RV College of Engineering®

Electronics & Instrumentation Engineering

Bachelor of Engineering (B.E)

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, 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)

1501+
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

ELECTRONICS & INSTRUMENTATION ENGINEERING

DEPARTMENT VISION

Achieving academic excellence in Instrumentation Technology by adopting interdisciplinary research with a focus on sustainable and inclusive technologies

DEPARTMENT MISSION

1. To create an environment for students to excel in domain areas and get motivated to involve in interdisciplinary research by utilizing state of the art infrastructure.
2. To impart technical knowledge, encourage experiential learning and develop future professional leaders.
3. To establish industry-academia networking and develop industry-ready students and future entrepreneurs, to meet societal & industrial challenges.
4. To motivate lifelong learning and research in sustainable technologies to find improved solutions for the betterment of society.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Apply Instrumentation, Electronics, Controls and Automation concepts to develop technical solutions for industrial problems.

PEO2: Exhibit competency in adapting to various industrial challenges and work in inter-disciplinary projects with team spirit and professional ethics for achieving Organizational goals.

PEO3: Pursue higher education in technology or management and achieve professional excellence by imbibing leadership qualities and communication skills.

PEO4: Become entrepreneurs with a focus on sustainable technologies and develop innovative solutions to meet industrial and societal needs.

PROGRAM SPECIFIC OUTCOMES

PSO1: Design, analyze and practice the instrumentation, controls and automation concepts and techniques required for industrial and/or research pursuits resulting in product development, publications or patents.

PSO2: Demonstrate the knowledge of basic science, mathematics, electronic system design and programming for real-time applications, towards developing industrial solutions and become technology leaders of future.

LEAD SOCIETY

International Society of Automation (ISA)

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

ELECTRONICS AND INSTRUMENTATION ENGINEERING

V SEMESTER												
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	HS351TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	HS	Theory	**100**	**----**	**3**	**100**	**----**
2	EC352IA	Digital VLSI Design (Common to EC & EI) (Theory & Practice)	3	0	1	4	EC	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	EI253IA	Automatic Process Control and Virtual Instrumentation (Theory & Practice)	3	0	1	4	EI	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	EC354TA	Embedded System Design (Common to EC & EI)	3	1	0	4	EC	Theory	**100**	**----**	**3**	**100**	**----**
5	EI255TBX	Professional Core Elective-I (Group-B)	3	0	0	3	EI	Theory	**100**	**----**	**3**	**100**	**----**
6	EI256TCX	Professional Core Elective-II (Group-C)	2	0	0	2	EI	**NPTEL**	**----**	**----**	**2**	**50**	
		Total				**20**							

Professional Core Elective-I (Group-B)		
Sl. No.	**Course Code**	**Course Title**
1	EI255TBA	Microelectromechanical Systems & Applications
2	EI255TBB	Safety Automation for Industries
3	EI255TBC	Product Design Technology
4	EI255TBD	Biopotentials & Medical devices
Professional Core Elective-II (Group-C)		
Sl. No.	**Course Code**	**Course Title**
1	EI256TCA	User-centric Computing for Human-Computer Interaction
2	AI256TCB	Design, Technology and Innovation
3	ET256TCC	Cloud Computing and Distributed Systems
4	EI256TCD	Fuzzy Logic and Neural Network
5	BT256TCE	Health Research and Fundamentals
6	ET256TCE	VLSI Signal Processing
7	EI256TCF	Mechatronics
8	EI256TCG	Data Base Management System

Bachelor of Engineering in

ELECTRONICS AND INSTRUMENTATION ENGINEERING

VI SEMESTER													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	HS261TA	Principles of Management and Economics	3	0	0	3	HS	Theory	**100**	**----**	**3**	**100**	**----**
2	EI362IA	Industrial Automation Technologies (Theory & Practice)	3	0	1	4	EI	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	EI363IA	Data Communication Networks (Theory & Practice)	3	0	1	4	EI	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	EC364TA	Digital Signal Processing with ML (Common to EC & EI)	3	1	0	4	EC	Theory	**100**	**----**	**3**	**100**	**----**
5	EI265TDX	Professional Core Elective-III (Group- D)	3	0	0	3	EI	Theory	**100**	**----**	**3**	**100**	**----**
6	XX366TEX	Institutional Electives – I (Group E)	3	0	0	3	XX	Theory	**100**	**----**	**3**	**100**	**----**
7	EI367P	Interdisciplinary Project	0	0	3	3	EI	Project	**----**	**100**	**3**	**----**	**100**
		Total				**24**							

Professional Core Elective-III (Group-D)		
Sl. No.	**Course Code**	**Course Title**
1	EI265TDA	Industrial Wireless Technologies
2	EI265TDB	Virtual and Augmented Reality
3	EI265TDC	Data Analytics
4	EI265TDD	System on chip

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

Semester: V						
ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS (Theory)						
Course Code	**:**	HS351TA		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	42L		**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.	
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 similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies.	
Unit –V	**09 Hrs**
Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India. **Industrial Design:** Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies. **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies.	

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

Reference Books	
1.	Entrepreneurship: Theory, Process, and Practice Donald F. Kuratko, South-Western Pub publishers, 10th Edition, 2016, ISBN-13: 978- 1305576247.
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Currency Publishers,1st Edition, 2011, ISBN-13: 978-0307887894.
3.	Law Relating to Intellectual Property, Dr B L Wadehra, Universa Law publishers, 5th Edition, ISBN : 978-9350350300 .
4	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**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						
DIGITAL VLSI DESIGN **Category: Professional Core Course** **(Common to EC & EI)** **(Theory & Practice)**						
Course Code	**:**	EC352IA		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	**:**	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	**:**	03+03 Hours

Unit-I	**09 Hrs**

VLSI Design Flow: Specification, Design entry, Functional simulation, planning placement and routing, timing simulation.

MOS Transistor: Introduction, Ideal I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non-ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Junction Leakage, Body effect, Tunneling.

DC Transfer Characteristics: Static CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin.

Combinational Circuit Design: CMOS Logic, Inverter, NAND Gate, NOR Gate, Combinational Logic, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers.

Unit – II	**09 Hrs**

Delay: Transient response, RC delay model, linear delay model

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Complementary Pass-Transistor Logic Circuits.

Datapath Subsystem: Single-Bit Addition, Mirror Adder, TG based adder, Zhaung full adder, Ripple Carry Adder, Carry lookahead adder, Carry Skip adder, Carry Select Adder, Manchester Carry chain adder, Braun, Baugh-Wooley and Booth multipliers.

Unit –III	**09 Hrs**

Sequential MOS Logic Circuitry: Behavioral of Bistable element, SR Latch Circuitry, Clocked latch and Flip-Flop Circuitry, C-MOS D-Latch and Edge Triggered Flip-Flop.

Sequencing Static Circuits: Introduction to Clock Skew and Jitter**,** Sequencing Methods, Max- Delay Constraints, Min-Delay Constraints, Time Borrowing.

Unit –IV	**09 Hrs**

Array Sub system SRAM: Memory cell Read/Write operation, Decoder, Bit-line conditioning and Column circuitry, Multi-Ported SRAM. DRAM Subarray Architectures.

Read-Only Memory: Programmable ROMs, NAND/NOR ROMs. Content-Addressable Memory, PLA

Unit –V	**09 Hrs**

CMOS Processing Technology: CMOS Technologies, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO_2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Metrology.

CMOS Layout Design Rules: Stick diagrams and Gate layouts,

Transistor Scaling: Constant voltage, Constant field and Generalized scaling.

Laboratory Experiments:

1.a MOS device Characterization
b Practice question :Plot g_mVs$V_{gs}$for NMOS/PMOS
2.a CMOS Inverter Static Characteristics
b Practice question: Plot the Voltage Transfer Characteristic graph of CMOS inverter and calculate the switching voltage for the given specification.
3. a Design and Analysis of NAND and NOR gates.
b Practice question: Realization of XOR & AOI32 logic and perform transient analysis.
4. a Realization of CMOS-adder circuits.
b Practice question: Realize 4-bit adder/subtractor.
5. a Sequential Circuit Design using Master-Slave configuration.
b Practice question: Realize 4-bit Ring counter/Johnson counter.
6. a Layout, DRC, LVS, RCX and post-layout simulation of CMOS Inverter.
b Practice question: Realize NOT gate with 2X the size for PMOS and NMOS.
7. a NAND/NOR gates layout and post simulation.
b Practice question: Realize the layouts of AOI32 logic.
8. a 6T SRAM Verify functionality, read and write stability.
b Practice question: Realize read and write operation 3T DRAM cell and perform the above observations.
9. a Synthesis of 8-bit counter and analyze delay, power, and area.
b. Practice question: Realize the 16-bit counter and analyze delay, power, and area.
10. a Synthesis of serial adder circuit and analyze delay, power, and area.
b. Practice question: Synthesis of 2X2 multiplier and analyze delay, power, and area.
11. Open Ended experiments.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyze transistor circuits and its impact on VLSI design flow.
CO2:	Design VLSI blocks using various architectures.
CO3:	Evaluate the different performance parameters of a digital integrated circuits & systems.
CO4:	Illustrate the application of various circuits and processes in logic families/designs.

Reference Books	
1.	CMOS VLSI Design, Neil H.E. Weste, David Harris, Ayan Banerjee, 3rd Edition, 2006, Pearson Education, ISBN: 0321149017.
2.	CMOS Digital Integrated Circuits, Sung MO Kang, YousfLeblebici, 3rd Edition, Tata McGraw Hill, ISBN: 0-7923-7246-8.
3.	Basic VLSI Design, Douglas.A.Pucknell, Kamaran Eshraghian, 3rd Edition 2010 ,PHI, ISBN: 0-321-26977-22.
4.	Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs, Jerry G. Fossum, Vishal P. Trivedi, 1st Edition 2013, Cambridge University Press, ISBN-13:978-1107030411.

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY and PRACTICE)		
#	**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 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 (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (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 and 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						
AUTOMATIC PROCESS CONTROL & VIRTUAL INSTRUMENTATION (Theory & Practice)						
Course Code	:	EI253IA		**CIE**	:	100+50 Marks
Credits: L : T : P	:	03:00:01		**SEE**	:	100+50 Marks
Total Hours	:	45L		**SEE Duration**	:	03 Hrs+03 Hrs

Unit-I	**09 Hrs**

Introduction to Process control: Process-Control Block Diagram, control system evaluation, Stability, Steady State & Transient Regulation, On/Off Control, Analog Control, Digital Control, Supervisory Control, Direct Digital control, Networked Control Systems, PLC Control application.

Controller principles: Introduction, Process Characteristics, Process Equation, Process Load, Process Lag, Process Regulation, Control System Parameters, Direct & Reverse Action of automatic controllers, problems.

Unit – II	**09 Hrs**

Analog controller Design: Introduction, Electronic controllers, Error Detector, Design of an Electronic 2-position Controller, Design of Single-Mode, 2-Mode and 3-Mode Continuous Controller Modes, Design exercises.

Alarms Design: Single-variable alarms, and multi-variable alarms, Design examples.

Unit –III	**09 Hrs**

Digital controllers: Computers in Process Controls, DAS, Supervisory Control, Controller Software, Computer Controller Modes, Digital Controller Algorithms for P, I, D, PI, and PID Computer Controllers - Examples & problems.

Control loop characteristics: Control system configurations, Cascade Control, Multi-Variable Control systems, Analog Control, Supervisory & Direct Digital Control, problems.

Unit –IV	**09 Hrs**

Process loop tuning methods: Ziegler-Nichols Open-Loop Transient Response Tuning method and Closed-Loop ultimate Cycling Tuning Method for P, PI, & PID control Modes, Frequency Response Tuning method for P, I, & D Modes.

P&ID Symbols: ISA Symbols, Connecting Lines, General Instruments & Functions, Actuators & Process Elements, ANSI/ISA-5.1-2009 Standard for Instrumentation Symbols and Identification, P&ID diagrams for Chemical Processes, ISA Flow Diagrams, - Drill Problems.

Unit –V	**09 Hrs**

Virtual instrumentation: Introduction to LabVIEW: Advantages, creating and saving VI, front panel and block diagram tool bar, palettes, controls and indicators, data types, creating sub-VIs,

Modular programming: Repetition and loops: For loops, while loops, shift registers, feedback nodes, Structures: Case, sequence, formula nodes.

Arrays & Clusters: : Creating one dimensional, two dimensional, array function, Clusters functions.

Course Outcomes: After completing the course, the students will be able to:	
CO1:	Understand the basic concepts, develop schematics & block diagrams for Industrial process control systems, using ISA Flow Diagrams, P&ID Symbols, and ISA Standards.
CO2:	Analyze & Design electronic analog P, I, D, PI, PD, PID controllers and write the algorithms for their digital implementation.
CO3:	Apply the techniques of control loop tuning for accurate control of Processes.
CO4:	Understand and apply the programming techniques of VI to simulate & interface, using myDAQ & myRIO.

Reference Books	
1.	Process Control Instrumentation Technology, Curtis D. Johnson, 7th Edition, 2012, PHI, ISBN: 81- 7758-410-3.
2.	Process Control – Concepts, Dynamics and Applications, S. K Singh, 2009, PHI, ISBN: 978-81- 203-3678-0.
3.	Instrument Engineers Handbook, Process Measurement, Bela G. Liptak, Volume 1, Process control Volume 2, 3rd Edition, 2010, Chilton book Company, ISBN 81-7956-540-8
4.	Instrumentation, Kirk and Rimboi ,2nd Edition, 2010, PHI, ISBN: 81-7758-410-5.
5.	Virtual Instrumentation Using LabVIEW, Jovitha Jerome, 2021, PHI, ISBN-978-81-203-4030-5.
6.	Virtual instrumentation using LabVIEW principles and practices of graphical programming, Sanjay Gupta & Joseph John, 2020, Tata McGraw-Hill, 2nd Edition, ISBN (13): 978-0-07-070028-4.

PRACTICALS: VIRTUAL INSTRUMENTATION Experiments:	
myDAQ EXPERIMENTS: -	
1	Determine warning VI using DAQ.
2	Acquisition of Temperature using DAQ.
3	Counter operation using DAQ.
4	Build Inverter circuit using myDAQ.
myRIO EXPERIMENTS: -	
5	Configuring on-board Sensors in myRIO.
6	Speed and direction control of DC motor using myRIO.
SIMULATION EXPERIMENTS: -	
7	Create a VI to find **nCr** and **nPr** of a given number using a For Loop, while loop, and **sub-VI**.
8	Build a VI to find the roots of a quadratic equation. Input the coefficients of x^2, x and constant as **a, b** and **c**, respectively. Display the roots and the message if the roots are real or imaginary.
9	To develop a VI to match the inputs and generate a Sine wave. Use a Tab control to give different inputs. Match the inputs; if the inputs match, generate a Sine wave, else generate a DC wave.
10	The random number data is written a text file and then transferring the same data to another file.
11	Create a 1-D numeric array which consists of ten elements and rotate it ten times. For each rotation, display the equivalent binary number of the first array element in the form of a Boolean array. Also, display the reversed Boolean array. Provide delay to view the rotation.
12	To create a table which consists of user names and passwords, input a user name and a password. Check whether the user name and password match the contents of the table. If they are matched, glow the "ACCESS GIVEN" LED, otherwise glow "ACCESS DENIED" LED. Also display the user name.
13	Build a **VI** to compute the following equations, and plot the results on a waveform graph. $y_1 = (x^3 + x^2 - 5)$; $y_2 = (x^2 + 4)$; Where x varies from 0 to 10, in steps of 0.2.
PROCESS CONTROL EXPERIMENTS	
14	Tuning and Testing the Performance of PI & PID **Flow** control loop.
15	Tuning and Testing the Performance of PD & PID **Temperature** control loop.
16	Tuning and Testing the Performance of P & PI **Level** control loop.
17	Tuning and Testing the Performance of ON/OFF & PID **Pressure** control loop.

Innovative Experiments: -

1. Advanced process control experiments (Cascade F/F and Ratio control system) using Universal Process Control Trainer set-up.
2. Ratio, FF, and Cascade controls, using Multi-process Trainer.
3. Producer Consumer design pattern
4. State machine operation
5. Master Slave operation - Notifier

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	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 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 (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (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 AND 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						
EMBEDDED SYSTEM DESIGN **Category: Professional Core Course** **(Common to EC & EI)** **(Theory)**						
Course Code	**:**	EC354TA		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:01:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L+15T		**SEE Duration**	**:**	03 Hrs

Unit-I	**07 Hrs**
Introduction to Embedded System Design: Introduction, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process: Requirements, Specifications, Hardware Software Partitioning, Architecture Design. **Embedded System Architecture:** Co-Processor & Hardware Accelerators, Processor performance Enhancement: Pipelining, Superscalar Execution, Multi Core CPUs..	
Unit – II	**07 Hrs**
Designing Embedded System Hardware –I: Memory systems: Memory organization, Error detecting and correcting memories, memory Access times, SRAM, DRAM, Flash, Interfacing program and data memory, Cache, Unified versus Harvard caches, Cache coherency, Cache, Cache replacement policies.	
Unit –III	**08 Hrs**
Designing Embedded System Hardware –II: I/O Devices: Watchdog Timers, Interrupt Controllers, Interfacing Protocols: I2C, I3C, CAN: Frame Formats, Interconnect Topology, Reset Circuits, Interfacing RTC, SATA, PCI, PCB design **Practice:** Wiring and connection of I2C, CAN on STM32F2407VG	
Unit –IV	**07 Hrs**
Designing Embedded System Software-I: Application Software, System Software, Cross-Platform Development Process, Board Support Library, Chip Support Library, Overview of Linkers and the Linking Process, Executable and Linking Format, Mapping Executable Images into Target Embedded Systems, Linker Command Files, Embedded System Initialization, Target System Tools and Image Transfer, Target Boot Scenarios, Target System Software Initialization Sequence, On-Chip Debugging Embedded System Coding Standards: MISRA C 2012	
Unit –V	**07 Hrs**
Designing Embedded System Software –II: OS based Design, Real Time Kernel, Process& Thread, Inter Process Communications, Synchronization, Kernel services, ISR, Software Timers, Case Study: RTX-ARM/FreeRTOS, **Practice:** Application code development on STM32F407VG with Kernel	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the architecture of embedded system, functional difference between general purpose system, operational & non-operational attributes of embedded system.
CO2:	Interpret hardware & software of an embedded systems with suitable processor architecture, memory, and communication interface.
CO3:	Developing embedded systems encompassing both software and hardware with the goal of meeting specified constraints.
CO4:	Engage in usage of tools to formulate, design, and analyze different applications realized with embedded processors.

Reference Books	
1	Introduction to Embedded Systems, Shibu K V, 2nd Edition, 2017, Tata McGraw Hill Education Private Limited, ISBN: 13: 978-9339219680.
2	Embedded Systems – A contemporary Design Tool, James K Peckol, 2009, John Weily, ISBN-13: 978-8126524563.
3	Real-Time Concepts for Embedded Systems, Qing Li and Carolyn Yao, 2003, CMP Books, ISBN: 1578201241.
4	Reference Manuals: I2C, SPI, CAN, Cache Design, MISRA C 2012, RTX-ARM, FreeRTOS.

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)* (Small case lets and case example in one subdivision)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
MICROELECTROMECHANICAL SYSTEMS & APPLICATIONS **Category: Professional Core Elective -I (Group B)** **(Theory)**						
Course Code	**:**	EI255TBA		**CIE**	:	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	:	100 Marks
Total Hours	**:**	45L		**SEE Duration**	:	03 Hrs

Unit-I	**09 Hrs**
Overview of MEMS & Microsystems: MEMS and Microsystems, Typical MEMS and micro system products, Evolution of micro fabrication, Microsystems and microelectronics, Multidisciplinary nature of Microsystems, Design and manufacture, Applications of Microsystems in automotive, healthcare, aerospace and other industries. **Working Principle of Microsystems**: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal.	
Unit – II	**09 Hrs**
Micro actuation: Using thermal forces, shape memory alloys, Piezoelectric crystals and electrostatic forces. MEMS with micro actuators: Microgrippers, micromotors, microvalves and micropumps, microaccelerometers, microfluidics**.** **Introduction to Scaling:** Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics.	
Unit –III	**09 Hrs**
Materials for MEMS and Microsystems: Substrates and wafers, Active substrate materials, Silicon as substrate material, Silicon Compounds, Si-Piezoresistors, GaAs, Quartz, Piezoelectric Crystals, Polymers and packaging materials. Three level of Microsystem packaging, Die level packaging, Device level packaging, System level packaging. Interfaces in microsystem packaging. Essential packaging technologies: die preparation, Surface bonding, Wire bonding, Sealing, 3D packaging.	
Unit –IV	**09 Hrs**
Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PVD-Sputtering, Deposition by Epitaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.	
Unit –V	**09 Hrs**
Micro Sensors, Actuators, Systems and Smart Materials: An Overview Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Fibre-optic sensors, Conductometric Gas Sensor, Electrostatic Comb drive, Magnetic Microrelay, Portable blood analyzer, Piezo electric Inkjet Print head,Micromirror array for Video projection, Micro-PCR Systems, Smart materials and systems.	

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

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

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

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

Semester: V						
SAFETY AUTOMATION FOR INDUSTRIES **Category: Professional Core Elective (Group B)** **(Theory)**						
Course Code	**:**	EI255TBB		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	03 Hrs

Unit-I	**09 Hrs**
Introduction to Safety Instrumented Systems: Scope, Safety Technology in Process Automation. Fire Triangle, Fire, Learning from Major Accidents. Basic Process control Systems (BPCS) & Safety Instrumented Systems (SIS). Block Diagrams, comparison. Advantages of SIS.	
Unit – II	**08 Hrs**
Introduction to Reliability engineering: Failure rate, Mean time between failures, Mean time to restore, Relationship between MTBF, MTTR and failure rate. Probability of failure on demand (PFD). **System Reliability engineering:** Reliability block diagram, series and parallel configurations,Fault-Tree analysis, Markov matrix & modeling, Markov solution technique.	
Unit –III	**08 Hrs**
Equipment Failure Modes: Fail-safe, Fail-danger, Detected/Undetected Failures, PFD, PFDavg, Problems on classification of Failure modes. **The concept of Safety integrity:** HAZOP (Hazard and operability study), (LOPA) Layer of protection Analysis, As low as reasonably Practicable (ALARP), Different levels of Safety Integrity Level (SIL).	
Unit –IV	**08 Hrs**
System Architectures: MooN architecture, redundancy and voting logic, Common Mode failure, importance of Redundancy and Diversity. **Hardware design principles for functional safety:** Meeting IEC 61508 Standard Part 2, Fault tolerance, Safety PLCs, Safety requirements, identification of safe faults, and dangerous faults.	
Unit –V	**08 Hrs**
Software design principles for functional safety: Meeting IEC 61508 Standard Part 3. **Software requirements for SIS:** Introduction to Safe failure fraction (SFF), Software Verification Requirements.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the functions of SIS and their applications.
CO2	Apply the principles of Reliability to evaluate systems.
CO3	Evaluate the SILs and System Architectures.
CO4	Analyze the H/w & S/w standards of various safety mechanisms.

Reference Books	
1.	Safety Instrumented Systems Verification: Practical Probabilistic Calculations, Harry Cheddie, W.M. Goble, 2004, ISA Publication, ISBN: 155617909X
2.	The Safety Critical Systems Handbook**,** A Straightforward Guide to Functional Safety: IEC 61508, IEC 61511 and Related Guidance, David Smith, 4th Edition, ISBN: 9780081008973.
3.	Safety Integrity Level Selection, Edward M. Marsza, 2002, ISA Publication, ISBN: 1556177771.
4.	Functional Safety in the Process Industry: A Handbook of Practical Guidance in the Application of IEC61511 and ANSI/ISA-84, KJ Kirkcaldy, D Chauhan, Lulu Publication, 2012.

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

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

Semester: V						
PRODUCT DESIGN TECHNOLOGY **Category: Professional Core Elective -I (Group B)** **(Theory)**						
Course Code	**:**	EI255TBC		**CIE**	**:**	100 Marks
Credits: L: T: P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hours

Unit-I	**09 Hrs**
Introduction: Characteristics of successful product development, who Designs and develops products, duration and cost of product development, the challenges of product development. **Development Processes and Organizations:** A generic development process, concept development: the front-end process, adapting the generic product development process. **Product Planning:** The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning.	
Unit – II	**09 Hrs**
Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. **Product Specifications:** What are specifications, when are specifications established, establishing target specifications, setting the final specifications. **Concept Generation and Selection:** The activity of concept generation, clarifies the problem search externally, search internally, explore Systematically, and reflect on the results and the process**.** Concept screening, concept scoring.	
Unit –III	**09 Hrs**
PCB Technology: Introduction to PCB, Types of PCB, PCB layout design and artwork generation Using CAD. Properties of copper clad sheets, materials used for fabrication of copper clad sheet, PCB film, Properties of film, film master preparation, Multilayer PCB Design and test consideration.	
Unit –IV	**09 Hrs**
Industrial Design: What Is Industrial Design? Assessing the Need for Industrial Design, The Impact of Industrial Design, The Industrial Design Process, Management of the Industrial Design Process, Assessing the Quality of Industrial Design.	
Unit –V	**09 Hrs**
Prototyping, Product Development Economics, Managing Projects Prototyping basics, principles of prototyping, Technologies, planning for prototypes. Elements of economic analysis, base case financial mode. Understanding and representing task, baseline project planning. Accelerating projects. Project execution. Post-mortem project evaluation.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand principles and concepts of process development and product planning.
CO2	Apply concept of adaptive and original redesign of engineering and consumer products.
CO3	Understand concepts of PCB design and fabrication as per customer needs.
CO4	Able to understand Industrial Design process, product prototyping, product development economics and Project management task.

Reference Books	
1.	Product Design and Development, Karl.T.Ulrich and Steven D Eppinger, 5th Edition, 2011, Tata McGraw-Hill, ISBN: 978 – 0073404776.
2.	Printed circuit Boards: Design and Technology, Walter C Boshart, 29th reprint, 2009, McGraw- Hill, ISBN: 978 – 0074515495.
3.	Product Design and Manufacturing, C Chitale and R C Gupta,5th Edition, 2011, PHI, ISBN: 978 – 8120342828.
4.	New Product Development, Timjones, Butterworth Heinmann, 1st Edition, 1996, Oxford. UCI, ISBN: 978 – 0750624275.

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						
BIO-POTENTIALS AND MEDICAL DEVICES **Category: Professional Core Elective -I (Group B)** **(Theory)**						
Course Code	**:**	EI255TBD		**CIE**	**:**	100 Marks
Credits: L: T: P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hours

Unit-I	**09 Hrs**
Sources of Biomedical Signals & device development: Introduction to sources of Biomedical signals, Basic Medical Instrumentation System with block diagram, Constraints in design of Biomedical Systems, Device classification, Overview of FDA and the approval process in India. Important medical device standards.	
Unit – II	**09 Hrs**
Electrodes for Bio-electric signal Acquisition: Electrodes for ECG; Limb electrode, Floating Electrodes, Pre-gelled Disposable electrodes and paste less electrodes, The electrode skin interface and motion artifact, Electrodes for EEG, Sleep EEG and EMG, Micro electrodes, Needle Electrodes.	
Unit –III	**09 Hrs**
Cardiac Devices: Functioning of Heart, Electrical Conductivity of Heart, Basic Principles of ECG, Cardiac Pacemakers-Need, types and functional characteristics, Cardiac defibrillators, disadvantages, DC defibrillator, types Instantaneous, Synchronized.	
Unit –IV	**09 Hrs**
Respiratory Aids: Basics of Respiratory System, Mechanics of Respiration, Pulmonary Function tests Ventilator- Need, Types, Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameter, Humidifier, Nebulizer, Aspirator.	
Unit –V	**09 Hrs**
Central Nervous system & BCI: Basics of CNS, Neuron, Propagation of impulses, EEG, Brain Computer Interface. Brain Computer Interface Types, Types of BCI Signals, Monitoring Brain Activity using EEG, EcoG BCI System, Brain Computer Interface Applications, BCI Trends.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Identify the source of Bio-Electric potentials.
CO2	Identify the various types of electrodes for acquisition of Bio-electric potentials.
CO3	Understand how bioelectric potentials can be used for disease diagnosis.
CO4	Understand the integration of Biopotentials of major organ systems in development of devices.

Reference Books	
1.	Handbook of Biomedical Instrumentation, Khandpur, R.S, 3rd Edition 2014 McGraw Hill Education, ISBN: 9789339205430.
2.	Introduction to Biomedical Equipment Technology, Joseph .J.Carr and John .M.Brown, 4th Edition 2000 Pearson, ISBN:978-0130104922.
3.	Therapeutic medical devices, application and design, Albert M.Cook and Webster.J.G, Prentice Hall Inc., New Jersey, 1982, ISBN:0139147969 9780139147968.
4.	Medical Instrumentation Application and Design, John G.Webster ,4th Edition, ISBN 13: 978- 0471-67600-3.
5.	Essentials of Medical Physiology, Prema Sembulingam, K Sembulingam, 8th Edition, 2019 Jaypee Brothers Medical Publisher, ISBN:978-9352706921.
6.	Brain Computer Interfaces-Applying Your Minds to Human-Computer Interaction, Desney S.Tan, Anton Nijholt, ISBN: 978-1-84996-271-1, DOI: 10.1007/978-1-84996-272-8.

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: VI						
PRINCIPLES OF MANAGEMENT & ECONOMICS (Theory)						
Course Code	**:**	HS261TA		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45Hrs		**SEE Duration**	**:**	03 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 Equity theory, Vroom's Expectancy Theory. **Caselets / Case studies.** **Leadership:** Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. **Caselets / Case studies.**	
Unit –IV	**10 Hrs**
Introduction to Economics: Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems. **Essentials of Microeconomics:** Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly.	
Unit –V	**09 Hrs**
Macroeconomic Indicators: Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations, ESG an overview. **Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India.	

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

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

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

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

Semester: VI						
Industrial Automation Technologies **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	:	EI362IA		**CIE**	:	100+50 Marks
Credits: L:T:P	:	03:00:01		**SEE**	:	100+50 Marks
Total Hours	:	45L + 30P		**SEE Duration**	:	03 Hours

Unit-I	**09 Hrs**
Introduction: Introduction to Industrial Automation, Historical background, Principles of Operations, PLC Versus Other types of Controls, PLC Product Application Ranges, why to use PLC, Introduction to Fixed and Modular I/O Hardware PLC Operation: Binary Data representation, Input and output status files for modular PLC, Input and output status files for Fixed PLC Addressing concept.	
Unit – II	**09 Hrs**
PLC Hardware: Input modules: Discrete and Analog input modules, Output Modules: Discrete output module switching, solid state output module switching, TTL and Relay output modules.	
Unit –III	**09 Hrs**
Basics of PLC Programming: Processor memory organization, Program scan, PLC programming languages, Basic Relay Instruction, Bit or relay instructions, NO, NC, One Shot, Output latching software, negated Output and Internal Bit Type instructions, mode of operations **Special programming Instructions:** Timer instructions: On and Off delay, retentive timer instructions, with an example, cascading timer. Counter Instructions: PLC Counter up and Counter down instructions, combining counters and timers **Program Control Instructions, Comparison & Data manipulation Instructions:** Jump, Subroutine Instructions, EQU, NEQ, LES, LEQ, GRT, GEQ, MOVE, MOVM, FRD TOD, COPY, Mathematical Instructions, Logical Instructions: AND, OR, XOR, NOT, Looping Instructions.	
Unit –IV	**09 Hrs**
SCADA, DCS and HMI systems Building Block of SCADA System, Hardware structure of Remote Terminal Unit, Block diagram of Distributive Control System. **Creating SCADA Applications** Creating database tags, Creating and editing graphical display with animations, Object movements with blinking and visibility, Trends in real-time and hysteresis, Commissioning and networking.	
Unit –V	**09 Hrs**
Industrial and Data Communications: Serial Communication, Interface, Ethernet -IP, MODBUS, Field bus, Profibus network, HART, CAN, OPC Protocol communication.	

Laboratory Component:

PART B:

1. Write a Ladder diagram for simulating Valve Movement A+B+A-B-using Automation Studio software.
2. Write a LD for manual operation on simple piston extraction.
3. Write a LD for sequencing of a Piston using. Piston, where the piston will extract and retract after a delay of 10s. The simulation should stop after a count of 5 piston movements.
4. Write a Ladder diagram for three motors operating in Sequence using Delay Timers.
5. Write a Ladder diagram for 2 Way Traffic Light to using HMI and timers.
6. Write a LD for Pneumatic AND &OR Operation using Automation Studio pneumatic Libraries.
7. Write a ladder program for designing a 24 Hr clock using timer and counters.
8. Write a LD for analyzing a latch and implementation of logic gates in a single ladder diagram.
9. Write a Ladder diagram for simulating the Elevator System using ABB PLC.
10. Write a Ladder diagram for simulating Bottle-filling process using ABB PLC.
11. Write a Ladder diagram using automation studio for the implementing Bottle-filling system.
12. Write a Ladder diagram using automation studio for Robotic Arm application using OPC Server and I/O Kit.
13. Write a Ladder diagram for simulating Automatic Material Sorting by Conveyor using ABB PLC.
14. Simulating a PLC program to drive AC motor (Speed Control) using variable Frequency Drive in ABB Hand /Auto Macro mode.
15. Write a Ladder diagram to drive Servo motor (Speed Control/ Direction) using AB PLC
16. Write a Ladder diagram to drive Stepper motor (Speed Control/ Direction) using AB PLC.

Innovative Experiments:

1. HMI Programming for speed control of Servo Stepper motors.
2. SCADA Programming for ON OFF Control,
3. Data acquisition using Communication Protocols like HART, MODBUS, PROFIBUS
4. Interfacing and Communication with multiple process control loops using DCS

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the basic concepts of PLC's and SCADA techniques.
CO2	Apply the programming concepts to interface peripheral.
CO3	Analyze and evaluate the automation techniques for industrial applications.
CO4	Develop a system for automation application.

Reference Books	
1.	Introduction to Programmable Logic Controllers, Garry Dunning, CENGAGE Learning, 3rd Edition, 2007, ISBN: 978-8131503027.
2.	Industrial Control and Instrumentation, Bolton W, Universities Press, 6th Edition, 2006. ISBN: 978-0128029299.
3.	Computer Based Industrial control, Krishna Kant, PHI Publishers, 2nd Edition, 2010. ISBN: 978-8120339880.
4.	Programmable-Controllers-Theory-Implementation, Bryan, Library of Congress Cataloging-in-Publication Data, 2nd Edition, 2010, ISBN:978-0826913005.
5.	Data and Computer Communication, Stallings Williams, 4th Edition, PHI Learning, New Delhi,2006, ISBN-10: 1425982026.

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY and PRACTICE)		
#	**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 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 (10) Designing & Modeling (10) **Phase 2 will be done in exhibition mode (Demo/Prototype/any outcome). 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 and PRACTICE)	**150**

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 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						
DATA COMMUNICATION NETWORKS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	EI363IA		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	**:**	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	**:**	03 Hrs+03 Hrs
Unit-I						**09 Hrs**
Introduction: Data Communication, Components, Data flow, Data Representation, Networks. **Network Models**: Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite, Addressing.						
Unit – II						**09 Hrs**
Data and Signals: Transmission Impairment, Data Rate Limits, Performance, **Multiplexing**: Frequency Division Multiplexing, Wavelength Division Multiplexing, Time Division Multiplexing **Transmission Media**: Guided Media. **The Data Link Layer**: Data link layer design issues, Error detecting Codes, Sliding window protocols.						
Unit –III						**09 Hrs**
The medium access control sublayer: The channel allocation problem, multiple access protocols-ALOHA, CSMA/CD, CSMA/CA. **Ethernet:** Classic Ethernet Physical Layer, Classic Ethernet MAC sublayer protocol, Ethernet Performance, Switched Ethernet**.**						
Unit –IV						**09 Hrs**
Routing Algorithms: The optimality principle, shortest path algorithm, flooding, Distance vector routing, Link state vector routing, Hierarchical Routing. **The network layer in the internet:** IP version 4, IP address, Classful Addressing,IP version 6.						
Unit –V						**09 Hrs**
Network Security: Introduction to Cryptography, substitution Ciphers, transposition Ciphers**.** **Symmetric Key algorithm:** DES, AES, RSA algorithm, Firewall**.**						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Acquire a solid foundation in the principles of computer communication networks and the many strategies used in these networks.
CO2	Utilise the numerous networking protocols and methods appropriate for the networking circumstance at hand.
CO3	Conduct research into the various networking principles and algorithms, as well as the applications of each.
CO4	Create simulation models for computer network infrastructure.

Reference Books	
1.	Data Communications and Networking, Behrouz A Forouzan, 5th Edition, 2012, McGraw-Hill, ISBN: 9781259064753.
2.	Computer Networks, Andrews S. Tanenbaum, 5th Edition, 2014, Pearson Publication, ISBN: 978-93-325-1874-2.
3.	Data and Computer Communications, W. Stallings, 10th Edition, 2014, Pearson Education, ISBN: 978-0024542526.
4.	Introduction to Data Communications and Networking, Wayne Tomasi, 1st Edition, 2011, Pearson Education, ISBN: 978-81- 31709306.

Practicals:

1) Test and verify Network configurations using Packet Tracer.
2) Configure Inter VLAN network using Packet Tracer.
3) Configure and test a given network using Packet Tracer.
4) Simulate & Analyze CSMA/CD and CSMA/CA Protocols.
5) Implement Bit stuffing Algorithm using C program.
6) Implement Character stuffing algorithm using C program.
7) Implement Cyclic Redundancy Check codes for error detection using C program.
8) Implement Encryption and Decryption algorithms using C program.
9) Implement STOP and WAIT protocol using socket programming concept using C Program.
10) Implement RSA algorithm using C program.

Innovative Experiment

Simulate using CISCO Packet tracer different routing protocols and IoT applications.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**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 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 (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (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 AND 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						
DIGITAL SIGNAL PROCESSING AND MACHINE LEARNING **Category: Professional Core Course** **(Theory)** **(Common to EC & EI)**						
Course Code	**:**	EC364TA		**CIE Marks**	**:**	100 Marks
Credits: L:T:P	**:**	03:01:00		**SEE Marks**	**:**	100 Marks
Total Hours	**:**	36L		**SEE Duration**	**:**	03 Hours

Unit-I	**07 Hrs**
Digital Filters: Introduction, ideal frequency selective filter, non-ideal frequency selective filter, discrete time frequency selective filter described by difference equation. **IIR Filter:** Characteristic of Analog filter: Butterworth (derivation), comparison of Butterworth, Chebyshev, Elliptic, Bessel filter. Analog to digital filter transformation technique: BLT (derivation), Comparisons of bilinear transformation, impulse invariance, backword difference equation, Digital filter design for Butterworth (LP, HP, BP, BS) using Bilinear Transformation.	
Unit – II	**07 Hrs**
Design of FIR Filters: Symmetric and anti-symmetric FIR Filters, Design of Linear phase FIR Filters using Windows, Design of Linear phase FIR filters by frequency Sampling method. Comparison of Design Methods for Linear -Phase FIR filters, Applications of IIR and FIR filters. Introduction to multirate filter and adaptive filter and adaptive systems.	
Unit –III	**08 Hrs**
Machine learning algorithms: Overview of Probability Theory, Types and applications of Machine Learning, Basic types of data in machine learning, Exploring structure of data, Data pre-processing, Model Selection, Stochastic gradient Descent, learning algorithms, Boosting and Regularization Paths **Supervised Learning Algorithm:** Linear Regression, logistic regression, Bayesian Linear Regression, Classification Model**,** Linear and logistic classifier, Support vector machines, k-Nearest Neighbour.	
Unit –IV	**07 Hrs**
Supervised Learning Algorithm: Decision tree**,** Random forest model, Naïve Bayes classifier. Application of Supervised Learning, Clustering, case studies on supervised machine learning. **Unsupervised Learning Algorithms:** Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering, K-means Clustering, Principal Component Analysis, case studies on unsupervised machine learning.	
Unit –V	**07 Hrs**
Deep Learning techniques: Introduction of Neural Network, Deep Neural Network, Various architecture of CNN, LeNet, AlexNet, ZF-Net, VGGNet, Object Detection: RCNN, Faster RCNN, YOLO, Backpropagation. Recurrent Neural Network, Long Short Term Memory (LSTM) Cells, Generative Adversarial Networks (GANs).	

Course Outcomes (CO): **After completing the course, the students will be able to: -**	
CO1	Know the characteristics and structures of IIR, FIR and adaptive systems
CO2	Use the concept of filter design, machine learning to analyse and acquire knowledge aboutthe system and select proper tools for further analysis.
CO3	Design, implementation, analysis and comparison of digital filters for processing of discretetime signals and also various machine learning algorithms.
CO4	Assess the techniques, skills, and modern engineering tools necessary for analysis of different signals and filtering out noise signals in engineering practice.

Reference Books	
1.	Digital Signal Processing, Proakis G, Dimitris G. Manolakis; PHI, 4th Edition; 2007; ISBN: 978-0131873742.
2.	Discrete Time Signal Processing, Alan. V.Oppemheim, PHI, 2nd Edition, 1998; ISBN:0-13-754920-2.
3.	Pattern Recognition and Machine Learning, Christopher M Bishop, Springer, 2006, ISBN-13: 978-0387-31073-2.
4.	The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, Springer, 2008, ISBN 978-0387848570.
5.	Goodfellow, Y, Bengio, A. Courville, "Deep Learning", MIT Press, 2016, ISBN-0262035618.

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 OFTWO 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 beconducted**. 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 andpractical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10**)** Real time problem solving (10) **ADDINGUPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR THE 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						
INDUSTRIAL WIRELESS TECHNOLOGIES **Category: Professional Core Elective -III (Group D)** **(Theory)**						
Course Code	**:**	EI265TDA		**CIE**	**:**	100 Marks
Credits: L: T: P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs
Unit-I						**09 Hrs**
Evolution of Wireless Communication Systems: Brief History of Wireless Communications, Advantages of Wireless Communications, Disadvantages of Wireless Communications, Wireless Network Generations, Comparison of Wireless Systems, Evolution to Next-Generation Networks, Applications of Wireless Communications, Potential Market Areas, Challenges for Research.						
Unit – II						**09 Hrs**
Multiple Access Techniques: Introduction, Frequency Division Multiple Access, Time-Division Multiple Access, Code Division Multiple Access, Comparison of Multiple-Access Techniques, Overview of OFDM.						
Unit –III						**09 Hrs**
Technical Principles: Industrial Wireless Sensor Networks- Applications, Standardization Activities, Technical challenges. RFID Technology and Its Industrial Applications- RFID Architecture, Item Tracking and Tracing. Ultralow-Power Wireless Communication-Introduction, Hardware approaches.						
Unit –IV						**09 Hrs**
Application-Specific Areas: Embedded Networks in Civilian Aircraft Avionics Systems, Process Automation, Building and Home Automation, Communications in Medical Applications.						
Unit –V						**09 Hrs**
Technologies: LonWorks, 6LoWPAN: IP for Wireless Sensor Networks and Smart Cooperating Objects, Wireless HART, ISA100.11a, LoRa, AT command set.						

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the basics of wireless communication and multiple access techniques
CO2	Analyze the technical principles involved in different wireless systems.
CO3	Apply wireless technologies in different application areas.
CO4	Evaluate different case studies involved using industrial wireless technologies.

Reference Books	
1.	Wireless communication, T L Singal, 1st Edition, 2010, Tata McGraw Hill Education Private Limited, ISBN: 978-007068178-1.
2.	Industrial communication systems, Bogdan M. Wilamowski and J. david Irwin,2nd Edition, 2011, CRC Press, ISBN 978-1-4398-0281-6.
3.	Wireless Communications: Principles and Practice, Theodore.S. Rappaport, 2nd Edition, 2009, Pearson Education, ISBN: 978-8131731864.
4.	The Wireless Internet of Things, Daniel Chew,1st Edition, 2019, John Wiley & Sons, ISBN: 9781119260578.

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						
VIRTUAL & AUGMENTED REALITY **Category: Professional Core Elective (Group – D)** **(Theory)**						
Course Code	**:**	EI265TDB		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

Unit-I	**09 Hrs**
Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality: Input - Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output - Visual /Auditory / Haptic Devices.	
Unit – II	**09 Hrs**
Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering. Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Menus, Object Grasp.	
Unit –III	**09 Hrs**
Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools. Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.	
Unit –IV	**09 Hrs**
Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality. Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	
Unit –V	**09 Hrs**
Applications: Medical, robotics, Advanced Real time Tracking, games, movies, simulations, therapy. Frontiers: Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the perspective on the VR/AR landscape; past, present, and future.
CO2	Apply the fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR
CO3	Demonstrate insights to key application areas for VR/AR.
CO4	Design and implement VR/AR experiences.

Reference Books	
1.	Augmented Reality: Principles and Practice, D. Schmalstieg and T. Höllerer, Addison-Wesley, Boston, 2016, ISBN-13 978-0-32-188357.
2.	Virtual Reality, Steven M. LaValle Cambridge, University Press, 2017, http://vr.cs.uiuc.edu/ (Links to an external site.) (Available online for free)
3.	Hand-written VR lecture notes from UIUC course in Spring 2015, on which the book was based
4.	Steve LaValle's recorded VR lectures from NPTEL at IIT Madras, July 2015.

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						
DATA ANALYTICS **Category: Professional Core Elective -III (Group D)** **(Theory)**						
Course Code	**:**	EI265TDC		**CIE**	**:**	100 Marks
Credits: L: T: P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

Unit-I	**09 Hrs**
Introduction to Data Analytics and Python Fundamentals: Overview of data analytics, Importance and applications of data analytics in various domains, Data integration and data quality issues, Data visualization techniques (histograms, box plots, scatter plots, etc.), Python programming essentials.	
Unit – II	**09 Hrs**
Probability and Sampling: Introduction to probability, Sampling techniques and distributions, Understanding hypothesis testing, Two-sample testing and ANOVA.	
Unit –III	**09 Hrs**
Regression Analysis: Linear regression, Multiple regression, Concepts of Maximum Likelihood Estimation (MLE), Logistic regression, Receiver Operating Characteristic (ROC) curve, Building regression analysis models.	
Unit –IV	**09 Hrs**
Cluster Analysis and Classification: Introduction to cluster analysis, Clustering techniques, Classification using Regression Trees (CART).	
Unit –V	**09 Hrs**
Time Series Methods: ARIMA, SARIMA, forecast accuracy measures, and feature extraction. **Case Study:** Data Analytics for weather forecasting.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental principles of data science and the role of R as a tool for data analysis.
CO2	Acquire knowledge and skills in optimization techniques, which are essential for solving data science problems efficiently.
CO3	Apply logistic regression for classification problems, using it to make informed decisions based on data.
CO4	Demonstrate competence in clustering as additional tools for solving classification tasks.

Reference Books	
1.	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython ,McKinney, W. O'Reilly Media, Inc.,2012.
2.	Statistics for Business and Economics, Anderson Sweeney Williams ,Cengage Learning,2011.
3.	Applied Logistic Regression, Wiley Series in Probability and Statistics, David W. Hosmer, Stanley Lemeshow (2000).. Wiley-Interscience Publication.
4.	Data Mining: Concepts and Techniques ,Jiawei Han and Micheline Kamber (2006).

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						
SYSTEM ON CHIP (SOC) **Category: Professional Core Elective -III (Group D)** **(Theory)**						
Course Code	:	EI265TDD		**CIE**	:	100 Marks
Credits: L:T:P	:	03:00:00		**SEE**	:	100 Marks
Total Hours	:	45L		**SEE Duration**	:	03 Hrs

Unit-I	**09 Hrs**
Introduction to the concept of a SOC: Microprocessor and Microcontroller based systems, Embed- ded systems. Differences between Embedded systems and SOCs. System design, Concept of system, importance of system architectures, introduction to IMD, SSID, MIMD and MISD architectures, con- cept of pipelining and parallelism. **Motivation for SoC Design:** Review of Moore's law and CMOS scaling, benefits of system-on- chip integration in terms of cost, power, and performance. Comparison on System-on-Board, Sys- tem-in-Package and System-on-Chip. Typical goals in SoC design – cost reduction, power reduction, design effort reduction, performance maximization.	
Unit – II	**09 Hrs**
System buses: Introduction to busses used in SOCs. Introduction to AMBA bus. Detailed studies ofIBM's core connect bus, concept of PLB-processor local bus and OPB-on chip peripheral bus. **Processors used in SOCs:** Introduction to CISC, RISC, Von Neuman and Harward Architecture. Concept of Soft processors and study of Microblaze RISC processor. Study of IBM's power PC,SOC implementation.	
Unit –III	**09 Hrs**
Embedded Memories: Some Basic Concepts, Semiconductor RAM Memories, Read Only Memo- ries cache memories, flash memories, embedded DRAM. Topics related to cache memories. Cache coherence. MESI protocol and Directory-based coherence. Study of features like embedded RAM's,multipliers, Digital clock management etc. Performance Considerations, Virtual Memories.	
Unit –IV	**09 Hrs**
System On Chip Design Process: A canonical SoC Design, SoC Design flow, waterfall vs spiral, top down vs bottom up, Specification requirement, Types of Specification, System Design Process, System level design issues, Soft IP vs Hard IP, IP verification and Integration, Hardware-Software code sign, Hardware Accelerators in Soc. Productivity gap issues and the ways to improve the gap –IP based design and design reuse.	
Unit –V	**09 Hrs**
Introduction to Network on Chip: On chip buses and interfaces. Bus architecture and its limitations. Network on Chip (NOC) topologies. Mesh- based NoC. Routing in an NoC. Packet switching and wormhole routing. MPSoCs: What, Why, How MPSoCs, Techniques for designing MPSoCs, Performance and flexibil ity for MPSoCs design.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand components of digital hardware, analog hardware and embedded software.
CO2	Apply the concept to understand the design flows for digital hardware, analog hardware and embedded software.
CO3	Analysis and evaluate the architectures and trade-offs concerning performance, cost and power consumption of single chip and embedded systems using tools and techniques in these three domains.
CO4	Develop a simulation model of SoC for a particular application.

Reference Books	
1.	Computer System Design: System on Chip, Michael J. Flynn, 2012, Wiley India Pvt Ltd, ISBN 13: 9788126535682.
2.	Introduction to system on package sop- Miniaturization of the Entire System, Rao R. Tumma-la, Madhavan Swaminathan, 2008, McGraw-Hill, ISBN: 9780071459068
3.	CMOS Digital Integrated Circuits, Sung-Mo Kang, Yusuf Leblebici,3rd Edition, Tata McGraw-Hill, ISBN: 978007246537.
4.	Reuse Methodology Manual for System on Chip designs, Michael Keating, Pierre Bricaud, 2nd Edition, 2008, Kluwer Academic Publishers,ISBN13: 9780306476402.

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						
FUNDAMENTALS OF AEROSPACE ENGINEERING **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	AS266TEA		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

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

Reference Books	
1	Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
3	Rocket Propulsion Elements, Sutton G.P., 8th Edition, 2011, John Wiley, New York, ISBN: 1118174208, 9781118174203.
4	Aircraft structural Analysis, T.H.G Megson, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4
5	Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of 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						
HEALTHCARE ANALYTICS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	BT266TEB		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	03 Hrs

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

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

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

Semester: VI						
INDUSTRIAL SAFETY ENGINEERING **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	CH266TEC		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	40L		**SEE Duration**	**:**	03 Hrs

Unit-I	**08 Hrs**

Introduction Safety:
Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, problems on OSHA

Unit – II	**08 Hrs**

Risk assessment and control: Risk assessment, Risk perception, acceptable risk, problems on net present value, internal rate of return, payback period concepts including real life examples.
Hazard Identification Methods: Preliminary Hazard List (PHL), worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analysis. Design and development of fault tree and event tree for high pressure reactor system.

Unit –III	**08 Hrs**

Hazard analysis: Hazard and Operability Study (HAZOP): Guide words, HAZOP matrix, Procedure, HAZOP studies on reactors, heat exchanger, design of HAZOP table, Failure Modes and Effects Analysis (FMEA) concept, methodology, problems of FMEA, examples.

Unit –IV	**08 Hrs**

Risk analysis on capital budgeting: Risk adjusted discount rate (RADAR) method, certainty equivalent approach, scenario analysis, probability distribution, quantification of risk using statistical parameters and associated problems.

Unit –V	**08 Hrs**

Safety in process industries and case studies: Personnel Protection Equipment (PPE): Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire.

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

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

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

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

Semester: VI						
ROBOTICS PROCESS AUTOMATION **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	CS266TED		**CIE**	**:**	100
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100
Total Hours	**:**	36L		**SEE Duration**	**:**	03 Hrs

Unit – I	**8 Hrs**

RPA Concepts: RPA Basics, History of Automation, what is RPA? RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated? Types of Bots, Workloads that can be automated.

RPA Advanced Concepts: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.

Unit – II	**7 Hrs**

RPA Tool Introduction: Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, Managing Arguments, The Arguments Panel, Namespaces; Control flow statements in UiPath, Sequences and Flowcharts, Control Flow Activities

Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation, main string methods.

UiPath Recording: Basic, Desktop and Web Recording, Image and Native Citrix Recording, Input/output methods, Types of OCR, Data Scraping, Advanced Scraping techniques.

Unit – III	**7 Hrs**

Advanced Automation Concepts: Selectors, Types of Selectors (Full, partial, dynamic), Defining and Assessing Selectors, Customization, Debugging.
Image, Text & Advanced Citrix Automation – Introduction, Keyboard based automation, Information Retrieval, Best Practices
Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table, Extracting Data from Data Table, Anchors, Using anchors in PDF

Unit – IV	**7 Hrs**

Email Automation, Exceptions and Deploying Bots: Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output.
Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors.
Overview of orchestration Server, orchestrator functionalities, Connecting Bot to orchestrator

Unit – V	**7 Hrs**

Hyperautomation: Components and application of Hyperautomation, 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

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

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

Semester: VI						
INTELLIGENT TRANSPORTATION SYSTEMS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	CV266TEE		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	40L		**SEE Duration**	**:**	03 Hrs

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.

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

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

Semester: VI						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	CV266TEF		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	42L		**SEE Duration**	**:**	03 Hrs
Unit-I						**08 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration.						
Unit – II						**08 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence						
Unit –III						**08 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.						
Unit –IV						**08 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.						
Unit –V						**08 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components						

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

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

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

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

Semester: VI						
ADVANCED ENERGY STORAGE FOR E-MOBILITY **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	CM266TEG		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	42L		**SEE Duration**	**:**	03 Hrs

Unit-I	**07 Hrs**
Energy storage in electric vehicles Introduction to E-mobility, background of alternative energy sources and sustainability. Types of electric vehicles and their salient features along with their energy requirement. Fundamentals of advanced battery technology. Battery characteristics. Specification of advanced battery for e mobility.	
Unit – II	**08 Hrs**
Advanced lithium-ion batteries Basic concepts of lithium batteries. Types of advanced cathode and anode materials employed in lithium batteries. Construction, working and future applications of lithium cobalt oxide, lithium iron phosphate, Lithium air, lithium sulfur and lithium polymer batteries with their advancement in vehicle electrification.	
Unit –III	**09 Hrs**
Non lithium batteries for e mobility Limitations of lithium batteries. Overview of non-lithium battery technology. Construction and working of advanced non-Lithium batteries such as Lead acid, Nickel Metal Hydride, Redox flow, Zebra, Sodium and Magnesium batteries. Electrode materials and electrolyte considerations in non lithium batteries. Performance comparison with lithium-ion batteries. Battery requirement in charging infrastructure.	
Unit –IV	**09 Hrs**
Chemistry of alternative storage devices Introduction to super capacitor. Construction, working and applications of supercapacitors along with the materials used in electrodes. Types of advanced supercapacitors. Application of supercapacitors in regenerative braking. Advancement in battery-supercapacitor hybrid, Battery-fuel cell hybrid, and Battery-solar cell hybrid electric vehicles with their advantages and limitations.	
Unit –V	**09 Hrs**
Battery management and recycling: Battery management systems (BMS): Fundamentals of battery management systems and controls, State-of-charge (SoC), state-of-health (SoH) and Cell balancing techniques. Battery Thermal Management: Passive and active cooling systems. Safety mechanisms, thermal runaway and thermal management. Battery recycling: Economic aspects, environmental safety and process of recycling of advanced batteries.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Implement the fundamentals of chemistry in advanced energy storage and conversion devices.
CO2	Apply the chemistry knowledge used for hybridization of various energy storage and conversion devices.
CO3	Analyze the different battery system for achieving maximum energy storage for vehicle electrification
CO4	Evaluation of efficiency of a battery with respect to cost, environmental safety, material, energy consumption and recycling.

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

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

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

Semester: VI						
HUMAN MACHINE INTERFACE (HMI) **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	EC266TEH		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**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 test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

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

Semester: VI						
ENERGY AUDITING & STANDARDS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	EE266TEJ		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	50 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Explain the need for energy audit, prepare a flow for audit and identify the instruments needed.
CO2	Design and perform the energy audit process for electrical systems.
CO3	Design and perform the energy audit process for mechanical systems
CO4	Propose energy management scheme for a building

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

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

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

Semester: VI						
BIOMEDICAL INSTRUMENTATION **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	EI266TEK		**CIE**	:	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	:	100 Marks
Total Hours	**:**	45L		**SEE Duration**	:	03 Hrs

Unit-I	**09 Hrs**
Fundamentals: Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	
Unit – II	**09 Hrs**
Electrocardiograph: Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG), Block diagram description of an Electrocardiograph, ECG lead systems, Multi-channel ECG machine. **Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG.	
Unit –III	**09 Hrs**
Patient Monitoring System: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement, Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method. **Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter.	
Unit –IV	**09 Hrs**
Blood Flow Meters: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **Cardiac Pacemakers and Defibrillators:** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator, Defibrillator electrodes, DC defibrillator with synchronizer.	
Unit –V	**09 Hrs**
Advances in Radiological Imaging: X-rays-principles of generation, Conventional X-ray radiography, Fluoroscopy, Angiography, Digital radiography, Digital subtraction angiography (DSA). Basic principle of computed tomography, magnetic resonance imaging system and Ultrasonic imaging system.	

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

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

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

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

Semester: VI						
TELECOMMUNICATION SYSTEMS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	ET266TEM		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

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

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

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

Semester: VI						
MOBILE COMMUNICATION NETWORKS AND STANDARDS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	ET266TEN		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 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: After completing the course, the students will be able to :-	
CO1	Describe the concepts and terminologies for Cellular Communication.
CO2	Analyze the Architecture, Hand-off and Security aspects in 2G and 3G Networks.
CO3	Compare the performance features of 2G and 3G Cellular Technologies.
CO4	Analyze and Compare the architectures of various Wireless technologies and standards.

Reference Books	
1.	Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1
2.	Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar S Manvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3.	Wireless Communication, Upena Dalal, 1st Edition, 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
4	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4

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

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

Semester: VI						
MOBILE APPLICATION DEVELOPMENT **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	IS266TEO		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of Android application and its architecture.
CO2:	Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications.
CO3:	Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools.
CO4:	Create innovative applications, understand the economics and features of the app marketplace by offering the applications for download.

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	Android Studio Development Essentials-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 Android2.ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1stEdition, 2012, ISBN-13:9788126525898.
5	Beginning Android3, Mark Murphy, A press Springer India Pvt Ltd,1stEdition,2011, ISBN-13:978-1-4302-3297-1
6	AndroidDeveloperTraining-https://developers.google.com/training/android/AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

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

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

Semester: VI						
ELEMENTS OF FINANCIAL MANAGEMENT **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	IM266TEQ		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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 Edition, 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. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
OPTIMIZATION TECHNIQUES **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	IM266TER		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	42L		**SEE Duration**	**:**	03 Hrs

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. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
AUTOMOTIVE MECHATRONICS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	ME266TES		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

UNIT – I	**08 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	**09 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	**09 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	**08 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: After completing the course, the students will be able to	
CO1:	Describe the functions of Mechatronic systems in a modern automobile
CO2:	Evaluate the performance of an engine by its parameters
CO3:	Analyse the automotive exhaust pollutants as per emission norms
CO4:	Demonstrate communication of control modules using a On-Board Diagnostic kit

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

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

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

Semester: VI						
MATHEMATICAL MODELLING **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	MA266TEU		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

Unit-I	**09 Hrs**
Introduction to Mathematical Modelling: Basic concepts, steps involved in modelling, classification of models, assorted simple mathematical models from diverse fields.	
Unit – II	**09 Hrs**
Mathematically Modelling Discrete Processes: Difference equations - first and second order, Introduction to Difference equations, Introduction to discrete models-simple examples, Mathematical modelling through difference equations in economics, finance, population dynamics, genetics and other real world problems.	
Unit –III	**09 Hrs**
Markov modelling: Mathematical foundations of Markov chains, application of Markov Modelling to problems.	
Unit –IV	**09 Hrs**
Modelling through graphs: Graph theory concepts, Modelling situations through different types of graphs.	
Unit –V	**09 Hrs**
Variational Problem and Dynamic Programming: Optimization principles and techniques, Mathematical models of variational problem and dynamic programming, Problems with applications.	

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

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

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

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

Semester: VI						
MATHEMATICS FOR QUANTUM COMPUTING **Category: Institutional Electives-I (GROUP-E)** **(Theory))**						
Course Code	**:**	MA266TEV		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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's 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 problem (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, 2021, Springer, ISBN 978-3-030-61600-7.
5	Concise guide to quantum computing, Sergei Kurgalin, Sergei Borzunov, 2021, Springer, ISBN 978-3-030-65051-3, ISBN 978-3-030-65052-0 (eBook).

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

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

Semester: VI						
APPLIED PSYCHOLOGY FOR ENGINEERS **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	HS266TEW		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	03 Hrs

Unit-I	**08 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**08 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit –III	**10 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio-Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment.	
Unit –IV	**10 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	
Unit –V	**09 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. **Psychological Stress**: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress.Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control. Type A and Type B. **Psychological Counseling** - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	

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

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

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

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

Semester: VI						
UNIVERSAL HUMAN VALUES-III **Category: Institutional Electives-I (GROUP-E)** **(Theory)**						
Course Code	**:**	HS266TEY		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	**:**	100 Marks
Total Hours	**:**	44L		**SEE Duration**	**:**	03 Hrs

Unit-I	**10 Hrs**
Introduction-Basic Human Aspiration, its fulfilment through All-encompassing Resolution. The basic human aspirations and their fulfilment 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, ISBN 978-93-87034-47-1.
2	Avartansheel Arthshastra, A Nagraj, Divya Path Sansthan, Amarkantak, India, ISBN 978-8-174-46781-2.
3	Economy of Performance- a quest for social order based on non – violence, J C Kumarappa, 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India.
4	Energy and Equity, Ivan Illich, 1974, The Trinity Press, Worcester & Harper Collins, USA, ISBN: 0060803274, 9780060803278 .

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
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	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
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3 & 4	Unit 2 : Question 3 or 4	16
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7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester VI						
INTERDISCIPLINARY PROJECT						
Course Code	**:**	EI367P		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	0:0:3		**SEE**	**:**	50 Marks
Total Hours	**:**	15P		**SEE Duration**	**:**	02 Hours

Interdisciplinary Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 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 theproject. 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 goalsareas or in line with CoE's(Centre of Excellence) identified by the college*** or **List ofproject 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 draftcopy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of theteam needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report inthe prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage tothe project evaluation committee.

Course Outcomes: After completion of the course the students will be able to	
CO1	Identifying critical thinking and problem-solving abilities by analyzing and addressing interdisciplinary challenges, utilizing creative approaches and innovative solutions.
CO2	Exhibit proficiency in conducting comprehensive research, including literature review, data collection, modelling, simulation, and analysis, to address significant technical challenges and propose innovative solutions.
CO3	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.
CO4	Utilize appropriate engineering tools, technologies, and software to design, test, and implement project solutions, ensuring adherence to technical specifications, safetystandards, and industry best practices.

CIE Assessment:

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

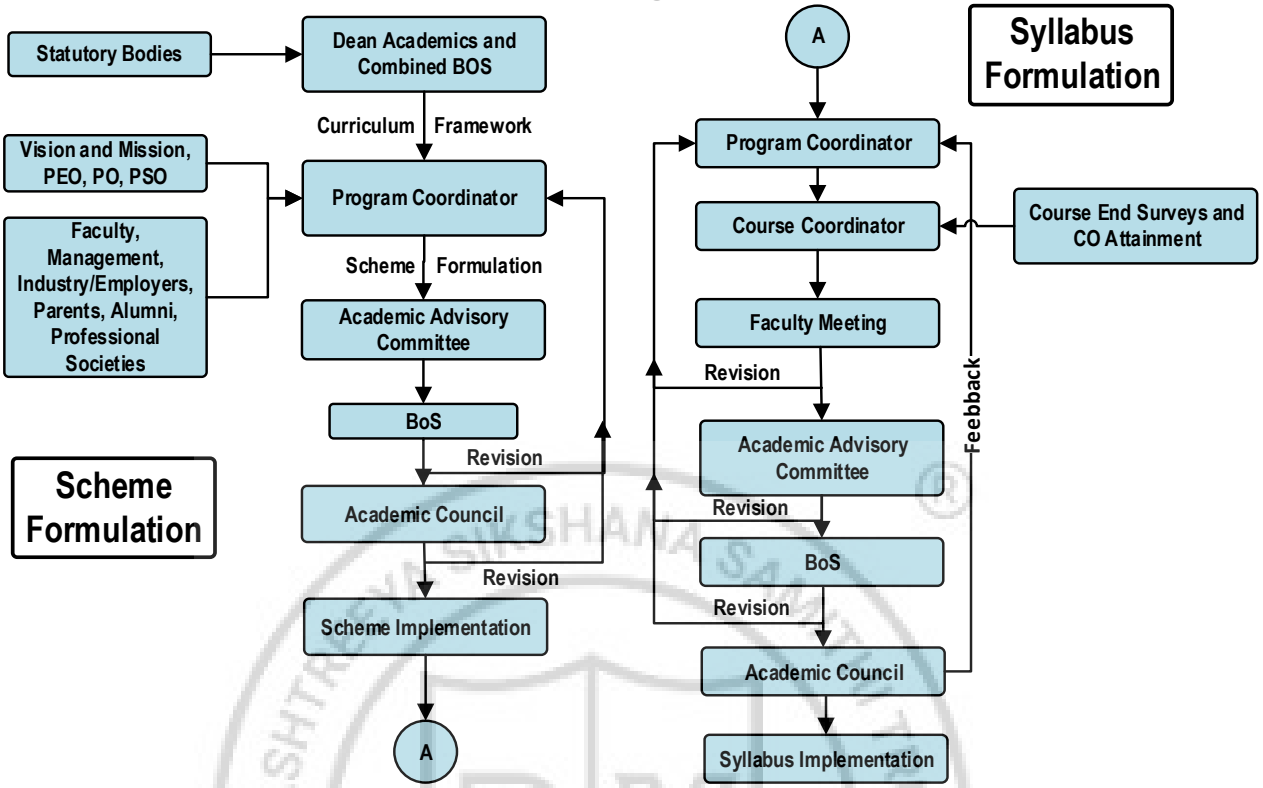
1.	Selection of the topic and formulation of objectives	10%
2.	Design and Development of Project methodology	25%
3.	Execution of Project	25%
4.	Presentation, Demonstration and Results Discussion	30%
5.	Report Writing & Publication	10%

SEE Assessment:

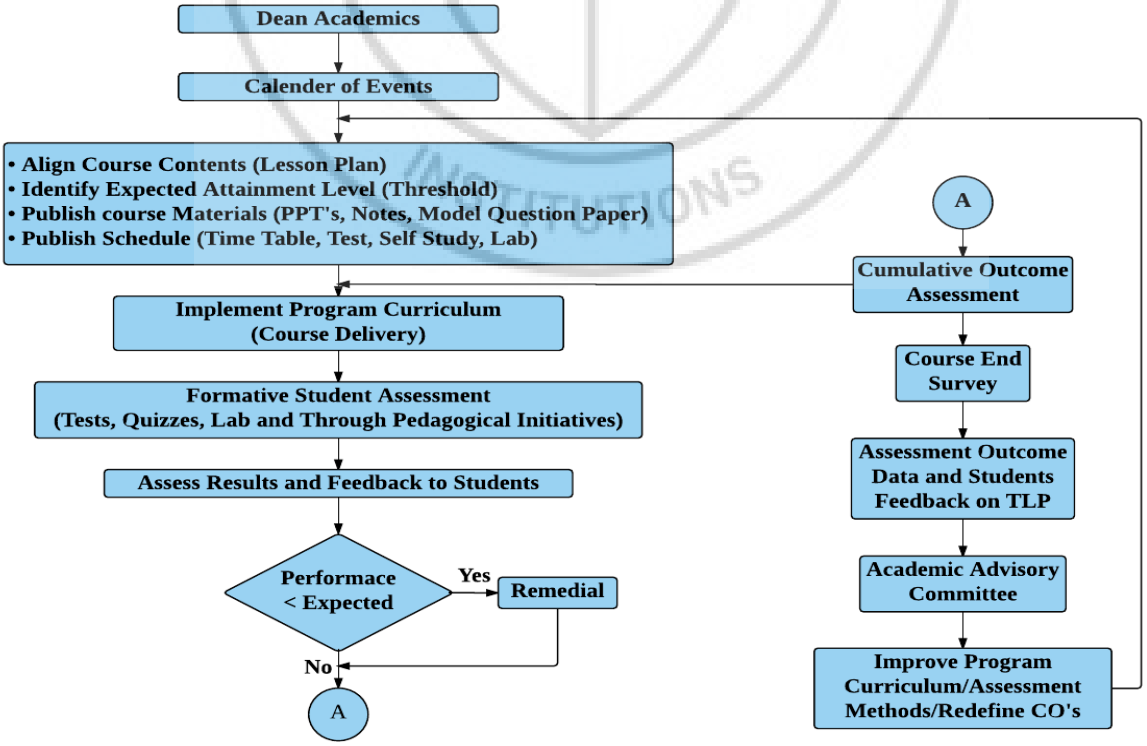
The following are the weightages given during Viva Examination.

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%

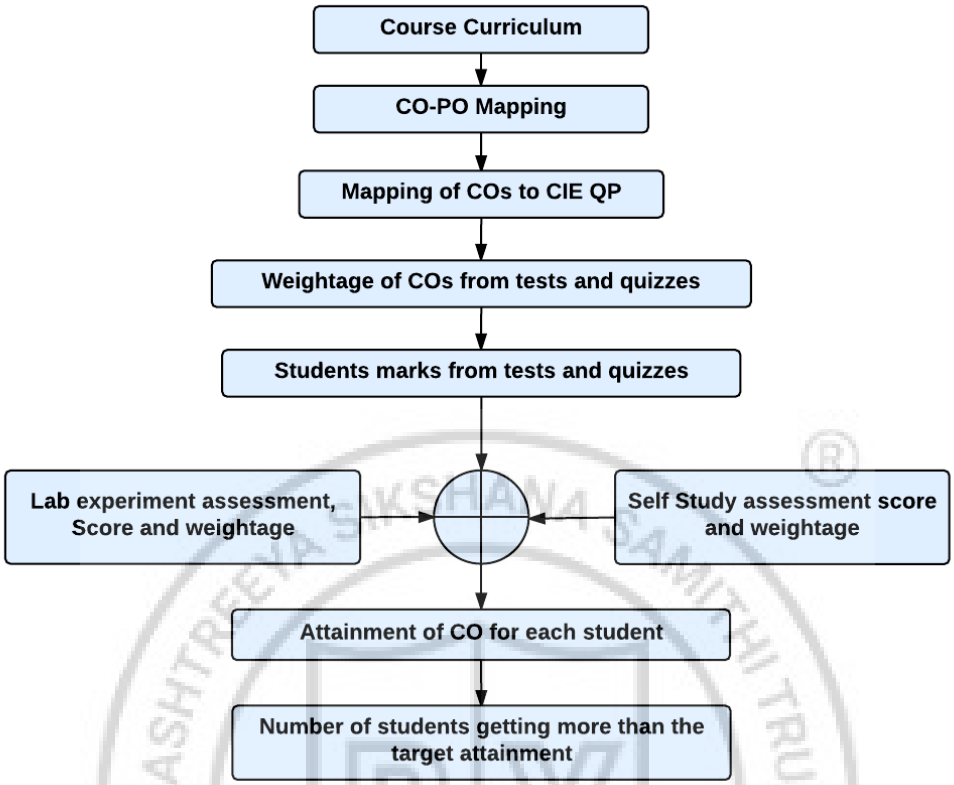
Curriculum Design Process



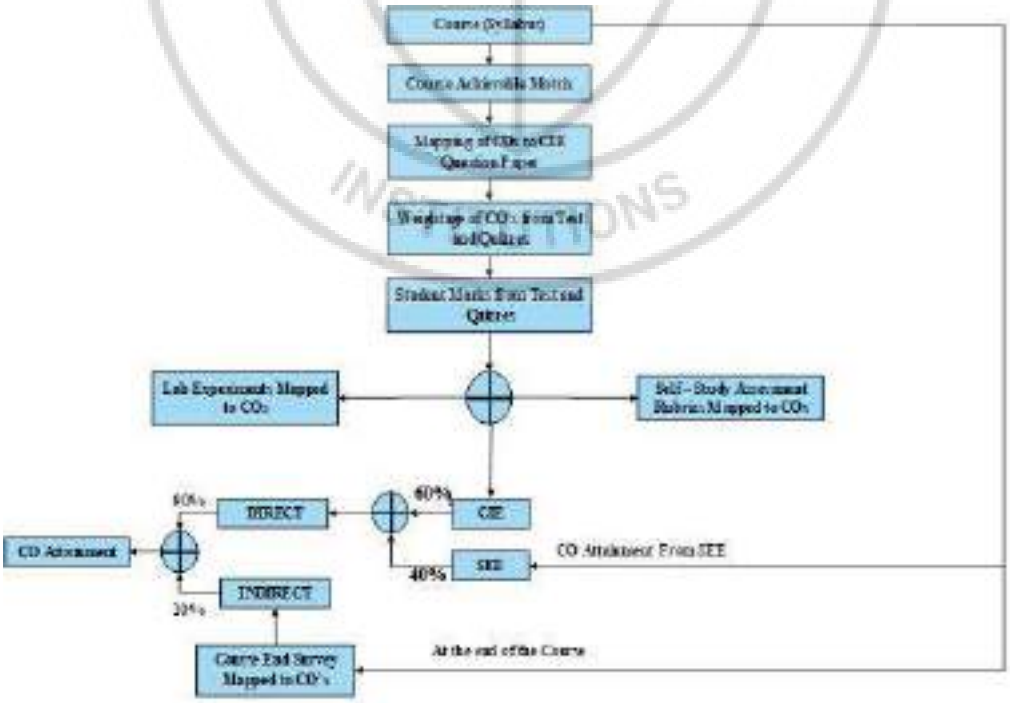
Academic Planning and Implementation



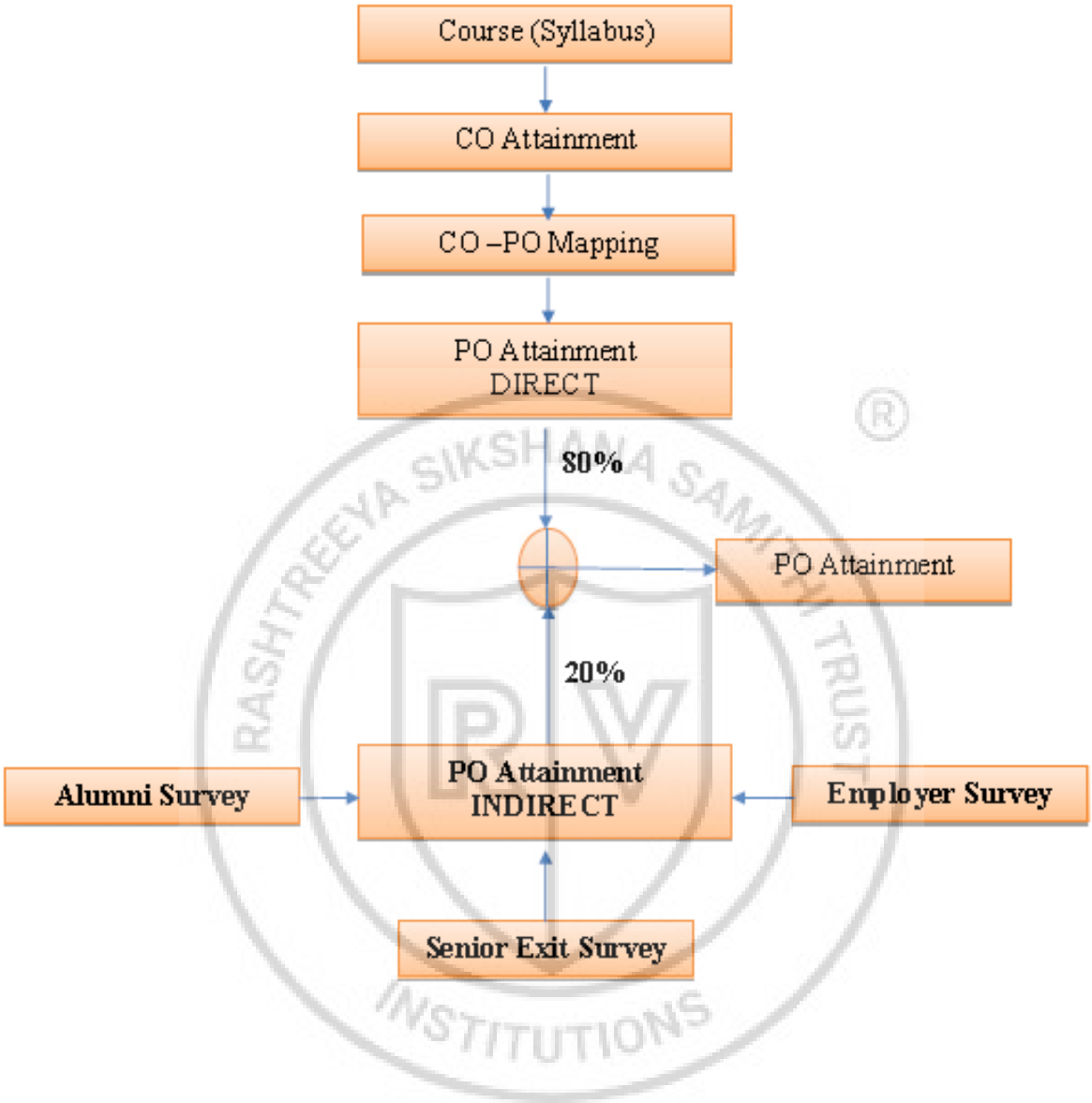
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



KNOWLEDGE & ATTITUDE PROFILE

- **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.

PROGRAM OUTCOMES (POs)

- **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/5.3 (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