RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

Electrical & Electronics 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

2024

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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2024

Department Vision

Attain technical excellence in Electrical and Electronics Engineering through graduate programs and interdisciplinary research related to sustainability in power, energy and allied fields.

Department Mission

1. To provide technical education that combines rigorous academic study and the excitement of innovation enabling the students to engage in lifelong learning.
2. To establish Center of Excellence in sustainable electrical energy, smart grids and systems.
3. To establish tie-ups with industries and institutions of repute and to foster building up of a wide knowledge base to keep in tune with upcoming technologies.
4. To motivate commitment of faculty and students to collate, generate, disseminate, preserve knowledge and to work for the benefit of society.
5. To develop simple, appropriate and cost effective inclusive technologies which are instrumental in the up-liftment of rural society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. To provide a strong foundation in Mathematics, Science and Engineering fundamentals as well as comprehend, analyze, design, innovate and develop products for real life applications.

PEO2. To inculcate ethical attitude, effective communication skills, leadership qualities and team spirit for a successful professional career with concern for society.

PEO3. To provide a holistic academic environment to foster excellence, entrepreneurship and multidisciplinary approach to inculcate an aptitude for research and lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	The B.E EEE Program must demonstrate knowledge and competence in the application of circuit analysis, control systems, field theory, analog and digital electronics, Power Electronics, microcontrollers , microprocessors, Signal processing and conditioning, computer hardware and software to the design, building , testing, protection and operation of electrical machines, power systems, electrical and electronic systems.
PS02	The B.E. EEE Program must demonstrate knowledge and competence in the application of basic sciences, rigorous mathematics and project management techniques in the design of complex electrical and electronic systems.
PSO3	The B.E. EEE Program must demonstrate the ability to effectively work in a team, communicate correctly and develop an ethical attitude and concern for society and environment.

ABBREVIATIONS

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

INDEX

Bachelor of Engineering in
ECTRICAL AND ELECTRONICS ENGINEERING

V SEMESTER													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**				**Theory**	**Lab**		**Theory**	**Lab**
1	HS351TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	HSS	Theory	1.5	**100**	----	**3**	**100**	----
2	EE352IA	Electrical Machines (Theory & Practice)	3	0	1	4	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
3	EE353IA	Control System Engineering (Theory & Practice)	3	0	1	4	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	EE254TA	Power Transmission & Distribution	3	1	0	4	EE	Theory	1.5	**100**	----	**3**	**100**	----
5	EE355TBX	Professional Core Elective-I (Group-B)	3	0	0	3	EE	Theory	1.5	**100**	----	**3**	**100**	----
6	EE256TCX	Professional Core Elective-II (Group C)	2	0	0	2	EE	**NPTEL**	1	----	----	**2**	**50**	----
						20								

PROFESSIONAL CORE ELECTIVE-I (GROUP-B)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	EE355TBA	Fuzzy Logic Control and Applications	03
2.	EE355TBB	VLSI Circuits	03
3.	EE355TBC	Computer Communication and Networking	03
4.	EE355TBD	Algorithms and Data Structures with C++	03

PROFESSIONAL CORE ELECTIVE-II (GROUP C) NPTEL			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	EE256TCA	Optimal Control	02
2.	EE256TCB	Electromagnetic Compatibility	02
3.	EE256TCC	Introduction To Operating systems	02
4.	EE256TCD	Introduction To Machine Learning	02
5.	EE256TCE	Digital Control System	02

Bachelor of Engineering in
ELECTRICAL AND ELECTRONICS ENGINEERING

VI SEMESTER														
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**				**Theory**	**Lab**		**Theory**	**Lab**
1	HS261TA	Principles of Management and Economics	3	0	0	**3**	HSS	Theory	1.5	**100**	**----**	**3**	**100**	**----**
2	EE362IA	Digital Signal Processing and Applications (Theory & Practice)	3	0	1	4	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
3	EE363IA	Power System Analysis (Theory & Practice)	3	0	1	4	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	EE364TA	Electric Vehicles: Power Train and Drives	3	1	0	4	EE	Theory	1.5	**100**	**----**	**3**	**100**	**----**
5	EE365TDX	Professional Core Elective – III (Group- D)	3	0	0	3	EE	Theory	1.5	**100**	**----**	**3**	**100**	**----**
6	XX366TEX	Institutional Electives – I (Group E)	3	0	0	3	RES. BoS	Theory	1.5	**100**	**----**	**3**	**100**	**----**
7	EE367P	Interdisciplinary Project	0	0	3	3	EE	Lab	1	**----**	**100**	**3**	**----**	**100**
						24								

PROFESSIONAL CORE ELECTIVE-III (GROUP- D)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	EEX65TDA	Smart grid Technologies	03
2.	EEX65TDB	Industrial Drives & Applications	03
3.	EEX65TDC	Electrical Power & Utilization	03
4.	EEX65TDD	High Voltage Engineering	03

INSTITUTIONAL ELECTIVES-I (GROUP-F)				
Sl. No.	**Course Code**	**BoS**	**Course Title**	**Credits**
1.	AS266TEA	AS	Fundamentals of Aerospace Engineering	03
2.	BT266TEB	BT	Bioinformatics	03
3.	CH266TEC	CH	Industrial Safety Engineering	03
4.	CS266TED	CS	Robotics Process Automation	03
5.	CV266TEE	CV	Intelligent Transport Systems	03
6.	CV266TEF	CV	Integrated Health Monitoring of Structures	03
7.	CM266TEG	CM	Advanced Energy Storage for E-Mobility	03
8.	EC266TEH	EC	Human Machine Interface (HMI)	03
9.	EE266TEJ	EE	Energy Auditing and Standards	03
10.	EI266TEK	EI	Biomedical Instrumentation	03
11.	ET266TEM	ET	Telecommunication Systems	03
12.	ET266TEN	ET	Mobile Communication Networks and Standards	03
13.	IS266TEO	IS	Mobile Application Development	03
14.	IM266TEQ	IM	Elements of Financial Management	03
15.	IM266TER	IM	Optimization Techniques	03
16.	ME266TES	ME	Automotive Mechatronics	03
17.	MA266TEU	MA	Mathematical Modelling	03
18.	MA266TEV	MA	Mathematics of Quantum Computing	03
19.	HS266TEW	HS	Applied Psychology for Engineers	03
20.	HS266TEY	HS	Universal Human Values	03

Semester: V						
FUNDAMENTALS OF ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS (Theory)						
Course Code	**:**	HS351TA		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42		**SEE Duration**	**:**	**03 Hours**

Unit-I	**08 Hrs**
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	**08 Hrs**
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 similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies.	
Unit –IV	**09 Hrs**
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	
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 completing the course, the students 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). THREE tests will be conducted (Two regular tests & One optional Improvement test). 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 (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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						
ELECTRICAL MACHINES **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	EE352IA		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	3:0:1		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L+30P		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
DC Machines: **DC Generator**: Construction, types of dc machine, EMF equation, Lap and Wave windings, armature reaction, commutation, characteristics of dc generators. **DC motor**: Back E.M.F, equivalent circuit, torque equation, types, characteristics, 3-point starter, speed control of Shunt & Series motors, losses, efficiency.	
Unit – II	**09 Hrs**
Testing of DC Motors: Swinburne's Test, Hopkinson's test, Retardation test Types of Electric braking, Regenerative, dynamic, reverse current. **Transformers**: Construction, Phasor diagram on No-load and load condition, equivalent circuit derivation, voltage regulation, losses, OC and SC tests, Sumpner's test, predetermination of efficiency, condition for maximum efficiency, all-day efficiency, auto transformer.	
Unit –III	**09 Hrs**
Three Phase Transformers: Construction, vector groups, three -phase transformer connections, Scott connection, parallel operation, polarity and testing of polarity, three-phase auto transformer, Inrush of magnetising current, Harmonics in transformers. **Induction Motor:** Rotating magnetic field, Equivalent circuit, power flow diagram, torque and air gap power, starters.	
Unit –IV	**09 Hrs**
Testing of Induction Motor: No-load and Blocked rotor tests, Circle diagram, characteristics, cogging and crawling. **Speed control:** Stator voltage control, variable frequency control, rotor resistance, applications. **Single-phase induction motor:** Double revolving field theory, equivalent circuit, methods of starting and types.	
Unit –V	**09 Hrs**
Synchronous Machines: Advantage of rotating field, construction, e.m.f equation**,** armature windings, armature reaction (lag, lead and unity power factor) , synchronous impedance, equivalent circuit, voltage regulation – E.M.F, M.M.F, ZPF methods, parallel operation, synchronization, effect of field excitation change, slip-test, V and inverted V curves. **Synchronous motor:** Principle, equivalent circuit, starting, causes and effect of hunting, applications. **Special Motors**: Construction and characteristics - Stepper motor, Universal motor, BLDC motor, Reluctance Motor	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the construction, operations of AC, DC machines.
CO2	Analyze the tests and performance of Electrical machines.
CO3	Evaluate the losses, efficiency, and regulations of Electrical machines.
CO4	Design and demonstrate the performance of various machines under different load specifications.

Reference Books	
1.	Theory and Performance of Electrical Machines, J.B. Gupta, 15th Edition, 2022, S.K. Kataria & Sons, ISBN: 978-93-5014-277-6.
2.	Electric Machinery, A.E Fitzgerald, Charles Kingsley, Stephen D Umans, 6th Edition, 16th August 2022, McGraw-Hill Education / Asia, ISBN 978-0071230100.
3.	Electrical Machines, Ashfaq Husain, 3rd Edition, Dhanpat Rai and Co, 2018, ISBN: 978-81-7700-166-2.
4.	Electrical Machines, Nagarath and D. P . Kothari, TMHP publishers, 5th Edition, ISBN: 978-8123910277.

PART – A : Laboratory Experiments

1. No- Load and Load test on DC shunt generator.
2. Test on DC shunt motor
   a) Load test and b) Swinburn's test.
3. Voltage regulation of alternators
   a) EMF method b) MMF method and c) ZPF method.
4. Speed control of DC shunt motor
   a) Armature voltage control and b) Field control.
5. Predetermine the efficiency and regulation by open circuit and short circuit test in a single phase transformer.
6. Slip Ring Single Phase IM with Speed Controller
7. No-load and Blocked rotor test on three -phase induction motor and performance using circle diagram.
8. Connection of three 1-phase transformers
   a) Star - Delta and b) Delta - Delta
9. Scott connection of transformer
   a) Balanced load and b) Un balanced loads.
10. EV PMSM Mid Drive Motor & Controller

PART B
Innovative Experiments (IE)

11) Virtual Lab for retardation test on DC machines

12) Switched Reluctance Motor Using VSI and FPGA Controller

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 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 (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
MAXIMUM MARKS FOR THE CIE (THEORY + PRACTICE)		**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: V						
CONTROL SYSTEMS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	EE353IA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L+30P		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Definitions, Classification, linear and nonlinear, time variant and time invariant, continuous, and discrete time systems. Block diagram of a typical closed loop control system **Modeling and Representation:** The transfer function concept, transfer function of simple electrical networks, different forms of transfer functions, transfer function of a closed loop system, block diagrams, signal flow graphs. Masons gain formula. Modeling of mechanical translational and rotational systems, gear trains, modeling of AC &DC servomotors.	
Unit – II	**09 Hrs**
Time Response of Feedback Control Systems: Standard test signals, step response of first and second order systems, time domain specifications. Type and order of the system, Steady state error and static error constants. Effect of feedback on sensitivity. **Stability Analysis:** Concept of stability, types of stability, Routh Hurwitz criterion, relative stability analysis.	
Unit –III	**09 Hrs**
Root Locus: Introduction, concept of magnitude and angle criterion, construction of root loci, effect of adding a pole/zero to the system. **Frequency Domain Analysis:** Frequency domain specifications, concept of phase margin and gain margin. **Frequency domain plots:** Introduction, Nyquist plots and Nyquist stability criterion. Bode plots, stability analysis using Bode diagrams.	
Unit –IV	**08 Hrs**
Compensation Techniques: lag, lead and lag-lead networks, design of compensation networks using time response and frequency response of the system. **Feedback compensation**: P, PI, PID controllers, Analog implementation of controllers.	
Unit –V	**10 Hrs**
Non-linear systems Analysis: Introduction, behavior of non-liner system, common physical non-linearity saturation, friction, backlash, dead zone, relay, multivariable non-linearity. **Stability of Non-linear systems:** Stability Analysis by Describing Function Method, Concept of Phase Plane Analysis, Construction of Phase Portraits, System Analysis on the Phase Plane, Lyapunov Stability Definitions, Lyapunov Stability Theorems, Lyapunov Functions for Nonlinear Systems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understanding of basics of control system, time and frequency domain techniques, control actions and nonlinear systems
CO 2	Analyse the dynamic model of the different systems, time and frequency domain techniques, different compensation techniques and non-linear systems.
CO 3	Evaluate the performance of system using time and frequency domain techniques, different compensation techniques and stability of nonlinear system.
CO 4	Design the compensator for the desired performance parameters of any system.

Reference Books	
1.	Control System Engineering , J Nagarath and I.J.Nagarath and M Gopal, 5th Edition, 2007, New age international publishers, ISBN: 0071231277, 9780071231275.
2.	K. Ogata, Modern Control Engineering, 5th Edition, PHI, ISBN: 1-317- 1887-2.
3.	Modern Control Systems, R.C. Dorf and R.H.Bishop, 12th Edition, 2010, Addison Wesley, ISBN 13: 978-013602458.
4.	Automatic Control Systems, Kuo B.C 9th Edition, 2014, Prentice Hall of India Ltd., New Delhi, ISBN- 13: 978-8126552337.
5.	Control Systems Engineering, Norman S Nise, 6th Edition, 2011, Wiley Publications, ISBN: 978-8126571833.

Laboratory Component

Cycle-I

1. Time Response Characteristics of Second Order Systems
2. Frequency Response Characteristics of a Second Order Systems
3. Root Locus Using MATLAB
4. Bode plots Using MATLAB

Cycle-II

5. P, PI & P I D Control of First & Second Order Systems
6. Frequency Response of a Lead-Lag Network
7. Simulation of DC Position Control System Using MATLAB
8. Mathematical Modelling of Physical System

Cycle-III

9. Verification of Cross Over Frequencies of a Given Third Order Type One System.
10. Study of the Responses of A Second Order System With And Without Compensators Using MATLAB

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 **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**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY + PRACTICE)	**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: V						
POWER TRANSMISSION AND DISTRBUTION **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	EE254TA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L +15 T		**SEE Duration**	**:**	3 Hours

Unit – I	**09 Hrs**
Transmission line parameters: Introduction, Representation of lines, Types of Conductors, Inductance of a conductor, Inductance of a single phase two wire system; Flux linkage in composite conductors – concept of GMR and GMD; Inductance of three phase lines; Bundled conductors; Transposition of overhead lines; Capacitance of a single-phase line, Capacitance of symmetrically and unsymmetrically spaced three phase lines; Skin effect and Proximity effect.	
Unit –II	**09 Hrs**
Performance of Short and Medium Transmission Lines: Introduction Representation of lines, Classification of transmission lines, short transmission line, Receiving end voltage in terms of line and load parameters, General network constraints, A,B,C,D constants for short transmission lines, Medium transmission line. **Performance of Long Transmission line**: Rigorous Method, A,B,C,D constants, Surge impedance	
Unit –III	**09 Hrs**
Overhead Line Insulators: Introduction: Insulator Materials, Type insulators, Potential distribution over a string of suspension insulators, Mathematical expression for voltage distribution, String efficiency, Methods of improving string efficiency. **Corona**: Corona formation, Effects of corona, Electric stress, Critical disruptive voltage, Visual critical voltage, Power loss due to corona, Advantages and Disadvantages of corona, Effect of corona online design. **Underground Cables**: Materials, insulation resistance, Capacitance and inters heath grading, dielectric loss, and location of faults in underground cables	
Unit –IV	**09 Hrs**
DC Distribution: Introduction, Classification, Design considerations, **AC distribution**: Power factor referred to the receiving end, Power factor referred to respective load voltages **Distribution management systems**: Data sources and associated external systems, SCADA, Customer information system, Modelling and analysis tools, Distribution system modelling, Topology analysis, State estimation, other analysis tools, Applications: System monitoring, System operation, System management, Outage management system (OMS).	
Unit - V	**09 Hrs**
DC Power transmission technology: Introduction, Comparison of HVAC and HVDC transmission system, Application of DC transmission, Description of DC transmission system, Configurations, Modern trends in DC transmission. **Power flow analysis in AC/DC systems:** Overview, Modelling of DC links, Solution of DC load flow, Discussion, Per Unit system for DC quantities	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts involved in electric power generation, transmission and distribution.
CO 2	Analyse the performance characteristics of high voltage DC and AC power transmission.
CO 3	Evaluate the parameters and performance of transmission lines, distribution systems, insulators and cables.
CO 4	Design and demonstrate the DC and AC distribution system including the insulators.

Reference Books	
1.	Electric Power Generation Transmission and Distribution, S. M. Singh, 3rd Edition, 2010, Prentice Hall of India Publishers, ISBN: -978-81-203-3560-8
2.	Electrical Power Systems, C.L.Wadhwa, , 4th Edition , 2009, Wiley Easten Ltd, ISBN 0- 470-21808-8
3.	Electrical Power Transmission and Distribution, J. B. Gupta, 4th Edition, 2010, S. K. Kataria & Sons Publisher, ISBN 978-0470-40863-6

4.	Smart Grid Technologies and Applications, Janaka Ekanayaka, Jianzhong Wu, 1st Edition, 2012, Wiley Publishers, ISBN: 978-0-470-97409-4.

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

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

Semester: V						
FUZZY LOGIC CONTROL AND APPLICATIONS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	EE355TBA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction to Fuzzy Logic: An Historical Perspective, Utility and Limitations of Fuzzy Systems, Fuzzy Sets and Membership, Chance versus Fuzziness, Classical Sets, Operations on Classical Sets, Properties of Classical Sets, Mapping of Classical Sets to Functions, Fuzzy Sets, Fuzzy Set Operations, Properties of Fuzzy Sets, Non interactive Fuzzy Sets, Alternative Fuzzy Set Operations. **Fuzzy Relations:** Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations.	
Unit – II	**09 Hrs**
Properties of Membership Functions, Fuzzification, and Defuzzification: Features of the Membership Function, Fuzzification, Defuzzification to Crisp Sets, Lambda-cuts for Fuzzy Relations, Defuzzification to Scalars. **Defuzzification methods** - center of gravity, center of mass, height, center of largest area, firstof maxima, middle of maxima, comparison and evaluation of defuzzification methods, Illustrative Examples.	
Unit –III	**09 Hrs**
Fuzzy systems : Fuzzy Control from an Industrial Perspective, Knowledge Based System for Process Control, Knowledge Based Controllers (KBCs), Knowledge Representation in KBCs, Fuzzy Implication, Approximate reasoning-Linguistic variables, fuzzy propositions, fuzzy if- then-else statements, inference rules, rule of inference, representing a Set of Rules – Mamdani vs Godgel, Properties of a set of rules, illustrative Examples.	
Unit –IV	**09 Hrs**
Fuzzy Knowledge Base Controller (FKBC): Design Parameters, Structure of FKBC, Rule Base,Data Base, Inference Engine, Choice of Fuzzification Procedure; Nonlinear Fuzzy Control - Introduction, Control Problem, FKBC as a Nonlinear Transfer Element, Types of FKBC- PID FKBC, sliding mode FKBC, Sugeno FKBC, Illustrative Examples.	
Unit –V	**09 Hrs**
Adaptive Fuzzy Control: Introduction, Design and Performance Evaluation, The Main Approaches to Design. **Fuzzy Logic Applications:** in power systems, flight control, Aerospace, industrial drives andsmart lighting systems-case studies. **Fuzzy Control Systems:** Simple Fuzzy Logic Controllers, Examples of Fuzzy Control System Design.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explore and Understand basic concepts of all types of fuzzy sets, fuzzy relations and their operations.
CO 2	Analyse and select appropriate Fuzzification and defuzzification method in respective real time applications.
CO 3	Design fuzzy systems, FKBC and solve complex problems using various fuzzy techniques.
CO 4	Apply an adaptive control as appropriate for a given typical application.

Reference Books	
1.	Fuzzy logic with engineering applications, Timothy J Ross, 3rd Edition, 2004, John Wiley and Sons, ISBN: 978-0-470-74376-8
2.	An Introduction to Fuzzy Control, D Driankov, H Hellendoorn, M Reinfrank, 1st Edition 1996, Narosa Publishing House Reprint, ISBN 978-81-7319-069-8.
3.	Fuzzy Sets and Fuzzy Logic-Theory and Applications, George J. Klir, Bo Yuan, 1st Edition, 2008, Prentice Hall, ISBN: 81-203-0695-3.
4.	Research Papers on Fuzzy Logic applications in engineering and case studies.

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: V						
VLSI FUNDAMENTALS & CIRCUITS **Category: Professional Course Elective** **(Theory)**						
Course Code	**:**	EE355TBB		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
VLSI Design Flow: Specification, Design entry, Functional simulation, planning placement and routing, timing simulation. **MOS Transistor Principle:** NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams.	
Unit – II	**09 Hrs**
CMOS Processing Technology: CMOS Technologies, Wafer Formation, photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Methodology, Lambda Design Rules. **Designing Combinational Logic Circuits:** Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles. *To Realize CMOS logic gates using Cadence Software	
Unit –III	**09 Hrs**
Designing Sequential Logic Circuits: Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design. * To Realize Sequential logic circuit using Cadence Software	
Unit –IV	**09 Hrs**
Designing Arithmetic Building Blocks: Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff.	
Unit –V	**09 Hrs**
Implementation Strategies – ASIC: Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the basic principle of MOS transistor and its scaling strategies to analyse the impact of fabrication technologies in terms of area, speed, and power.
CO 2	Analyse combinational logic circuits to design arithmetic building blocks.
CO 3	Analyse sequential logic circuits to realize memory architectures and its control.
CO 4	Implement different design strategies to develop an application specific integrated circuit

Reference Books	
1.	Digital Integrated Circuits: A Design Perspective, Jan Rabaey, Anantha Chandrakasan, B.Nikolic, 2nd Edition, 2003, Prentice Hall of India, ISBN-13: 978-0130909961.
2.	Application Specific Integrated Circuits, M.J. Smith, 2nd Edition, 1997, Addisson Wesley, ISBN-10: 2101500221.
3.	CMOS VLSI Design, Neil H.E. Waste, David Harris, Ayan Banerjee, 3rd Edition, 2006, Pearson Education, ISBN: 0321149017.
4.	CMOS Digital Integrated Circuits, Sung MO Kang, Youssef Leblebici, 3rd Edition, 2003, Tata McGrawHill, ISBN: 0-7923-7246-8.

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). 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: V						
COMPUTER COMMUNICATION AND NETWORKING **Category: Professional Course Elective** **(Theory)**						
Course Code	**:**	EE355TBC		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Overview of Computer Networks: **Data communication:** Components, data flow, physical structures and categories of networks. **Network models:** Need of layered architecture, layers in the OSI model and TCP/IP protocol suite.	
Unit – II	**09 Hrs**
Physical Layer and Media: **Data and signals:** Analog and digital signals, data rate limits and performance. Analog-to-digital (only PCM) and Digital-to-analog conversions, multiplexing, spread spectrum and Transmission media.	
Unit –III	**09 Hrs**
Data Link Layer (A): **Error detection and correction:** Types of errors, parity check, cyclic redundancy check, checksum and Hamming code procedure. Data link control – Framing, ARQ protocols, HDLC and Point-to- point protocol. Connecting devices- Hubs, Repeaters, Bridges, Switches and Routers.	
Unit –IV	**09 Hrs**
Data Link Layer (B): Media Access control: Random Access, Controlled Access and Channelization **Network Layer:** **Logical addressing:** IPv4 Addresses- classful and classless addressing, Network address translation and Subnetting	
Unit –V	**09 Hrs**
Transport and Application Layers: Process-to-process delivery, User datagram protocol and its operation, TCP – services and features, segment, TCP connection, flow control and error control. Congestion control and Quality of Service. Email:- SMTP, MIME, POP3, IMAP – HTTP.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand and describe the basic concept of Intranet, LAN, WAN, MAN, different topologies
CO 2	Evaluate the performance of different topologies, common networking protocols and algorithms
CO 3	Analyze the performance of different network protocols.
CO 4	Design and implement different network protocols.

Reference Books	
1.	Data Communications and Networking, Behrouz A. Forouzan, 4th Edition, 2009, Tata McGraw Hill, ISBN-13: 978-0-07-125442-7.
2.	Data Communications, Computer Networks and Open systems Fred Halsall, 4th Edition, 2005, Pearson Education, ISBN-13: 9780201422931.
3.	Data and Computer Communications, William Stallings, 8th Edition, 2007, Pearson Education, ISBN: 0-13-243310-9 Education, ISBN: 0-13-243310-9
4.	Computer Networking, A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, 3rd Edition, 2005, Addison Wesley, ISBN-10 : 0321269764.

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: V						
ALGORITHMS AND DATA STRUCTURES WITH C++ **Category: (Professional Core Elective)** **(Theory)**						
Course Code	**:**	EE355TBD		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Classes &Objects: Class Specification, Class Objects, Scope resolution operator, Access members, Defining member functions, Data hiding, Constructors, Destructors, Parameterized constructors, Static data members. Friend functions, Passing objects as arguments, Returning objects, Arrays of objects, Dynamic objects, Pointers to objects, Copy constructors, Generic functions and classes, Applications.	
Unit – II	**09 Hrs**
I**nheritance** : Operator overloading using friend functions such as +, - , pre-increment, post-increment, overloading **Inheritance:** Base Class, Inheritance and protected members, protected base class inheritance, inheriting multiple base classes. **Inheritance II:** Constructors, Destructors and Inheritance, Passing parameters to base class constructors, Granting access, Virtual base classes.	
Unit –III	**09 Hrs**
Algorithm Specifications: Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best and worst case analysis).Data Management concepts,Data types – primitive and non-primitive **Types of Data Structures**: Linear & Non Linear DataStructures. **Array:** Representation of arrays, Applications of arrays,sparse matrix and its representation., **Stack:** Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation,Recursion, Tower of Hanoi,	
Unit –IV	**09 Hrs**
Queue: Representation Of Queue, Operations On Queue,Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue, **Linked List:** Singly Linked List, Doubly Linked list, Circular linked list, Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	
Unit –V	**09 Hrs**
Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Sorting On Several Keys, List and Table Sort, Linear Search, Binary Search. **Hashing:** The symbol table, Hashing Functions, Collision-Resolution Techniques, File Structure: Concepts of fields, records and files.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand data abstraction, data structures, order notation, various complexity measures.
CO 2	Analyze and identify relevant data structures to develop solutions for a problem.
CO 3	Evaluate the algorithms based on the data structures used, order of notation and performance metrics.
CO 4	Apply relevant data structures and programming techniques to design efficient algorithms for different applications.

Reference Books	
1.	Introduction to Algorithms, Thomas H Corman, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 3rd edition, 2009, The MIT press, Cambridge, Massachusetts, London, England, ISBN:978-0-262-53305-8
2.	Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson-Freed, 2nd Edition, 2012,University Press, ISBN: 978-81-7371-605-8
3.	Introduction to Analysis and Design of Algorithms, Anany Levitin,3rd Edition, 2016, ISBN-13:978-03-2135-828-8
4.	Computing Without Computers: A Gentle Introduction to Computer Programming, Data Structures and Algorithms, Paul Curzon, Version 0.15

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						
PRINCIPLES OF MANAGEMENT & ECONOMICS (Theory)						
Course Code	**:**	HS261TA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 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: -	
CO 1	Elucidate the principles of management theory & recognize the characteristics of an organization.
CO 2	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO 3	Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation.
CO 4	Demonstrate an understanding on the usage and application of basic economic principles.
CO 5	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**
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						
DIGITAL SIGNAL PROCESSING AND APPLICATIONS **Category: Professional Core Course** **(Theory & Practice)**						
Course Code	**:**	EE362IA		**CIE**	**:**	150Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	150 Marks
Total Hours	**:**	45 L + 30 P		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
LTI Systems and Z Transforms: LTI Systems: Transfer Function, Causality and Stability, Inverse Systems and System Identification. **Realization of IIR systems:** Direct form structures, Transposed structures, Cascade form and Parallel-Form Structures.	
Unit – II	**09 Hrs**
Analog Filters: Characteristics of commonly used Analog Filters–Butterworth and Chebyshev Type-1 filters, Design of analog filters, Frequency transformation in the Analog Domain. **Digital Filters:** Analog to Digital Transformations: Impulse Invariance Technique, Bilinear Transformation. Design of Digital IIR Filters using Impulse Invariance and Bilinear Transformation.	
Unit –III	**10 Hrs**
FIR Filters: Characteristics of practical Frequency Selective Filters, Symmetric and anti-symmetric FIR Filters, Window functions: Rectangular, Hann, Hamming, Blackmann and Kaiser. Design of FIR Filters using Windows, Design of Linear phase FIR filters by frequency sampling method. **Realization of FIR filters:** Direct form, Linear Phase form, Cascade form and lattice form structures. Quantization of coefficients in FIR filters, Round-off effects in digital filters: Scaling to prevent overflow.	
Unit –IV	**10 Hrs**
Digital Signal Processor: Features of fixed point and floating point processors. TMS320C67x Processor: Introduction, Features, Internal architecture, CPU, General purpose Register files, Functional units and operations, Data paths, control Register file. **Applications of DSP:** Digital Audio system, Speech Coding and Compression, Compact-Disc recording system, Interference cancellation in electrocardiography, DTMF generation and detection.	
Unit –V	**07 Hrs**
Multirate Digital Signal Processing: Introduction, Up sampling, Down sampling, Interpolation and Decimation. Sampling rate conversion (Reduction, Increase), Sampling rate change by noninteger factor, Multistage Decimation, Poly phase structures and implementation.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of digital signals, signal processing, DSP processors and filters
CO 2	Analyze different types of digital signals and filters.
CO 3	Design, simulation and implementation of digital filters
CO 4	Implementation of techniques for signal analysis , signal processing and filter algorithms

Reference Books	
1.	Digital Signal Processing : Principle, Algorithms and Applications, Proakis, 3rd Edition, 2004, Pearson Education / PHI, ISBN-81-203-1129-9.
2.	Digital Signal Processing – Fundamentals and Applications, Li Tan, 2008, Elsevier, ISBN: 978-0-12-374090-8
3.	Digital Signal Processors: Architecture, Programming and Applications; B. Venkataramani and M. Bhaskar, 2nd Edition, 2012, McGraw Hill, ISBN:978-0-07-070256- 1.
4.	Modern Digital Signal Processing, V.Udayashankara, 2nd Edition, 2012, PHI, ISBN: 978- 81-203-4567-6.
5.	Signals and Systems, Simon Haykin and Barry Van Veen, 2nd Edition, 2008. John Wiley & Sons, ISBN: 13: 978-0471164746.
6.	Signals and Systems, V Oppenheim, Alan Willsky and A Hamid Nawab, Alan, 2nd Edition, 2006,Pearson Education Asia/ PHI, ISBN 10: 0138147574

Laboratory Component

Sample Programs

1. Verification of sampling Theorem in Time Domain and FrequencyDomain
2. Cross Correlation of Given Two Sequences
3. Circular Convolution by matrix method
4. Linear Convolution: Implementation of Formula
5. Design and Implementation of IIR Filter – Butterworth
6. Design and Implementation of IIR Filter - Chebyshev (Type-1)
7. Design And Implementation of FIR Filter
8. Realization of FIR filter
9. Solution of Difference Equation
10. Impulse Response of a given First/Second order system (MATLAB)

Innovative Experiment:

1. Generation of Sinusoidal signal using DSP Processor
2. Noise Cancellation using DSP Processor

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) **ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY + PRACTICE)	**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						
POWER SYSTEM ANALYSIS **Category: Professional Core Course** **(Theory & Practice)**						
Course Code	**:**	EE363IA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L + 30 P		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Representation of power system components: Circuit models of transmission line, synchronous machines, Transformer and load. One line diagram, impedance and reactance diagram, Per unit system, per unit impedance diagram of power system. **Symmetrical three phase faults:** Short-Circuit current and the reactance of synchronous machines. Analysis of unbalanced loads connected to balanced three-phase supply, neutral shift.	
Unit – II	**09 Hrs**
Symmetrical components: Resolution of unbalanced phasors into their symmetrical components, phase shift of symmetrical components in star-delta transformer bank, power in terms of symmetrical components. Sequence impedance and sequence networks of power system elements (alternator, transformer and transmission line), sequence networks of power systems. **Unsymmetrical faults:** L-G, L-L, L-L-G faults on an alternator and in power system with and without fault Impedance.	
Unit –III	**09 Hrs**
Formation of YBUS by method of inspection (including transformer off-nominal tap setting), by method of singular transformation with and without mutual coupling. **Load Flow Studies:** Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss-Siedal method- Algorithm and flow chart for PQ and PV buses, Acceleration of convergence. Newton Raphson Method – Algorithm & flow chart for NR method in polar coordinates (numerical problem for one iteration only); Algorithm for Fast Decoupled load flow method; Comparison of load flow methods.	
Unit –IV	**09 Hrs**
Economic Operation of Power System: Introduction, performance curves, Economic generation scheduling neglecting losses Iterative techniques; Economic Dispatch including transmission losses- approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula.	
Unit –V	**09 Hrs**
Transient Stability Studies: Steady state and transient stability, Power angle equation for non-salient pole machines, Rotor dynamics and the swing equation Equal-area criterion for transient stability evaluation and its applications. Numerical solution of Swing equation – Point-by-Point method, Modified Euler's method, Runge-Kutta method.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamentals concepts and representation of power system and operation under various conditions.
CO 2	Apply numerical techniques to evaluate the power flows, optimum generation schedule and stability of power systems.
CO 3	Analyse the power system behaviour under fault conditions and to obtain load flow solution for stability analysis.
CO 4	Evaluate for the given power system problems using software simulation tools.

Reference Books	
1.	Power System Analysis, John Grainger and William D. Stevenson,Jr., TMH,1994, ISBN-0-07-061293-5.
2.	Modern Power System Analysis, I.J Nagrath and D.P.Kothari , 2nd Edition, 2004,TMH, New Delhi, 1989, ISBN 0-471-15040.
3.	Power System Analysis, Hadi Sadat, 1st Edition, 2002, TMH, ISBN: 978-0-9845438-0-9
4.	Computer Techniques and Models in Power Systems, K.Uma Rao ,1st Edition , IK International, ISBN 978-8-1-89866402

LABORATORY EXPERIMENTS	
1.	Formation of Y-BUS with off-nominal turns ratio by inspection method in MATLAB.
2.	Formation of Y Bus for power systems by singular transformation method with & without mutual coupling in MATLAB.
3.	Program to perform load flow analysis using different methods in MATLAB.
4.	Determination of bus currents, bus power and line flows for a specified system voltage (bus) profile.
5	To determine fault currents and fault MVA for various faults using MI-POWER.
6	Transient Stability Studies using Mi Power software package.
7	Solution of swing curve with Modified Euler's method and Runge - Kutta method in MATLAB.
8	Economical generator scheduling for thermal power plants with and without losses in MATLAB
9	Study of Load frequency analysis of single area system using MATLAB Simulink.
10	Study of Load frequency analysis of two area system using MATLAB Simulink.
Innovative Experiments	
11	Modelling of Renewable Energy System in ETAP
12	Fault analysis in PV systems

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 **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**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY + PRACTICE)	**150**

RUBRIC FOR THE SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	10
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	14
5 & 6	Unit 3 : Question 5 or 6	14
7 & 8	Unit 4 : Question 7 or 8	14
9 & 10	Unit 5: Question 9 or 10	14
11	Lab Component (Compulsory)	20
	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						
ELECTRIC VEHICLES: POWER TRAIN AND DRIVES **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	EE363IA		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L + 15T		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: History and benefits of electric vehicles, fundamentals of EVs, tractive effort, vehicular dynamics, drive cycle and vehicle control unit **Electric Drive-Trains:** Basic concept of electric traction, Introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis **Hybrid Electric Drive-Trains:** Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.	
Unit – II	**09 Hrs**
Electric Propulsion unit & drives Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	
Unit –III	**09 Hrs**
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Introduction to BMS and its topologies.	
Unit –IV	**09 Hrs**
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies and implementation issues of energy management strategies. **Sizing the drive system**: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems	
Unit –V	**09 Hrs**
Charger Classification and standards: classification based on charging, levels (region-wise), modes, plug types, standards related to: connectors, communication, supply equipments, EMI/EMC. **On-board Chargers:** Basics of nonisolated/isolated DC-DC and grid connected converters; classification of EV chargers; modelling and control of bi-directional DC-DC converters; discussions on V2X applications. **Communications, Supporting Subsystems:** In vehicle networks- CAN.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamentals of EV, HEV, components of drive train, energy storage and management, charging infrastructure.
CO 2	Analyze electric and hybrid drive-train, different energy sources, energy management strategies, charging levels and charging modes.
CO 3	Evaluate EV based on ac & dc drives, different storage & management system, performance of EV battery chargers.
CO 4	Sizing the drive system.

Reference Books	
1.	Electric Vehicle Technology Explained, by James Larminie, John Lowry, 2nd Edition, Wiley Publisher, 2012, *ISBN: 9781119942733.*
2.	Electric & Hybrid Vehicles –Design Fundamentals, Iqbal Hussain, 2nd Edition, CRC Press, 2011, *ISBN 0-8493-1466-6.*
3.	Automotive Electrical and Electronic Systems, by Tom Denton, 5th Edition, Routledge, 2017, ISBN: 978-0415725774.
4.	Advanced Electric Drive Vehicles, by Ali Emadi, 1st Edition, CRC Press, 2014, ISBN: 978-1466597693.
5	Davide Andrea,"Battery Management system for large Lithium Battery Packs", ARTECH HOUSE 2010, *ISBN-13 978-1-60807-104-3.*
6	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, by Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay and Ali Emadi, 1st Edition, CRC Press, 2004, ISBN: *978-0849331541*

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						
SMART GRID TECHNOLOGIES **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	EE365TDA		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	50 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	2 Hours

Unit-I	**09 Hrs**
Introduction to Smart Grid: Concept of Smart Grid, Conventional Grid Vs Smart Grid, Smart Grid Domains, Early Smart Grid Initiatives, Overview of the technologies required for the Smart Grid, Core Applications of Smart grid. **Modern Technologies in Transmission and Distribution for Smart Grid:** Present Challenges on Transmission Grids, Smart Transmission, Energy management systems, Wide Area applications, Substation automation, Distribution management systems, Applications for distribution network automation.	
Unit – II	**09 Hrs**
Measurement and Monitoring in Smart Grid: Intelligent Electronic devices, RTU, Evolution of Smart meters, Communication Infrastructure for smart Metering, WAMPAC, Multiagent System Technology. **Communication Technologies for Smart Grid:** Introduction, Communication Technologies, Smart Grid Network architecture. **Interoperability, Cyber Security and standards**: Interoperability, Information security for smart grid, Encryption and Decryption for security, Authentication, Digital signatures, Cyber security standards, Cyber security risks.	
Unit –III	**09 Hrs**
Communication technologies for smart grid **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**
Renewable Energy Sources and Storage in Smart Grids: Sustainable energy options for smart grid, Penetration and variability issues associated with sustainable energy technology, Demand response issues, Energy Storage Technologies, Selection of storage technology, Case study of micro grid with renewable energy, Case study of renewable Energy Resources integration.	
Unit-V	**09 Hrs**
Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. **Indian Smart Grid Scenario:** Indian Power Sector, Renewable energy development in India, Smart grid Drivers for India, Smart grid Initiatives in India, Roadmap, Smart grid pilot projects, Case studies.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of a smart grid and discuss the technologies needed for it.
CO 2	Analyse the power quality and cyber risks of the smart grid and propose appropriate measures.
CO 3	Select suitable energy storage devices for a given grid.
CO 4	Design a WAM system for the grid, including the metering and communication infrastructure.

Reference Books	
1.	Smart Grid Applications, Communications, and Security, by Lars T. Berger and Krzysztof Iniewski, 1st Edition, Wiley, 2015, ISBN: 978-8126557363.
2.	Smart Grid: Technology And Applications, by Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, and Nick Jenkins, 1st Edition, John Wiley & Sons, 2012, ISBN: 978-0470974094.
3.	Smart Grid: Fundamentals of Design and Analysis, by James Momoh, 1st Edition, Wiley IEEE-Press, 2012, ISBN: 978-0470889398.
4.	Smart Grids – Fundamentals and Technologies in Electricity Networks, by Buchholz, Bernd M., Styczynski, Zbigniew, 2nd Edition, Springer, 2020, ISBN: 978-3662609293.
5.	Smart Grid: Infrastructure, Technology and Solutions, by Stuart Borlase, 1st Edition, CRC Press, 2012, ISBN: 978-1439829059.
6.	Fundamentals of Smart Grid Technology, by Bharat Modi, Anu Prakash, Yogesh Kumar, 1st Edition, S.K.Kataria & Sons, 2015 ISBN: 978-9350144855.

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

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

Semester: VI						
INDUSTRIAL DRIVES AND APPLICATIONS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	EE365TDB		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	50 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	2 Hours

Unit-I	**09 Hrs**
Control of DC motors by single phase and three phase converters: Introduction to Thyristor controlled Drives, single-Phase and three-phase semi and fully controlled converters connected to DC separately excited and DC series motors, Continuous current operation, Output voltage and current waveforms, Speed and Torque expressions, Speed, Torque Characteristics, Problems on Converter fed DC motors.	
Unit – II	**09 Hrs**
Four quadrant operation of dc drives: Introduction to Four quadrant operation, Motoring operations, Electric Braking, Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of DC motors by dual converters, Closed loop operation of DC motor (Block Diagram Only).	
Unit –III	**09 Hrs**
Control of dc motors by choppers: Single quadrant, Two - quadrant and four quadrant chopper fed dc separately excited and series excited motors, Continuous current operation, Output voltage and current wave forms, Speed torque expressions, speed torque characteristics, Problems on Chopper fed DC Motors, Closed Loop operation (Block Diagram Only).	
Unit –IV	**09 Hrs**
Control of induction motor on stator side: Variable voltage characteristics, Control of Induction Motor by AC Voltage Controllers, Waveforms, speed torque characteristics, Variable frequency characteristics, Variable frequency control of induction motor by Voltage source and current source inverter and cyclo converters, PWM control, Comparison of VSI and CSI operations. **Control of induction motor on rotor side:** Static rotor resistance control, Slip power recovery, Static Scherbius drive, Static Kramer Drive, Their performance and speed torque characteristics, Advantages applications, problems.	
Unit-V	**09 Hrs**
Control of synchronous motors: Separate control & self-control of synchronous motors, Operation of self-controlled synchronous motors by VSI and CSI cyclo-converters. Load commutated CSI fed Synchronous Motor, Operation, Waveforms, Speed torque characteristics, Applications Advantages and Numerical Problems, Closed Loop control operation of synchronous motor drives (Block Diagram Only), Variable frequency control, Cyclo converter, PWM, VFI, CSI.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand and explain the specifications, selection of drive system for a given application.
CO 2	Design the electric drive system as per given specifications.
CO 3	Analyse the control modules for closed loop operation of an electric drive system.
CO 4	Evaluate the issues related to effect of harmonics and external disturbances of electric drives.

Reference Books	
1.	Fundamentals of Electric drives, Gopal K Dubey, 2nd Edition, 2010, Narosa publisher, ISBN: 978-81-7319-428-3.
2.	Electric drives. DW, N. and Sen, P.K., 1999. PHI Learning Pvt. Ltd..
3.	Power Electronics, Bimbhra, D.P., 2009. Khanna Publishers.
4.	Power electronics: circuits, devices, and applications, Rashid, M.H., 2009. Pearson Education India.

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						
ELECTRIC POWER UTILIZATION AND ILLUMINATION **Category: Professional Core Eective** **(Theory)**						
Course Code	**:**	EE365TDC		**CIE**	**:**	100Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit – I	**09 Hrs**
Illumination: Definition – Laws of illumination – Polar curves – Calculation of MHCP and MSCP. Lamps: Incandescent lamp, Sodium Vapour lamp, fluorescent lamp. Requirement of good lighting scheme –Types, Design and Calculation of illumination. Street lighting, LED lighting and Factory lighting -Storage batteries – Numerical Problems.	
Unit –II	**09 Hrs**
Electrical Heating and Welding: Advantages, Methods of Electric heating – Resistance, arc, Induction and dielectric heating. Methods of Electric Welding–Types – Resistance, Electric arc, gas welding. Ultrasonic, Welding electrodes of various metals, Defects in welding.	
Unit –III	**09 Hrs**
Electric Traction Mechanics: Introduction – Systems of Electric Traction. Comparison between A.C. and D. C Traction – Special features of Traction Motors - Methods of Electric Braking – Plugging, Rheostatic and Regenerative types – Mechanics of train movement. Speed-time curves of different services – trapezoidal and quadrilateral, speed-time curves for train movement – Numerical Problems.	
Unit –IV	**09 Hrs**
Electric Traction Analysis: Calculations of tractive effort, Power, specific energy consumption - effect of varying acceleration and braking retardation, Adhesive weight and coefficient of adhesion – Problems. **Electrolysis:** Electroplating, Electro deposition, Extraction of metals Current, Efficiency - Batteries – types – Charging Methods	
Unit - V	**09 Hrs**
Economic Aspects of Electric Energy Utilization: Introduction – definitions – load curve – load duration curve - Cost of electrical energy – interest and depreciation - Power Factor Improvement, Economic limits - Improvement of Load Factor – Electrical vehicle and smart grid concepts.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of illumination systems
CO 2	Analyze economic aspects of electric energy utilization
CO 3	Evaluate the performance various electric heating, welding and traction mechanism.
CO 4	Design and demonstrate the lighting scheme for various illumination system.

Reference Books	
1.	Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, 1st Edition, The Orient Black swan, 2006, ISBN-108125016406
2.	Generation, Distribution and Utilization of Electrical Energy, C.L. Wadhwa, 3rd Edition, 2015, New Age International Private Limited, ISBN: 8122438539
3.	Utilization of Electrical Power including Electric drives and Electric traction, N.V. Suryanarayana, 2nd Edition, 2017, New Age Publishers, ISBN-10 : 8122436811.
4.	Utilization of Electrical Power, R. K. Rajput, 2nd Edition, Laxmi Publications, ISBN-10 : 8131808297.

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						
HIGH VOLTAGE ENGINEERING **Category: (Professional Core Elective)** **(Theory)**						
Course Code	**:**	EE365TDD		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Advantages of transmitting electrical power at high voltages. Need for generating high ac, dc and impulse voltages in a lab. **Generation of HVAC & HVDC:** Working, advantages and limitations of HV & cascaded HV transformers & series resonant sets. Tesla coil. HVDC: Voltage doubler circuit, Cockroft-Walton type HVDC set. Calculation of regulation, ripple and optimum number of stages for minimum voltage drop. **Generation of Impulse Voltages:** Analysis of impulse forming circuits. Single & multi-stage impulse generators. Marx circuit. Rating of impulse generator components. Principle of trigatron and three electrode gap. Principles of switching surge and impulse current generation.	
Unit – II	**09 Hrs**
Measurement of High Voltages: Electrostatic voltmeter-principle, construction and limitation. Chubb and Fortescue method for HV AC measurement. Generating voltmeter- Principle, construction. Series resistance micro ammeter for HV DC measurements. Standard sphere gap measurements of HV AC, HV DC, and impulse voltages; Factors affecting the measurements. Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Surge current measurement- Klydanograph and magnetic links.	
Unit –III	**09 Hrs**
Breakdown Phenomena: Gaseous dielectrics: Primary and secondary ionization processes. Townsend's criteria for breakdown. Limitations of the theory. Streamer's theory of breakdown. Space charge effects. Cathode processes. Corona discharges. Breakdown in electro-negative gases. Paschen's law. Formative and statistical time lags. Breakdown in solid dielectrics: Intrinsic, avalanche, thermal & electromechanical modes. Breakdown of liquid dielectrics: Suspended particle theory, electronic breakdown, and cavity and electro-convection breakdown.	
Unit –IV	**09 Hrs**
Dielectric Measurements: Parallel and series equivalent circuits. Concept of relaxation & complex dielectric constant. Schering bridge. Earthing and shielding. Wagner's device. Measurement of insulation resistance. Working and use of a megger. Tracking and treeing principles. **Partial Discharges:** Physical basis of partial discharges. Effects of PD. Methods of detection. Straight and balanced methods. Factors affecting the discharge detection.	
Unit –V	**09 Hrs**
High Voltage Testing & Insulation Coordination: High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination& testing of cables. Introduction to FDM and FEM.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the practical techniques to generate and measure high-voltages (DC, AC, impulse).
CO 2	Analyze high voltage testing techniques of Power apparatus and causes of over voltage in Power systems
CO 3	Clarify the concepts used for the measurement of high voltages and currents and design corresponding circuits.
CO 4	Designing the test generator circuits for ac, dc and impulse voltages and currents.

Reference Books	
1.	High Voltage Engineering, by D. V. Razevig (Translated by Dr. M. P. Chourasia), Khanna Publishers, 2nd Edition, 1993, ISBN: 978-8174090720.
2.	High Voltage Engineering Fundamentals, by E. Kuffel, W. S. Zaengl and J. Kuffel, Newnes Publication, 2nd Edition, 2000, ISBN: 978-0750636346.
3.	High Voltage and Electrical Insulation Engineering, by R. Arora and W. Mosch , John Wiley & Sons, 1st Edition, 2011, ISBN: 978-0470609613.
4.	High Voltage Engineering, by C.L.Wadhwa, 2nd Edition - New Age Intnl. Pvt. Ltd., 2007. ISBN 13 : 978-81-224-2323-5

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) **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: V						
FUNDAMENTALS OF AEROSPACE ENGINEERING **Category: Institutional Electives-I GROUP-E** **(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

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) **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: V						
BIOINFORMATICS **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	**BT266TEB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**03 Hours**

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	
1.	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.

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) **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: V						
INDUSTRIAL SAFETY ENGINEERING **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	**CH266TEC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40 L		**SEE Duration**	**:**	**03 Hours**

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.	Industrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102.

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) **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: V						
ROBOTOC PROCESS AUTOMATION **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	CS266TED		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	36 L		**SEE Duration**	**:**	**03 Hours**

Unit-I	**08 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	**07 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	**07 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	**07 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	**07 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

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) **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						
INTELLIGENT TRANSPORTATION SYSTEMS **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	CV266TEE		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40 L		**SEE Duration**	**:**	**03 Hours**

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

Reference Books	
1.	Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068
2.	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601
3.	Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3
4.	Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781,
5	R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004, ISBN-13: 978-0-13-459971-7.

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) **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						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	CV266TEF		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40 L		**SEE Duration**	**:**	**03 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

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) **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 ENERGY STORAGE FOR E-MOBILITY **Category: Institutional Electives** **(Theory)**						
Course Code	**:**	CM266TEG		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40 L		**SEE Duration**	**:**	**03 Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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.	

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.

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						
HUMAN MACHINE INTERFACE (HMI) **Category: Institutional Electives-I GROUP-E** **(Theory)** **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 Web-Server. Web-based HMI: Basics of TwinCAT and HTML, CSS, JavaScript. **HMI on Mobile**: Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites.	
Unit –V	**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 testwill 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, Variable Frequency 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						
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	**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 Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ET266TEM**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 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	**09 Hrs**
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	
Unit –V	**08 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: At the end of this course the student 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 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						
MOBILE COMMUNICATION NETWORKS AND STANDARDS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ET266TEN**		**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**
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	**09 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	**09 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	**09 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	**09 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: At the end of this course the student 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 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						
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. Acquirefamiliarity 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**

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
Total Hours	**:**	**45L**		**SEE Duration**	**:**	03 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.

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

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**
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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: VI						
AUTOMOTIVE MECHATRONICS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ME266TES**		**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**
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	**12 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	**06 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	**08 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: At the end of this course the student 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 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						
MATHEMATICAL MODELLING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**MA266TEU**		**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**
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 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**
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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						
MATHEMATICS FOR QUANTUM COMPUTING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**MA266TEV**		**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**
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 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						
APPLIED PSYCHOLOGY FOR ENGINEERS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
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	
2.	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). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
Universal Human Values - II **Category: Institutional Electives-I GROUP-E** **(Theory)**						
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**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). 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**

Semester: VI						
INTERDISCIPLINARY PROJECT						
Course Code	**:**	**EE367P**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:3**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**15 P**		**SEE Duration**	**:**	**2 Hours**

Major Project Guidelines:

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

Batch Formation:

- Students are free to choose their project partners from any other program.
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house only.
- ***The project work is to be carried out by a team of two to four students.***

Project Topic Selection:

The topics of the project work must be in the ***field of Sustainable Development goals areas or in line with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as given by Faculty. The projects as far as possible should have societal relevance with focus on sustainability.**

Project Evaluation:

Continuous monitoring of project work will be carried out and cumulative evaluation will be done.

- The students are required to meet their guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Guide regularly.
- For CIE assessment the project groups must give a final presentation with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.

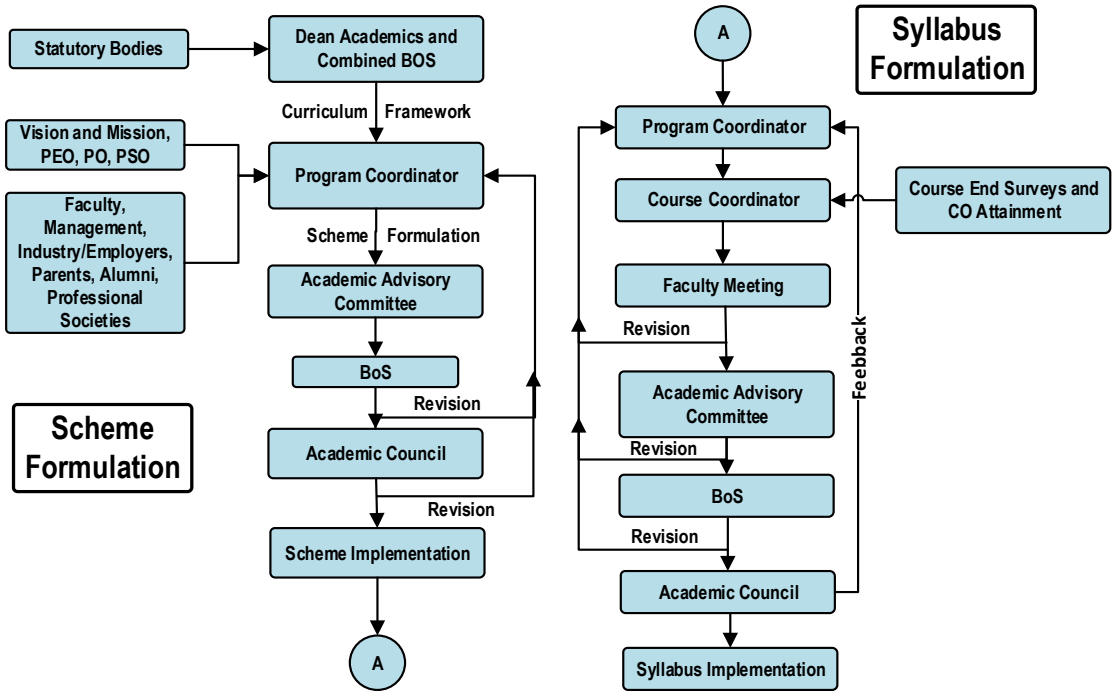
Course Outcomes:	
1	Identifying critical thinking and problem-solving abilities by analyzing and addressing interdisciplinary challenges, utilizing creative approaches and innovative solutions.
2	Exhibit proficiency in conducting comprehensive research, including literature review, data collection, modelling, simulation, and analysis, to address significant technical challenges and propose innovative solutions.
3	Demonstrate the ability to do effective teamwork, leadership, project management, and communication skills, while adhering to ethical standards and professional responsibility in delivering the project outcomes within time and budget constraints.
4	Utilize appropriate engineering tools, technologies, and software to design, test, and implement project solutions, ensuring adherence to technical specifications, safety standards, and industry best practices.

CIE Assessment:
The following are the weightings given for the various stages of the project.

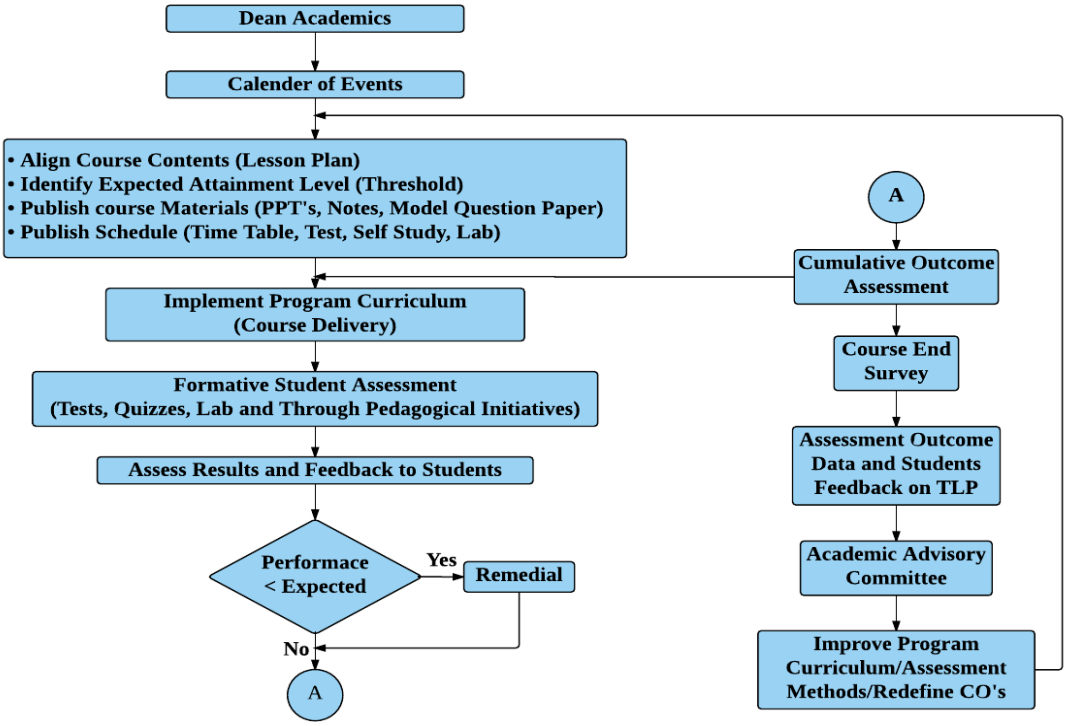
1.	Selection of the topic and formulation of objectives	10%
2.	Design and Development of Project methodology	25%
3.	Execution of Project	25%
4.	Presentation, Demonstration and Results Discussion	30%
5.	Report Writing & Publication	10%

SEE Assessment:
The following are the weightages given during Viva Examination.

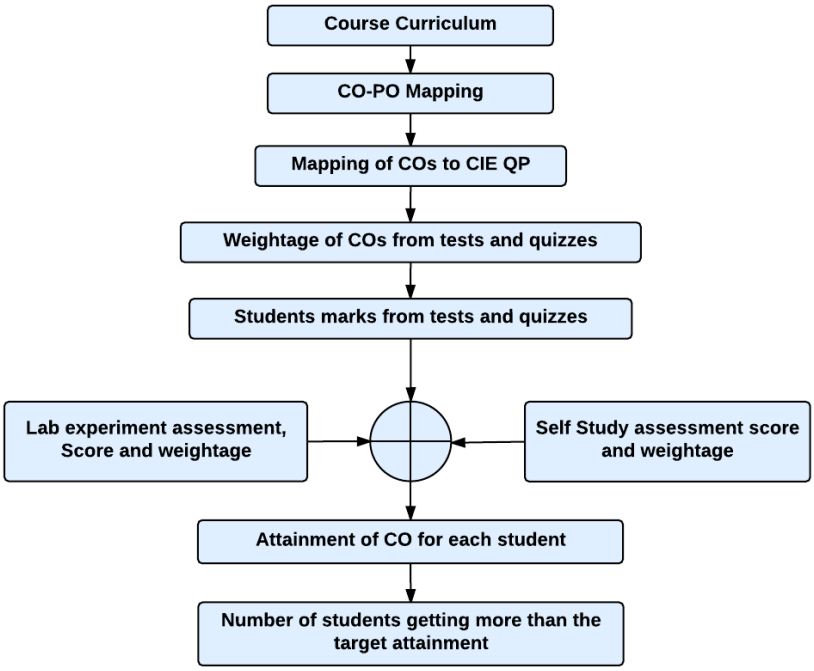
1.	Written presentation of synopsis	10%
2.	Presentation/Demonstration of the project	30%
3.	Methodology and Experimental Results & Discussion	30%
4.	Report	10%
5.	Viva Voce	20%



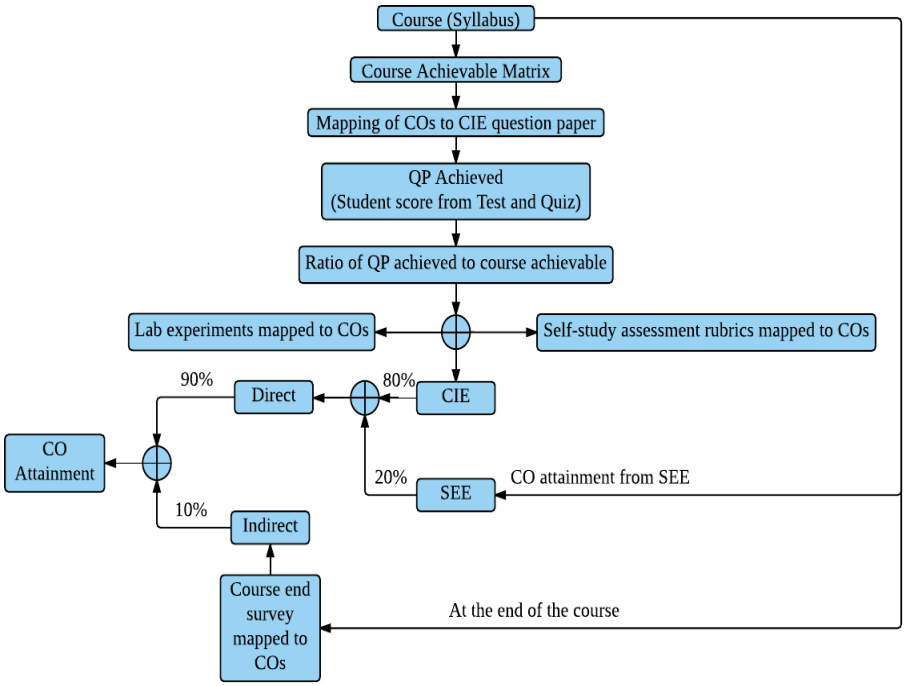
Academic Planning and Implementation



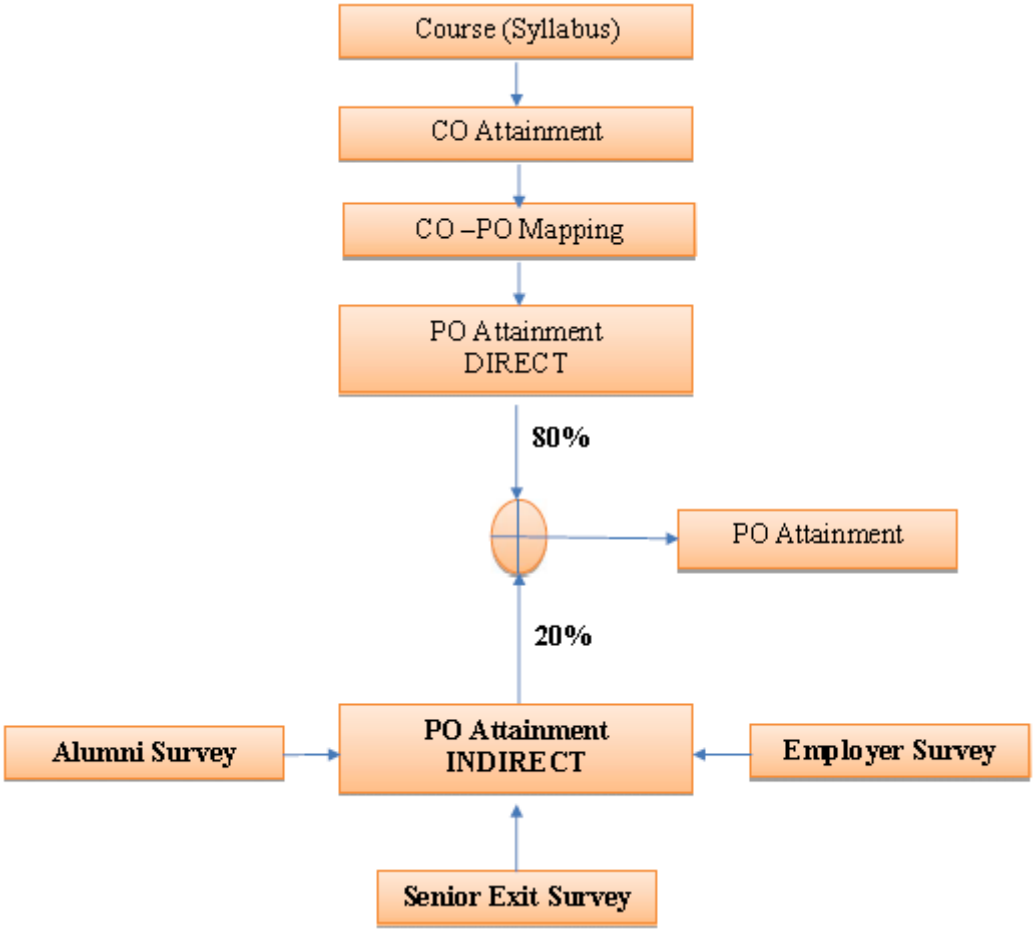
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome 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.

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

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- To deliver outcome based Quality education, emphasizing on experientiallearning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation