RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

Civil Engineering

Scheme And Syllabus Of V & VI Semester
(2022 Scheme)

B.E. Programs: AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs: All Departments are recognized as Research Centres by VTU Except AI & AS

2021

99TH
NIRF RANKING IN ENGINEERING (2024)

TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023
1501+
TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023 (ASIA)
501-600

EDUFUTURE EXCELLENCE AWARD
BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)
BY ZEE DIGITAL

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING INDIA
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

*ABILITY ENHANCEMENT COURSES (AEC), UNIVERSAL HUMAN VALUES (UHV), INDIAN KNOWLEDGE SYSTEM (IKS), YOGA.

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

MOUS: 90+WITH INSDUSTRIES / ACADEMIC INSTITUTIONS IN INDIA & ABROAD

EXECUTED MORE THAN RS.40 CRORES WORTH SPONSORED RESEARCH PROJECTS & CONSULTANCY WORKS SINCE 3 YEARS

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2021

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

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2022 Scheme Credit Structure: V Semester

V SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**
			L	**T**	**P**	**Total**		
1	HS351TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	HSS	Theory
2	CV352IA	Design & Drawing of RCC Structures	3	0	1	4	CV	Theory + Practice
3	CV353IA	Highway Engineering	3	0	1	4	CV	Theory + Practice
4	CV354TA	Hydrology and Irrigation	3	1	0	4	CV	Theory
5	CV255TBX	Professional Core Elective-I **(Group-B)**	3	0	0	3	CV	Theory
6	CV256TCX	Professional Core Elective-II **(Group C)**	2	0	0	2	CV	**NPTEL**
		Total				**20**		

GROUP-B: Professional Core Electives

GROUP-B		
Sl. No.	**Course Code**	**Course Title**
1	CV255TBA	Geo-Informatics
2	CV255TBB	Traffic Engineering
3	CV255TBC	Alternate Building Materials and Technologies
4	CV255TBD	Bridge Engineering
5	CV255TBE	Air Pollution & Control

GROUP-C: V Sem: Professional Core Electives (NPTEL)

GROUP-C		
Sl. No.	**Course Code**	**Course Title**
1	CV256TCA	Earthquake Resistant Design of Foundations
2	CV256TCB	Expansive Soil
3	CV256TCC	Introduction to Accounting and Finance for Civil Engineers
4	CV256TCD	Laboratory Practices in Earth Sciences: Landscape Mapping
5	CV256TCE	निर्माण प्रबंधि (Construction Management) केनिद्धंत[Nirman prabandhan (Construction Management) ke Siddhant]

Semester:V						
ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS (Theory)						
Course Code	**:**	**HS351TA**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42 L		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08Hrs**
Introduction to Entrepreneurship: Definition and Scope of Entrepreneurship, Importance of Entrepreneurship in Engineering Innovation and Economic Growth, Techniques for Identifying Entrepreneurial Opportunities, Types of Entrepreneurs: Innovative, Imitative, Fabian, Characteristics and Traits of Successful Entrepreneurs. **Role in economic development**- Emerging Trends in Entrepreneurship, Entrepreneur and Entrepreneurship, characteristics of Entrepreneur, Myths about Entrepreneurship, Entrepreneur vs Intrapreneur, Role of Entrepreneurial Teams **Activities**: Case study on Entrepreneurship in Indian Scenario, Ideation Workshops and Hackathons.	
Unit – II	**08 Hrs**
Entrepreneurial Opportunity Evaluation: Identifying Market Opportunities and Trends, Integration of Engineering Principles in Ideation Process, Cross-Disciplinary Collaboration for Technological Innovation, Assessing Market Feasibility and Demand Analysis, Evaluating Technical Feasibility: Prototype Development, Proof of Concept, Financial Feasibility Analysis: Cost Estimation, Revenue Projection, Break-Even Analysis**.** **Business Planning and Strategy Development**: Elements of a Business Plan, Executive Summary, Company Description, Market Analysis, writing a Business Plan: Structure and Components, Strategic Planning: Vision, Mission, Goals, Objectives, SWOC Analysis, Competitive Strategy: Porter's Generic Strategies, Differentiation, Cost Leadership, Focus Strategy, Growth Strategies: Organic Growth, Mergers and Acquisitions, Strategic Alliances **Activities**: Writing a Business Plan on given templates, Developing Business Models and Prototypes Based on Generated Ideas	
Unit –III	**08Hrs**
Entrepreneurial Marketing and Sales: Basics of Marketing: Product, Price, Place, Promotion (4Ps), Market Segmentation, Targeting, and Positioning (STP), Branding and Product Development Strategies, Creating a Unique Value Proposition (UVP) Digital Marketing: Social Media Marketing, Content Marketing, SEO, SEM, Sales Techniques and Customer Relationship Management (CRM). Entrepreneurial Finance and Resource Management: Sources of Financing: Equity Financing, Debt Financing, Venture Capital, Angel Investors, Crowdfunding, Financial Management: Budgeting, Cash Flow Management, Financial Statements Analysis, Risk Management and Insurance, Human Resource Management: Recruitment, Training, Performance Evaluation, Legal and Ethical Issues in Entrepreneurship: Intellectual Property Rights, Contracts, Corporate Governance Activities:Case Studies and Practical Applications	
Unit-IV	
Introduction to IP : 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. **Trade Marks:** Concept, function and different kinds and forms of Trade marks, Registrable and non-registrable marks. Registration of Trade Mark; Deceptive similarity;	**09Hrs**

Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies.	
Unit –V	**09 Hrs**
Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India. **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.	

Course Outcomes:
After going through this course, the student will be able to

CO1	Understand the concepts of entrepreneurship and cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership.
CO2	Comprehend the process of opportunity identification of market potential and customers while developing a compelling value proposition solutions.
CO3	Analyse and refine business models to ensure sustainability and profitability and build a validated MVP of their practice venture idea and prepare business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture.
CO4	Apply insights into the strategies and methods employed to attain a range of benefits from these IPs and deliver an investible pitch deck of their practice venture to attract stakeholders
CO5	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.

Reference Books

1.	Donald F. Kuratko,"Entrepreneurship: Theory, Process, and Practice", South-Western Pub publishers, 10th edition, 2016,978-ISBN-13: 1305576247
2.	Eric Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Currency Publishers,1st Edition, 2011, ISBN-13: 978-0307887894.
3.	Dr B L Wadehra, Law Relating to Intellectual Property, universa Law publishers 05th edition, ISBN : 9789350350300 .
4	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.

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 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. 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		**100**

	RUBRIC FOR SEMESTER END EXAMINATION (THEORY)	
Q. NO.	**MARKS**	
	PART A	
1	Objective type questions covering entire syllabus	20
	(Maximum **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

Semester: V						
DESIGN AND DRAWING OF RCC STRUCTURES **Category: Professional Core Course** **(Theory and Lab)**						
Course Code	**:**	**CV352IA**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3+3 Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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	**08 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 slab, two-way slab with and without torsion reinforcement.	

4. Dog legged and Open well staircase.
5. Square, rectangular and Circular Isolated column with footing.

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

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply the philosophy and principles of limit state method and analyze RC sections
CO2	Analyze and design RC beams and slabs by limit state method as per codal provisions
CO3	Analyze and design RC columns, stairs and footings by limit state method as per codal provisions
CO4	Sketch rebar details and calculate the quantity of steel for RC sections as per codal provisions

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. 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		**150**

Semester: V						
HIGHWAY ENGINEERING **Category: Professional Core Course** **(Theory and Lab)**						
Course Code	**:**	**CV353IA**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3+3 Hours**

Unit-I	**08 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	**08 Hrs**
Highway Geometric Design: Design factors; Cross-section elements, Sight distances-Types, Factorsaffecting and measurements. Design of Horizontal alignment and vertical alignment. (Note: Derivation not required)	
Unit –III	**08 Hrs**
Pavement Design: Factors affecting design; Traffic volume and Axle load survey, Layers, designrequirements, Flexible pavement design as per IRC: 37 – 2018. Design of rigid pavement as per IRC:58 – 2015(Excluding design of joints)	
Unit –IV	**08 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	**08 Hrs**
Highway Maintenance and Economics: Importance of highway maintenance, Distresses and remedial measures for Flexible and Rigid pavements. Importance of Highway Economics, user benefits andcosts, Economic analysis, Highway financing in India.	

Laboratory

Tests on Soil

1. California bearing Ratio

Tests on aggregates

2. Crushing Test
3. Impact Test
4. Shape of aggregates
5. Ten percent fines
6. Los Angeles abrasion

Tests on Bitumen

7. Kinematic Viscosity
8. Softening Point
9. Ductility

10.Penetration 11.Specific Gravity **Tests on mixes** 12.Proportioning of aggregates **Innovative Experiments** Marshall method of mix design

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain suitable geometry, materials and drainage system for design and construction of pavements.
CO2	Compute the design requirements for geometry, drainage and pavements.
CO3	Select suitable geometry, materials and drainage for design and construction of pavements.
CO4	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, Reprinted2018, 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, V Edition, 2009,ISBN 9788185240213
5	Khanna, S.K. and Justo, C.E.G, Veeraragavan A, 'Highway Engineering', Nemechand and Bros.Roorkee, 10th Edition, 2014 ISBN: 9788185240633, 8185240639

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		**150**

Semester: V						
HYDROLOGY AND IRRIGATION **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	**CV354TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L:28T**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 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	**09 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	**08 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	**08 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	**08 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:-	
CO1	Describe various hydrological parameters and irrigation practices in use for design of water resources projects.
CO2	Understand the hydrological aspects of surface water and concepts of irrigation water management
CO3	Determine various hydrological parameters over a catchment, crop water requirement and storage capacity of a reservoir.

CO4	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.	Applied Hydrology, VenTe Chow, Tata McGraw Hill Edition, 2010, ISBN-13:9780070702424, ISBN-10:007070242X.
3.	Irrigation Engineering and Hydraulic Structures, S.K.Garg, Khanna publications, New Delhi.2006, ISBN-10: 8174090479, ISBN-13: 978-8174090478.
4.	Irrigation water resources and water Power Engineering, P.N.Modi, Standard book house, 9th edition, 2008, ISBN 8189401297, ISBN-13: 978-8189401290
5	Irrigation Engineering, R.K. Sharma, S Chand & company; Revised edition 2007, ISBN-10: 8121921287, ISBN-13: 978-8121921282.

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 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 (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: V						
GEOINFORMATICS **Category: Professional Core Elective - I** **(Group - B)** **(Theory)**						
Course Code	**:**	**CV255TBA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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). Sensors, sensor resolutions (spatial, spectral, radiometric, and temporal). Image registration and Image and False color composite, elements of visual interpretation techniques.	
Unit – II	**08 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. 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	**08 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	**08 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	**08 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: -	
CO1	Describe the various principles of Remote sensing, energy interactions and visual interpretation techniques
CO2	Explain distortion properties associated with platforms, sensors and capturing of remotely sensed data
CO3	Explain the data models, coordinate systems and attribute data management with respect to GIS

CO4	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, *Pearson Education 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). 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)	
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 Elective** **(Theory)**						
Course Code	**:**	**CV255TBB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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 geometriccharacteristics, introduction to road safety.	
Unit – II	**08 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	**08 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	**08 Hrs**
Intersections design and control: Classification, factors considered in design, design principles, conflict points at intersection, signal timings for different color indications. Introduction to control devices – markings, signs, signals, special controls.	
Unit –V	**08 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., Engineering', Khanna Publishers, VII Edition, 2001, ISBN 8174091653, 'Traffic 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). 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)		
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	PART A	
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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 (Theory)						
Course Code	**:**	**CV255TBC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40 Hrs**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**8 Hrs**
Introduction to Energy in building materials and buildings 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.	
Unit – II	**8 Hrs**
Introduction to alternative to cement and mortars, Masonry units Alternatives to Cements and aggregates, Mortars, Types, Preparation, Properties, Masonry materials Classification and properties of mortars, selection of mortars. Polymer mortars. Manufacturing process and Characteristics of alternative masonry units – Properties, Specification and selection – Stabilized mud, Geo polymer, FaL- G Blocks, Aerated concrete blocks etc	
Unit –III	**8 Hrs**
Alternative Building Technologies Alternative Technology for wall construction, Ferro cement, 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	
Unit –V	**8 Hrs**
Cost Effective Building Design: Concept of appropriate Cost Effective buildings and Cost saving techniques adopted in planning, design and construction	

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

CO1	To study process that is environmental appropriate and resource-efficient throughout a building's life-cycle
CO2	To study innovative solutions using state-of-the-art technologies and building materials
CO3	To study how to minimize environmental impact by facilitating to use local and recycled materials to lessen energy in buildings
CO4	To study the behaviour of masonry materials and structures

Reference Books

1	Alternative building Materials and Technologies, K.S.Jagadish, B.V.Venkatarama Reddy and K.S.NanjundaRao, New Age International Private Limited; Second 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). 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)	
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 Elective** **(Theory)**						
Course Code	**:**	**CV255TBD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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	**08 Hrs**
Introduction to structural health monitoring in integration with AI: Simulation study and incorporation of different types of sensors. Inspection & Maintenance of bridges. **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.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Describe the principle of bridge site investigation, bridge hydrology and standards.
CO2	Apply the Codal provisions of IRC 6 and IRC 21 in the design of Bridges.
CO3	Analysis of bridges subjected to various loads.
CO4	Design of RCC Deck slab bridge for Class AA tracked vehicle loading.

Reference Books

1.	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). 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)		
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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						
Air pollution and Control Professional Core Elective (Theory) (Group - B)						
Course Code	**:**	**CV255TBE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P		**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 Hrs**
Introduction: Air Pollution Level in different cities, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, Global effects of air pollution.	
Unit – II	**08 Hrs**
Meteorology: Temperature lapse rates and Stability, Wind velocity and turbulence, plume behavior, Measurement of meteorological variables. Windrose diagram. Air pollution episodes. Measurement of ambient air quality parameters field visit	
Unit –III	**08 Hrs**
Modeling of Dispersion of Air Pollutants: Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian dispersion model. Equations for estimation of pollutant concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths. Numerical problems.	
Unit –IV	**08 Hrs**
Sampling and Particulate Pollution Control Methods: Atmospheric sampling and stack sampling methods. Air quality standards. Types of particulate pollution control methods – Settling chambers, Cyclone separators, Scrubbers, Filters and Electrostatic precipitators, design aspects and principle of these air pollution control units Measurement of Automobile exhaust emission. Field visit	
Unit –V	**08 Hrs**
Gaseous pollution control methods: Types of gaseous pollution control methods – absorption, adsorption and combustion processes. Emission standards for automobile pollution. **Noise Pollution:** Causes, Effects and control. Noise standards	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify the major sources of air pollution and understand their effects on environment, economics and health.
CO2:	Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
CO3:	Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
CO4:	Choose and design control techniques for particulate and gaseous emissions.

Reference Books

1	M. N. Rao and H V N Rao. Air Pollution, Tata Mc-Graw Hill Publication, ISBN 10- 0074518712, 13- 9780074518717, 2001,reprint 2013.
2	H. C. Perkins, Air Pollution. Tata McGraw Hill, ISBN 10- 0070493022, 13- 978-0070493025, 1974, Reprint 2013.
3	Noel De Nevers, Air Pollution Control Engineering, Waveland Pr Inc, ISBN 10- 1577666747, 13- 978 -1577666745, 2010.
4	Anjaneyulu Y, Text book of Air Pollution and Control Technologies, Allied Publishers, ISBN 13- 9788177641844, 2002.
5	https://onlinecourses.nptel.ac.in/noc23_ce14/preview - NPTEL course Air Pollution and Control By Prof. Bhola Ram Gurjar IIT Roorkee

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**
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MAXIMUM MARKS FOR THE CIE THEORY		**100**

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7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

2022 Scheme Credit Structure: VI Semester

VI SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**
			L	**T**	**P**	**Total**		
1	HS261TA	Principles of Management and Economics	3	0	0	3	HSS	Theory
2	CV362IA	Water & Waste water Engineering	3	0	1	4	CV	Theory + Practice
3	CV363IA	Geotechnical Engineering	3	0	1	4	CV	Theory + Practice
4	CV364TA	Design & Drawing of Steel Structures	3	0	1	4	CV	Theory
5	CV365TDX	**Professional Core Elective-IV (Group- D)**	3	0	0	3	CV	Theory
6	XX366TEX	**Institutional Electives – I (Group F)**	3	0	0	3	XX	Theory
7	CV367P	Extensive Survey Project	0	0	3	3	CV	Project
		Total				**24**		

VI Sem: Professional Elective Group-D

GROUP-D		
Sl. No.	**Course Code**	**Course Title**
1	CV365TDA	Advanced Concrete Technology
2	CV365TDB	Transportation Engineering
3	CV365TDC	Structural Masonry
4	CV365TDD	Disaster Management
5	CV365TDE	Integrated Watershed Management

VI Sem: Institutional Electives Group-E

GROUP-E (3 Credit Courses without prerequisites)			
Sl. No.	Course Code	BoS	Course Title
1	AS266TEA	AS	Fundamentals of Aerospace Engineering
2	BT266TEB	BT	Bioinformatics
3	CH266TEC	CH	Industrial Safety Engineering
4	CS266TED	CS	Robotics Process Automation
5	CV266TEE	CV	Intelligent Transport Systems
6	CV266TEF	CV	Integrated Health Monitoring of Structures
7	CM266TEG	CM	Advanced Energy Storage for E-Mobility
8	EC266TEH	EC	Human Machine Interface(HMI)
9	EE266TEJ	EE	Energy Auditing and Standards
10	EI266TEK	EI	Biomedical Instrumentation

VI Sem: Institutional Electives- GROUP-F

GROUP-F (3 Credit Courses without prerequisites)			
Sl. No.	**Course Code**	**BoS**	**Course Title**
11	ET266TEM	ET	Telecommunication Systems
12	ET266TEN	ET	Mobile Communication Networks and Standards
13	IS266TEO	IS	Mobile Application Development
14	IM266TEQ	IM	Elements of Financial Management
15	IM266TER	IM	Optimization Techniques
16	ME266TES	ME	Automotive Mechatronics
17	MA266TEU	MA	Mathematical Modelling
18	MA266TEV	MA	Mathematics of Quantum Computing
19	HS266TEW	HS	Applied Psychology for Engineers
20	HS266TEY	HS	Universal Human Values

2022 scheme						
PRINCIPLES OF MANAGEMENT & ECONOMICS (Theory)						
Course Code	**:**	**HS261TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**		**SEE Duration**	**:**	**3.00 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, **Behavioral 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 Equitytheory, 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. **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.						
Unit –V						**09 Hrs**
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, ESG an overview. **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						

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 &NeharikaVohra, 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**
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3.	**EXPERIENTIAL LEARNING:** Some of the Experiential learning topics may include Reading Leadership books and summarizing, Analysis and interpretation of various economic reports, Visit to various organizations to understand organizational mechanics. 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						
Water and Waste water Engineering (Theory & Practical)						
Course Code	**:**	**CV362IA**		**CIE**	**:**	**100 Marks+ 50Marks**
Credits: L:T:P		**3:0:1**		**SEE**	**:**	**100 Marks + 50Marks**
Total Hours	**:**	**40L+26P**		**SEE Duration**	**:**	**3.00 Hours + 3.00 Hours**

Unit-I	**08 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. Problems **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	**08 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	**08 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	**08 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. Problems.	
Unit –V	**08 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. Design of trickling filter, ASP.	

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 water and waste water treatment.

Laboratory Experiments
1. Determination of Solids in sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settable Solids.
2. Determination of Chloride and Sulphate.
3. Determination of Calcium, Magnesium and Total Hardness
4. Determination of Dissolved Oxygen.
5. Determination of BOD and COD
6. Determination of Iron, Phenanthroline method
7. Determination of Fluorides.
8. Total Count test and MPN Determination
9. Determination of Nitrates and phosphates.
10. Jar Test for optimum Dosage of Alum. Turbidity Determination by Nephelometer
11. Examination of different water and waste water samples and report.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand quality, quantity of various sources of water and compare with water quality standards, make appropriate choice for a community.
CO2:	Analyze water and Design different water treatment units to purify available raw water to the require standards.
CO3:	Evaluate collection and transportation system for water and sewage.
CO4:	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 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)	
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						
GEOTECHNICAL ENGINEERING **Category: Professional Core Course** **Stream: Theory & Practice**						
Course Code	**:**	**CV363IA**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**40L+28P**		**SEE Duration**	**:**	**3.0 Hours + 3Hours**

Unit-I	**07 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	**09 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	**08 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	**08 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	**08 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 6. Standard Proctor Compaction Test 7. Field Density Test a) Core Cutter Method b) Sand Replacement Method 8. Determination of Permeability of soils a) Constant Head Method b) Variable Head Method 9. Determination of Shear Strength of soils a) Direct Shear Test b) Triaxial Shear Test (UU only) c) 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. NewDelhi, 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.

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	10
2	Conduction of the Experiments	30
3	Viva	10
	TOTAL	**50**

Semester: VI						
DESIGN AND DRAWING OF STEEL STRUCTURES **Category: Professional Core Course** **Stream: Theory& Practice**						
Course Code	**:**	**CV363TA**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100**
Total Hours	**:**	**40L+28T**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**08 Hrs**
Introduction: Advantages and disadvantages of steel structures, load and load combinations, design philosophies, structural forms. **Bolted connections**: Advantages, Types, Modes of failures, Introduction to simple , semi rigid and rigid connections, Eccentric connections(plane of connection parallel and perpendicular to the plane of moment). Detailing of Simple beam to beam and beam to column connections: Framed, stiffened, unstiffened seated connections.	
Unit – II	**08 Hrs**
Welded connections: Advantages, disadvantages. Types of joints, weld symbols, Design of simple joints, eccentric connections, (plane of connection parallel and perpendicular to the plane of moment). Detailing of Simple beam to beam and beam to column connections, Framed, stiffened, unstiffened seated connections using welds.	
Unit –III	**07 Hrs**
Design of tension members: Modes of failures, Analysis and design of tension members- angles.	
Unit –IV	**09 Hrs**
Design of compression members: Failure modes, section used for compression member, member classification, analysis and design of simple axially loaded members. Design of lacing, battens.	
Unit –V	**08 Hrs**
Plastic Analysis: Introduction to plastic hinge, Plastic section modulus, shape factor for rectangle, circle, square, I section, T section and hollow rectangular, circular sections, Concept of collapse load and Plastic moment(No numericals) **Design of beams:** Beam types, section classification, design of laterally supported beams.	

Reference Books	
1.	Subramanian N, _Design of Steel structures‘, Oxford University press, 2nd Edition, 2016, ISBN 9780199460915
2.	S K Duggal, _Limit state design of steel structures‘, Tata McGraw Hill Education Private Limited, 2017, 2nd edition, ISBN-13 978-9351343493
3.	Bhavikatti S S, _Design of Steel structures‘, I K International Publications, 2016, 3rd edition ISBN9789382332091
4.	Shiyekar, M. R., Limit state design in Structural Steel,PHI Learning pvt ltd, 3rd Edition, ISBN : 9788120353503
5	BIS Codes: i) IS-800-2007, General construction in steel-code of practice. ii) IS 875-1987, Code of practice for design loads, iii) SP6(6)- 1972, IS handbook for structural engineers-application of plastic theory in design of steel structures. iv) SP6(1)-1964,Reaffirmed in 2003 Handbook for structural engineers- Structural steel sections

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 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**

Semester: VI						
ADVANCED CONCRETE TECHNOLOGY **Category: Professional Core Elective-III** **(Group - D)** **(Theory)**						
Course Code	**:**	**CV365TDA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Hydration: Importance, Hydrated Cement Paste, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete.	
Unit – II	**08 Hrs**
Admixtures- Mechanism of chemical admixture, Plasticizers and super plasticizers, dosage and their effect on concrete properties in fresh and hardened state, mineral admixtures-Fly ash, Silica fume, GGBFS, metakaolin and rice husk ash. Typical case studies	
Unit –III	**08 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. Shrinkage, creep, and thermal effects. Typical case studies**.**	
Unit –IV	**08 Hrs**
Mix Proportioning: Concrete Mix proportioning by ACI and other methods – Numerical examples. Differences between ACI and IS methods of proportioning using IS-10262-2019. Nano materials in construction. Geopolymer - Properties and applications Geopolymer concrete, Self-compacting concrete Properties and applications of self-compacting concrete.	
Unit –V	**08 Hrs**
Special concretes: Fiber reinforced concrete – Fibers types and properties, Behaviour of FRC in flexure and Tension, Applications. Concept of Hybrid Fibre Reinforced Concrete, Light weight concrete-materials properties and types. Typical light weight concrete mix, High density concrete, Reactive powder concrete, Bacterial concrete.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand dimensional stability, microstructure and properties of cement paste and concrete
CO2	Assess the methods of determining the suitable admixture and ingredients for making concrete and design the mix
CO3	Outline the importance of the durability of conventional and other concrete
CO4	Describe properties and applications of concretes

Reference Books	
1.	Santhakumar.A. R, Concrete technology, Oxford University Press; Second edition (1 April 2018), ISBN-10 :0199458529, ISBN-13: 978-0199458523.
2.	Shetty. M.S., Concrete Technology Theory and Practice, S. Chand& Co Ltd., New Delhi, 2007 ISBN-10 : 9788121900034, ISBN-13 : 978-8121900034
3.	Kumar Mehtha.P and Paulo J M Monteiro., Concrete Microstructre, Properties and Materials, Indian Edition, Indian Concrete Institute, Chennai, SBN-10 : 933920476X, ISBN-13 : 978-93392047611, Publisher: McGraw Hill Education; 4th edition ,2017.
4.	Neville. A.M, Properties of Concrete V Edition, (2012) Peaerson Education, Inc, and Dorling Kindersley Publishing Inc. ISBN-10: 8131791076, ISBN-13 : 978-8131791073.

5	Gambhir M L., Concrete Technology theory and Practice, Fifth Edition, Tata McGraw Hill Education Private Ltd, New Delhi. 2017, ISBN-10 : 1259062554, ISBN-13 : 978-1259062551.

Codes	
1	IS: 10262-2019, Code of practice for concrete mix proportioning.
2	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). 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)	
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: Department Elective** **(Theory)**						
Course Code	**:**	**CV365TDB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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	**08 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:-	
CO1	Recognize and choose the scope and objectives of railway Engineering
CO2	Identify and interpret the importance of tunnel construction.
CO3	Explain and illustrate the necessity, components, types and application of harbors.
CO4	Categorize, design and construct the various features of airport.

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 OzaG.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). 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)	
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 (Theory)						
Course Code	**:**	**CV365TDC**		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40 Hrs**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**6 Hrs**
Introduction: Masonry units, materials and types: History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure	
Unit – II	**8 Hrs**
Characteristics of masonry constituents: Types of masonry units such as stone, bricks, concrete, clay and stabilized mud etc. Properties of masonry units like strength, modulus of elasticity and water absorption etc. Masonry mortars – Classification and properties of mortars, selection of mortars	
Unit –III	**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 –IV	**8 Hrs**
Shear and Flexure Behavior of Masonry: Importance of Shear and Flexure properties of masonry,Factors affecting bond strength, Bond between masonry unit and mortar, Effect of Bond strength on Compressive strength, Flexure and Shear strength of Masonry.Test methods for determining flexural and shear bond strengths, Test procedures for evaluating flexural and shear strength. Concept of Earthquake resistant masonry buildings	
Unit –V	**10 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 to 8 storeys using BIS codal provisions	

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

CO1	Choose appropriate masonry unit and mortar mixes for masonry construction
CO2	Distinguish wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions
CO3	Appraise knowledge of structural masonry for advanced research and construction procedures
CO4	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). 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)	
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: Professional Core Elective-IV (Group- D)** **(Theory)**						
Course Code	**:**	**CV365TDD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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	**08 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	**08 Hrs**
Geo-informatics in Disaster Management Remote sensing, Geographical Information System, Global Positioning System, Drone technology, Indian Regional Navigation Satellite System (IRNSS), Indian Tsunami Early Warning System (ITEWS), Use of ICT and Mobile technology for Disaster Management, Application of Drone Technology.	
Unit –IV	**08 Hrs**
Disaster Management Act Institutional frame work under Disaster Management Act 2005, Role of National Disaster Management Authority (NDMA), Disaster Response plan, Search and Rescue operations, Evacuation and Logistic Management, Demonstration of Earthquake evacuation Drill, Demonstration of Fire Drill.	
Unit –V	**08 Hrs**
Disaster Mitigation and Management 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, Cyclones and hurricanes, inter department cooperation. Regional and global disaster mitigation.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Study the environmental impact of natural and manmade calamities
CO2	Learn to analyze and assess risk involved due to disasters.
CO3	Understand the role of public participation.
CO4	Learn the management tools and mitigation 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, Riki Therivel, 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, 6 th 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). 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)	
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 Elective III** **Group D** **(Theory)**						
Course Code	**:**	**CV365TDE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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	**08 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:-	
CO1	Cognize the concepts of watershed management and its effect on land, water and ecosystem resources.
CO2	Evaluate the impact of watershed planning through watershed characterization, runoff and soil loss estimation.
CO3	Analyse the public policies and practices of watershed planning.
CO4	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). 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)	
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						
FUNDAMENTALS OF AEROSPACE ENGINEERING **Category: Institutional Electives-I** **(Theory)**						
Course Code	**:**	**AS266TEA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Basics of Flight Vehicles: History of aviation, International Standard atmosphere (ISA), Temperature, pressure and altitude relationships, Simple Problems on Standard Atmospheric Properties, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions.	
Unit – II	**10 Hrs**
Aircraft Aerodynamics: Bernoulli's theorem, Centre of Pressure, Lift and Drag, Types of Drag, Aerodynamic Coefficients, Aerodynamic Centre, Wing Planform Geometry, Airfoil Nomenclature, Basic Aerodynamic characteristics of Airfoil, Simple Numericals on Lift and Drag.	
Unit –III	**12 Hrs**
Aerospace Propulsion: Introduction, Turbine Engines: Brayton Cycle, Operation of Turbojet, Turboprop, Turbofan, Turboshaft, RAMJET and SCRAMJET Engines, Rocket Engines: Principles of operation of Solid, Liquid, Hybrid, Nuclear and Electric Rockets. **Introduction to Space Mechanics:** Basic Orbital Mechanics-Types of Trajectories, Escape and Orbital Velocities, Kepler's Laws of Planetary Motion, Simple Numericals.	
Unit –IV	**06 Hrs**
Aerospace Structures and Materials: General types of construction-Monocoque, Semi-Monocoque & Geodesic, Structure of Wing and Fuselage, Metallic and Composite Materials.	
Unit –V	**08 Hrs**
Aircraft Systems & Instruments: Instrument Displays, Basic Air data systems & Pitot Probes- Mach meter, Air speed indicator, Vertical speed indicator, Altimeter. **Basics of Aircraft Systems:** Hydraulic and pneumatic systems, Electrical System, Aircraft Fuel System, Environmental Control System.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Identify the fundamental nuances of Aerospace Engineering and appreciate their significance on the Flight Vehicles design and performance
CO2:	Interpret the design parameters that influence the design of the Aerospace Vehicles systems and its sub-systems
CO3:	Evaluate critically the design strategy involved in the development of Aerospace vehicles
CO4:	Categorically appraise the operation of the Aerospace Vehicles for different operating conditions

Reference Books	
1	Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
3	Rocket Propulsion Elements, Sutton G.P., 8th Edition, 2011, John Wiley, New York, ISBN: 1118174208, 9781118174203.

4	Aircraft structural Analysis, T.H.G Megson, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4
5	Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206

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 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**

Semester: VI					
Bioinformatics **(Category: Institutional Electives -I)** **(Theory)**					
Course Code	**:**	**BT266TEB**	**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**	**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**	**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Introduction to tools and databases: Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases – genome and microarray, Applications of these databases, examples, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method	
Unit – II	**09 Hrs**
Sequence Analysis: Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation.	
Unit –III	**09 Hrs**
Introduction to Next-Generation Sequencing (NGS) analysis: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads, automation in NGS analysis and advantages (shell scripting)	
Unit –IV	**09 Hrs**
Structural analysis & Systems Biology: Gene prediction programs – ab initio and homology-based approaches. ORFs for gene prediction. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition. Structure prediction - Prediction of secondary structure, tertiary structure prediction methods, Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology, Flux Balance analysis.	
Unit –V	**09 Hrs**
Drug Screening: Introduction to Computer-aided drug discovery, target selection, ligand preparation and enumeration, molecular docking, post-docking processing, molecular dynamics simulations, applications and test cases, AI/ML in Drug discovery	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Gain proficiency in utilizing a range of bioinformatics tools and databases for comprehensive sequence and structural analysis.
CO2	Investigate and apply innovative sequencing technologies and analytical methods to solve complex biological questions and advance research in genomics and molecular biology.

CO3	Demonstrate expertise in NGS technologies, including performing data quality assessments, read processing, and managing large-scale data.
CO4	Apply bioinformatics tools for modeling and simulating biological processes, with a focus on gene prediction using both ab initio and homology-based approaches.

Reference Books	
	Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13.
2.	Buehler LK, Rashidi HH, editors. Bioinformatics basics: applications in biological science and medicine. CRC Press; 2005 Jun 23.
3.	Ghosh Z, Mallick BM. Bioinformatics principles and Applications. Oxford University Press; 2018 Jun 13.
4.	Low L, Tammi MT. Introduction to next generation sequencing technologies. Bioinformatics. WORLD SCIENTIFIC. 2017 Jul 26:1-21.
5.	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
6.	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866.

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					
INDUSTRIAL SAFETY ENGINEERING **Category: Institutional Elective** **(Theory)**					
Course Code	**:**	**CH266TEC**	**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, problems on OSHA					
Unit – II					**08 Hrs**
Risk assessment and control: Risk assessment, Risk perception, acceptable risk, problems on net present value, internal rate of return, payback period concepts including real life examples. **Hazard Identification Methods:** Preliminary Hazard List (PHL), worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analysis. Design and development of fault tree and event tree for high pressure reactor system.					
Unit –III					**08 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Guide words, HAZOP matrix, Procedure, HAZOP studies on reactors, heat exchanger, design of HAZOP table, Failure Modes and Effects Analysis (FMEA) concept, methodology, problems of FMEA, examples.					
Unit –IV					**08 Hrs**
Risk analysis on capital budgeting: Risk adjusted discount rate (RADAR) method, certainty equivalent approach, scenario analysis, probability distribution, quantification of risk using statistical parameters and associated problems.					
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	Understand the risk assessment techniques used in process industry
CO2	Interpret the various risk assessment tools.
CO3	Use hazard identification tools for safety management.
CO4	Analyze tools and safety procedures for protection in process industries.

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

4.	ndustrial 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). 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)		
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						
ROBOTOC PROCESS AUTOMATION (INSTITUTIONAL ELECTIVE) (THEORY)						
Course Code	**:**	**CS266TED**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Duration	**:**	**36**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**8 Hrs**
RPA Concepts: RPA Basics, History of Automation, what is RPA? RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated? Types of Bots, Workloads that can be automated. **RPA Advanced Concepts**: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.	
Unit – II	**7 Hrs**
RPA Tool Introduction: Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, Managing Arguments, The Arguments Panel, Namespaces; Control flow statements in UiPath, Sequences and Flowcharts, Control Flow Activities Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation, main string methods. **UiPath Recording:** Basic, Desktop and Web Recording, Image and Native Citrix Recording, Input/output methods, Types of OCR, Data Scraping, Advanced Scraping techniques.	
Unit – III	**7 Hrs**
Advanced Automation Concepts: Selectors, Types of Selectors (Full, partial, dynamic), Defining and Assessing Selectors, Customization, Debugging. Image, Text & Advanced Citrix Automation – Introduction, Keyboard based automation, Information Retrieval, Best Practices Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table, Extracting Data from Data Table, Anchors, Using anchors in PDF	
Unit – IV	**7 Hrs**
Email Automation, Exceptions and Deploying Bots: Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output. Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors. Overview of orchestration Server, orchestrator functionalities, Connecting Bot to orchestrator	
Unit – V	**7 Hrs**
Hyperautomation: Components and application ofHyperautomation, Automation versus hyperautomation, Benefits and challenges of hyperautomation, use cases,Phases (Integration, Discover, Orchestration and Governance), Trends in Hyperautomation (low-code/no-code platform, HaaS)	

	Course Outcomes: After completing the course, the students will be able to
CO1	Understand RPA principles, its features and applications

CO2	Demonstrate proficiency in handling variables and decision making inside a workflow and data manipulation techniques
CO3	Gain insights into recording, Email Automation and exception handling and orchestrator.
CO4	Analyze the trends in automation and chose business strategy to design a real-world automation workflow.

Reference Books:	
1	Alok Mani Tripathi, "Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN: 9781788470940
2	PASCAL BORNET, Intelligent automation: Welcome to the world of hyperautomation, World Scientific Publishing Company, ISBN-13: 978-9811235481 December 2020
3	UiPath pdf manuals
4	https://www.uipath.com/rpa/robotic-process-automation
5	https://www.ibm.com/topics/hyperautomation
6	https://www.pega.com/hyperautomation

Semester: VI						
INTELLIGENT TRANSPORTATION SYSTEMS **Category: Institution Elective-I** **(Theory)**						
Course Code	**:**	**CV266TEE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Introduction to Intelligent Transportation Systems **(**ITS): Historical background, Urbanisation, Motorisation, Transport system characteristics, Transport problems and issues, Challenges and opportunities in ITS: ITS-Today and tomorrow, ITS training and education needs, Role and importance of ITS in context of Indian Transport system and opportunity for sector growth of ITS.	
Unit – II	**08 Hrs**
ITS Architecture: introduction, Functionalities required for User service, Logical architecture, Physical architecture, Equipment and Market packages, Need of ITS Architecture to solve problems in Urban area. Technology building blocks for ITS: Introduction, Data acquisition, Communication tools, Data analysis and Traveller information. Various detection, Identification and collection methods for ITS.	
Unit –III	**08 Hrs**
Traffic management system components and ITS: Introduction, objectives, traffic management measures, ITS for traffic management, Development of traffic management system, Traffic Management Centre, Advance Traffic Management System, Advanced Traveller Information System, Advance Vehicle Control Systems, Advance Public Transport System, Commercial Vehicle Operations, ITS For Intermodal Freight Transport.	
Unit –IV	**08 Hrs**
ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options.	
Unit –V	**08 Hrs**
ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing. ITS for smart cities and Case studies.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Identify and apply ITS applications at different levels
CO2	Illustrate ITS architecture for planning process
CO3	Examine the significance of ITS for various levels
CO4	Compose the importance of ITS in implementations

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)	
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 HEALTH MONITORING OF STRUCTURES **Category: Institutional Electives - I** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**CV266TEF**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**
Unit-I						**08 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration.						
Unit – II						**08 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence						
Unit –III						**08 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.						
Unit –IV						**08 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.						
Unit –V						**08 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Diagnose the distress in the structure understanding the causes and factors.
CO2	Understand safety aspects, components and materials used in Structural Health Monitoring.
CO3	Assess the health of structure using static field methods and dynamic field tests.
CO4	Analyse behavior of structures using remote structural health monitoring

Reference Books	
1	Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes,2006, John Wiley and Sons, ISBN: 978-1905209019
2	Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, 2007,John Wiley and Sons, ISBN:9780470033135
3	Structural Health Monitoring and Intelligent Infrastructure, J. P. Ou, H. Li and Z. D. Duan, Vol1,2006,Taylor and Francis Group, London, UK. ISBN: **978-0415396523**
4	Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, 2007, Academic Press Inc, ISBN: 9780128101612

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)		
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						
ADVANCED ENERGY STORAGE FOR E-MOBILITY (Theory)						
Course Code	**:**	**CM266TEG**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3.00 Hours**
Course Learning Objectives: The students will be able to						
1	Understand the fundamentals and technologies of energy storage in electric vehicles					
2	Analyze and compare advanced battery technologies for e-mobility					
3	Impart the principles of electrochemistry for analyzing issues in electric/hybrid vehicles.					
4	Develop solutions for battery management systems and recycling of advanced storage devices.					
Unit-I						**07 Hrs**
Energy storage in electric vehicles Introduction to E-mobility, background of alternative energy sources and sustainability. Types of electric vehicles and their salient features along with their energy requirement. Fundamentals of advanced battery technology. Battery characteristics. Specification of advanced battery for e mobility.						
Unit – II						**08 Hrs**
Advanced lithium-ion batteries Basic concepts of lithium batteries. Types of advanced cathode and anode materials employed in lithium batteries. Construction, working and future applications of lithium cobalt oxide, lithium iron phosphate, Lithium air, lithium sulfur and lithium polymer batteries with their advancement in vehicle electrification.						
Unit –III						**09 Hrs**
Non lithium batteries for e mobility Limitations of lithium batteries. Overview of non-lithium battery technology. Construction and working of advanced non-Lithium batteries such as Lead acid, Nickel Metal Hydride, Redox flow, Zebra, Sodium and Magnesium batteries. Electrode materials and electrolyte considerations in non lithium batteries. Performance comparison with lithium-ion batteries. Battery requirement in charging infrastructure.						
Unit –IV						**09 Hrs**
Chemistry of alternative storage devices Introduction to super capacitor. Construction, working and applications of supercapacitors along with the materials used in electrodes. Types of advanced supercapacitors. Application of supercapacitors in regenerative braking. Advancement in battery-supercapacitor hybrid, Battery-fuel cell hybrid, and Battery-solar cell hybrid electric vehicles with their advantages and limitations.						
Unit –V						**09 Hrs**
Battery management and recycling: Battery management systems (BMS): Fundamentals of battery management systems and controls, State-of-charge (SoC), state-of-health (SoH) and Cell balancing techniques. Battery Thermal Management: Passive and active cooling systems. Safety mechanisms, thermal runaway and thermal management. Battery recycling: Economic aspects, environmental safety and process of recycling of advanced batteries.						
Course Outcomes: After completing the course, the students will be able to						
CO1:	Implement the fundamentals of chemistry in advanced energy storage and conversion devices.					

CO2:	Apply the chemistry knowledge used for hybridization of various energy storage and conversion devices.
CO3:	Analyze the different battery system for achieving maximum energy storage for vehicle electrification
CO4:	Evaluation of efficiency of a battery with respect to cost, environmental safety, material, energy consumption and recycling.

Reference Books	
1	Battery reference book, T. R. Crompton., 3rd edition, NEWNES Reed Educational and Professional Publishing Ltd 2000, ISBN: 07506 4625 X.
2	Batteries for Electric Vehicles, D. A. J. Rand, R. Woods, and R. M. Dell, Society of Automotive Engineers, Warrendale PA, 2003. ISBN 10: 0768001277.
3	• Lithium Batteries, Science and Technology, GA. Nazri and G. Pistoa, Kluwer Academic Publisher, 2003, ISBN 978-0-387-92675-9.
4	Battery Technology Handbook, H. A. Kiehne, Marcel Dekker, NYC, 2003. ISBN: 0824742494 9780824742492.
5	Electric Vehicle Technology Explained, James Larminie and John Lowry. 2nd Edition, Wiley, ISBN-13: 978-1118505429.
6	Electric Vehicle Technology and Design, Antoni Gandia. CRC Press, ISBN-13: 978-1138551912.
7	Sustainable Transportation: Problems and Solutions. William R. Black, The Guilford Press, ISBN-13: 978-1462532072.

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

High-3: Medium-2: Low

Semester: VI					
HUMAN MACHINE INTERFACE (HMI) **Institutional Elective Industry Assisted Elective-BOSCH**					
Course Code	**:**	**EC266TEH**	**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**	**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**	**SEE Duration**	**:**	**03 Hrs**
Unit-I					**09 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					**09 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					**09 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					**09 Hrs**
HMI User Interface: User-centered HMI development process, Basics of Webserver. 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					**09 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 completing 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 systems.

Reference Books	
1.	Touch based HMI; Principles and Applications, Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan, Springer Nature Switzerland AG, 1st Edition.
2.	Unity 2020 by Example: A Project based guide to building 2D, 3D augmented reality and Virtual reality games from sratch, Robert Wells, Packt Publishing ltd, 2020.
3.	GUI Design and Android Apps, Ryan Cohen, Tao Wang, 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 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. 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		**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						
ENERGY AUDITING & STANDARDS **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	**EE266TEJ**		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	50 Marks
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	2 Hours

Unit-I	**06 Hrs**
Types of Energy Audit and Energy-Audit Methodology: Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training. **Survey Instrumentation:** Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data Acquisition System, **Energy Audit of a Power Plant:** Indian Power Plant Scenario, Benefit of Audit, Types of Power Plants, Energy Audit of Power Plant.	
Unit – II	**10 Hrs**
Electrical-Load Management: Electrical Basics, Electrical Load Management, VariableFrequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor, Transmission and Distribution Losses. **Energy Audit of Motors:** Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling. **Energy Audit of Pumps, Blowers and Cooling Towers:** Pumps, Fans and Blowers, Cooling Towers	
Unit –III	**09 Hrs**
Communication & Standards: **Wireless technologies:** WPANs, LAN, Wireless metropolitan area network, cellular network, satellite communication, Zigbee, Bluetooth, LAN, NAN **Wireline communication:** Phone line technology, powerline technology, coaxial cable technology; Optical communication, TCP/IP networks	
Unit –IV	**09 Hrs**
Energy Audit of Boilers: Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods. **Energy Audit of Furnaces:** Parts of a Furnace, classification of Furnaces, Energy saving Measures in Furnaces, Furnace Efficiency **Energy Audit of Steam-Distribution Systems :** S team as Heating Fluid, Steam Basics, Requirement of Steam, Pressure, Piping, Losses in Steam Distribution Systems, Energy Conservation Methods	
Unit-V	**09 Hrs**
Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities. **Energy Audit Applied to Buildings:** Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the need for energy audit, prepare a flow for audit and identify the instruments needed.
CO 2	Design and perform the energy audit process for electrical systems.
CO 3	Design and perform the energy audit process for mechanical systems

CO 4	Propose energy management scheme for a building

Reference Books	
1	Handbook of energy audit, Sonal Desai, Kindle Edition, 2015, McGraw Hill Education, ISBN: 9339221346, 9789339221348.
2	Energy management handbook, Wayne C Turner and Steve Doty, 6th Edition, 2015, CRC Press, ISBN: 0-88173-542-6.
3	Energy management, Sanjeev Singh and Umesh Rathore, 1st Edition, 2016, Katson Books, ISBN 10: 9350141019, ISBN 13: 9789350141014.
4	Energy audit of building systems, Moncef Krarti, 2nd Edition, 2010, CRC Press ISBN: 9781439828717

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					
BIOMEDICAL INSTRUMENTATION **Category: Institutional Elective** **(Theory)**					
Course Code	**:**	**EI266TEK**	**CIE**	:	100 Marks
Credits: L:T:P	**:**	**03:00:00**	**SEE**	:	100 Marks
Total Hours	**:**	**45L**	**SEE Duration**	:	03 Hrs
Unit-I					**09 Hrs**
Fundamentals: Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.					
Unit – II					**09 Hrs**
Electrocardiograph: Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG), Block diagram description of an Electrocardiograph, ECG lead systems, Multi-channel ECG machine. **Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG.					
Unit –III					**09 Hrs**
Patient Monitoring System: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement, Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method. **Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter.					
Unit –IV					**09 Hrs**
Blood Flow Meters: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **Cardiac Pacemakers and Defibrillators:** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator, Defibrillator electrodes, DC defibrillator with synchronizer.					
Unit –V					**09 Hrs**
Advances in Radiological Imaging: X-rays-principles of generation, Conventional X-ray radiography, Fluoroscopy, Angiography, Digital radiography, Digital subtraction angiography (DSA). Basic principle of computed tomography, magnetic resonance imaging system and Ultrasonic imaging system.					

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the sources of biomedical signals and basic biomedical instruments.
CO2	Apply concepts for the design of biomedical devices
CO3	Analyze the methods of acquisition and signal conditioning to be applied to the physiological parameters.
CO4	Develop instrumentation for measuring and monitoring biomedical parameters.

Reference Books	
1.	Handbook of Biomedical Instrumentation, R. S. Khandpur,3rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553.
2.	Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2nd Edition, Reprint 2015, ISBN: 9780130771315.
3.	Medical instrumentation: Application and Design, J. G. Webster, 3rd Edition, Reprint 2015, Wiley Publications, ISBN: 9788126511068.
4.	Principles of Medical Imaging, K.Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 2016, ISBN: 978-0126409703.

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						
TELECOMMUNICATION SYSTEMS **Category: Institutional Elective Course** **Stream: Electronics & Telecommunication Engineering** **(Theory)**						
Course Code	**:**	**ET266TEM**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**8 Hrs**
Introduction to Electronic Communication: The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications. **The Fundamentals of Electronics:** Gain, Attenuation, and Decibels. **Radio Receivers:** Super heterodyne receiver.	
Unit – II	**10 Hrs**
Modulation Schemes: Analog Modulation: AM, FM and PM- brief review. **Digital Modulation:** PCM, Line Codes, ASK, FSK, PSK & QAM (Architecture). **Wideband Modulation:** Spread spectrum, FHSS, DSSS. **Multiple Access:** FDMA, TDMA, CDMA.	
Unit –III	**10 Hrs**
Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.	
Unit –IV	**9 Hrs**
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	
Unit –V	**8 Hrs**
Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse, Internet Telephony. **Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee, Mesh Wireless Networks, WiMax, and Wireless Metropolitan Area Networks.	

Course Outcomes: After completing the course, the students will be able to :-	
CO1	Describe the basics of communication systems.
CO2	Analyze the importance of modulation and multiple access schemes for communication systems.
CO3	Analyze the operational concept of cell phone and other wireless technologies.
CO4	Justify the use of different components and sub-system in advanced communication systems.

Reference Books	
1.	Principles of Electronic Communication Systems, Louis E. Frenzel, 4th Edition, 2016, Tata McGraw Hill, ISBN: 978-0-07-337385-0.
2.	Electronic Communication Systems, George Kennedy,3rd Edition, 2008, Tata McGraw Hill, ISBN: 0-02-800592-9.
3.	Introduction to Telecommunications, Anu A. Gokhale, 2nd Edition, 2008, Cengage Learning ISBN: 981-240-081-8

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)		
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						
Mobile Communication Networks and Standards **Category: Institutional Elective Course Stream: Electronics & Telecommunication Engineering (Theory)**						
Course Code	**:**	**ET266TEN**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**
Unit-I						**9 Hrs**
Principle of Cellular Communication: Cellular Terminology, Cell Structure and Cluster, Frequency Reuse Concept, Cluster size and System Capacity, Method of Locating Co-channel cells, Frequency Reuse distance, Co-channel Interference and Signal Quality, Co-channel interference Reduction Methods.						
Unit – II						**9 Hrs**
Basic Cellular system: Consideration of components of a cellular system- A basic cellular system connected to PSTN, Main parts of a basic cellular system, Operation of a Cellular system, Performance criteria- Voice quality, Trunking and Grade of Service, Spectral Efficiency of FDMA and TDMA systems						
Unit –III						**9 Hrs**
Second generation Cellular Technology: GSM: GSM Network Architecture, Identifiers used in GSM System, GSM channels, Authentication and Security in GSM, GSM Call Procedure, GSM Hand-off Procedures.						
Unit –IV						**9 Hrs**
3G Digital Cellular Technology: GPRS: GPRS technology, GPRS NetworkArchitecture, GPRS signalling, Mobility Management in GPRS. **UMTS:** UMTS Network Architecture, UMTS Interfaces, UMTS Air Interface Specifications, UMTS Channels**.**						
Unit –V						**9 Hrs**
Wireless Personal Area Networks: Network architecture, components, Bluetooth, Zigbee, Applications. **Wireless Local Area networks:** Network Architecture, Standards, Applications. Wireless Metropolitan Area Networks: IEEE 802.16 standards, advantages, WMAN Network architecture, Protocol stack						

Course Outcomes: After completing the course, the students will be able to :-	
CO1	Describe the concepts and terminologies for Cellular Communication.
CO2	Analyze the Architecture, Hand-off and Security aspects in 2G and 3G Networks.
CO3	Compare the performance features of 2G and 3G Cellular Technologies.
CO4	Analyze and Compare the architectures of various Wireless technologies and standards.

Reference Books	
1.	Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1
2.	Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar SManvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.

3.	Wireless Communication, Upena Dalal, 1st Edition, 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
4	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4

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). 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)		
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					
MOBILE APPLICATION DEVELOPMENT **Category: INSTITUTIONAL ELECTIVE** **GROUP E**					
Course Code	**:**	**IS266TEO**	**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	**3:0:0**	**SEE**	**:**	100 Marks
TotalHours	**:**	**45L**	**SEE Duration**	**:**	03 Hours

Prerequisite: - Programming in Java.

Unit-I	**09 Hrs**
Introduction: Smart phone operating systems and smart phones applications. Introduction to Android, Installing Android Studio, creating an Android app project, deploying the app to the emulator and a device. UI Design: Building a layout with UI elements, Layouts, Views and Resources, Text and Scrolling Views. Activities and Intents, The Activity Lifecycle, Managing State, Activities and Implicit Intents, The Android Studio Debugger, Testing the Android app, The Android Support Library.	
Unit–II	**09 Hrs**
User experience: User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Testing app UI, Testing the User Interface	
Unit–III	**09 Hrs**
Working in the background: Async Task and Async Task Loader, Connect to the Internet, Broadcast Receivers and Services. Scheduling and optimizing background tasks – Notifications, Scheduling Alarms, and Transferring Data Efficiently	
Unit–IV	**09 Hrs**
All about data: Preferences and Settings, Storing Data, Shared Preferences. Storing data using SQLite, SQLite Database. Sharing data with content providers. Advanced Android Programming: Internet, Entertainment and Services. Displaying web pages and maps, communicating with SMS and emails, Sensors.	
Unit–V	**09 Hrs**
Hardware Support & devices: Permissions and Libraries, Performance and Security. Fire base and AdMob, Publish and Polish, Multiple Form Factors, Using Google Services.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of Android application and its architecture.
CO2:	Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications.
CO3:	Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools.

CO4:	Create innovative applications, understand the economics and features of the app marketplace by offering the applications for download.

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4	Professional Android2ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898
5	BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1
6	AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

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. 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 **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 (10) Designing & Modeling (10) **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						
ELEMENTS OF FINANCIAL MANAGEMENT **(Institutional Elective)** **(Theory)**						
Course Code	**:**	**IM266TEQ**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 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.	
Unit – II	**10 Hrs**
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)** **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.	
Unit –III	**10 Hrs**
Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications. **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. **(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.	
Unit –V	**09 Hrs**
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)**	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the features and elements of a financial system.
CO2	Recognize the relevance basic principles of financial management in decision making.
CO3	Describe the processes and techniques of capital budgeting and working capital financing by organizations.
CO4	Demonstrate an understanding of various sources of finance.

Reference Books:	
1.	Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill Education (India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5
2.	Financial Management, I M Pandey, 12th edn, 2021, Pearson, ISBN-939057725X, 978-9390577255

3.	Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education (India) Pvt. Ltd, ISBN: 9353162181, 9789353162184
4.	Fundamentals of Financial Management, Eugene F Brigham, Joel F Houston, 8th Edition, 2014, Cengage Learning, ISBN: 9781285065137, 1285065131.

Semester: VI						
OPTIMIZATION TECHNIQUES (Institutional Elective) (Theory)						
Course Code	**:**	**IM266TER**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hours**

UNIT – I	**08 Hrs**
Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel. **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables.	
UNIT – II	**09 Hrs**
Simplex Algorithm: How to Convert an LP to Standard Form, Preview of the Simplex Algorithm, Direction of Unboundedness, Why Does an LP Have an Optimal basic feasible solution, The Simplex Algorithm, Using the Simplex Algorithm to Solve Minimization Problems, Alternative Optimal Solutions, Degeneracy and the Convergence of the Simplex Algorithm, The Big M Method, The Two-Phase Simplex Method.	
UNIT – III	**09 Hrs**
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	
UNIT – IV	**08 Hrs**
Project Management Using Network Analysis: Network construction, CPM & PERT, Determination of critical path and duration, floats. Crashing of Network. Usage of software tools to demonstrate N/W flow problems	
UNIT – V	**08 Hrs**
Game Theory: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance	

Course Outcomes: After going through this course the student will be able to	
CO1	Understand the characteristics of different types of decision – making environments and the appropriate decision making approaches and tools to be used in each type.
CO2	Build and solve Transportation Models and Assignment Models.
CO3	Design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.
CO4	Implement practical cases, by using TORA, WinQSB, Excel, GAMS.

Reference Books:	
1	Operation Research An Introduction, Taha H A, 10th Global Edition, 2017, Pearson Education Limited, ISBN 13: 978-1-292-16554-7
2	Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg, 2nd Edition, 2007, John Wiley & Sons (Asia) Pvt Ltd, ISBN 13: 978-8126512560

3	Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 10th Edition, 2017, McGraw Hill Education, ISBN 13: 978-9339221850
4	Operations Research Theory and Application, J K Sharma, 6th Edition, 2009, Trinity Press, ISBN : 978-93-85935-14-5

Semester: V						
AUTOMOTIVE MECHATRONICS **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	**ME266TES**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**03 Hours**

Unit-I	**09 Hrs**

Automobile Engines
Classifications of Internal Combustion Engines**.** Engine nomenclature and mechanics. Mixture formation – External, internal, quality and quantity control – homogeneous and stratified injection. Thermodynamic principles of Otto and Diesel cycle. Characteristics – pressure curve and energy yield, engine speed, torque, and power

Unit-II	**10 Hrs**

Engine Auxiliary Systems:
Turbocharger, Intercooler, Exhaust manifold, 3-way catalytic convertor, Exhaust Gas Recirculation system.
Common Rail Fuel Injection system- Low pressure and high pressure fuel systems, Return line, Quantity control valve and Injectors.

Unit-III	**10 Hrs**

Vehicular Auxiliary Systems:
Vehicle frame and body classification- Hatchback, Sedan, SUV, Coupe, Roadster. Adaptive Brakes - Disc and drum brakes, Antilock Braking Systems, ESP, TCS. Wheels and Tyres- Toe-In, Toe-Out, Caster and Camber angle. Classification of tyres, Radial, Tubeless.
Supplemental Restraint System: Active and passive safety, Vehicle structure, Gas generator and air bags, Belt Tensioner, Acceleration sensor, Rollover sensor, Seat occupancy recognition.

Unit-IV	**09 Hrs**

EV Technology: Types of EV's, ICE vs EV torque output, Architecture and Working of EV's.
Battery Thermal Management System, Regenerative braking, Safety system and Impacts of EV on the environment.

Unit-V	**07 Hrs**

Telematics in vehicles – Radio Transmission, Exchange of information, signal path & properties, Concept of radio waves.
Sensors: Oxygen sensors, Crankshaft/Cam shaft Sensor, Boost Pressure Sensor, Coolant Temperature Sensor, Hot Film Air Mass flow Sensor, Throttle Position Sensor, Rain/Light sensor

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the functions of Mechatronic systems in a modern automobile
CO2:	Evaluate the performance of an engine by its parameters
CO3:	Analyse the automotive exhaust pollutants as per emission norms
CO4:	Demonstrate communication of control modules using a On-Board Diagnostic kit

Reference Books	
1.	Automotive Technology – A systems approach, Jack Erjavec, 5th Edition, Delamr Cengage Learning, ISBN-13: 978-1428311497
2.	Automotive Engineering Fundamentals, Richard Stone and Jeffrey K. Ball, 2004, SAE International, ISBN: 0768009871
3.	Bosch Automotive Handbook, Robert Bosch, 9th Edition, 2004, ISBN: 9780768081527
4.	Understanding Automotive Electronics, William B Ribbens, 5th Edition, Butterworth–Heinemann, ISBN 0-7506-7008-8

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 up to 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)		
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 **(Theory)** **Category: INSTITUTIONAL ELECTIVE** **(Elective F)**						
Course Code	**:**	**MA266TEU**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basic procedure of mathematical modeling.
2	Use the concepts of continuous and discrete process models to the problems arising in various fields.
3	Apply the concepts of Markov modelling to stochastic problems.
4	Demonstrate demonstrate the practical importance of graph theoretic models, variational problem and dynamic programming.

Unit-I	**09 Hrs**
Introduction to Mathematical Modelling: Basic concepts, steps involved in modelling, classification of models, assorted simple mathematical models from diverse fields.	
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 chains, application of Markov Modelling to problems.	
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, Problems with 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 engineering.
CO2:	Apply the knowledge and skills of discrete and continuous models to understand various types of analysis.
CO3:	Analyze the appropriate mathematical model to solve the real world problem and to 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 (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**

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

High-3: Medium-2: Low-1

Semester: VI						
MATHEMATICS FOR QUANTUM COMPUTING **(Theory)** **Category: INSTITUTIONAL ELECTIVE** **(Elective F)**						
Course Code	**:**	**MA266TEV**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basic principles of Quantum Computing.
2	Use the concepts of Quantum gates to build quantum algorithms
3	Apply the Quantum algorithms to solve the problems arising in various fields.
4	Demonstrate the practical importance of Quantum computing.

Unit-I	**09 Hrs**
Introduction to Quantum Computing: Quantum superposition, Qubits, Linear algebra for quantum computing, Inner products and Tensor products of vector spaces, Quantum states in Hilbert space, The Bloch sphere, Generalized measurements, No-cloning theorem.	
Unit – II	**09 Hrs**
Quantum Gates: Universal set of gates, quantum circuits, Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits.	
Unit –III	**09 Hrs**
Quantum Algorithm - I: Deutsch Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazarani Algorithm, Simon periodicity algorithm, Phase estimation algorithm, Quantum Fourier transform.	
Unit –IV	**09 Hrs**
Quantum Algorithm - II: Grover search algorithm, Shor quantum factoring algorithm, Harrow-Hassidim-Lloyd (HHL) algorithm for solving linear system problems.	
Unit –V	**09 Hrs**
Applications of Quantum Computing: Application to: order-finding, discrete logarithm, quantum counting, Boolean satisfiability problems(SAT), graph theory problems.	

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

CO1:	Explore the fundamental concepts of quantum computing.
CO2:	Apply the knowledge and skills of quantum computing to understand various types of problems arising in various fields engineering
CO3:	Analyze the appropriate quantum algorithm to solve the real-world problem and to optimize the solution.

CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, 2007, Oxford University press.
2	Quantum Computing for Everyone, Chris Bernhardt, 2020, The MIT Press, Cambridge.
3	Quantum Computation and Quantum Information, M. A. Nielsen & I. Chuang, 2013, Cambridge University Press.
4	Quantum Computing for the quantum curious, Cirian Hughes et. al., 2021, Springer, ISBN 978-3-030-61600-7.
5	Concise guide to quantum computing, Sergei Kurgalin, Sergei Borzunov, 2021, Springer, ISBN 978-3-030-65051-3, ISBN 978-3-030-65052-0 (eBook).

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**

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

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

High-3: Medium-2: Low-1

Semester: VI						
Applied Psychology for Engineers (Theory - Institutional Electives – I))						
Course Code	**:**	**HS266TEW**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3 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, IV edition, (1996) McGraw Hill India
2.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3.	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4.	Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5
5	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

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: VI						
Universal Human Values - II (Institutional Electives – I)						
Course Code	**:**	**HS266TEY**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 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 SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
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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**
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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**

Semester: VII						
EXTENSIVE SURVEY PROJECT **Category: Professional Core Course** **Stream: Practice**						
Course Code	**:**	**CV367P**		**CIE**	**:**	**50**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.0 Hours**

New Tank Project;

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

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

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

Village survey & preparation of drawings for waste water drainage

Highway Project;

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

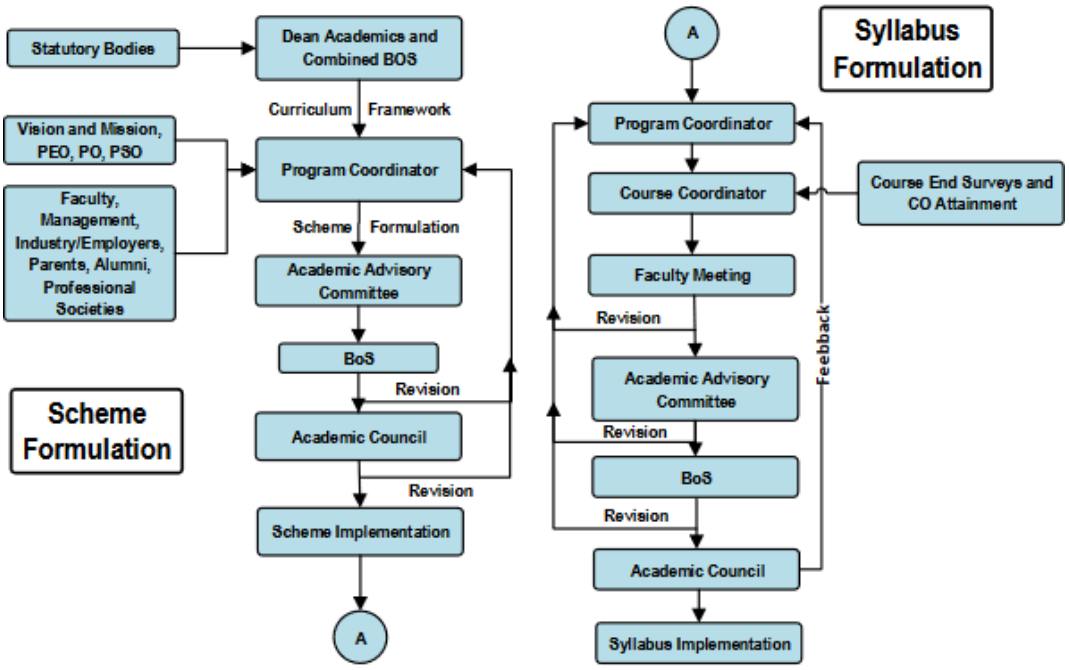
Preparation of finalized drawings and related calculations of cutting and filling for the following projects

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

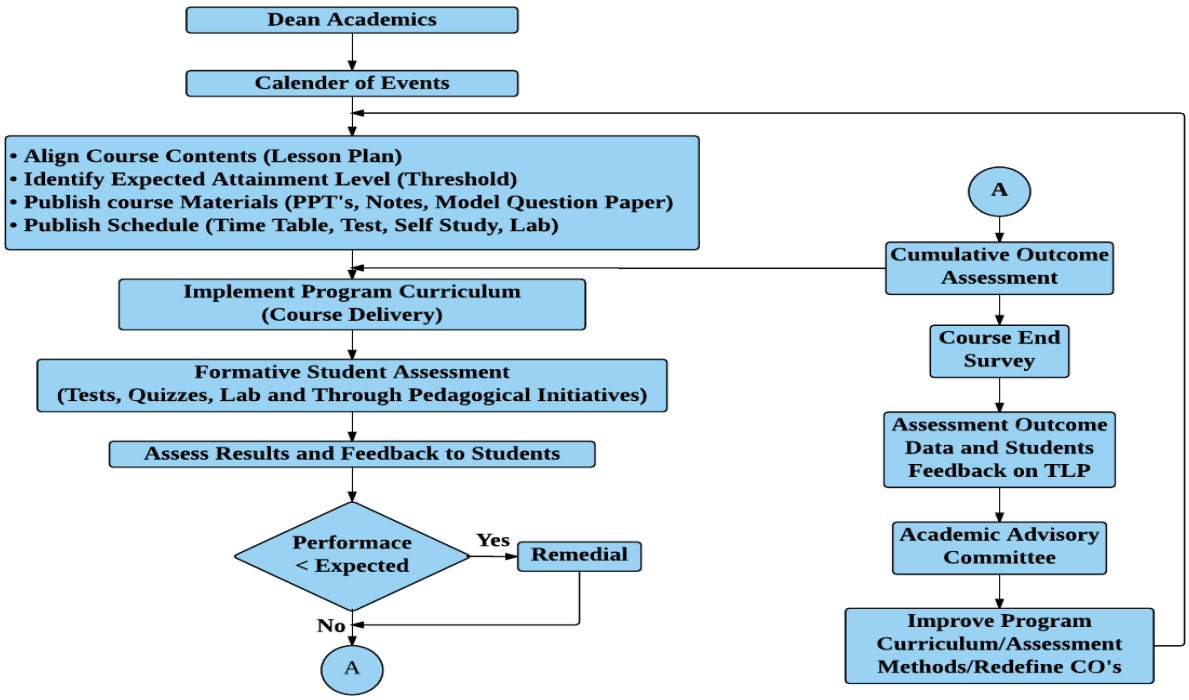
Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the different surveys required for various Civil Engineering projects
CO 2	Apply the various equipments and methods of survey for different civil engineering projects
CO 3	Analyze the field data and prepare the drawings based on the survey field work
CO 4	Evaluate and calculate the bill of quantities for various works based on the survey and drawings prepared

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
PRACTICALS	**50**	**50**
TOTAL MARKS FOR THE COURSE	**50**	**50**

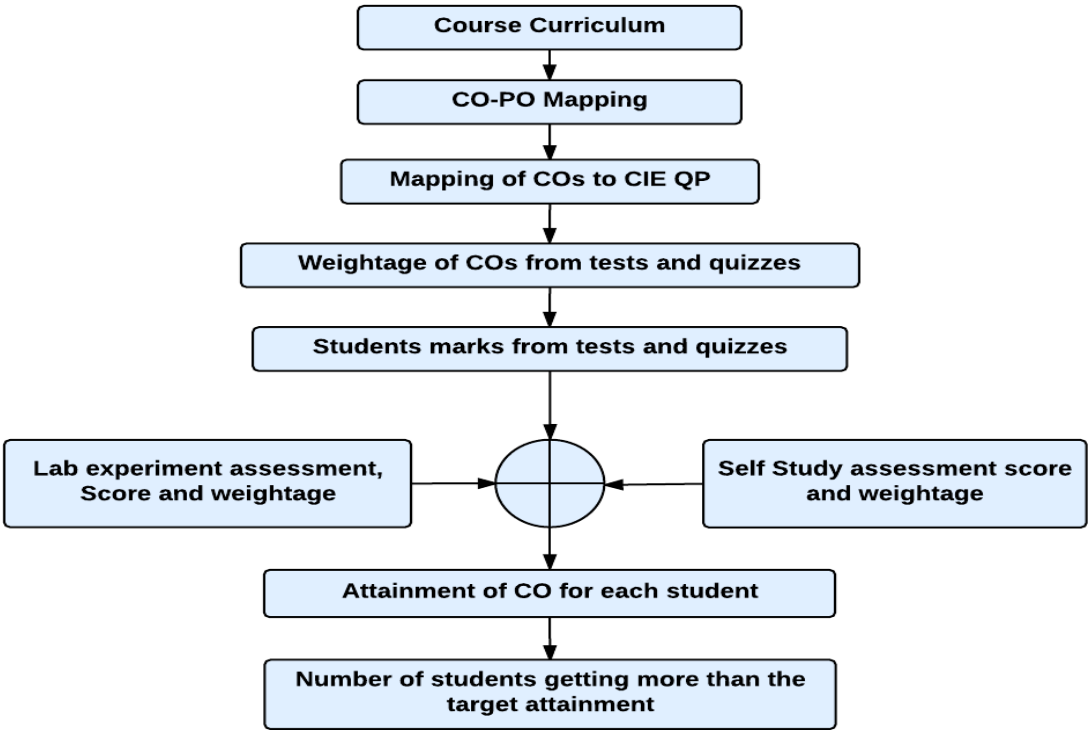
Curriculum Design Process



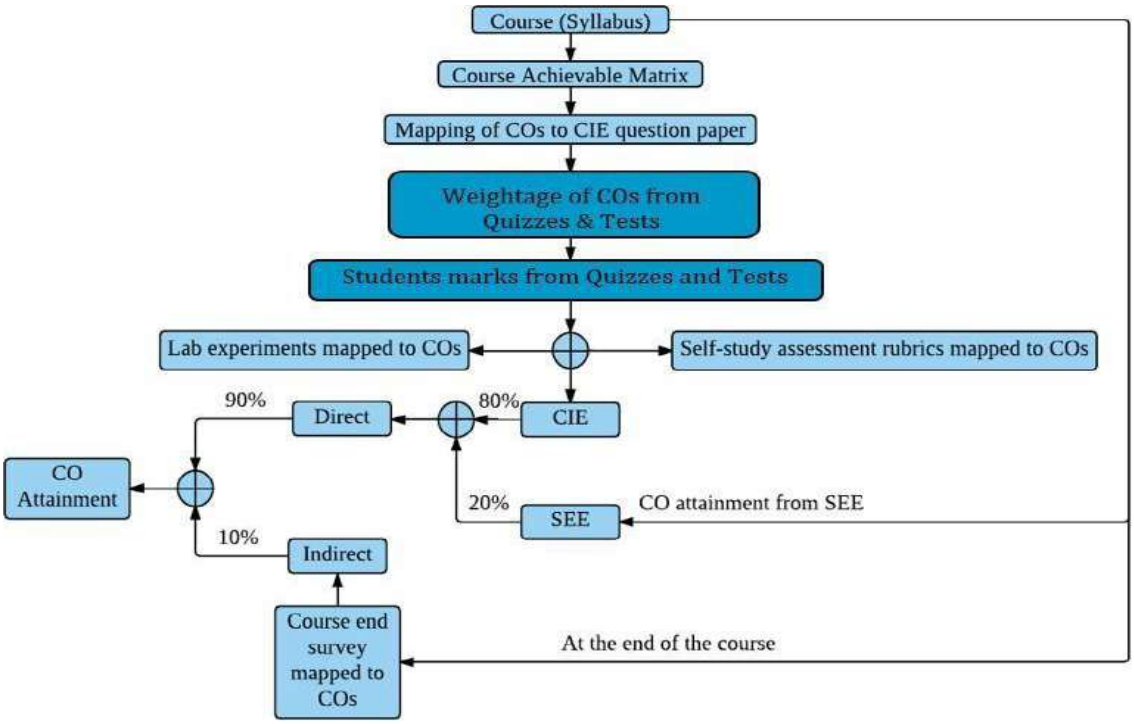
Academic Planning and Implementation



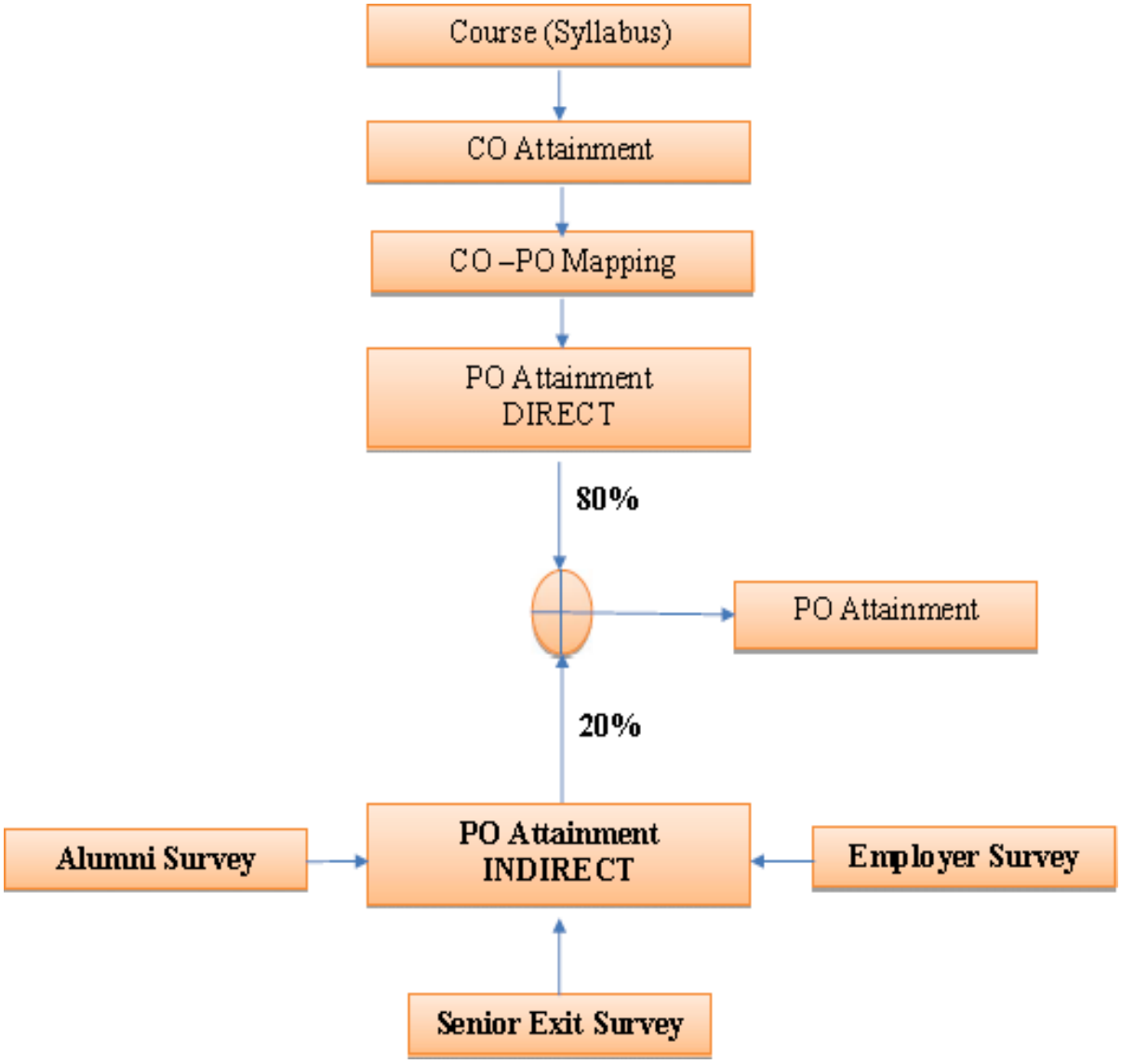
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcomes Attainment Process



Knowledge and Attitude Profile (WK)

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- **WK9:** Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

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New Program Outcomes(PO)

- **PO1:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- **PO3:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- **PO5:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6**: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- **PO7:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- **PO8:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9:** Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- **PO10:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- **PO11:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

INNOVATIVE TEAMS OF RVCE

Ashwa Mobility Foundation (AMF): Designs and fabricates Formula-themed race cars and mobility solutions to address urban transportation issues.

Astra Robotics Team: Focuses on designing and building application-specific robots.

Coding Club: Helps students gain coding skills and succeed in competitions like GSoC and ACM-ICPC.

Entrepreneurship Development Cell (E-Cell): Promotes entrepreneurship through workshops, speaker sessions, and mentoring for startups.

Frequency Club Team: Works on software and hardware, emphasizing AI and Machine Learning.

Team Garuda: Develops a supermileage urban concept electric car and E-mobility products.

Team Jatayu: Builds low-cost UAVs with autonomous capabilities for various tasks.

Solar Car Team: Aims to create a solar electric vehicle for sustainable transportation.

Team Antariksh: Focuses on space technology and the development of operational rockets.

Team Chimera: Builds a Formula Electric Car through R&D in E-Mobility.

Helios Racing Team: Designs and tests All-Terrain Vehicles, participating in SAE's BAJA competitions.

Team Hydra: Develops autonomous underwater vehicles for tasks like water purification.

Team Krushi: Creates low-cost farming equipment to assist farmers in cultivation and harvesting.

Team Vyoma: Designs and tests radio-controlled aircraft and UAVs.

Team Dhruva: Engages in astronomy-related activities and collaborates on projects with organizations like ICTS and IIA.

Ham Club: Promotes Amateur Radio and explores technical innovations in communications, especially for disaster response.

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making

NSS of RVCE

NCC of RVCE