents and remedy, Case studies
Patent Search and Patent Drafting, Commercialization and Valuation of IP. Case examples.

Unit – II	**08 Hrs**

Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India.
Trade Marks: Concept, function and different kinds and forms of Trade marks, Registrable and non-registrable marks. Registration of Trade Mark; Deceptive similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies. Case Examples.

Unit –III	**08 Hrs**

Industrial Design: Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies.
Copy Right: Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies.
Introduction to Cyber law: Information Technology Act, cybercrime and e-commerce, data security, confidentiality, privacy, international aspects of computer and online crime.

Unit –IV	**09 Hrs**

Entrepreneurship: Introduction, Evolution of the Entrepreneurship, Importance of Entrepreneurship, Concept of Entrepreneurship, Characteristics of a successful Entrepreneur, Classification of Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development Models, Problems Faced by Entrepreneurs and Capacity Building for Entrepreneurship .Women Entrepreneurship in Asia, Women Entrepreneurship in India, Challenges Faced by Women Entrepreneurs. Case studies.
Entrepreneurship in the New Age: Getting to know your Business, it's Eco-system and Environment, Passion and Values driving, building and growing Family businesses, Challenges and suggested management approaches.

Unit –V	**11 Hrs**

Business Plans: Introduction ,Purpose of a Business Plan ,Contents of a Business Plan, Business Concept, Business Strategy, Marketing Plan, Operations Plan, Financial Plan, Presenting a Business Plan, Oral and Visual Presentation, Why Do Some Business Plans Fail? Procedure for Setting Up an Enterprise, Business Models and Business Model Innovation Creating a Business Plan. Case lets/Case studies.
Preparation of project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. Use of standard templates for preparation of project report.

Reference Books	
1.	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.
2.	Intellectual Property and the Internet, Rodney Ryder, 2002, Lexis Nexis U.K., ISBN: 8180380025, 9788180380020.
3.	Poornima M. Charantimath "Entrepreneurship Development and Small Business Enterprise", Pearson Education, 2005, ISBN: 9788177582604
4.	Dynamics of Entrepreneurial Development & Management-Vasant Desai, Himalaya Publishing House, 6th Edition, 2018, ISBN - 978-93-5299-133-4
5	Entrepreneurial development, Khanka, Shobhan Singh, S. Chand Publishing, 2006, ISBN - 8121918014, 9788121918015

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Comprehend the applicable source, scope and limitations of Intellectual Property within the purview of engineering domain.
CO2	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.
CO3	Enable the students to have a direct experience of venture creation through a facilitated learning environment.
CO4	It allows students to learn and apply the latest methodology, frameworks and tools that entrepreneurs use to succeed in real life.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)* (Small case lets and case example in one subdivision)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
WATER AND WASTE WATER ENGINEERING **Category: Professional Core Course** **Stream: Theory& Practice**						
Course Code	**:**	**21CV62**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3.0 Hours + 3.0Hours**

Unit-I	**8 Hrs**
Demand of water: Conservation of water resources. Need of protected water supply. Types of water demands -domestic demand, industrial, institutional and commercial, public uses, fire demand **Percapita consumption** -factors affecting, population forecasting - different methods with merits and demerits, Problems, Variations in demand of water, Peak factor, Design periods and factors governing the design period. Numerical **Sources:** Various sources with their quality and quantity comparison. Need for protected water supply. **Collection and Conveyance of water:** Types of pumps with working principles. Design of the economical diameter for the rising main.	
Unit – II	**8 Hrs**
Pipe appurtenances: Valves and different Pipe materials with their advantages and disadvantages. Factors affecting the selection of pipe material. CPHEEO Guidelines **Intake structures** - Types. Factors to be considered in the selection of sites for intake structures. Master balancing reservoir, Over Head tanks, Intermediate pump stations and their designs. **Examination of water** of Physical, Chemical and Microbiological Examinations, using analytical & Instrumental techniques. Drinking water standards BIS, ICMR & WHO standards.	
Unit –III	**8 Hrs**
Water treatment: Objectives, Treatment flow chart, Screening – types **Plain Sedimentation** – Theory of sedimentation, Types of settling, Sedimentation tank Types, design problems **Coagulant Aided sedimentation**- Common coagulants used with reaction, advantages and disadvantages. **Filtration:** theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning. Design excluding under drainage system. **Distribution system**: Methods- gravity, pumping, combined, Layouts- Dead end, Radial, Grid Iron, Circular system. Network analysis- Hardy cross method, Hazen Williams formula, Numerical problems, EPANET and WATERGEMS	
Unit –IV	**8 Hrs**
Types of sewerage system and their suitability. **Construction of sewers**: Types of sewers, self cleansing and non scouring velocity, planning of sewerage system, layout and construction of sewer line, testing of sewer line, cleaning and maintenance of sewer line, ventilation of sewers **Sewer appurtenances** – inlets, catch basins, clean outs, manholes, drop manholes, lamp holes, flushing tanks, grease and oil traps, inverted siphons, storm regulators. **Waste water characteristics** - Physical, chemical and biological characteristics. BOD and COD Determination. Numerical	

Unit –V	8 Hrs
Methods of treatment for waste water: preliminary, Primary, Secondary, tertiary Unit operations/processes and treatment systems used to remove major contaminants of waste water. trickling filter and ASP excluding design. **Methods of waste water disposal** - Dilution method – conditions favouring the method, Self-purification of natural stream, Zones of pollution in stream, Oxygen sag analysis, problems. Sewage sickness, Disposal by land treatment: condition favourable, methods. **Introduction to Artificial Intelligence in WWT:** Types and application of AI in waste water treatment.	
Laboratory Experiments	
1. Jar Test for optimum Dosage of Alum. Turbidity Determination by Nephelometer 2. Determination of Iron, Phenanthroline method 3. Determination of Fluorides and Nitrate 4. Design of complex Water Supply system from Source to Destination with all the components using EPANET 5. Hydraulic Design of Intake structure – Intake well and Jackwel as per CPHEEO guidelines 6. Economical diameter analysis of a rising main as per CPHEEO guidelines 7. Determining the critical path for the pump head in multi-directional pumping stations 8. Model a typical Multi-village water supply system using EPANET 9. Model typical in-village water supply system using EPANET 10. Examination of different water and waste water samples and report.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand quality, quantity of various sources of water and compare with water quality standards, make appropriate choice for a community.
CO 2	Analyze water and Design different water treatment units to purify available raw water to the require standards.
CO 3	Evaluate collection and transportation system for water and sewage.
CO 4	Evaluate waste water quality and environmental significance of various parameters and Select suitable waste water treatment and disposal method

Reference Books	
1.	Environmental Engineering vol-I, S.K.Garg; M/s Khanna Publishers; 33rd edition, New Delhi 2010, ISBN 978-8174091208
2.	Environmental Engineering Vol II, S.K.Garg; M/s Khanna Publishers; New Delhi 2013, ISBN 978-8174092304
3.	Environmental Engineering I, B.C. Punmia and Ashok Jain Laxmi Publications (P)Ltd., New Delhi 2018, ISBN 81-7008-825-9
4.	Environmental Engineering II , B.C. Punmia and Ashok Jain Laxmi Publications (P)Ltd., New Delhi 2010, ISBN: 9788131805961, 9788131805961
5.	Water & Waste Water Technology, Mark.J Hammer, John Wiley & Sons Inc., New York, 2008. Howard S. Peavy, Donald R. Rowe, George T, Environmental Engineering - McGraw Hill International Edition. New York, 2000.ISBN 9780070191342ISBN 9780131745421
6.	Chemistry for Environment Engineering, Sawyer and McCarthy, Tata Mc Graw Hill Publications (2003 Edition). ISBN 0070549788, 9780070549784
7.	CPHEEO Manual of Water Supply and treatment 1999 & sewerage and sewage treatment 2013

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE THEORY & LABORATORY	**150**

Semester: VI						
GEOTECHNICAL ENGINEERING **Category: Professional Core Course** **Stream: Theory & Practice**						
Course Code	**:**	**21CV63**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**42L + 28P**		**SEE Duration**	**:**	**3.0Hours + 3.0Hours**

Unit-I	**9 Hrs**
Index Properties: Definition, Basic Terminology, Soil as a Three phase system, Soil Mass, Void ratio, Porosity, Degree of saturation, Air content, Percentage Air Voids, Water content, Unit weight, Specific gravity. Interrelations and related problems, Tests for water content and specific gravity, Particle Size Distribution (Sieve analysis and Hydrometer analysis), Consistency of Soils- Atterberg Limits, Field Density and Density Index.	
Unit – II	**9 Hrs**
Classification Of Soil: Soil Classification Purpose, Unified Soil Classification System and Indian Standard Soil Classification System, Field identification of soils. **Soil Structure and Clay Mineralogy:** Soil structure types, Common clay minerals in soil and their structures - Kaolinite, Montmorillonite and Illite. **Permeability:** Darcy's Law and its Limitations, Discharge Velocity and Seepage Velocity, Factors affecting Permeability, Aquifers and flow through aquifers, Determination of Coefficient of Permeability, Permeability of Stratified Soil Deposits, related problems.	
Unit –III	**8 Hrs**
Compaction: Introduction, Compressibility, Compaction, Standard Proctor Test, Modified Proctor Test, Zero air voids line, Field Compaction Method, Placement Water Content, Field Compaction Control, Factors affecting Compaction, Effect of Compaction on Soil Properties, Compaction equipment's.	
Unit –IV	**8 Hrs**
Consolidation : Introduction, Piston-Spring Analogy, Primary and Secondary Consolidation, Terzaghi's Theory of One Dimensional Consolidation, Normally consolidated, under consolidated and over consolidated soils, Pre-consolidation pressure and its determination by Casagrande's method, Laboratory one dimensional consolidation test – Determination of Compression index and co-efficient of consolidation, Determination of co-efficient of consolidation by square root of time fitting method and logarithmic time fitting method.	
Unit –V	**8 Hrs**
Shear Strength of Soils : Introduction, Mohr Circle for Two Dimensional Stress System, Mohr-coulomb failure theory, Total and effective shear strength parameters, Determination of Shear Parameters - Direct Shear Test, Triaxial Compression Test, Unconfined Compression Test based on Drainage Conditions, Skempton's Pore Pressure Parameters, Shear Strength of sands and Clays, Sensitivity and Thixotropy.	

LABORATORY
List of Experiments
1. Specific Gravity determination 2. Moisture Content determination 3. Sieve Analysis for Coarse-grained Soils 4. Hydrometer Analysis for Fine-grained Soils 5. Atterberg Limits and Indices a. Liquid limit b. Plastic limit c. Shrinkage limit Standard Proctor Compaction Test Field Density Test . Core Cutter Method a. Sand Replacement Method Determination of Permeability of soils . Constant Head Method a. Variable Head Method Determination of Shear Strength of soils . Direct Shear Test a. Triaxial Shear Test (UU only) b. Unconfined Compression Test

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Describe the Index and Engineering properties of Soils and soil structure.
CO 2	Determine the permeability, compaction characteristics and shear parameters of soil.
CO 3	Evaluate index and Engineering properties of soils, analyze and interpret the experimental data
CO 4	Predict the Suitability of soil for a particular project based on its Engineering properties.

Reference Books	
1.	Soil Mechanics and Foundations, B.C. Punmia, 17th Edition, Laxmi Publishing Co. New Delhi, ISBN-10: 8170087910.
2.	Soil Engineering in Theory and Practice, Alam Singh and Chowdhary G.R, 2001, CBS Publishers and Distributors ltd., New Delhi, ISBN 9788123900391.
3.	Foundation Analysis and Designs, Bowles JE, 5th Edition, 2017, McGraw Hill Publishing co., New York, ISBN-10: 9781259061035.
4.	Soil Mechanics and Foundation Engineering, VNS Murthy, 1st Edition, 2015, UBS Publishers and Distributors, New Delhi, ISBN-10: 8123913621.
5.	Basic and Applied Soil Mechanics, Gopal Ranjan and Rao ASR, 2016, New Age International (P) ltd, New Delhi, ISBN-10: 8122440398.
6.	Geotechnical Engineering, Narasimha Rao AV and Venkatramaiah C, 2015, University press, India ltd, Hyderabad, ISBN-10: 8173711453.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE THEORY & LABORATORY	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	20
2	Conduction of the Experiments	20
3	Viva	10
	TOTAL	**50**

Semester: VI						
ADVANCED CONCRETE TECHNOLOGY **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV64D1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Correlation between hydration and CSH gel, Microstructure of hydrated cement paste -Structure of a Hydrated Cement Paste, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete. Shrinkage and creep.	
Unit – II	**8 Hrs**
Chemical admixtures- Mechanism of chemical admixture, Plasticizers and super Plasticizers, dosage and their effect on concrete properties in fresh and hardened state, Mineral Admixture-Fly ash, Silica fume, GGBS, metakaolin. New generation admixtures	
Unit –III	**8 Hrs**
Durability of concrete - Introduction, impermeability of concrete, acid attack, efflorescence, Corrosion- Factors influencing corrosion, pH, carbonation, Freezing and thawing, Alkali Aggregate Reaction, IS456-2000 requirement for durability. Remedial measures.	
Unit –IV	**8 Hrs**
Mix design: Concrete Mix Design by ACI and other methods – Numerical examples. Differences between ACI and IS methods of proportioning using IS-10262-2019, Basic concepts of Machine Learning in concrete mix design – case studies. Geopolymer Properties and applications Geopolymer concrete, Self-compacting concrete Properties and applications of self-compacting concrete.	
Unit –V	**8 Hrs**
Fiber reinforced concrete – Fibers types and properties, Behavior of FRC in compression, Applications. Light weight concrete-materials properties and types. Typical light weight concrete mix High density concrete.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse microstructure and properties of cement paste and concrete
CO 2	Assess the methods of determining the suitable admixture and ingredients for making concrete.
CO 3	Outline the importance of durability of conventional and other concretes.
CO 4	Describe properties and applications of special concrete mixes.

Reference Books	
1.	Shanthakumar.A.R, Concrete technology, Oxford University Press, New Delhi, 2007, ISBN 9780195671537
2.	Shetty. M.S., Concrete Technology Theory and Practice, S.Chand& Co Ltd., New Delhi, 2007 ISBN-13: 978-8121900034.
3.	Kumar Mehta.P and Paulo J M Monteiro., Concrete Microstructure, Properties and Materials, Indian Edition, Indian Concrete Institute, Chennai, 1997 ISBN-13: 978-9339204761, Publisher: McGraw Hill Education; 4th Edition ,2014.
4.	Neville. A.M, Properties of concrete V Edition,(2012) Pearson Education, Inc, and Dorling Kindersley Publishing Inc. ISBN-13: 978-8131791073.
5.	Gambhir M L., Concrete Technology theory and Practice, 5th Edition, Tata McGraw Hill Education Private Ltd, New Delhi. 2013 ISBN-13: 978-1259062551.

6.	Narayan V. Nayak, K.G. Guptha and Purnanand S, A Text book of Concrete technology, 1st Edition, Creative Books, Delhi. 2021, ISBN: 978-81-948633-0-4.
7.	IS: 10262-2019, Code of practice for concrete mix proportioning.
8.	ACI Committee 211, 1-81, Standard Practice for selecting proportions for Normal, Heavyweight, and Mass Concrete Part I, ACI Manual Concrete Practice 1994.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
TRANSPORTATION ENGINEERING **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV64D2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction: Role of railways in transportation- selection of routes Permanent way: Requirements for an ideal permanent way, typical Cross sections of single and double line, B.G. tracks – in cutting , embankment. Gauges and types of gauges with dimensions. Coning of wheels and tilting of rails. Rails functions, requirements, types of rail sections, length of rails, defects in rails.	
Unit – II	**8 Hrs**
Ballast and sleepers: Functions and requirements, calculation of quantity of materials needed for laying a track, traction and Tractive resistances, tractive power, Hauling capacity, Problems on above. Geometric design of track: Necessity of Geometric Design of railway track, gradient and types of gradient. Speed of train, transition curve, super elevation, cant deficiency, negative cant- speed calculation based on Indian Railways Formulae for High speed tracks only-problems on above.	
Unit –III	**8 Hrs**
Tunnels and Mass transit systems: Tunnels-Benefits from tunneling, Notations in tunneling, Cross sections of the tunnels for the roads and rails, alignments of the tunnels, Methods of tunneling, Mass transportation- planning, Mass transit, definitions and classifications, capacity and level of service of urban transit.	
Unit –IV	**8 Hrs**
Harbors : Harbors-Layouts and components, classification of harbors, Effect of wind, wave, tides, Break waters-Purpose, different types of break waters, wharfs, quays, jetties and pies, Dry dock and wet docks, navigational aids. Container handling and management. Concepts of Ferry and Inland waterways.	
Unit –V	**8 Hrs**
Airways – Introduction, Layout of an airport with component parts and functions of each, Aircraft Characteristics – Airport Classifications, - Site selection- regional Planning. Orientation of runway by using wind rose diagram with examples. Runway: Basic length of the runway assumptions –corrections to runway length- Factors affecting the layout of the taxiway-geometrics of taxiway- design of Exit taxiways- ICAO Specifications. Problems on above. Visual Aids: Airport marking – lightings-Instrumental landing systems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Recognize and choose the scope and objectives of transportation Engineering.
CO 2	Identify and interpret the importance of transportation modes.
CO 3	Explain and illustrate the necessity, components, types and application of different types of transportation modes
CO 4	Categorize, design and construct the various features of different types of transportation modes

Reference Books	
1.	Railway Engineering , Saxena and Arora, 13th Edition, 2013, Dhanpat Rai and Sons, New Delhi, ISBN: 13: 978-8189928834.
2.	Tunnel Engineering, Srinivasan R, Harbour, Dock C, 27th Edition, 2015, Charotar Publishing House. ISBN: 978-81-928692-6-1.
3.	Airport Planning and Design, Khanna, Arora and Jain, 6th Edition, 1999, Nemchand , Roorkee ISBN: 9788185240688.
4	Docks and Harbor Engineering", Oza H.P. and Oza G.H , 7th Edition, 2013, Charotar Publishing House, ISBN:978-93-80358-78-9.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
INTEGRATED WATERSHED MANAGEMENT **Category: Professional Core Course (Department Elective)** **Stream:** **(Theory)**						
Course Code	**:**	**21CV64D3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction: Watershed – Definition and Classification – Components – Basic factors influencing watershed development – Codification – Watershed delineation – Characteristics of watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology – Socio - economic characteristics.	
Unit – II	**8 Hrs**
Soil Conservation Measures: Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Control – Estimation of Soil Erosion – Soil Loss Models – Sedimentation – Soil Conservation Practices: Vegetative and Mechanical.	
Unit –III	**8 Hrs**
Water Harvesting and Conservation: Types of storage Structures –Water yield from Catchments – Losses of stored water – Water Conservations Methods – Water harvesting methods and Techniques – Rainwater Harvesting – Catchment, Harvesting structures, Roof water harvesting – Soil Moisture Conservation – Check Dams – Artificial Recharge – Farm Ponds – Percolation tanks.	
Unit –IV	**8 Hrs**
Watershed Management: Project Proposal Formulation – Watershed Development Plan Entry Point Activities – Estimation – Watershed Economics – Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – Developing Collaborative know how – People's Participation – Evaluation of Watershed Management.	
Unit –V	**8 Hrs**
Watershed Organization: Methodology of planning a watershed management – Identification of watershed problems, Socio – Economic issues – Application of Remote Sensing and GIS in watershed management.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Cognize the concepts of watershed management and its effect on land, water and ecosystem resources.
CO 2	Evaluate the impact of watershed planning through watershed characterization, runoff and soil loss estimation.
CO 3	Analyse the public policies and practices of watershed planning.
CO 4	Integrate the control and mitigation techniques for watershed problems.

Reference Books	
1.	"Watershed Management" – V. V. Dhruva Narayana, G. Sastry, U. S. Patnaik, Central Soil & Water Conservation Research & Training Institute, Indian Council of Agricultural Research, 1990.
2.	Glenn O. Schwab, "Soil and Water Conservation Engineering", John Wiley and Sons, New York, 1981.
3.	Ghanashyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000
4.	"Watershed Management – Guidelines for Indian Conditions", Tideman E.M, 1st Edition, Omega Publishers, New Delhi,2011, ISBN-9788185399348
5.	"Remote Sensing in Hydrology" Edwin T. Engman, R.J. Gurney, Springer Netherlands, 2013, ISBN 9401066701, 9789401066709

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
STRUCTURAL MASONRY **Category: Professional Core Course (Department Elective)** **Stream: Theory**						
Course Code	**:**	**21CV64D4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
History of masonry, historical buildings **Characteristics of masonry constituents:**Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars	
Unit – II	**8 Hrs**
Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context	
Unit –III	**8 Hrs**
Shear and Flexure Behavior of Masonry: Bond between masonry unit and mortar, test methods for determining flexural and shear bond strengths, test procedures for evaluating flexural and shear strength, factors affecting bond strength, effect of bond strength on compressive strength, flexure and shear strength of masonry.	
Unit –IV	**8 Hrs**
Design of load bearing masonry buildings: concept of basic compressive stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 storeys using BIS codal provisions	
Unit –V	**8 Hrs**
Concept of Earthquake resistant masonry buildings Concept of Reinforced Masonry Masonry arches, domes and vaults: Components, classification and construction procedure	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Choose appropriate masonry unit and mortar mixes for masonry construction
CO 2	Distinguish wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions
CO 3	Appraise knowledge of structural masonry for advanced research and construction procedures
CO 4	Design masonry buildings for sustainable development

Reference Books	
1.	Structural Masonry, Hendry A.W, 2nd Edition, Palgrave Macmillan, Macmillan Education Ltd. ,ISBN 10:0333733096 ISBN 13:9780333733097
2.	Masonry structures- Behavior and Design, Robert G Drysdale, Ahmad A Hamid, 3rd Edition ,2008 Boulder, CO : Masonry Society, , ISBN 1929081332 9781929081332
3.	Structural Masonry, Jagadish K S, 2015, I K International Publishing House Pvt Ltd, ISBN – 10: 9384588660, ISBN 13: 978-9384588663
4.	Code Books: IS 1905: 1987, Indian standard Specification for Code of Practice for Structural Use of Unreinforced

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
DISASTER MANAGEMENT **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	**21CV65E1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Natural disasters and Disaster management -Introduction to natural and Industrial Hazards- floods, landslides, earthquakes, volcanoes, avalanche, cyclones, drought, fire, release of effluents, harmful gases, Blast etc. Prediction and perception. Environmental risk due to project activities. Preparation of on-site and off-site disaster management plans - Pre disaster, actual disaster, Post disaster plans. Relief camp organization. Role of voluntary organization and armed forces during disasters.	
Unit – II	**8 Hrs**
Risk analysis and assessment Basic concept. Purpose of risk analysis. Analytical techniques and tools of risk assessment. Toxicology. Significance of risk. Risk characterization. Risk communication and Management, AI in emergency responses	
Unit –III	**8 Hrs**
Environmental Impact Assessment (EIA) Definition, Basic concepts and principles of EIA, Regulatory framework in India, Environmental inventory, Base line studies. Over view of EIA studies. **Assessment and Methodologies** Physical, Biological, Natural resources, Socio economic and cultural environmental assessment, Checklist approaches, Public participation in environmental decision making. Procedures for reviewing EIA analysis and statement. Decision methods for evaluation of alternatives.	
Unit –IV	**8 Hrs**
Disaster Mitigation Measures Basic principles, early warning systems, building design and construction in highly seismic zones, retrofitting of building, Usage of Remote sensing and GIS techniques, Awareness programs, Assessment on preparedness for disaster, Regional and global disaster mitigation, Mitigation Plans and Guidelines	
Unit –V	**8 Hrs**
Disaster Management Techniques Introduction, types, modes of disaster management, tools and techniques, primary and secondary data. Natural disasters its causes and remedies-Earthquake hazards-Causes and remedies, Flood and Drought assessment, causes and remedies, Landslides-causes and remedies. Fire hazards in buildings, Fire hazard management, Traffic management, inter department cooperation.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Study the environmental impact of natural and manmade calamities
CO 2	Learn to analyze and assess risk involved due to disasters.
CO 3	Understand the role of public participation.
CO 4	Learn the management and mitigation tools and techniques

Reference Books	
1.	Environmental Impact Analysis Hand Book, John G Rau and David C Wooten, Edition: 2013, ISBN: 978-0070512177.
2.	Introduction to environmental Impact assessment, John Glasson, RikiTherivel, Andrew Chadwick, Edition: 2012, Research Press, ISBN:000-0415664705.2005, Reliance Publishing House, New Delhi
3.	Natural Disaster Reduction, Girish K Mishrta, G C Mathew (eds), Edition, 2005, Reliance Publishing House, New Delhi
4.	Remote Sensing and Image Interpretation, Thomas M. Lillisand and R.W. Keifer, 6th Edition, 2002, John Wiley, ISBN:9780470052457

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
SOLID WASTE MANAGEMENT **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	**21CV65E2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**8 Hrs**
Introduction: Land Pollution due to improper solid waste management. Merits and demerits of present and scientific solid waste disposal methods. Scope and importance of solid waste management. Definition and functional elements of solid waste management. **Sources**: Sources of Solid waste, types of solid waste, composition of municipal solid waste. Generation rate, Numerical Problems.	
Unit – II	**8 Hrs**
Collection and transportation of municipal solid waste: Collection of solid waste- services and systems, Primary and secondary collection and transportation equipment and vehicles. Route optimization. Solid waste management rules with amendments. Site visit to collection system. Numerical problems	
Unit –III	**8 Hrs**
Composting Aerobic and Anaerobic composting - process description, process microbiology, Vermicomposting, Numerical problems, Site visit to compost plant. **Sanitary landfilling:** Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.	
Unit –IV	**8 Hrs**
Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, Recent hazardous waste (management, handling) rules with amendments. Site visit to hazardous landfill site	
Unit –V	**8 Hrs**
Bio medical waste management: Impact of improper biomedical waste on health and environment. Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Recent Bio medical waste management rules with amendments. site visit to hospital to see the collection and transportation system and visit to biomedical waste incineration plant **Plastic waste management:** Types of plastic and its uses. Impact of plastic waste on land, marine and wild life, Greener alternatives to plastic, Recent Plastic waste management rules with amendments.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the existing waste management system and to identify their drawbacks.
CO 2	Identify the adverse effects of improper waste management on environment.
CO 3	Evaluate and monitor the flow of waste as per the rules laid by Ministry of Environment and Forest.
CO 4	Design Recycling and scientific disposal options for different types of waste.

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 waste (Management & Handling Rules). Ministry of Environment & Forest Notification, New Delhi.
4.	Hazardous waste (Management& Handling Rules). Ministry of Environment & Forest Notification, New Delhi.
5.	Bio medical waste management rules. Ministry of Environment & Forest Notification, New Delhi.
6.	Plastic waste management rules. Ministry of Environment & Forest Notification, New Delhi.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
BIO-ENERGY TECHNOLOGY **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	**21CH65E1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**08 Hrs**
Introduction: Bioresources: Definition, examples, and classification. Opportunities and challenges. Global trends in bioresource technology. Classification of bioresource technology. Biomass: Synthesis, significance, world energy scenario, physico-chemical properties, composition, and characteristics.	
Unit – II	**08 Hrs**
Conversion Technologies 1: Introduction, conversion technologies for biomass into energy. Comparison between various thermochemical conversion technologies. Comparison between biological and thermo-chemical conversions.Combustion. Pyrolysis. Gasification.	
Unit –III	**08 Hrs**
Conversion Technologies 2: Anaerobic Digestion: Introduction, potential benefits, process and pathway, Factorsaffecting, Advantages and disadvantages, Anaerobicco-digestion, Bio gasification of cow dung. Design of anaerobic digester	
Unit –IV	**08 Hrs**
Biofuels: Introduction, Pre-treatment of LCB, biofueltypes, relevance of biofuel technology. Sources of liquid biofuels for automobiles. Bioethanol, Bio-aviation Turbine Fuel, Bio-pulping. Biogas.	
Unit –V	**08 Hrs**
Case studies: Ethanol production from starchy crops and lignocellulosic biomass. Bio methanation of water hyacinth for biogas production, Butanol production from lignocellulosic biomass. Biodiesel from Jatropa	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Describe the nature and principle of different biomass energy extraction systems.
CO2	Identify how to choose the suitable biomass fuels for different bio-energy applications
CO3	Recognize drivers and barriers for biofuel production
CO4	Develop sustainable biofuel production considering ecological and socio-economic criteria

Reference Books	
1	Mark Crocker (Ed.), 2010. Thermochemical Conversion of Biomass to Liquid Fuels and Chemicals. RSC Publishing, ISBN:9781849730358
2	Donald L. Klass, 1998. Biomass for Renewable Energy, Fuels and Chemicals. Academic Press, San diego, CA. ISBN: 978-0-12-410950-6
3	Daizo Kunii and Octave Levenspiel. Fluid ization Engineering, 2nd Edition. Butterworth-Heinemann series in Chemical Engineering. ISBN 0-409-90233-0 1
4	Charles E. Wyman (Ed.), 1996. Handbook on Bioethanol: Production and Utilization.CRC Press, New York. ISBN 1-56032055304
5	Brigit Kamm, Patrick R. Gruber and Michael Kamm (Ed.), 2008. Biorefineries -Industrial Processes and Products: Status Quo and Future Directions, Vol. 1 & 2. Wiley-VCH, Weinheim, Germany.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
HYDROGEN TECHNOLOGY **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	21CH65E2		**CIE**	**:**	**100**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**08 Hrs**
Hydrogen: Peculiarity and Types Salient features of hydrogen, properties of hydrogen, terminology and types of hydrogen, advantages, disadvantages, comparison with other fuels, and global status of supply and demand	
Unit – II	**08 Hrs**
Hydrogen Generation Generation of different types of hydrogen, conventional methods, nonconventional methods, generation from non-renewable sources, generation from renewable sources and challenges	
Unit –III	**08 Hrs**
Hydrogen Storage Storage as compressed gas, storage as cryogenic liquid, storage as metal hydrides, storage through liquid organic hydrogen carriers, and storage in carbon nano tubes	
Unit –IV	**08 Hrs**
Hydrogen Handling and Safety Classification of hydrogen hazards, compressed and liquid hydrogen related hazards, regulation, codes and standards related to hydrogen handling and transport, personal protective equipment	
Unit –V	**08 Hrs**
Hydrogen Applications Applications of hydrogen in various sectors such as refineries, petrochemicals, fertilizer industries, steel industries, transport and automotive sectors	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the importance of hydrogen and its use as an energy carrier
CO2	Explain the production, storage and handling of hydrogen
CO3	Analyzethe need for hydrogen as an alternate fuel and the associated challenges
CO4	Appraise the importance of safety, regulations and codes

Reference Books	
1.	Hydrogen Fuel: Production, Transport and Storage, Gupta, R. B., CRC Press, Taylor & Francis Group, 1st Edition, 2009, ISBN: 9780429147364
2.	Hydrogen Production: Electrolysis, AgataGodula-Jopek, Wiley-VCH, 1st Edition, 2015, ISBN:9783527333424
3.	Handbook of Hydrogen Storage, Michael Hirscher, Wiley-VCH, 1st Edition, 2010, ISBN:9783527322732
4.	Fuel Cell Systems Explained, James Larminie and Andrew Dicks, John Wiley & Sons, 2nd Edition, 2003, ISBN 978 0470 848579

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted &each quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
NANOBIOTECHNOLOGY **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	**21BT65E1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 Hrs**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**07 Hrs**
Introduction to nanomaterials History, Types of nanomaterials: Fullerenes (Grephene, Bucky ball, Nano tubes, Diamond like carbon, DLC), Nanoshells, Quntum dots, Dendrimers, Nanocarriers. Nanowires. **Nanobiomaterials:** Introduction & overview of 1st generation 2nd generation & 3rd generation biomaterials, DNA and Protein based Nano structures, array nanostructures. Function and application of DNA and protein based nanostructures.	
Unit – II	**08 Hrs**
Nanomaterials, Synthesis and Characterization: Approaches of Fabrication: Top-Down and Bottom-up methods of nanofabrication and Nanosynthesis: Ball milling, CVD, Sol gel, Plasma arching. Biosynthesis of Nanoparticles. Nanolithography: hard (Optical, UV, EUV, X-ray) and soft lithography. Characterization of nanomaterials using spectroscopic (UV-VIS, FTIR and Raman) and microscopic methods Atomic Force Microscopy, Scanning & Tunneling Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy (AFM, STM, SEM and TEM).	
Unit –III	**07 Hrs**
Nanosensors and Nanobiosensors: Overview of nanosensors, prospects and market. Types of Nanosensors and their applications. Electromagnetic nanosensors: Magnetic nanosensors. Mechanical nanosensors. Types of nanobiosensors: Cantilever, nanotube, nanowire and nanoparticle based sensor, Nanosensors, Biosensors in modern medicine.	
Unit –IV	**07 Hrs**
Micro & Nano Electromechanical systems and Microfluidics: MEMS/NEMS: Nanotransducers: Nano-mechanical, electrical, electronic, Magnetic and Chemical Transducers. Nano sensors and Nano Actuators: types of actuators. Microfludics: Laminar flow, Hagen- Peouiselle equation, basic fluid ideas, Special considerations of flow in small channels, mixing, microvalves & micropumps.	
Unit –V	**10 Hrs**
Medical Nano Technology: Diagnostics, therapeutics, drug delivery, Nano Surgery and Tissue Engineering. Diagnostics: Resonance Light Scattering (RLS) Technology, Nano chips, gene and protein chips. Therapeutic: Drug delivery: Bioavailability, Drug Delivery Applications, Bioavailability, Sustained and targeted release. Benefits of Nano drug delivery system. Use of Microneedles and nanoparticles for targeted and highly controlled drug delivery. Nano robots in drug delivery and cleaning system. Design of nanoparticles for oral delivery of peptide drugs, Tissue Engineering.. Nanotoxicity assessment: In-vitro laboratory tests on the interaction of nanoparticles with cells. Body on a chip and lab on a chip.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Remember, understand and apply knowledge about nanomaterials and their uses. Interpret and apply the techniques of manufacturing and characterization processes.
CO2	Understand the Micro & Nano Electromechanical systems and Microfluidics Interpret and apply the techniques and processes.
CO3	Understand and apply knowledge of nanosensors and nanobiosensors applications like electronics, mechanical, chemical, and biological systems
CO4	Apply knowledge of nanosensors and nanobiosensors to create and evaluate nano- design, devices and systems applicable to various medical disciplines.

Reference Books	
1	Textbook of Nanosciences and Nanotechnology, B.S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday, 2013, Springer, Co-publication with University Press (India) Pvt. Ltd. VCH, XII. ISBN-978-3-642-28030-6.
2	Springer Handbook of Nanotechnology**,** Editors: Bhushan, Bharat (Ed.), 2017, Springer, ISBN 978-3-662-54357-3.
3	Nanotechnology and Nanomaterial Applications in Food, Health, and Biomedical Sciences (Innovations in Agricultural & Biological Engineering), Deepak Kumar Verma, Megh R. Goya, Hafiz Anasr Rasul Suleria, 2019, Apple Academic Press, CRC Press, Taylor & Francis Group**,** ISBN-10 1771887648.
4	Nanotechnology Trends and Future Applications, Tahir, Muhammad Bilal, Rafique, Muhammad, Sagir, Muhammad, 2021, Springer, (Eds.), ISBN 978-981-15-9437-3.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: Question 3 or 4	16
5 & 6	Unit 3: Question 5 or 6	16
7 & 8	Unit 4: Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
NATURE IMPELLED TECHNOLOGIES **Category: Cluster Elective** **Stream: (Common to CH, CV, & BT) Theory**						
Course Code	**:**	**21BT65E2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**06 Hrs**
Nature-inspired materials: Bioinspiration, bio-imitation and biomimicry. Emerging trends and prospects: Nature-inspired processes, Nature-inspired design approach, nature-inspired materials by virtue of the gain; Design and functionality, engineering and manufacturing and materials.	
Unit – II	**08 Hrs**
Plant inspired Technologies: Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. Lotus leaf effect for super hydrophobic surfaces. Flectofin®, a new façade-shading system inspired by flower of the Bird-of-Paradise, Plantoid ; Robotic Solutions Inspired by Plant Root. Plant cockleburs and Velcro.	
Unit –III	**08 Hrs**
Nature inspired technologies for medical applications: Organ system- Circulatory- artificial blood, artificial heart, pacemaker. Respiratory- artificial lungs. Excretory- Artificial kidney and skin. Artificial Support and replacement of human organs: artificial liver and pancreas. Total joint replacements- artificial limbs. Visual prosthesis -optical tweezers.	
Unit –IV	**08 Hrs**
Nature driven technologies for industrial applications: Biosensors, Thermal insulation and storage materials. Bio-robotics; design, control actuation and sensing. Human inspired hyper dynamic manipulation. Humanoid Robot.	
Unit –V	**08 Hrs**
Nature inspired computing: Cellular automata, evolutionary computing, swarm intelligence, artificial life and complex networks. Genetic Algorithms, Artificial Neural Networks. Artificial intelligence and MEMS.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the concepts and phenomenon of natural processes
CO2	Apply the basic principles for design and development of nature inspired structures
CO3	Analyse and append the concept of bio-mimetics for diverse applications
CO4	Designing technical solutions by utilization of natured-inspiration modules.

Reference Books	
1	Yoseph Bar-Cohen. Biomimetics: Biologically Inspired Technologies D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence", CRC Press, 2018. ISBN: 1420037714, 9781420037715.
2	Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. John Wiley, 2018. ISBN: 978-1-119-390336.
3	M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials Cambridge University Press, 2014 ISBN 978-1-107-01045.
4	Tao Deng. Bioinspired Engineering of Thermal Materials. Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
INDUSTRIAL SAFETY AND RISK MANAGEMENT **Category: Institutional elective** **Stream: Chemical Engineering (Theory)**						
Course Code	**:**	**21IE6F1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

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

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

Reference Books	
1.	Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North corolina, Lulu publication, ISBN:1291187235.
2.	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X.
3.	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003,The University of albertapress,Canada, ISBN: 0888643942.
4.	Industrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao,4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

Semester: VI						
RENEWABLE ENERGY SYSTEMS **Category: Institutional elective** **Stream: Electrical & Electronics Engineering (Theory)**						
Course Code	:	21IE6F2		**CIE**	:	100Marks
Credits: L:T:P	:	3:0:0		**SEE**	:	100 Marks
Total Hours	:	40L		**SEE Duration**	:	3.0 Hours

Unit-I	**08Hrs**
Introduction: Energy systems model causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. **Basics of Solar Energy:** Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Application. Block diagram of solar energy conversion.	
Unit – II	**08Hrs**
Solar PV Systems: Basic Principle of SPV conversion – Types of PV Systems(Standalone, Grid connected, Hybrid system)- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Array design (different methodologies),peak-power operation, system components.Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications..	
Unit –III	**08Hrs**
Wind Power Systems: **Wind speed and energy:**Introduction, history of wind energy, scenario- world and India. Basic principle of Wind energy conversion system (WECS), Classifications of WECS, part of a WECS. Derivation of power in the wind, electrical power output and capacity of WECS, wind site selection consideration, advantages and disadvantages of WECS.Maximum energy capture, maximum power operation, , environmental aspects.	
Unit –IV	**08Hrs**
Geothermal and ocean energy systems: Geothermal well drilling, advantages and disadvantages, Comparison of flashed steam and total flow concept (T-S diagram). Associated Problems, environmental Effects. **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. Issues Faced in Exploiting Tidal Energy	
Unit –V	**08Hrs**
Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production through block diagram, Use of Hydrogen Energy, Merits and Demerits, Problems Associated with Hydrogen Energy. **Biomass Energy:** Introduction-Biomass resources –Energy from Biomass: conversion processes-Biomass Cogeneration-Environmental Benefits. Biomass products – ethanol, biodiesel, biogas Electricity and heat production by biomass.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the working principle and operation of various renewable energy sources and systems.
CO 2	Analyze the performance and characteristics of renewable energy sources and systems.
CO 3	Evaluate the parameters of wind and solar energy systems.
CO 4	Design and demonstrate the applications of renewable energy sources in a typical systems.

Reference Books	
1.	Non conventional energy sources, by G.DRai, Khanna publishes, 19th Edition, 2017, ISBN: 978-81-7409-073-8
2.	Solar photo voltaic Technology and systems, byChetan Singh Solanki, 3rd Edition, PHI, Learning private limited New Delhi, 2013, ISBN: 978-81-203-4711-3.
3.	Wind and solar power system design, Analysis and operation, Mukund R. Patel, 2nd Edition. CRC Group,Taylor and Francis group, New Delhi, ISBN 978-0-8493-1570-1.
4.	Renewable energy: Technology, Economics and Environment, Martin Kaltschmitt, Wolfgang Streicher Andreas Wiese, Springer Publication, 2007, ISBN 978-3-540-70947- 3

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

Semester: VI

SYSTEMS ENGINEERING
Category: Institutional elective
Stream: Industrial Engineering & Management (Theory)

Course Code	**:**	**21IE6F3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**06 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	**10 Hrs**

Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem.
Needs Analysis: Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems.
Concept Exploration: Developingthe system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.

Unit –III	**10 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	**10 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	**09 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.

Reference Books:	
1	Alexander Kossoaikoff, William N Sweet, "Systems Engineering – Principles and Practice" John Wiley & Sons, Inc, edition: 2012, ISBN: 978-81-265-2453-2
2.	Andrew P. Sage, William B. Rouse, "Handbook of Systems Engineering And Management" John Wiley & Sons, Inc., edition:1999, ISBN 0-471-15405-9
3.	Ludwig von Bertalanffy, "General System Theory: Foundation, Development, Applications", Penguin University Books, 1973, Revised, ISBN: 0140600043, 9780140600049.
4.	Blanchard, B., and Fabrycky, W. Systems Engineering and Analysis, Saddle River, NJ, USA: Prentice Hall, 5th Edition, 2010.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI

MECHATRONICS

Category: Institutional elective

Stream: Mechanical Engineering (Theory)

Course Code	**:**	21IE6F4		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3.0 Hours**

Unit-I — **09 Hrs**

Overview of Mechatronic Systems

Traditional and mechatronic design, automatic washing machine, automatic door, dishwasher, compact disc drive copy machine, camera, and temperature control. Principle and working of hall sensor, displacement sensor, absolute and incremental encoders, photoelectric sensors, inductive and capacitive proximity sensors, Relays and solenoids, Brushless DC, AC and servo motors, pulse width modulation by basic transistor circuit, H bridge circuit, Stepper motor: variable reluctance and permanent magnet, stepper motor control circuits, selection of motors.

Unit – II — **10 Hrs**

Signal Conditioning

Operational Amplifiers - circuit diagrams and derivation - Numerical, filtering, multiplexers, 4:1 MUX, time division multiplexing -seven segment display, data acquisition, Analog and digital signals, analog to digital converters. Introduction to Digital signal processing – difference equation (Numericals).

Programmable logic controllers

Components, principle of operation, modifying the operation, basic PLC instructions, and concepts of ladder diagram, latching, timer instructions, counter instructions.

Unit –III — **10 Hrs**

Ladder Diagram for PLCs

Examples with ladder logic programs, simple programs using Boolean logic, word level logic instructions. Relay to ladder conversion examples.,

Industrial applications of PLCs

Central heating system, valve sequencing, traffic light control in one direction, water level control, overhead garage door, sequential process, continuous filling operation, Fluid pumping with timers, parking garage counter, can counting in assembly line.

Unit –IV — **08 Hrs**

Microcontrollers

Components of a full featured microcontroller, Memory, I/O Ports, Bus, Read & Write Cycle, Architecture of Intel 8051 microcontroller, Pin diagram, simple instructions for a microcontroller. – Data transfer, arithmetic functions, logical operations, Jump and branching operation.

Digital circuits

Digital representations, Combinational logic - Case studies: BCD to 7 segment decoder, calendar subsystem in a smartwatch., timing diagrams, Karnough maps – 3 variable and 4 variable, design of logic networks, flip-flops, Counters

Unit –V — **08 Hrs**

Dynamic Responses of Systems

Closed loop system, Terminology, transfer functions, step response of first order and second order systems, performance measures for first and second order systems, - Numerical

Mechanical Actuation Systems

Four bar chain, slider crank mechanism, Cams and followers, gear trains - Numerical

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes
CO2	Apply the electrical and logic concepts and inspect the functioning of mechatronic systems.
CO3	Evaluate a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers
CO4	Develop conceptual design for Mechatronics products based on potential customer requirements

Reference Books	
1.	Nitaigour Premchand, 'Mechatronics-Principles, Concepts & Applications', TMH 1st Edition, 2009, ISBN: 9780070483743
2.	Bolton W., 'Mechatronics-Electronic Control System in Mechanical and Electrical Engineering', Pearson Education, 4th Edition, 2012; ISBN:9788131732533
3.	Tilak Thakur 'Mechatronics', Oxford University Press, 1st Edition, 2016, ISBN: 9780199459329
4.	Petruzella, Frank D, Programmable logic controllers, McGraw-Hill, 4th Edition, 2013, ISBN-13: 978-0-07-351088-0

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VI						
MATHEMATICAL MODELLING **Category: Institutional elective** **Stream: Mathematics (Theory)**						
Course Code	**:**	21IE6F5		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**09 Hrs**
Continuous Models Using Ordinary Differential Equations: Basic concepts, real world problems (Science and Engineering), approximation of the problem, steps involved in modelling, formation of various continuous models.	
Unit – II	**09 Hrs**
Mathematically Modelling Discrete Processes: Difference equations - first and second order, introduction to difference equations, introduction to discrete models-simple examples, mathematical modelling through difference equations in economics, finance, population dynamics, genetics and other real-world problems.	
Unit –III	**09 Hrs**
Markov modelling: Mathematical foundations of Markov chain, applications of Markov modelling.	
Unit –IV	**09 Hrs**
Modelling through graphs: Graph theory concepts, modelling situations through different types of graphs.	
Unit –V	**09 Hrs**
Variational Problem and Dynamic Programming: Optimization principles and techniques, mathematical models of variational problem and dynamic programming and applications.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamental concepts of mathematical models arising in various fields of engineering.
CO2:	Apply the knowledge and skills of discrete and continuous models.
CO3:	Analyze the appropriate mathematical model to solve the real-world problem and optimize the solution
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	Mathematical Modeling, J. N. Kapur, 1st Edition, 1998, New Age International, New Delhi, ISBN: 81-224-0006-X.
2	Mathematical Modeling: Models, Analysis and Applications, Sandip Banerjee, 2014, Chapman and Hall/CRC Textbook, ISBN 9781439854518.
3	Case Studies in Mathematical Modeling, D. J. G. James and J. J. Mcdonald, 1981, Stanly Thames, Cheltonham, ISBN: 0470271779, 9780470271773.
4	Modeling with Difference Equations, D. N. Burghes, M. S. Borrie, Ellis Harwood, 1981, ISBN 13: 9780853122869.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks . **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

Semester: VI

INDUSTRY 4.0 - SMART MANUFACTURING FOR THE FUTURE
Category: Institutional elective
Stream: Mechanical Engineering (Theory)

Course Code	**:**	21IE6F6		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42 Hrs		**SEE Duration**	**:**	**3.0 Hours**

Unit-I — **07 Hrs**

Introduction:
The Various Industrial Revolutions, Need – Reason for Adopting Industry 4.0, Definition, Goals and Design Principles – Interoperability, Virtualization, Decentralization, Real-time Capability, Service Orientation, Modularity. Individualization, Volatility, Energy and resource efficiency. Road to Industry 4.0 - Internet of Things (IoT), Architecture of IoT, Technologies for IoT & Industrial Internet of Things (IIoT), Internet of Services, Standardization, Cyber-Physical Systems, Smart Manufacturing, Network via Ethernet/ Wi-Fi for high-speed data transmission, Mobile technologies

Unit – II — **10 Hrs**

Opportunities and Challenges
Lack of resources, Availability of skilled workers, Broadband infrastructure, Policies, Future of Works and Skills in the Industry 4.0 Era, Disruption as manufacturing's greatest modern challenge

Robotics in Industry 4.0
Robotic Automation and Collaborative Robots, Human-Machine Interaction

Big Data
Evolution**,** Essential of Big Data in Industry 4.0, Big Data Merits, Data transparency, Business Intelligence, Production planning, Quality, Acquisition of Automation Data, Digital Traceability, Radio-Frequency Identification (RFID), GPS, Data transformation, Big Data Characteristics, Data as a new resource for organizations, Data driven applications, Harnessing and sharing knowledge in organizations, Data analytics - Descriptive Analytics, Diagnostic analytics, Predictive Analytics, Prescriptive analytics

Unit –III — **10 Hrs**

Cloud Computing
Fundamentals, Cloud/Edge Computing and Industry 4.0, The IT/OT convergence, Cyber Security

Horizontal and Vertical integration
End-to-end engineering of the overall value chain, Digital integration platforms, Role of machine sensors, Sensing classification according to measuring variables, Machine-to-Machine communication

Artificial Intelligence/Machine Learning in Industry 4.0
Fundamentals, Case Studies, Technology paradigms in production logistics - Intelligent conveyor system, Intelligent commissioning system, Intelligent production machine, Intelligent load carrier, Application-specific demand on Intelligent Objects (user-oriented functions), Technological realization of Intelligent Objects (product-oriented functions)

Unit –IV — **08 Hrs**

Augmented Worker
Augmented and Virtual Reality, softwares, Industrial Applications – Maintenance, Assembly, Collaborative operations, Training

Digital-to-Physical
Additive Manufacturing technologies, Advantages, impact on environment, Applications – Automotive, Aerospace, Electronics and Medical

Unit –V — **07 Hrs**

Digital twin, Virtual factory, Total Productive Maintenance, Industry 4.0 case studies, Understanding I 4.0 in MSMEs, What's Next: Industry 5.0/Society 5.0

Course Outcomes: After completing the course, the students will be able to:	
CO1	Identify the basic components of Industry 4.0
CO2	Analyse the role of Big data for modern manufacturing
CO3	Create AR/VR models for industrial scenario
CO4	Create simple Additive manufactured parts

Reference Books	
1.	Industry 4.0: Managing the Digital Transformation, Alp Ustundag, Emre Cevikcan, 2017, Springer, ISBN: 978-3-319-57869-9, ISBN: 978-3-319-57870-5
2.	The Concept Industry 4.0 - An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, 2017, Springer Gabler, ISBN 978-3-658-16501-7 ISBN 978-3-658-16502-4
3.	Industry 4.0 - The Industrial Internet of Things, Alasdair Gilchrist, 2016, APRESS, ISBN-13 978-1-4842-2046-7 ISBN-13: 978-1-4842-2047-4
4.	Digitizing the Industry – Internet of Things connecting the Physical, Digital and Virtual Worlds, Ovidiu Vermesan, 2016, River Publishers, ISBN 978-87-93379-81-7 ISBN 978-87-93379-82-4

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VI						
INDUSTRIAL PSYCHOLOGY FOR ENGINEERS **Category: Institutional elective** **Stream: Humanities & Social Sciences (Theory)**						
Course Code	**:**	21IE6F7		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**08 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**08 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	**10 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.	
Unit –IV	**10 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.	
Unit –V	**09 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. **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. Type A and Type B.**Psychological Counseling** - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI

ELEMENTS OF FINANCIAL MANAGEMENT

Category: Institutional elective

Stream: Industrial Engineering & Management (Theory)

Course Code	**:**	**21IE6F8**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3.0 Hours**

Unit-I — **06 Hrs**

Financial Management-An overview: Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework.
The financial System: Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system.
Financial statements, Taxes and cash flow: Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes.
(Conceptual treatment only)

Unit – II — **10 Hrs**

Time Value of Money: Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity.
Valuation of securities: Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches.
Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications
(Conceptual and Numerical treatment)

Unit –III — **10 Hrs**

Techniques of Capital Budgeting: Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Payback period, Accounting rate of return.
Cost of Capital: Preliminaries Cost of debt and preference, cost of retained earnings, cost of external equity, determining the proportions, weighted average cost of capital, weighted marginal cost of capitalschedule.
Capital structure and cost of capital: Assumptions and concepts, net income approach, net operating income approach, traditional position, Modigliani and Miller Position, Taxation and Capital structure, Otherimperfections and Capitalstructure
(Conceptual and Numerical treatment)

Unit –IV — **10 Hrs**

Long term finance: Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking
Securities Market: Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market.
Working Capital – Policy and Financing: Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper,Factoring
(Conceptual treatment only)

Unit –V — **09 Hrs**

Contemporary topics in Finance: Reasons and Mechanics of a merger, Takeovers,Divestures, Demergers, World monetary system, Foreign exchange markets, raising foreign currency finance, International capital budgeting, Options market, Futures market, Warrants, Venture capital financing framework, Indian venture capital scenario. (Conceptual treatment only)

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the features of financial system and basic principles of financial management.
CO2	Describe the processes and techniques of capital budgeting and theories of capital structure.
CO3	Demonstrate an understanding of various sources of long term and working capital financing by organizations.
CO4	Analyze the trends in global financial scenarios.

Reference Books:	
1.	Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill
2.	Education(India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5
3.	Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018,
4.	McGraw Hill Education(India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
Universal Human Values - II **Category: Institutional elective** **Stream: Humanities & Social Sciences (Theory)**						
Course Code	**:**	**21IE6F9**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**10 Hrs**
Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution. The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	
Unit – II	**10 Hrs**
Right Understanding (Knowing)- Knower, Known & the Process. The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	
Unit –III	**08 Hrs**
Understanding Existence (including Nature). A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
Unit –IV	**08 Hrs**
Understanding Human Being. Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body, the activities and potentialities of the self, Reasons for harmony/contradiction in the self.	
Unit –V	**08 Hrs**
Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living. Understanding Human Conduct, Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	

Course Outcomes: After completion of the course the students will be able to	
CO1	Understand the basic human aspiration with program of its fulfilment and meaning of resolution in the complete expanse of human living.
CO2	Understand human being in depth and see how self is central to human being
CO3	Understand existence in depth and see how coexistence is central to existence
CO4	Understand human conduct and the holistic way of living leading to human tradition

Reference Books	
1	A foundation course in human values and professional ethics, R. R. Gaur, R Asthana, G P Bagaria, 2nd revised Edition, excel books, New Delhi – 2019, ISN 978-93-87034-47-1
2	Avartansheel Arthshastra, A Nagraj, Divya Path Sansthan, Amarkantak, India, ISBN 978-8-174-46781-2
3	Economy of Performance- a quest for social order based on non – violence, J C Kumarappa, 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India
4	Energy and Equity, Ivan Illich, 1974, The Trinity Press, Worcester & Harper Collins, USA, ISBN, 0060803274, 9780060803278

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
Human Machine Interface (HMI) **Category: Institutional elective** **Stream: Electronics & Communication Engineering (Theory)**						
Course Code	**:**	**21IE6F10**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**10 Hrs**
FOUNDATIONS OF HMI: The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms. **Introduction to HMI and domains**: Automotive, Industrial, CE, Medical, ECUs within car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN, LIN, Most, FlexRay, Ethernet etc).	
Unit – II	**10 Hrs**
Automotive Human-Machine Interfaces: Automotive infotainment system - Evolution road map, Feature sets, System architecture, Trends, Human factors and ergonomics in automotive design, Automotive User Experience (UX) Design Principles, In-Vehicle Information Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touchscreen Interfaces and Controls, Usability Testing and Evaluation in Automotive HMIs, Safety Considerations and Regulations in Automotive HMIs, Emerging Technologies in Automotive HMIs, Human-Machine Interfaces for Autonomous Vehicles	
Unit –III	**08 Hrs**
UX and Guidelines: Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts, Graphic design tools - Adobe Photoshop, Adobe XD, Blender, GIMP, Asset Design - Overview , Guidelines and norms, 2D/3D rendering, OpenGL, OSG.	
Unit –IV	**08 Hrs**
HMI User Interface: User-centered HMI development process, Basics of Web-Server. Web-based HMI: Basics of TwinCAT and HTML, CSS, JavaScript. **HMI on Mobile:** Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites	
Unit –V	**08 Hrs**
HMI Control Systems: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UI controls. **Haptics in Automotive HMI:** Kinesthetic Feedback Systems, Tactile Feedback Systems, Haptics in Multimodal HMI, Automotive Use-Cases **HMI Testing:** Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - Graphics Test Systems (GTS). **UI analytics:** Usage patterns, Debugging, Performance Profiling, Use Cases.	

Course Outcomes: After completion of the course the students will be able to	
CO1	Understanding the application of HMIs in various domain.
CO2	Comparison of various communication protocols used in HMI development
CO3	Apply and Analyse the car multimedia system free software and hardware evolution
CO4	Design and Evaluate the graphic tools and advanced techniques for creating car dashboard multimedia system

Reference Books	
1	Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan " Touch based HMI; Principles and Applications" Springer Nature Switzerland AG, 1st Edition.
2	Robert Wells, " Unity 2020 by Example: A Project based guide to building 2D, 3D augumented reality and Virtual reality games from sratch" Packt Publishing ltd , Edition 2020
3	Ryan Cohen, Tao Wang, "GUI Design and Android Apps" Apress, Berkley, CA,2014

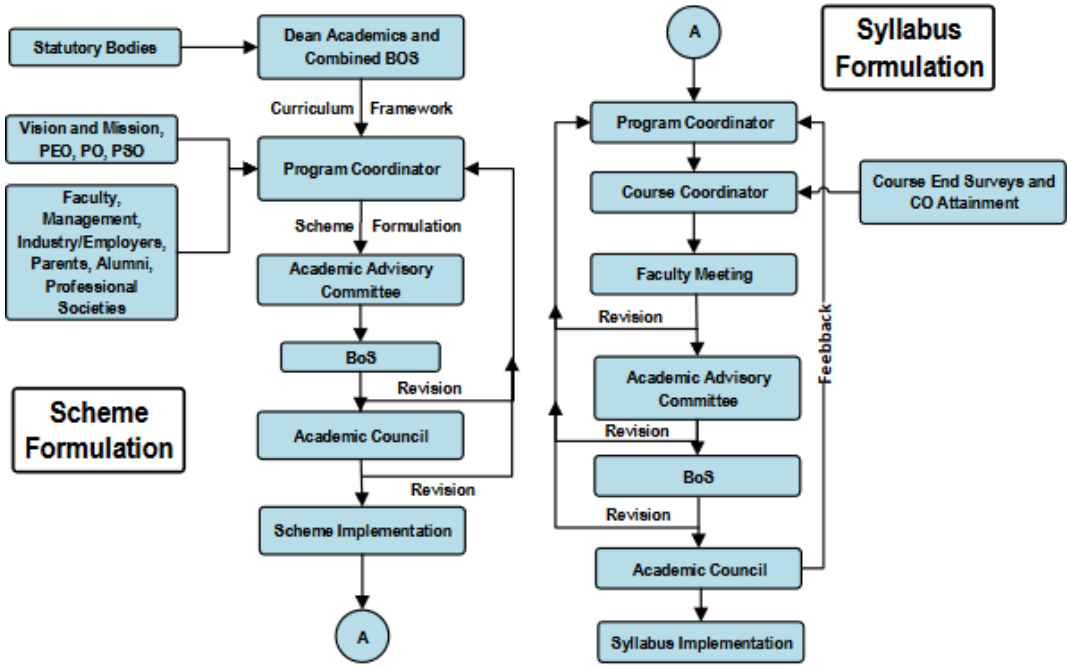
RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

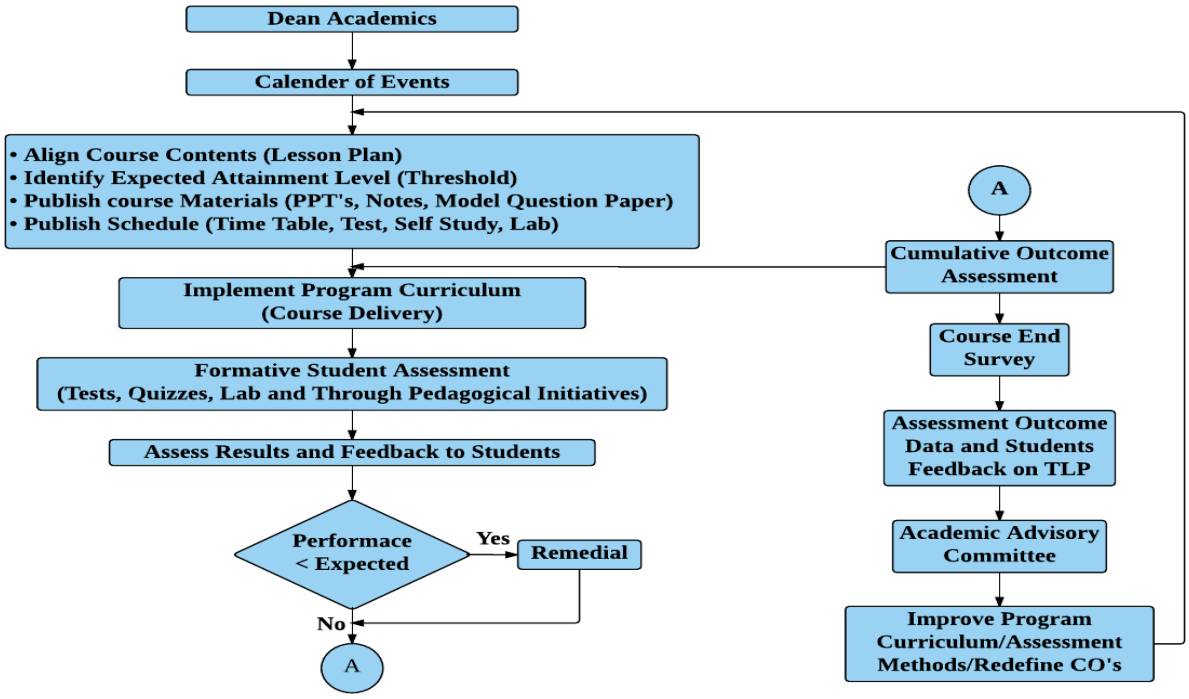
RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

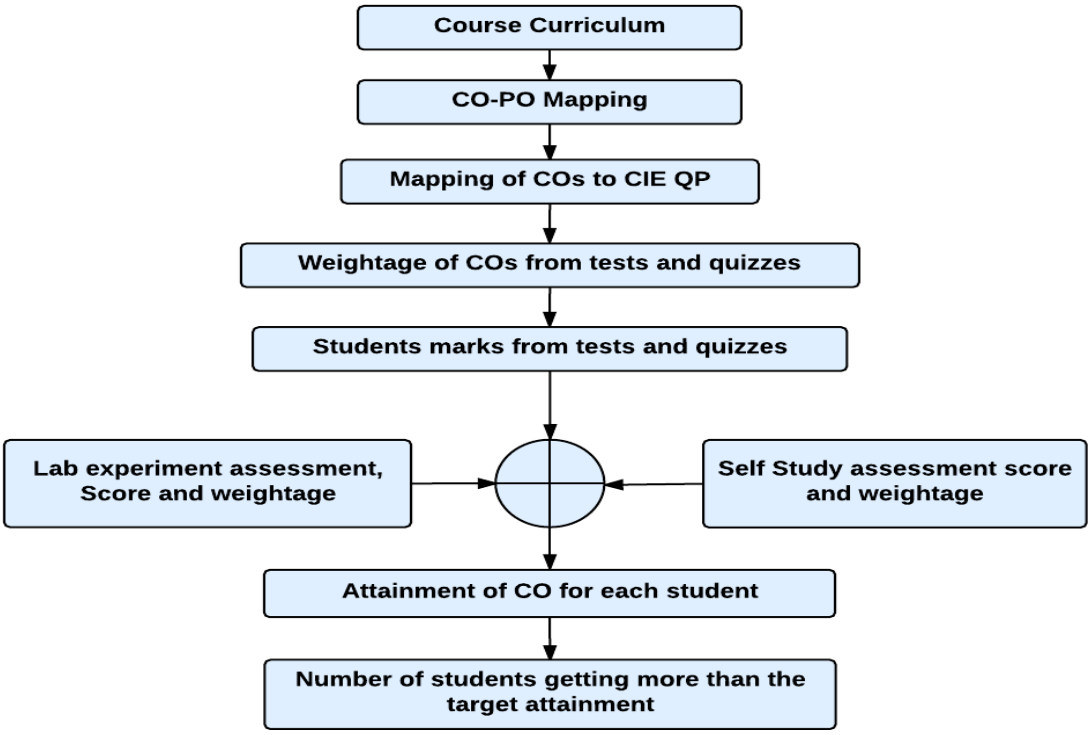
Curriculum Design Process



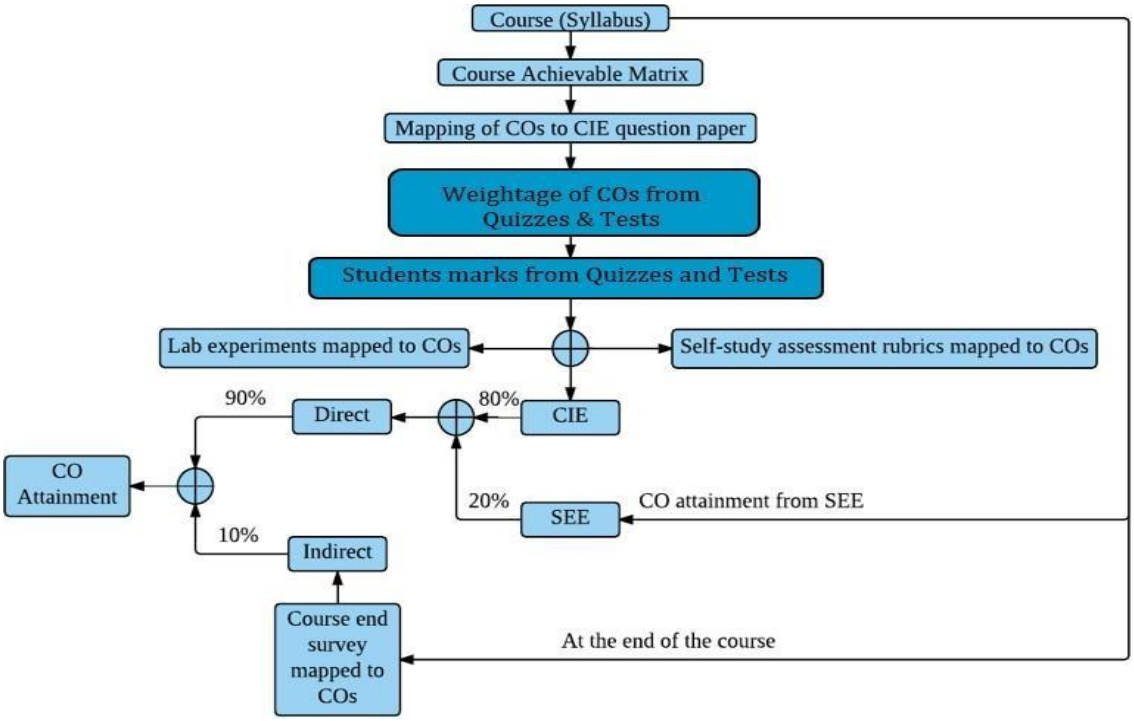
Academic Planning and Implementation



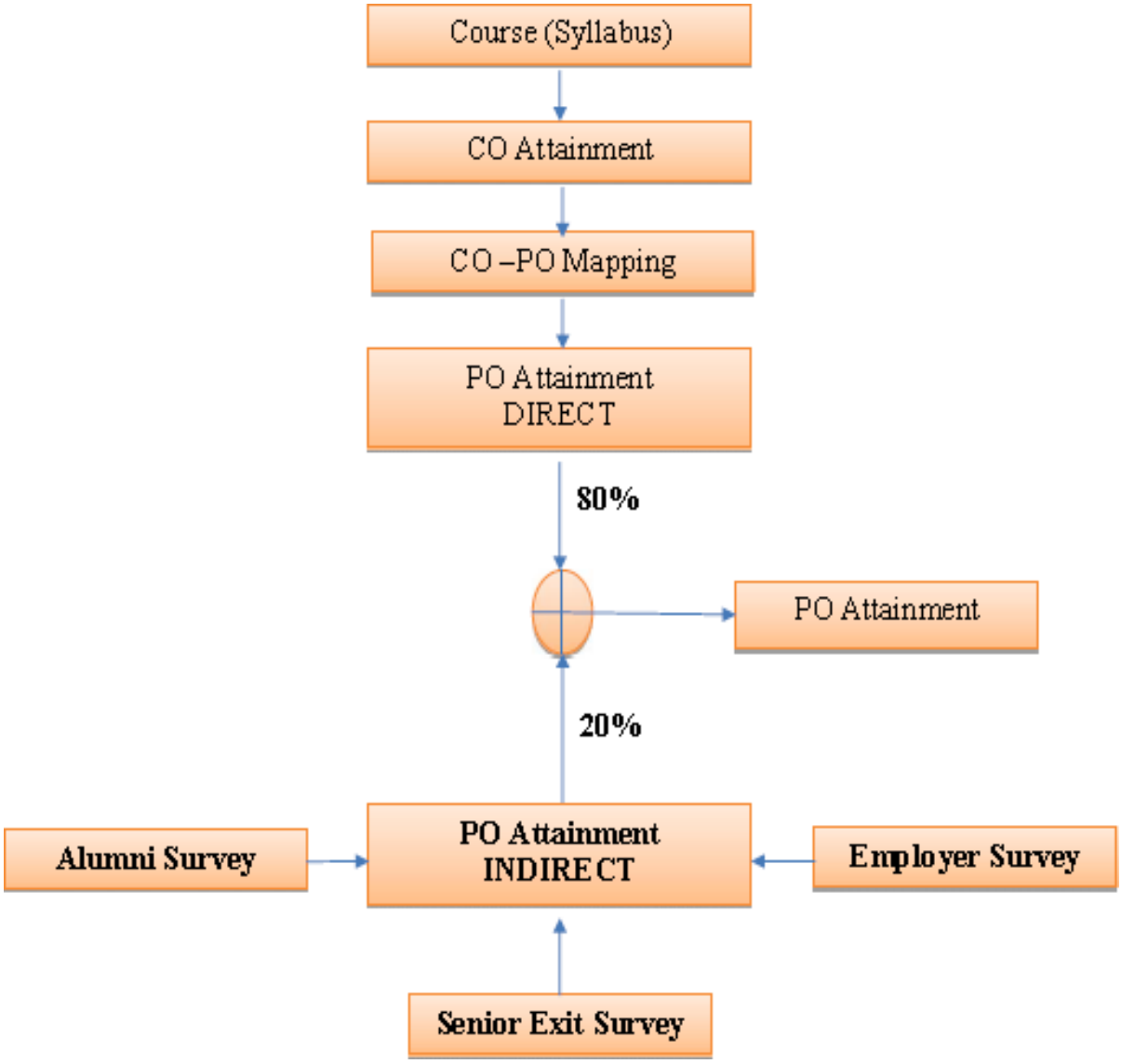
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcomes Attainment Process



Program Outcomes

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the 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 modeling 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 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: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.