RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

BACHELOR OF ENGINEERING (B.E)
2021 SCHEME

SCHEME & SYLLABUS
THIRD YEAR B.E. PROGRAM

ELECTRICAL & ELECTRONICS ENGINEERING

ACADEMIC YEAR 2023-24

Department Vision

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

Department Mission

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAM SPECIFIC OUTCOMES (PEOs)

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

ABBREVIATIONS

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

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Bachelor of Engineering in
ELECTRICAL AND ELECTRONICS ENGINEERING

V SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21HS51A	Intellectual Property Rights & Entrepreneurship	3	0	0	**3**	HSS	Theory	1.5	**100**	****	**3**	**100**	****
2	21EE52	Electrical Machines	3	0	1	**4**	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
3	21EE53	Control Systems	3	0	1	**4**	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	21EE54	Power Transmission & Distribution	3	1	0	**4**	EE	Theory	1.5	**100**	****	**3**	**100**	****
5	21EE55BX	Professional Core Elective-I **(Group-B)**	3	0	0	**3**	EE	Theory	1.5	**100**	****	**3**	**100**	****
6	21EE56CX	Professional Core Elective-II **(Group C)**	2	0	0	**2**	EE	**NPTEL**	1	**50**	****	**2**	**50**	****
7	21EEI57	Summer Internship- II	0	0	2	**2**	EE	Internship	1	****	**50**	**2**	****	**50**
						22								

GROUP-B		
Sl. No.	**Course Code**	**Course Title**
1.	21EE55B1	Fuzzy Logic Control and Applications
2.	21EE55B2	VLSI Circuit and Design
3.	21EE55B3	Computer Communication and Networking
4.	21EE55B4	Algorithms and data structure with C++

GROUP-C (NPTEL)			
Sl. No.	**Course Code**	**Course Title**	**Duration**
1	21EE56C1	Advanced Power Electronics and Control	08 Weeks
2	21EE56C2	System Design Through Verilog	08 Weeks
3	21EE56C3	Introduction to Machine Learning	08 Weeks
4	21EE56C4	Introduction To Operating systems	08 Weeks
5	21EE56C5	Electromagnetic Compatibility	08 Weeks

Bachelor of Engineering in
ELECTRICAL AND ELECTRONICS ENGINEERING

VI SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21HS61B	Principles of Management & Economics	3	0	0	**3**	HSS	Theory	1.5	100	****	3	100	****
2	21EE62	Solar and Wind Energy Systems	3	0	1	**4**	EE	Theory + Lab	1.5	100	50	2	100	50
3	21EE63	Signal Systems and Processing	3	0	1	**4**	EE	Theory + Lab	1.5	100	50	3	100	50
4	21EE64DX	Professional Core Elective-III **(Group – D)**	3	0	0	**3**	EE	Theory	1.5	100	****	3	100	****
5	21EE65EX	Professional Core Elective (Cluster Elective) - **(Group- E)**	3	0	0	**3**	EE	Theory	1.5	100	****	3	100	****
6	21IE66FX	Institutional Electives – I- **(Group F)**	3	0	0	**3**	Res. BoS	Theory	1.5	50	****	2	50	****
						20								

GROUP-D		
Sl. No.	**Course Code**	**Course Title**
1.	21EE64D1	Electric Vehicle - Power Train & Drives
2.	21EE64D2	High Voltage Engineering
3.	21EE64D3	Special Electrical Machines
4.	21EE64D4	Electrical Power Utilization and Illumination
GROUP-E		
Sl. No.	**Course Code**	**Course Title**
1.	21EE65E1	Smart Grid Technology
2.	21EE65E2	Modern Control Theory
3.	21EC65E1	Real Time Systems
4.	21EC65E2	Digital System Design with FPGA
5.	21EI65E1	Electronics Equipment Integration and Prototype Building
6.	21EI65E2	Virtual Instrumentation
7.	21ET65E1	Smart Antennas
8.	21ET65E2	Satellite Communication

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

Semester: V						
INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP (Common to all Programs) **(Theory)**						
Course Code	**:**	21HS51A		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction: Types of Intellectual Property **Patents:** Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; protection of traditional knowledge, Infringement of patents and remedy, Case studies Patent Search and Patent Drafting, Commercialization and Valuation of IP. Case examples.	
Unit – II	**08 Hrs**
Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India. **Trade Marks:** Concept, function and different kinds and forms of Trade marks, Registrable and non-registrable marks. Registration of Trade Mark; Deceptive similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies. Case Examples.	
Unit –III	**08 Hrs**
Industrial Design: Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies. **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies. **Introduction to Cyber law**: Information Technology Act, cybercrime and e-commerce, data security, confidentiality, privacy, international aspects of computer and online crime.	
Unit –IV	**09 Hrs**
Entrepreneurship: Introduction, Evolution of the Entrepreneurship, Importance of Entrepreneurship, Concept of Entrepreneurship, Characteristics of a successful Entrepreneur, Classification of Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development Models, Problems Faced by Entrepreneurs and Capacity Building for Entrepreneurship. Women Entrepreneurship in Asia, Women Entrepreneurship in India, Challenges Faced by Women Entrepreneurs. Case studies. **Entrepreneurship in the New Age**: Getting to know your Business, it's Eco-system and Environment, Passion and Values driving, building and growing Family businesses, Challenges and suggested management approaches.	
Unit –V	**11 Hrs**
Business Plans: Introduction, Purpose of a Business Plan, Contents of a Business Plan, Business Concept, Business Strategy, Marketing Plan, Operations Plan, Financial Plan, Presenting a Business Plan, Oral and Visual Presentation, Why Do Some Business Plans Fail? Procedure for Setting Up an Enterprise, Business Models and Business Model Innovation Creating a Business Plan. Case lets/Case studies. **Preparation of project**: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. Use of standard templates for preparation of project report.	

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

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

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						
ELECTRICAL MACHINES **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	21EE52		**CIE**	**:**	150Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	150 Marks
Total Hours	**:**	45 L+30P		**SEE Duration**	**:**	3 Hours

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

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the construction, operations of AC, DC machines.
CO 2	Analyze the tests and performance of Electrical machines.
CO 3	Evaluate the losses, efficiency, and regulations of Electrical machines.
CO 4	Design and demonstrate the performance of various machines under different load specifications.

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

PART – A : Laboratory Experiments

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

PART B

Innovative Experiments (IE)

11) BLDC Motor - Performance and characteristics

12) Switched Reluctance Motor - Performance and characteristics

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

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

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	TOTAL	**50**

Semester: V						
CONTROL SYSTEMS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	21EE53		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L+30P		**SEE Duration**	**:**	3 Hours

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

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

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

Laboratory Component

Cycle-I

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

Cycle-II

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

Cycle-III

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
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5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	TOTAL	**50**

Semester: V						
POWER TRANSMISSION AND DISTRBUTION **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	21EE54		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

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

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

CO 1	Understand the fundamental concepts involved in electric power generation, transmission and distribution.
CO 2	Analyse the performance characteristics of high voltage DC and AC power transmission.
CO 3	Evaluate the parameters and performance of transmission lines, distribution systems, insulators and cables.

CO 4	Design and demonstrate the DC and AC distribution system including the insulators.

Reference Books	
1.	Electric Power Generation Transmission and Distribution, S. M. Singh, 3rd Edition, 2010, Prentice Hall of India Publishers, ISBN: -978-81-203-3560-8
2.	Electrical Power Systems, C.L.Wadhwa, , 4th Edition , 2009, Wiley Easten Ltd, ISBN 0- 470-21808-8
3.	Electrical Power Transmission and Distribution, J. B. Gupta, 4th Edition, 2010, S. K. Kataria & Sons Publisher, ISBN 978-0470-40863-6
4.	Smart Grid Technologies and Applications, Janaka Ekanayaka, Jianzhong Wu, 1st Edition, 2012, Wiley Publishers, ISBN: 978-0-470-97409-4.

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

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

Semester: V						
FUZZY LOGIC CONTROL AND APPLICATIONS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	21EE55B1		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

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

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

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

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

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

Semester: V						
VLSI CIRCUIT AND DESIGN **Category: Professional Course Elective** **(Theory)**						
Course Code	**:**	21EE55B2		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
VLSI Design Flow: Specification, Design entry, Functional simulation, planning placement and routing, timing simulation. **MOS Transistor Principle:** NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams.	
Unit – II	**09 Hrs**
CMOS Processing Technology: CMOS Technologies, Wafer Formation, photolithography, Well and Channel Formation, Silicon Dioxide (SiO_2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Methodology, Lambda Design Rules. **Designing Combinational Logic Circuits:** Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles. *To Realize CMOS logic gates using Cadence Software	
Unit –III	**09 Hrs**
Designing Sequential Logic Circuits: Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design. * To Realize Sequential logic circuit using Cadence Software	
Unit –IV	**09 Hrs**
Designing Arithmetic Building Blocks: Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff.	
Unit –V	**09 Hrs**
Implementation Strategies – ASIC: Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.	

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

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

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

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

Semester: V						
COMPUTER COMMUNICATION AND NETWORKING **Category: Professional Course Elective** **(Theory)**						
Course Code	:	21EE55B3		**CIE**	:	100Marks
Credits: L:T:P	:	3:0:0		**SEE**	:	100 Marks
Total Hours	:	45L		**SEE Duration**	:	3 Hours

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

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

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

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

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

Semester: V						
ALGORITHMS AND DATA STRUCTURES WITH C++ **Category: (Professional Core Elective)** **(Theory)**						
Course Code	**:**	21EE55B4		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

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

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

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

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

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

Semester: V						
SUMMER INTERNSHIP **Category: Professional Core Course** **(Practice)**						
Course Code	**:**	21EEI57		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	0:0:2		**SEE**	**:**	50 Marks
Total Hours	**:**	03 Weeks		**SEE Duration**	**:**	2 Hours

Guidelines	**09 Hrs**

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

B. At RVCE Center of Excellence/Competence

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

C. At InternShala

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

D. At Engineering Colleges nearby their hometown

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

E. At Industry or Research Organizations

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

Procedures for the Internship:

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

Training certificate to be obtained from industry.

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Develop interpersonal, critical skills, work habits and attitudes necessary for employment.
CO 2	Assess interests, abilities in their field of study, integrate theory and practice and explore career opportunities prior to graduation.
CO 3	Explore and use state of art modern engineering tools to solve the societal problems with affinity towards environment and involve in ethical professional practice.
CO 4	Compile, document and communicate effectively on the internship activities with the engineering community.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (LAB)		
#	**COMPONENTS**	**MARKS**
1.	**REVIEW 1:** Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments, exhibiting professional and ethical practice, communication skills (oral and body language)	**25**
2.	**REVIEW 2:** Presentation in the form of digital poster, report writing, exhibiting ethics in report writing, oral presentation.	**25**
	MAXIMUM MARKS FOR THE CIE LAB	**50**

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						
PRINCIPLES OF MANAGEMENT & ECONOMICS (Common to all) (Theory)						
Course Code	**:**	21HS61B		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	3 Hours

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

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

CO5	Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation.

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; 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						
SOLAR AND WIND ENERGY SYSTEMS **Category: Professional Core Course** **(Theory & Practice)**						
Course Code	**:**	21EE62		**CIE**	**:**	150Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	150 Marks
Total Hours	**:**	45L + 30P		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Industry overview, incentives for renewable, utility perspective, prospectus of renewable energy sources **Photovoltaic power systems:** photovoltaic power, PV projects, Building-integrated PV system, PV cell technologies, solar energy maps, Technology trends, Photovoltaic Power Systems: PV cell, Module and Array, Equivalent electrical circuit, open-circuit voltage and short-circuit current, I-V and P-V curves, Array design (different methodologies), peak-power operation, system components.	
Unit – II	**09 Hrs**
Solar PV system Design and Integration: Types of Solar PV System: Standalone, Grid connected, Hybrid system. **Design Methodology for Solar PV system:** Approximate design of standalone system, Solar PV system design chart, Lookup table for PV system design. **Grid connected solar PV power systems:** Configuration, Components, design for small power application and for power plants.	
Unit –III	**09 Hrs**
Wind Power Systems: **Wind speed and energy:** Speed and power relations, power extracted from the wind, Air density, Global wind patterns, wind speed distribution (parameters calculations), wind speed prediction, system components , turbine rating , power vs. speed and TSR, maximum energy capture, maximum power operation, system-design trade-offs , system control requirements, environmental aspects.	
Unit –IV	**09 Hrs**
Electrical Generators and Drives: Induction Generator, Doubly Fed Induction Generator, Direct-Driven Generator, Speed Control Regions, Generator Drives: One Fixed-Speed Drive, Two Fixed-Speed Drive, Variable-Speed Gear Drive, Variable-Speed Power Electronics, scherbius Variable-Speed Drive, Variable-Speed Direct Drive, Drive Selection, Cut-out Speed Selection.	
Unit –V	**09 Hrs**
Hybrid Energy Systems: Need for Hybrid Energy Systems – Solar-Wind, Classification of Hybrid Energy systems -Importance of Hybrid Energy systems – Advantages and Disadvantages. **Case studies for hybrid renewable energy systems**: Range and type of Hybrid systems, Performance Analysis, Cost Analysis, Wind-PV, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the operating principle of photovoltaic, wind and hybrid energy systems.
CO 2	Analyze the performance characteristics of PV, wind and hybrid energy systems.
CO 3	Evaluate the design parameters and performance of various systems.
CO 4	Design and demonstrate the case studies of wind and solar systems.

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

Lab Component	
S.No	**Experiments**
1.	a)V – I characteristics of a PV panel with and without partial shading b) Performance analysis of series and parallel connected PV with and without partial shading
2.	DC – DC buck-boost converters for two-stage PV applications
3.	Design of 1-phase inverter for PV system- ON/OFF load.
4.	Grid connected PV system synchronization and its performance analysis.
5.	Simulation study on PV system.
6.	Simulation of Wind energy generator.
7.	Wind energy turbine emulator.
8.	Grid connected wind energy generation using PMSG.
9.	Simulation study on Hybrid (PV – Wind) power system.
10.	Simulation on Intelligent controller for hybrid system
Innovative Experiment	
1.	Design and analysis of renewable based charging station.
2.	PV -Wind based hybrid system using Fuzzy logic controller

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

RUBRIC FOR THE SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	10
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	14
5 & 6	Unit 3 : Question 5 or 6	14
7 & 8	Unit 4 : Question 7 or 8	14
9 & 10	Unit 5: Question 9 or 10	14
11	Lab Component (Compulsory)	20
	TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	TOTAL	**50**

Semester: VI						
SIGNAL SYSTEMS AND PROCESSING **Category: Professional Core Course** **(Theory & Practice)**						
Course Code	**:**	21EE63		**CIE**	**:**	150Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	150 Marks
Total Hours	**:**	45 L + 30 P		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction to different signals and systems: Signal and system types, Classification of signals-Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Classification of systems- CT systems and DT systems-Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable, step response, impulse response and convolution integral.	
Unit – II	**09 Hrs**
Periodic signal: Fourier series and properties; Aperiodic signal: Fourier Transform - its properties and sinusoidal steady state analysis of systems, Convolution and multiplication with Mixtures of periodic and Non-Periodic signals, **Z-transform:** Direct z-Transform, Inverse z-Transform, Inversion of z-transform, Properties of z-Transform, Poles and Zeros, Pole location and time domain behaviour for causal signals, Analysis of LTI systems in z-Domain, One-sided z-transform. Fourier Transform representation of discrete time signals, sampling Concept.	
Unit –III	**10 Hrs**
The Discrete Fourier transform Frequency domain Sampling and Reconstruction of Discrete time signals, DFT, DFT as a linear Transformation, and Relationship of DFT to other transforms. Properties of DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and circular convolution, additional DFT properties.	
Unit –IV	**10 Hrs**
Digital Filters **Methods of converting analog filters to digital filter (IIR)**: bilinear transformation, Impulse invariant transformation. **Methods of designing the FIR filters:** window- based methods, frequency sampling method. **Realization of IIR systems:** Direct form structures, Transposed structures, Cascade form and Parallel-Form Structures **Realization of FIR filters:** Direct form, Cascade form, Frequency sampling, Lattice IIR filter - Direct form I, Direct form II cascade form parallel form	
Unit –V	**07 Hrs**
Digital Signal Processor: Features of fixed point and floating point processors. **TMS320C67x Processor:** Introduction, Features, Internal architecture, CPU, General purpose Register files, Functional units and operations, Data paths, control Register file. **Applications of DSP:** Digital Audio system, Speech Coding and Compression, Compact-Disc recording system, Interference cancellation in electrocardiography, DTMF generation and detection. Introduction to Multirate signal processing.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of basic signals, LTI system and its response in time and frequency domains, digital signals, signal processing, DSP processors and filters.
CO 2	Analyze both continuous and discrete time systems in time, frequency and z-domains, different types of filters.
CO 3	Evaluate techniques for signal analysis , signal processing including filter algorithms
CO 4	Design, simulation and implementation of digital filters

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

Laboratory Component

Sample Programs

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

Innovative Experiment:

1. Generation of Sinusoidal signal using DSP Processor

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

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

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	TOTAL	**50**

Semester: VI						
ELECTRIC VEHICLES: POWER TRAIN AND DRIVES **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	21EE64D1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	4:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3Hours**

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

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamentals of EV, HEV, components of drive train, energy storage and management, charging infrastructure.
CO 2	Analyze electric and hybrid drive-train, different energy sources, energy management strategies,

	charging levels and charging modes.
CO 3	Evaluate EV based on ac & dc drives, different storage & management system, performance of EV battery chargers.
CO 4	Sizing the drive system.

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

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

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

Semester: VI						
HIGH VOLTAGE ENGINEERING **Category: (Professional Core Elective)** **(Theory)**						
Course Code	**:**	21EE64D2		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45		**SEE Duration**	**:**	3 Hours

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

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

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

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

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

Semester: VI						
SPECIAL ELECTRICAL MACHINES **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	21EE64D3		**CIE**	**:**	100Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	40 L		**SEE Duration**	**:**	3 Hours

Unit – I	**08 Hrs**
Stepper Motor: Constructional features, Types, hybrid stepping motor – Operating principles, very slow speed synchronous motor for servo control, different configurations for switching the phase windings-control circuits for stepping motor-open loop controller for a 2-phase stepping motor.	
Unit –II	**08 Hrs**
Variable Reluctance Stepper Motor: Constructional features, Principle of operation, Variable reluctance motor, Single and multi-stack configurations, open loop & closed loop control of 3-phase VR step motor-Torque equations, Modes of excitation, Characteristics, Drive circuits, Microprocessor control of stepper motors, Closed loop control, Applications.	
Unit –III	**08 Hrs**
Switched Reluctance Motors: Constructional features – Rotary and Linear SRM, Principle of operation, Torque production, Steady state performance prediction, Analytical method -Power Converters and their controllers –Methods of Rotor position sensing – Sensor less operation, Characteristics and Closed loop control, Design of SRM with specific applications.	
Unit –IV	**08 Hrs**
Permanent Magnet Brushless D.C. Motors: Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics, Permeance coefficient, Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Power Converter Circuits and their controllers, Motor characteristics and control, Applications.	
Unit - V	**8 Hrs**
Permanent Magnet Synchronous Motors: Principle of operation, Ideal PMSM, EMF and Torque equations, Armature MMF, Synchronous Reactance, Sine wave motor with windings, Phasor diagram, Torque/speed characteristics, Power controllers and Converters, Applications	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the Construction, principle of operation, control and performance of various special electrical machines.
CO 2	Analyse performance characteristics different special machines
CO 3	Evaluate the designing parameter of SRM and PMSM motor.
CO 4	Design and demonstrate special machine for a typical specification.

Reference Books	
1.	Special Electrical Machines, K. Venkataratnam, 1st Edition Universities Press (India) Private Limited, 2021, ISBN: 978-8173716317
2.	Special electrical machines, E.G. Janardanan, 1st Edition PHI learning Private Limited, Delhi, 2014, ISBN: 9788120348806
3.	Brushless Permanent Magnet and Reluctance Motor Drives, 1st Edition, T.J.E. Miller, Clarendon Press, Oxford, 1989, ISBN 0-19-859369-4
4.	Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, R. Krishnan, 1st Edition, CRC Press, New York, 2001, ISBN 9780849308383

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

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

Semester: VI						
ELECTRIC POWER UTILIZATION AND ILLUMINATION **Category: Professional Core Course** **(Theory)**						
Course Code	**:**	21EE64D4		**CIE**	**:**	100Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	40 L		**SEE Duration**	**:**	3 Hours

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

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

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

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

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

Semester: VI						
SMART GRID TECHNOLOGY **Category: Professional Core Elective (Cluster)** **(Theory)**						
Course Code	**:**	21EE65E1		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	50 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	2 Hours

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

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

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

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

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

Semester: VI						
MODERN CONTROL THEORY **Category: Professional Core Course (Cluster)** **(Theory)**						
Course Code	**:**	21EE65E2		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: State Variable Analysis of Dynamic systems, State Equations, SISO and MIMO Systems. State Model of Physical Systems: Signal flow graphs, Relation between Transfer function and State equation. **Eigen Values:** Characteristic equation, Eigen values, Eigen vectors, generalized Eigen vectors, Similarity transformation, transformation of a state model to diagonal/Jordan canonical form.	
Unit – II	**09 Hrs**
Solution of State Model: Solution of state equation, transition matrix and its properties, computation using Laplace transformation, power series method, similarity transformation, Cayley-Hamilton method. **Controllability & Observability:** Concept of controllability & observability, methods of determining the same, Relation between controllability, observability & pole zero cancellations.	
Unit –III	**09 Hrs**
Stability of Linear Systems: Lyapunov stability criteria, Lyapunov functions, direct method of Lyapunov for the linear systems. **Pole placement design techniques:** Stability improvements by state feedback, necessary and sufficient conditions for arbitrary pole placement, state regulator design, and design of state observer.	
Unit –IV	**09 Hrs**
Non-Liner Systems: Introduction, behaviour of non-liner system, common physical non-linearity saturation, friction, backlash, dead zone, relay, multivariable non-linearity. Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories. **Stability of Non-linear systems:** Construction of Lyapunov functions for nonlinear system by Krasovskii's method	
Unit –V	**09 Hrs**
Nonlinear Control Design: Design and analysis of feedback control for nonlinear systems through linearization, feedback linearization and Lyapunov based methods, design and analysis of high gain feedback, e.g. sliding mode control, observers for non linear systems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the concepts of state space, eigen value and Eigen vectors, controllability and observability, pole placement, non-linear systems and Lyapunov stability.
CO 2	Represent the systems in state space, Response of systems with and without state feedback controllers and observers, Analysis of stability of linear and nonlinear systems
CO 3	Transform state models to canonical, observable and controllable forms. Asses the need of state feedback controllers and observers, Evaluate the stability of non-linear systems and Liapunov stability criterion.
CO 4	Design state feedback controllers and observers.

Reference Books	
1.	Modern Control Engineering, Katsuhiko Ogata, 5th Edition, 2003, PHI ISBN 81-7808-579-8.
2.	Automatic control system, Benjamin C. Kuo and Farid Golnaraghi, 8th Edition, 2003, John Wiley and Sons, ISBN 0-471-13476-7.
3.	Analysis and Design of Nonlinear Feedback Control Systems, G. J. Thaler and M. P. Pastel, 1st Edition, McGraw-Hill, 1962, ISBN: 978-1258427443.
4.	Analysis of Nonlinear Control Systems, D. Graham and D. McRuer John, 1st Edition, Wiley Publications, 1961.

5.	Modern Control Principles and Applications, J. C. Hsu and A. V. Meyer, 1st Edition McGraw-Hill, 1968, ISBN: 978-0070306356.
6.	Nonlinear Control Systems: Analysis and Design, H. J. Marquez, 1st Edition, John Wiley Interscience, 2003, ISBN: 978-0471427995.

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						
REAL TIME SYSTEMS **Category: Professional Core Elective (Cluster)** **(Theory)**						
Course Code	**:**	21EC65E1		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Overview, Real-Time Systems, Case Study: Radar System, Cross-Platform Development Process, Hardware Architecture, Build Target Images, Transfer Executable File Object to Target, Integrated Testing on Target, System Production, Interrupts Overview, Design patterns for ISR's, Interrupt Response time, System Bootloader, System Boot **I/O Resources: Memory:** Physical Hierarchy, Cache, Memory Planning, Memory shadowing	
Unit – II	**09 Hrs**
Real-Time UML: General Resource Modeling: Overview of UML, Architecture modelling in UML, Real-Time UML Profile, Resource Modeling, Time Modeling, Concurrency Modeling. **Real-Time UML: Model Analysis:** Elicitation of Timing Constraints, RT-UML Profile Schedulability Modeling Subprofile	
Unit –III	**09 Hrs**
Software Architectures for Real-Time Embedded Systems: Real-Time Tasks, WCET, Intermediate FO, Execution Efficiency, Round-Robin Architecture, Round Robin with Interrupts, Queue-Based Architecture, Multitask Design, Multitask Resource Sharing, Addressing Resource Deadlocks, Addressing Priority Inversion.	
Unit –IV	**09 Hrs**
Real-Time Scheduling: Clock-Driven Approach, Rate-Monotonic approach, Sporadic Server approach, Resource sharing, IPC: Message Ques, Pipes, Signalling, Remote Procedure and Sockets, Real Time Memory Management: Process Stack Management, Dynamic Allocation, Hardware and software timing management.	
Unit –V	**09 Hrs**
Nonlinear Control Design: Design and analysis of feedback control for nonlinear systems through linearization, feedback linearization and Lyapunov based methods, design and analysis of high gain feedback, e.g. sliding mode control, observers for non linear systems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of real-time system and real-time operating system
CO 2	Analyze the given requirements, design hardware & software for real time systems
CO 3	Apply modern engineering tools for real time firmware development & performance analysis
CO 4	Verify the specifications of various real time operating systems used for meeting time constraints of given problem

Reference Books	
1.	Real-Time Embedded Systems Design Principles and Engineering Practices by Xiaocong Fan, Newnes Publishers - an imprint of Elsevier, 2015, ISBN10: 0128015071
2.	Real-Time Embedded Systems and Components, Sam Siewert, 2007, Cengage Learning India Edition, ISBN: 9788131502532
3.	Real time systems, Krishna CM and Kang Singh G, 2003, Tata McGraw Hill, ISBN: 0-07- 114243-64
4.	Real-Time Concepts for Embedded Systems, Qing Li and Carolyn Yao, 2003 CMP Books, ISBN:1578201241
5.	Rea1 Time Systems, Jane W. S. Liu, 2000, Prentice Hall, ISBN:0130996513

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

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

Semester: VI						
DIGITAL SYSTEM DESIGN WITH FPGA **Category: Professional Core Elective (Cluster)** **(Theory)**						
Course Code	**:**	21EC65E2		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction to Verilog and Design Methodology: Verilog IEEE standards, Verilog Data Types: Net, Register and Constant. Verilog Operators, Number representation and Verilog ports, Simulation and Synthesis, Test-benches. **Verilog Primitives. Logic Simulation, Design Verification, and Test Methodology:** Four-Value Logic and Signal Resolution in Verilog, Test Methodology Signal Generators for Test benches, Sized Numbers. **Introduction to Design Methodology:** Digital Systems and Embedded Systems, Real-world circuits. Design Methodology: Design Flow-Architecture, Functional design and verification, Synthesis, Physical design. Design Optimization-Area, Timing and Power, System representation.	
Unit – II	**09 Hrs**
Number Basics and Verilog Modelling Styles: Number Basics: Unsigned and Signed Integers, Fixed-point and Floating-point Numbers. Boolean Functions and Boolean Algebra, Verilog models for Boolean switching function, Binary Coding. **Behavioural Modelling:** Latches and Level-Sensitive Circuits in Verilog, Cyclic Behavioural Models of Flip-Flops and Latches, Behavioural Models of Multiplexers, Encoders, Decoders and Arithmetic circuits. **Dataflow Modelling:** Boolean Equation-Based Models of Combinational Logic, Propagation Delay and Continuous Assignments. Linear-Feedback Shift Register. Tasks & Functions. **Structural Modelling:** Design of Combinational Logic, Verilog Structural Models, Top-Down Design and Nested Modules. (Hands on using Xilinx Vivardo tool)	
Unit –III	**09 Hrs**
Synthesis of Digital Sub-systems: **Synthesis of Combinational Sub-systems:** Introduction to Synthesis, Synthesis of Combinational Logic, Synthesis of Sequential Logic with Latches, Synthesis of Three-state Devices and Bus Interfaces. **Synthesis of Sequential Sub-systems:** Synthesis of Sequential Logic with Flip-Flops, Synthesis of Explicit State Machines, Registered Logic, State Encoding, Synthesis of Implicit State Machines, Registers and Counters. (Hand on using Xilinx Vivardo)	
Unit –IV	**09 Hrs**
System Implementation and Fabrics: CPLD vs FPGA Architecture - Programming Technologies-Chip I/O-Programmable Logic Blocks- Fabric and Architecture of FPGA. Xilinx Virtex VI Architecture – ALTERA Cyclone II Architecture - ALTERA Stratix IV Architecture, Hardcore and Softcore FPGA.	
Unit –V	**09 Hrs**
Processor Design and System Development: **Design of Processor Architectures**: Functional Units for Addition, Subtraction and Multiplication (overview). Design: Hierarchical Decomposition STG-Based Controller Design, Efficient STG-Based Sequential Binary Multiplier.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the digital system designs skills using VERILOG HDL based on IEEE-1364 standards and managed by Open Verilog International (OVI).
CO 2	Demonstrate the skill on cost-effective system designs through proper selection of implementation fabrics for the desired application.
CO 3	Analyze complete systems and build small scale applications using Interfacing concepts.

CO 4	Design and implement complete digital systems using VERILOG HDL and demonstrate the innovation skills.

Reference Books	
1.	Real-Time Embedded Systems Design Principles and Engineering Practices by Xiaocong Fan, Newnes Publishers - an imprint of Elsevier, 2015, ISBN10: 0128015071
2.	Real-Time Embedded Systems and Components, Sam Siewert, 2007, Cengage Learning India Edition, ISBN: 9788131502532
3.	Real time systems, Krishna CM and Kang Singh G, 2003, Tata McGraw Hill, ISBN: 0-07- 114243-64
4.	Real-Time Concepts for Embedded Systems, Qing Li and Carolyn Yao, 2003 CMP Books, ISBN:1578201241.
5.	Rea1 Time Systems, Jane W. S. Liu, 2000, Prentice Hall, ISBN:0130996513.

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: IV						
Electronics Equipment Integration and Prototype Building **Professional Core Elective (Cluster Elective) (Group- E)** **Theory**						
Course Code	**:**	21EI65E1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**03 Hours**

Unit-I	**09 Hrs**
Introduction to electronic products, examples from real life: Parts to system, simulation of flat prismatic parts, flat parts enclosures, real life parts to scale on a graph. **Product Concepts and Prototyping:** First steps of prototyping, top down, outside to internals, using a print and fabrication video, details of keys and displays, improvement on marking and skills.	
Unit – II	**09 Hrs**
Integrating sub systems to larger systems: Mass production in sheet metal, prototyping of user interfaces for concepts, stacking of equipment to make a system, Recapitualising a subsystem, off the shelf enclosures and making a user interface.	
Unit –III	**09 Hrs**
Small units: looking around for concepts and integration, representation on a paper, example features of solids and surfaces, simple and curved surfaces, describing inclined surfaces. **Drafting and Design:** Basics of engineering drawing, introduction to sizing and fits, practical mechanical assemblies, analogous mechanical to electronics detailing, solid modelling	
Unit IV	**09 Hrs**
Use of CAD drawing for detailing: Importance of dimensioning, ease of editing redesign, dimensioning of electronic components, 2D flat representation, Electronics to mechanical interfacing. **Practical example mock up:** complexity of 3D assemblies with wiring, illustrative simple design, practical detailing, rendered onscreen.	
Unit V	**09 Hrs**
A design fully by low cost 2D 3D CAD: Fastenings and hardware, fastener representation and detailing, practical detailing, Recapitulation, context of course, Low cost is the key. **Case studies:** physical simulation of small systems, building of prototype mock ups, Designs for production scale up, Design of front panel layout and graphics.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Understand the concepts of protype building
CO 2	Apply the concepts for designing the layout a system, and developing drawings that can be used for fabrication in a workshop
CO 3	Analyze the build model
CO 4	Design a working prototype of electronic equipment

Reference Books	
1.	Product Design and Development , Karl Ulrich, Steven D Eppinger, Tata Mc Graw Hill, 6th Edition, 2016, ISBN-13 : 978-0-07-802906-6
2.	Electronic Prototype Construction, Stephan D. Kasten, September 1983, Sams Technical Publishing, ISBN-13 : 978-0672218958

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: IV						
VIRTUAL INSTRUMENTATION **Professional Core Elective (Cluster Elective) (Group- E)** **Theory**						
Course Code	**:**	21EI65E2		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**03 Hours**

Unit-I	**09 Hrs**
Virtual instrumentation: Virtual instrument and traditional instrument, hardware and software in VI, graphical system design using LabVIEW. Introduction to LabVIEW: Advantages, software environment, creating and saving VI, front panel and block diagram tool bar, palettes, controls and indicators, block diagram, data types, data flow program.	
Unit – II	**09 Hrs**
Modular programming: Build a VI front panel and block diagram, building a connector pane, displaying sub-VIs and express VIs, creating sub-VIs, Repetition and loops: For loops, while loops, structure tunnels, terminal inside or outside loops, shift registers, feedback nodes, control timing, communication among multiple loops, local and global variables. Structures: Case, sequence, customizing, timed structures, formula nodes, event structures.	
Unit –III	**09 Hrs**
Arrays & Clusters: Creating one dimensional, two dimensional, multi-dimensional arrays, array initialization, deleting, inserting, replacing elements within an array, array function, auto indexing. Clusters functions. **File and Strings**: Introduction to Files, File Formats, File I/O Functions, File operation, Introduction to String Functions, LabVIEW String Functions, Typical examples, Visual display types- graphs, charts, XY graph	
Unit IV	**09 Hrs**
Data Acquisition with LabVIEW: PC based data acquisition, Typical onboard DAQ card, Resolution and sampling frequency, Multiplexing of analog inputs-Single-ended and differential inputs, Concept of universal DAQ card, Use of timer- counter and analog outputs on the universal DAQ card, DAQ Assistants, Analysis Assistants. Real time application using DAQ Cards.	
Unit V	**09 Hrs**
Design Pattern: Producer-Consumer Model, Event Structure Model, Master-Slave Model, State Machine Model, and Synchronization using Semaphore. Signal Processing Application, Real time application using myRIO, configure myRIO for speed control of DC Motor using encoder.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Remember and understand the fundamentals of Virtual Instrumentation and data Acquisition.
CO 2	Apply the theoretical concepts to realize practical systems.
CO 3	Analyze and evaluate the performance of Virtual Instrumentation Systems.
CO 4	Create a VI system to solve real time problems using data acquisition.

Reference Books	
1.	Jovitha Jerome, Virtual instrumentation Using LabVIEW,4th Edition, 2010, PHI Learning Pvt.Ltd , ISBN: 978-8120340305
2.	Sanjay Gupta & Joseph John, Virtual Instrumentation Using LabVIEW, 2nd Edition, 2017, Tata McGraw Hill Publisher Ltd, ISBN : 978-0070700284
3.	Lisa. K. Wills, LabVIEW for Everyone, 2nd Edition, 2008, Prentice Hall of India, , ISBN : 978-013185672
4.	Garry Johnson, Richard Jennings, LabVIEW Graphical Programming, , 4thEdition , 2017, McGraw Hill Professional, ISBN: 978-1259005336

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: IV						
SMART ANTENNAS **Professional Core Elective (Cluster Elective) (Group- E)** **Theory**						
Course Code	**:**	21ET65E1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**03 Hours**

Unit-I	**09 Hrs**
Arrays Introduction, Two-Element Array, N-Element Linear Array: Uniform Amplitude and Spacing, N-Element Linear Array: Directivity Design Procedure, N-Element Linear Array: Three-Dimensional Characteristics, Rectangular-to-Polar Graphical Solution, N-Element Linear Array: Uniform Spacing, Planar Array	
Unit – II	**09 Hrs**
Introduction to Smart Antennas: Need for Smart Antennas, Overview, Smart Antenna Configurations, Space Division Multiple Access, Architecture of Smart Antenna System, Benefits, Drawbacks, Basic Principles, Mutual Coupling Effects.	
Unit –III	**09 Hrs**
Beamforming: Fixed Weight Beamforming Basics - Maximum Signal-to-Interference Ratio, Minimum Mean-Square Error, Maximum Likelihood, Minimum Variance Adaptive Beamforming - Least Mean Squares, Sample Matrix Inversion, Recursive Least Squares Constant Modulus, Least Squares Constant Modulus, Conjugate Gradient Method, Spreading Sequence Array Weights, Description of the New SDMA Receiver	
Unit –IV	**09 Hrs**
Angle-of-Arrival Estimation: Array Correlation Matrix, AOA Estimation Methods -Bartlett AOA Estimate, Capon AOA Estimate, Linear Prediction AOA Estimate, Maximum Entropy AOA Estimate, Pisarenko Harmonic Decomposition AOA Estimate, Min-Norm AOA Estimate, MUSIC AOA Estimate, Root-MUSIC AOA Estimate, ESPRIT AOA Estimate.	
Unit –V	**09 Hrs**
Next generation Antennas: Metamaterial Antennas Metamaterial Antennas Based on NRI Concepts ,High-Gain Antennas Utilizing EBG Defect Modes, Reconfigurable Antennas: Introduction, Analysis, Overview of Reconfiguration Mechanisms for Antennas, UWB planar antennas, Phased array antennas for 5G communications ,MIMO antennas	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Elucidate parameters and principles of Adaptive Antennas, Application specific Antennas
CO 2	Apply signal processing concepts in analyzing beam forming techniques and Algorithms
CO 3	Analyze and Compare various techniques employed in designing Adaptive Antennas with Beam forming algorithms
CO 4	Design and evaluate the Industry specific Practical antennas

Reference Books	
1.	Introduction to Smart Antennas. Synth. Lect. Antennas, Balanis, C.A., Ioannides, P.I.: 2(1), 1– 175,2007, 9781598291766.(Unit-2,Unit-3)
2.	Smart Antennas with Matlab: Principles and Applications in Wireless Communication, Frank B Gross,2015, McGraw-Hill Professional, New York, ISBN- 978-0-07-182494-1(Unit-1,Unit-4)
3.	Frontiers in Antennas: Next Generation Design & Engineering, Frank B gross, 2011, Mcgraw Hill Publications, ISBN : 9780071637930. (Unit-5)
4.	Smart antenna, Lal Chand Godara, 2004, CRC press, London, ISBN: 9780849312069.

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						
SATELLITE COMMUNICATION **Category: Professional (Cluster) Elective Course** **Stream: Electronics and Telecommunication Engineering** **(Common to EC,EE,EI& ET Programs)** **(Theory)**						
Course Code	**:**	21ET65E2		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hrs	**:**	**45L**		**SEE Duration**	**:**	**3Hrs**

Unit-I	**09 Hrs**
Orbital Mechanics: Orbital Mechanics, Look Angle Determination, Orbital Perturbations, Orbit Determination, Launches and Launch Vehicles, Orbital Effects in Communication systems	
Unit – II	**09 Hrs**
Satellite Sub-Systems: Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment. **Satellite Link:** Basic transmission theory, system noise temperature and G/T ratio, Design of Uplinks and Downlink, C-Band system design Example.	
Unit –III	**09 Hrs**
Propagation effects: Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospheric Scintillation and Low angle fading, Rain Induced attenuation, rain induced cross polarization interference. **Multiple Access:** Frequency Division Multiple Access (FDMA), Intermodulation, Calculation of C/N. Time Division Multiple Access (TDMA), Frame structure, Burst structure, Satellite Switched TDMA On board processing, Demand Assignment Multiple Access (DAMA), CDMA Spread Spectrum Transmission and Reception.	
Unit –IV	**09 Hrs**
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems.	
Unit –V	**09 Hrs**
Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications. Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications. Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Application.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
CO2	Analyse the electronic hardware systems associated with the satellite subsystem and earth station.
CO3	Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques
CO4	Identify and Analyse the working of the satellites used for applications in remote sensing, weather forecasting and Navigation

Reference Books	
1.	Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003, John Wiley & Sons.
2.	Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt Ltd, 2015, ISBN: 978-81-265-2071-8.
3.	K. N. Raja Rao, Satellite Communication: Concepts and Applications, PHI Learning Private India, 2013, ISBN-978-81-203-4725-0.

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
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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						
INDUSTRIAL SAFETY AND RISK MANAGEMENT **Category: Institutional elective (Theory)**						
Course Code	**:**	**21IE6F1**		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	50 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	2 Hours

Unit-I	**09 Hrs**
Introduction Safety: Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, Hazard recognition.	
Unit – II	**09 Hrs**
Risk assessment and control: Individual and societal risks, Risk assessment, Risk perception, Acceptable risk, ALARP, Prevention through design. **Hazard Identification Methods:** Preliminary Hazard List (PHL): Overview, methodology, worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analyses.	
Unit –III	**09 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Definition, Process parameters, Guide words, HAZOP matrix, Procedure, Example. Failure Modes and Effects Analysis (FMEA): Introduction, system breakdown concept, methodology, example.	
Unit –IV	**09 Hrs**
Application of Hazard Identification Techniques: Case of pressure tank, heat exchanger, system breakdown structure, Accident paths, HAZOP application, risk adjusted discounted rate method, probability distribution, Hiller's model	
Unit-V	**09 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: -	
CO 1	Recall risk assessment techniques used in process industry
CO 2	Interpret the various risk assessment tools.
CO 3	Use hazard identification tools for safety management.
CO 4	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). 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						
RENEWABLE ENERGY SYSTEMS (Institute Elective) (Theory)						
Course Code	**:**	21IE6F2		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	40L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Energy systems model causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. **Basics of Solar Energy:** Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Application. Block diagram of solar energy conversion.	
Unit – II	**09 Hrs**
Solar PV Systems: Basic Principle of SPV conversion – Types of PV Systems(Standalone, Grid connected, Hybrid system)- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Array design (different methodologies),peak-power operation, system components.Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications..	
Unit –III	**09 Hrs**
Wind Power Systems: **Wind speed and energy:** Introduction, history of wind energy, scenario- world and India. Basic principle of Wind energy conversion system (WECS), Classifications of WECS, part of a WECS. Derivation of power in the wind, electrical power output and capacity of WECS, wind site selection consideration, advantages and disadvantages of WECS. Maximum energy capture, maximum power operation, , environmental aspects.	
Unit –IV	**09 Hrs**
Geothermal and ocean energy systems: Geothermal well drilling, advantages and disadvantages, Comparison of flashed steam and total flow concept (T-S diagram). Associated Problems, environmental Effects. **Energy from ocean:** OTEC power generation, OPEN and CLOSED cycle OTEC. Estimate of Energy and power in simple single basin tidal and double basin tidal system. Issues Faced in Exploiting Tidal Energy	
Unit –V	**09 Hrs**
Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production through block diagram, Use of Hydrogen Energy, Merits and Demerits, Problems Associated with Hydrogen Energy. **Biomass Energy:** Introduction-Biomass resources –Energy from Biomass: conversion processes-Biomass Cogeneration-Environmental Benefits. Biomass products – ethanol, biodiesel, biogas Electricity and heat production by biomass.	

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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						
SYSTEMS ENGINEERING **(Category : Institute Elective)** **(Theory)**						
Course Code	**:**	21IE6F3		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	40L		**SEE Duration**	**:**	3 Hours

Unit-I	**06 Hrs**
System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems. **Structure of Complex Systems:** System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions. **The System Development Process:** Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.	
Unit – II	**10 Hrs**
Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **Needs Analysis:** Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems. **Concept Exploration:** Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.	
Unit –III	**10 Hrs**
Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems **Advanced Development:** Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.	
Unit –IV	**10 Hrs**
Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. **Integration and Evaluation:** Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.	
Unit –V	**09 Hrs**
Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. **Operations and support**: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the Life Cycle of Systems.
CO 2	Explain the role of Stake holders and their needs in organizational systems.
CO 3	Develop and Document the knowledge base for effective systems engineering processes.
CO 4	Apply available tools, methods and technologies to support complex high technology systems.

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
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	PART A	
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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						
MECHATRONICS **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21IE66F4		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Overview of Mechatronic Systems Traditional and mechatronic design, automatic washing machine, automatic door, dishwasher, compact disc drive copy machine, camera, and temperature control. Principle and working of hall sensor, displacement sensor, absolute and incremental encoders, photoelectric sensors, inductive and capacitive proximity sensors, Relays and solenoids, Brushless DC, AC and servo motors, pulse width modulation by basic transistor circuit, H bridge circuit, Stepper motor: variable reluctance and permanent magnet, stepper motor control circuits, selection of motors.	
Unit – II	**10 Hrs**
Signal Conditioning Operational Amplifiers - circuit diagrams and derivation - Numerical, filtering, multiplexers, 4:1 MUX, time division multiplexing -seven segment display, data acquisition, Analog and digital signals, analog to digital converters. Introduction to Digital signal processing – difference equation (Numericals). **Programmable logic controllers** Components, principle of operation, modifying the operation, basic PLC instructions, and concepts of ladder diagram, latching, timer instructions, counter instructions.	
Unit –III	**10 Hrs**
Ladder Diagram for PLCs Examples with ladder logic programs, simple programs using Boolean logic, word level logic instructions. Relay to ladder conversion examples., **Industrial applications of PLCs** Central heating system, valve sequencing, traffic light control in one direction, water level control, overhead garage door, sequential process, continuous filling operation, Fluid pumping with timers, parking garage counter, can counting in assembly line.	
Unit –IV	**08 Hrs**
Microcontrollers Components of a full featured microcontroller, Memory, I/O Ports, Bus, Read & Write Cycle, Architecture of Intel 8051 microcontroller, Pin diagram, simple instructions for a microcontroller. – Data transfer, arithmetic functions, logical operations, Jump and branching operation. **Digital circuits** Digital representations, Combinational logic - Case studies: BCD to 7 segment decoder, calendar subsystem in a smartwatch., timing diagrams, Karnough maps – 3 variable and 4 variable, design of logic networks, flip-flops, Counters.	
Unit – V	**08 Hrs**
Dynamic Responses of Systems Closed loop system, Terminology, transfer functions, step response of first order and second order systems, performance measures for first and second order systems, - Numerical **Mechanical Actuation Systems** Four bar chain, slider crank mechanism, Cams and followers, gear trains - Numerical	

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
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	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VI						
MATHEMATICAL MODELLING (Theory) (Group E: Global Elective)						
Course Code	**:**	21IE6E5		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

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

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

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

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

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						
INDUSTRY 4.0 - SMART MANUFACTURING FOR THE FUTURE **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21IE66F6		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**07 Hrs**
Introduction: The Various Industrial Revolutions, Need – Reason for Adopting Industry 4.0, Definition, Goals and Design Principles – Interoperability, Virtualization, Decentralization, Real-time Capability, Service Orientation, Modularity. Individualization, Volatility, Energy and resource efficiency. Road to Industry 4.0 - Internet of Things (IoT), Architecture of IoT, Technologies for IoT & Industrial Internet of Things (IIoT), Internet of Services, Standardization, Cyber-Physical Systems, Smart Manufacturing, Network via Ethernet/ Wi-Fi for high-speed data transmission, Mobile technologies	
Unit – II	**10 Hrs**
Opportunities and Challenges Lack of resources, Availability of skilled workers, Broadband infrastructure, Policies, Future of Works and Skills in the Industry 4.0 Era, Disruption as manufacturing's greatest modern challenge **Robotics in Industry 4.0** Robotic Automation and Collaborative Robots, Human-Machine Interaction **Big Data** Evolution**,** Essential of Big Data in Industry 4.0, Big Data Merits, Data transparency, Business Intelligence, Production planning, Quality, Acquisition of Automation Data, Digital Traceability, Radio-Frequency Identification (RFID), GPS, Data transformation, Big Data Characteristics, Data as a new resource for organizations, Data driven applications, Harnessing and sharing knowledge in organizations, Data analytics - Descriptive Analytics, Diagnostic analytics, Predictive Analytics, Prescriptive analytics	
Unit –III	**10 Hrs**
Cloud Computing Fundamentals, Cloud/Edge Computing and Industry 4.0, The IT/OT convergence, Cyber Security **Horizontal and Vertical integration** End-to-end engineering of the overall value chain, Digital integration platforms, Role of machine sensors, Sensing classification according to measuring variables, Machine-to-Machine communication **Artificial Intelligence/Machine Learning in Industry 4.0** Fundamentals, Case Studies, Technology paradigms in production logistics - Intelligent conveyor system, Intelligent commissioning system, Intelligent production machine, Intelligent load carrier, Application-specific demand on Intelligent Objects (user-oriented functions), Technological realization of Intelligent Objects (product-oriented functions)	
Unit –IV	**08 Hrs**
Augmented Worker Augmented and Virtual Reality, softwares, Industrial Applications – Maintenance, Assembly, Collaborative operations, Training **Digital-to-Physical** Additive Manufacturing technologies, Advantages, impact on environment, Applications – Automotive, Aerospace, Electronics and Medical	
Unit –V	**07 Hrs**
Digital twin, Virtual factory, Total Productive Maintenance, Industry 4.0 case studies, Understanding I 4.0 in MSMEs, What's Next: Industry 5.0/Society 5.0	

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

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: 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 PSYCHOLOGY FOR ENGINEERS **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21IE66F7		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**10 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	
	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India
2.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3.	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3.
4.	Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5
5	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

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

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

Semester: VI						
ELEMENTS OF FINANCIAL MANAGEMENT **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21IE6F8		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
Financial Management-An overview: Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework. **The financial System:** Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system. **Financial statements, Taxes and cash flow:** Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes. **(Conceptual treatment only)**	
Unit – II	**10 Hrs**
Time Value of Money: Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity. **Valuation of securities:** Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches. **Risk and Return:** Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications **(Conceptual and Numerical treatment)**	
Unit –III	**10 Hrs**
Techniques of Capital Budgeting: Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Payback period, Accounting rate of return. **Cost of Capital:** Preliminaries Cost of debt and preference, cost of retained earnings, cost of external equity, determining the proportions, weighted average cost of capital, weighted marginal cost of capital schedule. **Capital structure and cost of capital:** Assumptions and concepts, net income approach, net operating income approach, traditional position, Modigliani and Miller Position, Taxation and Capital structure, Other imperfections and Capital structure **(Conceptual and Numerical treatment)**	
Unit –IV	**10 Hrs**
Long term finance: Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking **Securities Market:** Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market. **Working Capital – Policy and Financing:** Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper, Factoring **(Conceptual treatment only)**	
Unit –V	**09 Hrs**
Contemporary topics in Finance: Reasons and Mechanics of a merger, Takeovers, Divestures, Demergers, World monetary system, Foreign exchange markets, raising foreign currency finance, International capital budgeting, Options market, Futures market, Warrants, Venture capital financing framework, Indian venture capital scenario. (Conceptual treatment only)	

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

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

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

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

Semester: VI						
Universal Human Values - II (Institutional Electives) (Theory)						
Course Code	**:**	**21IE6F9**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution. The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	
Unit – II	**10 Hrs**
Right Understanding (Knowing)- Knower, Known & the Process. The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	
Unit –III	**08 Hrs**
Understanding Existence (including Nature). A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
Unit –IV	**08 Hrs**
Understanding Human Being. Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body, the activities and potentialities of the self, Reasons for harmony/contradiction in the self.	
Unit –V	**09 Hrs**
Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living. Understanding Human Conduct, Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	

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

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

#	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						
HUMAN MACHINE INTERFACE (HMI) **(Institutional Electives)** **(Theory)**						
Course Code	**:**	**21IE6F10**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3.00 Hours**

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.	

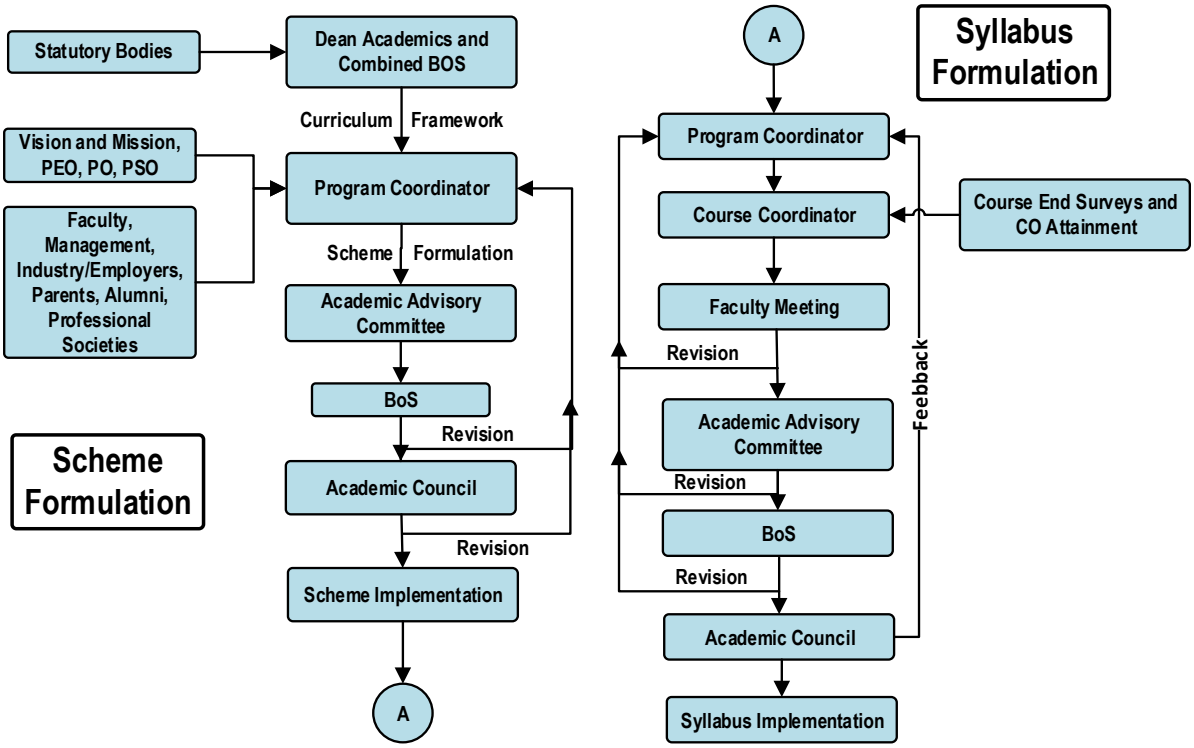
Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understanding the application of HMIs in various domain
CO2	Comparison of various communication protocols used in HMI development.
CO3	Apply and Analyse the car multimedia system free software and hardware evolution
CO4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

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

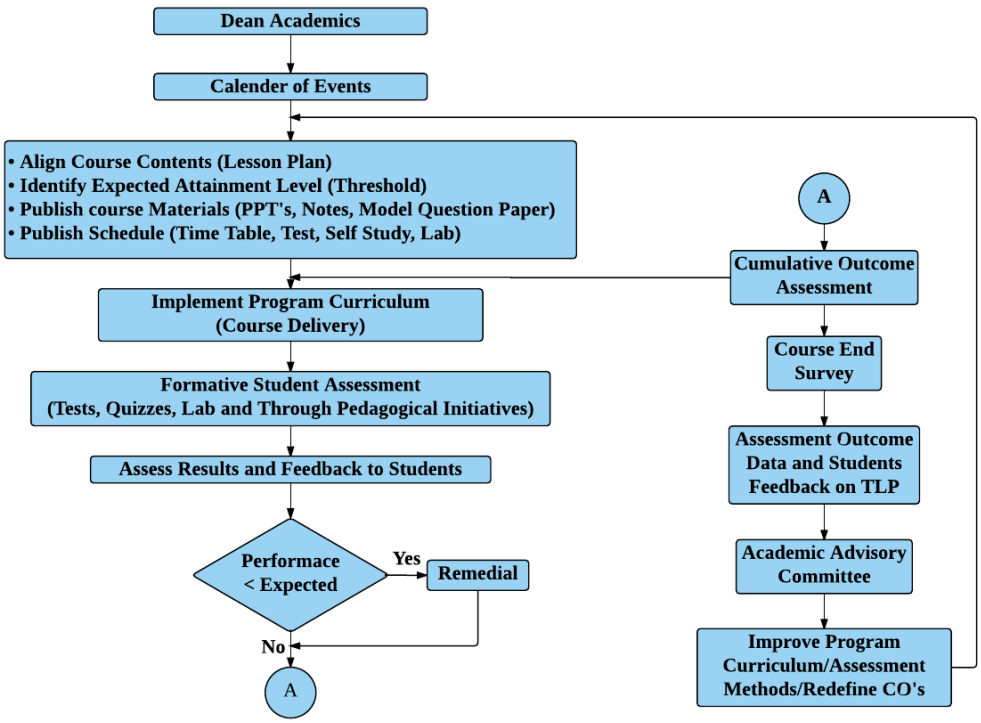
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different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

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

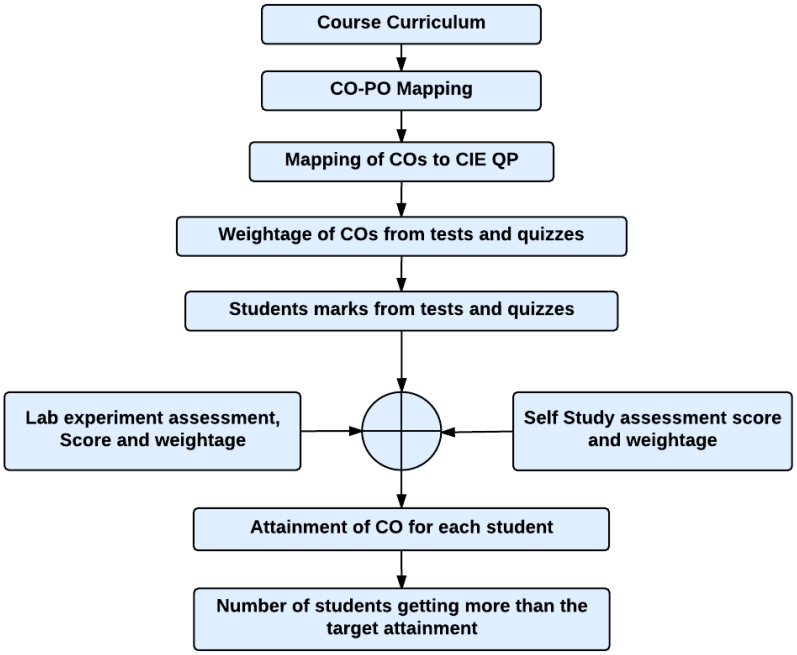
Curriculum Design Process



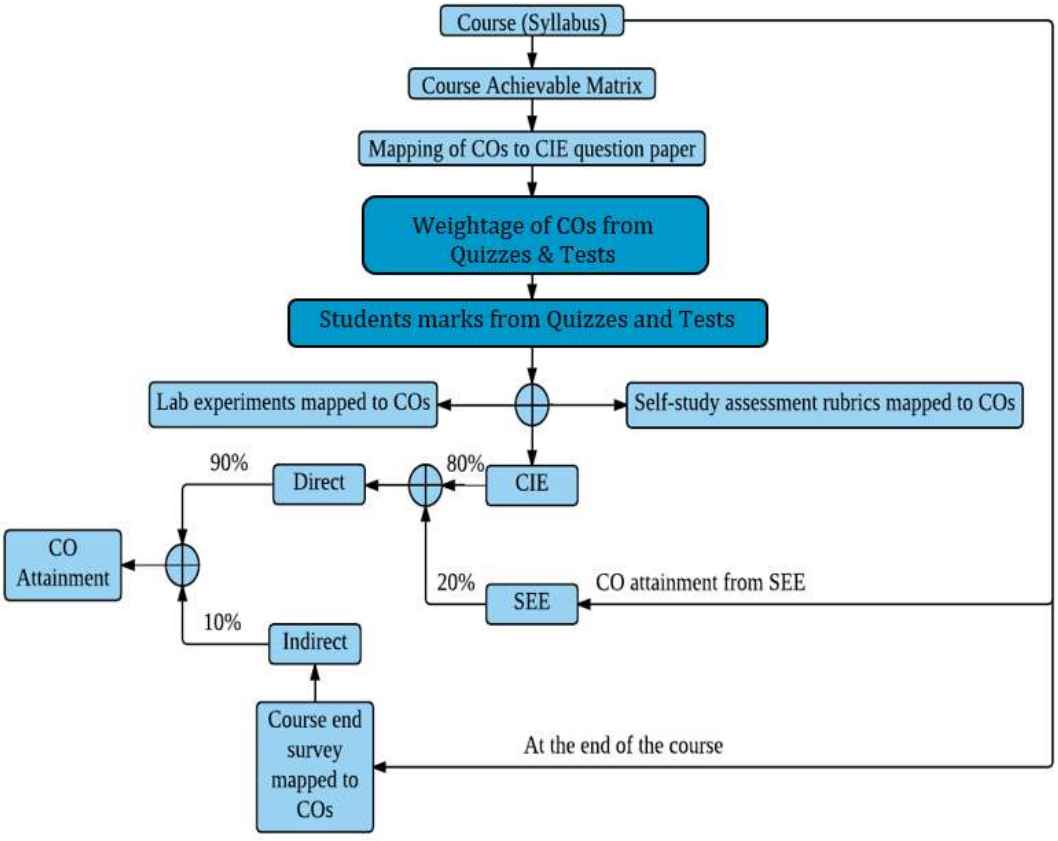
Academic Planning and Implementation



Process For Course Outcome Attainment



Final CO Attainment Process



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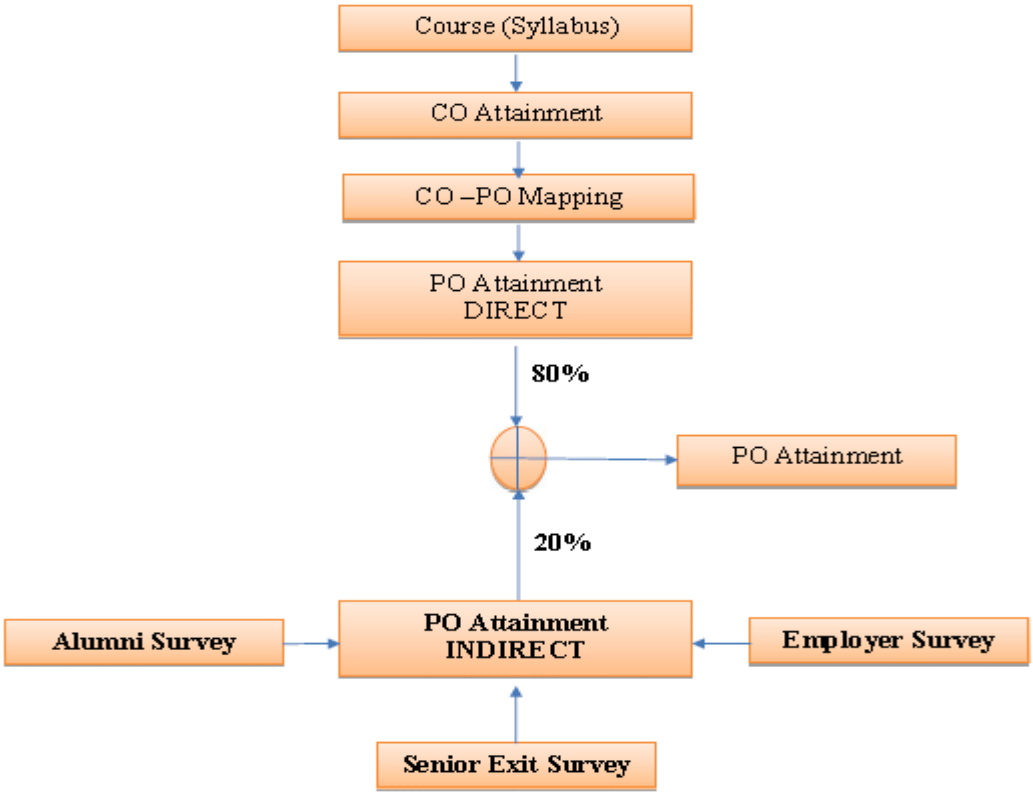
Program Outcomes Attainment Process



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PROGRAM OUTCOMES (POs)

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

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

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

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

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

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

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

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

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

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

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

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