RV College of Engineering®

Electrical & Electronics Engineering

Bachelor of Engineering (B.E)

Scheme And Syllabus Of VII & VIII Semester
(2021 Scheme)

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

2024

99TH
NIRF RANKING IN ENGINEERING (2024)

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

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

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

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

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

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

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

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

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

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2024

Department Vision

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

Department Mission

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

ABBREVIATIONS

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

INDEX

Bachelor of Engineering in
ELECTRICAL AND ELECTRONICS ENGINEERING

VII 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	21HS71	Constitution of India and Professional Ethics	3	0	0	3	HSS	Theory	1.5	**100**	********	**3**	**100**	********
2	21EE72	Power System Analysis ***(Theory and Practice)***	3	1	0	4	EE	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
3	21EE73GX	Professional Core Elective-III ***(Group – G)***	3	0	0	3	EE	Theory	1.5	**100**	********	**3**	**100**	********
4	21EE74HX	Professional Core Elective-IV ***(Group- H)***	3	0	0	3	EE	Theory	1.5	**100**	********	**3**	**100**	********
5	21XX75IX	Institutional Electives – II ***(Group I)***	3	0	0	3	RES. BoS	Theory	1.5	**100**	********	**3**	**100**	********
6	21EE76I	Summer Internship	0	0	1	2	EE	Theory	1.5	********	**50**	**2**	********	**50**
7	21EE77P	Minor Project	0	0	1	2	EE	Lab	1.5	********	**50**	**2**	********	**50**
						20								

PROFESSIONAL CORE ELECTIVE-III (GROUP-G)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	21EE73GA	Switch Gear and Protection	03
2.	21EE73GB	Switching Techniques in Power Electronic Converters	03
3.	21EE73GC	Programmable Logic Controller & SCADA Systems	03
4.	21EE73GD	Power Quality and Mitigation	03

PROFESSIONAL CORE ELECTIVE-II (GROUP - H)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	21EE74HA	Energy Estimation and Costing	03
2.	21EE74HB	Electric Drives and Applications	03
3.	21EE74HC	Hybrid Electric Vehicles	03
4.	21EE74HD	Artificial Intelligence in Smart grid	03
5.	21EE74HE	Distributed Generation and Micro Grid	03

Institutional Electives-II Group I				
Sl. No.	**Course Code**	**BoS**	**Course Title**	**Credits**
1.	21AS75IA	AS	Unmanned Aerial Vehicles	03
2.	21BT75IB	BT	Healthcare Analytics	03
3.	21CH75IC	CH	Sustainability and Life Cycle Analysis	03
4.	21CM75ID	CM	Advances in Corrosion Science and Management	03
5.	21CS75IE	CS	Prompt Engineering	03
6.	21CV75IF	CV	Integrated Health Monitoring of Structures	03
7.	21EC75IG	EC	Wearable Electronics	03
8.	21EE75IH	EE	E-Mobility	03
9.	21EI75IJ	EI	Programmable Logic Controller’s and Applications	03
10.	21ET75IK	ET	Space Technology and Applications	03
11.	21IS75IL	IS	Mobile Application Development	03
12.	21IM75IM	IM	Project Management	03
13.	21IM75IN	IM	Supply Chain Analytics	03
14.	21ME75IO	ME	Nuclear Engineering	03
15.	21HS75IQ	HS	Cognitive Psychology	03
16.	21HS75IR	HS	Principles and Practices of Cyber Law	03

Bachelor of Engineering in
ECTRICAL AND ELECTRONICS ENGINEERING

VIII 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	21EE81P	Major Project	0	0	12	12	EE	Project	1.5	****	**100**	**3**	****	**100**
						12								

Semester: VII						
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS **Category: Common to All** **(Theory)**						
Course Code	**:**	**21HS71**		**CIE**	**:**	**100Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Salient features of Indian Constitution; Preamble to the Constitution of India; Provisions Relating to Citizenship in India-Modes of Acquisition and Termination of Citizenship of India. Scope & Extent of Fundamental Rights-Articles 14-32 with case studies; Right to Information Act, 2005 with Case studies.	
Unit – II	**08 Hrs**
Significance of Directive Principles of State Policy; Fundamental Duties in the Constitution of India; Union Executive- President and State Executive- Governor; Parliament & State Legislature; Council of Ministers; Union and State Judiciary; Emergency provisions; Elections commission. Human Rights & Human Rights Commission.	
Unit –III	**08 Hrs**
Consumer Protection Law - Definition and Need of Consumer Protection; Consumer Rights under the Consumer Protection Act, 2019; Unfair Trade Practice, Defect in goods, Deficiency in services; Product liability and **Penal Consequences, False and Misleading Advertisement, E-Commerce, Alternate dispute Redress mechanism;** Redresses Mechanisms under the Consumer Protection Act, 2019.	
Unit –IV	**10 Hrs**
Introduction to Labour and Industrial Law, Theory and Concept of Industrial Relations, Industrial Relations Code 2020, Code on Social Security 2020, Code on Occupational Safety, Health and Working Conditions 2020, Code on Wages 2020, Industrial Disputes Act , **The Factories Act, 1948**, Analysis of Recent Amendments made in Labour Laws.	
Unit –V	**11 Hrs**
Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering. **Corporate Social Responsibility**. **Statutory Provision regarding prohibition and prevention of Ragging,** **The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.**	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Demonstrate the citizen's fundamental Rights, duties & consumer responsibility capability and to take affirmative action as a responsible citizen.
CO 2	Identify the conflict management in legal perspective and judicial systems pertaining to professional environment, strengthen the ability to contribute to the resolve of human rights & Ragging issues and problems through investigative and analytical skills.
CO 3	Understanding process of ethical and moral analysis in decision making scenarios and inculcate ethical behaviour as a trait for professional development
CO 4	Apply the knowledge to solve practical problems with regard to personal issues & business enterprises

Reference Books	
1.	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2020 edition
2.	V.N. Shukla's Constitution of India by Prof (Dr.) Mahendra Pal Singh (Revised) Edition: 13th 2017, Reprinted with Supplement 2021
3.	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN -13:978-9351452461
4.	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400

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

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

Semester: VII						
POWER SYSTEM ANALYSIS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	**21EE72**		**CIE**	**:**	**150Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**150 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 Hours**

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

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

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

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

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **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 (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE THEORY	**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	20
3	Viva	20
	TOTAL	**50**

Semester: VII						
SWITCH GEAR & PROTECTION **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE73GA		**CIE**	**:**	100Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Fuses: Introduction, Definition, Classification, HRC fuse, Selection of Fuses, characteristics **Circuit Breakers theory:** Arc characteristics, Theories of current interruption, Recovery, Restriking Voltage and Recovery voltages. Re-striking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching, Interruption of Capacitive Current Examples	
Unit – II	**09 Hrs**
Circuit Breakers: Air break CB, Air Blast CB, SF6CB: construction, operation, application and merits, Vacuum CB construction, operation, application and merits, CB ratings and Specifications: Types and Numerical Problems. auto-reclosing - definitions & features. **DC Circuit Breaker:** Introduction, DC Breaking, General design and construction. **Types of Switchgear:** AIS, GIS, Hybrid CB, Integrated CB, SMART CB, Dead & Live Tank CBs, Modern trends in Power System Protection.	
Unit –III	**09 Hrs**
Introduction to Relays: Principles and need for protective schemes –Relay terminology, definitions, Zones of protection and essential qualities of protection, relay classification, Relay design considerations. **Relay Operating Principles, construction and Characteristics:** Current, Voltage & IDMT Characteristics, Directional features, Impedance protection, Differential Protection, Protection Schemes, Protection Coordination. **Electromechanical relays:** over current: directional and non-directional, differential relays. Universal torque equation Illustrative examples **Static relays:** Introduction, Advantages and Disadvantages –IDMT static relays(Block diagram) **Numerical relays:** Introduction Block diagram of a numerical relay, Advantages of Numerical Technology, Flow Chart, IEDs, Bay Control & Protection, IEC61850 & Process Bus Technology& Digitization, Integrated Control & Protection, HMI, Parallel Redundancy Protocol, Disturbance & Event Recorder, Phasor Measurement	
Unit –IV	**09 Hrs**
Transformer Protection: Differential protection of power transformer, Biased differential Protection Buchhloz relay for incipient faults, Hormonic restraint relay - Illustrative examples **Generator protection:** Introduction to stator and rotor side protection, differential protection Illustrative examples **Bus bar protection:** Differential protection of bus bars, Low Impedance & High Impedance Differential Protection, Centralized & Distributed concepts	
Unit –V	**09 Hrs**
Protection of Transmission lines: Distance Protection of Transmission lines: Impedance, reactance and admittance characteristics with torque equations, relay settings for 3-zone protection, numerical relays for transmission line protection Numerical impedance relay (block diagram) and Flow chart, Effect of Arc Resistance on the Performance of Distance Relays, Reach and Effect of Power Surges (Power Swings), Effect of Line Length and Source Impedance on Performance of Distance Relays.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the operation of different types of protective devices in power systems
CO 2	Analyze and compare the performance of different protection relays, circuit breakers and fuses
CO 3	Evaluate the settings of various relays for equipment protection and ratings of circuit breakers
CO 4	Apply the advanced relaying techniques with pilot communication and modern circuit breakers in harmony with the present and future power system and practice to realise the numerical relaying schemes

Reference Books	
1.	Power System Protection and Switchgear ,BadriRam, 3rd Edition, 2011, TataMc-Graw Hill Pub, ISBN: 9780071077743, 9780071077743.
2.	Fundamentals of Power System Protection, Y.G. Paithankar and S.R. Bhide, 2nd Edition, 2003, Prentice Hall of India Pvt. Ltd., New Delhi, ISBN-13 : 978-8120341234.
3.	Power system relaying, Staley H.Horowitz&ArunG.Padke, 3rd Edition, 2008, John Wiley & Sons Inc., ISBN: 978-0-470-75878-6.
4.	A Text Book on PowerSystem Engineering, M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti , 2nd edition, 1998, DhanpatRai & Co. ISBN-13 : 978-8177000207. .

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

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

Semester: VII						
SWITCHING TECHNIQUES IN POWER ELECTRONIC CONVERTERS **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE73GB		**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: Purpose of PWM control of converters, Fourier series, Harmonic voltages and their effects. **Basic PWM Techniques:** Triangle-comparison based PWM: single pulse. Multiple pulse, SPWM, modified SPWM and phase displacement techniques, Third harmonic injection PWM (THIPWM), Bus-clamping PWM.	
Unit – II	**09 Hrs**
Advanced PWM Techniques: Hysteresis band current control PWM, Harmonic Cancellation techniques Concept of space vector, Conventional space vector PWM and bus-clamping PWM, Advanced bus-clamping PWM, Comparison of PWM techniques, Voltage and frequency control of single phase and three-phase inverters.	
Unit –III	**09 Hrs**
Synchronously revolving reference frame; error between reference voltage and applied voltage; integral of voltage error; evaluation of line current, ripple; hybrid PWM for reduced line. **Analysis of dc link current:** Relation between line-side currents and dc link current; dc link current and inverter state; rms dc current ripple over a carrier cycle; rms current rating of dc capacitors	
Unit –IV	**09 Hrs**
Analysis of Torque Ripple: Evaluation of harmonic torques and rms torque ripple, hybrid PWM for reduced torque ripple. **Analysis of Inverter's loss:** Simplifying assumptions in evaluation of inverter loss, dependence of inverter loss on line power factor, influence of PWM techniques on switching loss, design of PWM for low inverter loss. Requirement of dead-time.	
Unit –V	**09 Hrs**
PWM for Multilevel Inverters: Extension of sine-triangle modulation to three-level inverters, Extension of conventional space vector modulation to three-level inverters. **Overmodulation :** Per-phase approach to over modulation, Space vector approach to over modulation.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the basic concepts of switching techniques for power converters.
CO 2	Analyze the advance PWM methods for converters.
CO 3	Evaluate performance parameters like current ripple, torque ripple and losses.
CO 4	Design and apply the PWM techniques

Reference Books	
1.	Erickson R W, Chapman Hall, Fundamentals of Power Electronics, 1st Edition, 1997, Springer Publisher, ISBN 0-412-08541-0.
2.	Ned Mohan, Tore M. Undeland, William P Robbins, Power Electronics Converters, Applications, and Design, 3rd Edition, Wiley India Pvt Ltd, 2011,ISBN: 978-0-471-22693-2
3.	Euzeli Cipriano dos Santos Jr. and Edison Roberto Cabral Da Silva, Advanced Power Electronics Converters - PWM Converters Processing AC Voltages,1st Edition, 2014, Willey – IEEE Press, ISBN: 9781118880944
4.	D. Grahame Holmes, Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, Wiley-IEEE Press, 1st Edition, 2003, ISBN:978-0471208143.

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

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

Semester: VII						
PROGRAMMABLE LOGIC CONTROLLER AND SCADA SYSTEMS **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE73GC		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Programmable Logic Controllers An Overview: Programmable Logic Controllers, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. **PLC Hardware Components:** The I/O Section, Discrete, Analog and Special I/O Modules, Typical Discrete and Analog I/O Module Specifications, The Central Processing Unit(CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).	
Unit – II	**11 Hrs**
Fundamentals of Logic: The Binary Concept , AND, OR, NOT and XOR Function, Boolean Algebra , Developing Logic Gate circuits, from Boolean Expressions, Producing the Boolean Equation for a Given Logic Gate Circuit, Hardwired Logic versus Programmed Logic, Programming Word Level Logic Instructions, **Basics of PLC Programming:** Processor Memory Organization, Program Files, Data Files, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation.	
Unit –III	**10 Hrs**
Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs : Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC, Ladder Programs, Writing a Ladder Logic Program, Directly from a Narrative Description **Programming Timers:** Mechanical Timing Relays, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers. **Interfacing with different sensors:** Proximity sensors Inductive, capacitive sensors, Photoelectric Sensors and Switches, Encoders, Temperature sensors, position and displacement sensors, pressure sensors.	
Unit –IV	**09 Hrs**
Programming Counters: Counter Instructions, Up-Counter, One-Shot Instruction, Down-Counter, Cascading Counters, Incremental Encoder-Counter, Applications, Combining Counter and Timer Functions **Program Control Instructions:** Master Control Reset Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt, Fault Routine, Temporary End Instruction, Suspend instruction. **Data Manipulation Instructions:** Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs Closed-Loop Control, Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction Division Instruction.	
Unit –V	**09 Hrs**
SCADA System: History of Critical Infrastructure Directives, SCADA System Evolution, Definitions and Basic Architecture, SCADA Evolution, SCADA Definition, SCADA System Architecture, SCADA Applications, Redundancy as a Component of SCADA Security, SCADA System Desirable Properties. **SCADA Systems and its application:** Employment of SCADA Systems for various applications. (The Basic Refining Process, Nuclear Power Generation, The Boiling Water Reactor, The Pressurized Water Reactor, Conventional Electric Power Generation, Water Purification System , Crane Control) **SCADA Protocols:** Evolution of SCADA Protocols, Overview of the OSI Model, TCP/IP Model. MODBUS Model, and IEC61850 Standards, Ethernet/IP, Profibus.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the basic concepts of PLC and SCADA systems.
CO 2	Evaluate and assess the control needs of a process industry and evaluate various options of using PLC or SCADA
CO 3	Design and program the PLC to meet a specified control objective
CO 4	Develop a complete control system through integration of sensor with PLC.

Reference Books	
1.	Frank D. Petruzella "Programmable Logic Controllers", McGraw-Hill Book Company. ISBN 13: 9780073510880
2.	John R. Hackworth and Frederick D. Hackworth, Jr., "Programmable Logic Controllers: Programming Methods and Applications", Pearson/Prentice Hall, 2004 ISBN-9780130607188.
3.	W.Bolton, "Programmable Logic Controllers", Elsevier Fourth edition ISBN-13: 978-0-7506-8112-4
4.	Ronald L. Krutz, "Securing SCADA System", Wiley Publications.

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

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

Semester: VII						
POWER QUALITY AND MITIGATION **Category: Professional Elective Course** **(Theory & Practice)**						
Course Code	**:**	21EE73GD		**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: **Brief review of various power quality (PQ) problems:** Source of generation and their impacts on equipment and systems, need of monitoring, international power quality standards **Loads That Cause Power Quality Problems:** Introduction, Nonlinear Loads, Classification of Nonlinear Loads, Power Quality Problems Caused by Nonlinear Loads, Analysis of Nonlinear Loads.	
Unit – II	**09 Hrs**
Passive Filters: Introduction to Passive Power Filters, Classification, Principle of Operation, Analysis and Design, Modeling, Simulation, and Performance, Limitations Parallel Resonance of Passive Filters with the Supply System and Its Mitigation **Active Filters:** State of the Art, Classification, Principle of Operation	
Unit –III	**09 Hrs**
Active Series Compensation: Introduction, State of the Art on Active Series Compensators, Classification of Active Series Compensators, Principle of Operation and Control of Active Series Compensators, Analysis and Design of Active Series Compensators.	
Unit –IV	**09 Hrs**
Active Shunt Compensation: Introduction, State of the Art on DSTATCOMs, Classification of DSTATCOMs, Principle of Operation and Control of DSTATCOMs, Analysis and Design of DSTATCOMs, Modelling, Simulation, and Performance of DSTATCOMs, Numerical Examples	
Unit –V	**09 Hrs**
Transients, Short Duration & Long Duration Variations: Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption -Under Voltage – Over Voltage – Outage. Fundamentals of harmonics: Harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intraharmonics.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Evaluate power quality problems and identify the causes of PQ disturbances in a system.
CO 2	Analyse and Evaluate Passive and Active power filters, Harmonics and Transients
CO 3	Design the controllers for various compensators and power Filters.
CO 4	Design and Develop a suitable compensator and filter for a system.

Reference Books	
1.	Power Quality Problems and Mitigation Techniques, Bhim Singh, Ambrish Chandra, Kamal Al- Haddad, 1st Edition, 2015, John Wiley Publisher, ISBN: ISBN: 978-1-118-92205-7.
2.	Understanding Power Quality Problems: Voltage Sags and Interruptions, Math H.J. Bollen, 1st Edition, 1999, Wiley India Pvt Ltd Publisher, ISBN-13: 978-8126530397.
3.	Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh and Gerard Ledwich, 1st Edition, 2002, Kluwer Academic Press, ISBN 1-4020-7180-9.
4.	Power Quality, C. Sankaran , CRC Press, 1st Edition, 2002, ISBN: 0-8493-1040-7.

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

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

Semester: VII						
ENERGY ESTIMATION AND COSTING **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE74HA		**CIE**	**:**	100Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
General Principles of Estimation: Purpose of Estimating and costing, electrical schedule, catalogues, market survey, recording of estimates, determination of required quantity of material, labour conditions. Determination of cost of material and labour, contingencies, overhead charges, profit, purchase system, purchase enquiry and selection of appropriate purchase mode. Comparative statements, Purchase order, payment of bills. Tender form.	
Unit – II	**09 Hrs**
Wiring System: Introduction, distribution board, methods of wiring, insulating materials, types of cables. Conduit accessories and fittings. **Residential building electrification:** lighting circuits. General rules & guidelines, Determination of total load, procedure of designing the circuits and deciding the sub circuits. **Estimation:** size of conductor, Sequence to be followed to prepare estimate, preparation of detailed estimates and costing of residential installation. **Inspection and testing of installations:** Inspection of internal wiring, Testing of wiring installation. General idea about IE rules, major applicable IE rules and standards.	
Unit –III	**09 Hrs**
Electrification of commercial installation: Fundamental considerations for planning of an electrical installation system for commercial building. Design considerations for commercial building. Preparation of detailed estimate and costing of commercial installation and Standards. **Electrical wiring and installation for power circuits:** Motor installation. input power, input current to motors. Estimation of power circuits with standards.	
Unit –IV	**09 Hrs**
Design and Estimation of overhead transmission and distribution: Introduction, typical AC electrical power system, main components of overhead lines, line supports. Factors governing height of pole, conductor material, determination of size of conductor, cross arms, ole brackets and clamps, guys and stays. Conductors configuration, spacing and clearances, span lengths, overhead line insulators, insulator materials, types of insulators. Lightning arresters, phase plates, danger plates, ant climbing devices bird guards etc. Erection of supports, fixing of cross arms, insulators, conductor erection. Dear end clamps. Earthing of transmission lines. Guarding of overhead lines	
Unit –V	**09 Hrs**
Design of substations & Standards: Introduction, classification of substations, indoor substations, outdoor substations, selection and location of site for substation. Main electrical connections, graphical symbols for various types of apparatus and circuit elements, key diagrams of typical substations. Equipment for substations and switchgear installations, axillaries supply. Substation earthing. Concept of Internal Rate of Return(IRR). **Standards:** IEC 61850, IEC 60439, IEC 61439	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the estimating, costing and tender.
CO 2	Apply the technical knowledge in estimating the quantity of materials required for domestic and industrial electrification process.
CO 3	Design the circuits and sub circuits required for electrifying the commercial and power installation
CO 4	Design and estimate for the transmission lines and substation.

Reference Books	
1.	Electrical installation estimating and costing, J.B.Gupta, , 8th Edition, S.K Kataria and sons, New Delhi, 2013, ISBN : 9788188458998.
2.	Electrical Design Estimating and costing, K. Raina, S.K Bhattacharya, New age international, First Edition, 2005, ISBN: 81-224-0363-8.
3.	Electrical Wiring Estimating and Costing, Uppal, Khanna Publishers, Delhi. I.E Rules and Act Manuals, First Edition, 2012, ISBN: 8174092404, 9788174092403.
4.	Electrical Design Estimating and Costing, K .B. Raina, Bhatyachar, 2nd Edition, 2017, New Age International Private Limited, ISBN-13 : 978-8122443585.

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

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

Semester: VII						
ELECTRIC DRIVES AND APPLICATIONS **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE74HB		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

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

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Analyse the specifications, selection of drive system for a given application.
CO2	Design the electric drive system as per given specifications.
CO3	Analyse and Develop the control modules for closed loop operation of an electric drive system.
CO4	Evaluate the issues related to effect of harmonics and external disturbances of electric drives.

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

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

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

Semester: VII						
HYBRID ELECTRIC VEHICLES **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE74HC		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3Hours**

Unit-I	**10 Hrs**
Introduction to HEVs: Definition and classification of HEVs, History and evolution of HEVs, Types of HEVs (series, parallel, combined, plug-in hybrids), Benefits and challenges of HEVs compared to conventional vehicles, Environmental and Societal Impact. **HEV Components:** **Internal Combustion Engines in HEVs:** Downsizing and hybridization strategies for efficiency, Operating modes (Atkinson cycle, Miller cycle), Control strategies for emissions and fuel economy. **Electric Motors for HEVs:** DC motors, AC motors, Brushless DC motors (BLDC motors), Characteristics and selection criteria for HEV applications, Control strategies for torque and speed regulation. **Batteries for HEVs:** Types of batteries (Lead-acid, Nickel-metal hydride, Lithium-ion), Battery management systems (BMS), Charging infrastructure and standards, Degradation and lifespan of batteries. **Power Electronics in HEVs:** DC-DC converters, inverters, and other power electronics components, Function and control methods, Impact on efficiency and performance.	
Unit – II	**8 Hrs**
HEV Architectures and Design Considerations: In-depth analysis of series, parallel, combined, and other architectures, Working principles, advantages, and disadvantages of each architecture, Case studies of real-world HEV architectures (e.g., Toyota Prius, Chevrolet Volt). **Power Flow Management Strategies:** Rule-based, energy optimization, and equivalent fuel consumption methods, Regenerative braking and its impact on HEV efficiency, Control algorithms for power flow management. **Design Considerations:** Performance, fuel efficiency, emissions, cost, and drivability trade-offs, Component sizing and selection based on design goals, Optimization techniques for HEV design.	
Unit –III	**8 Hrs**
Advanced HEV Technologies and Optimization: Supercapacitors and Flywheels: Potential of supercapacitors and flywheels in HEVs, Energy storage characteristics and integration strategies, Benefits and challenges compared to batteries. **Fuel Cells in HEVs:** Operating principles and types of fuel cells (e.g., PEMFC), Integration challenges and potential benefits for HEVs, Future outlook and development of fuel cell technology. **HEV Optimization Techniques:** Genetic algorithms, simulated annealing, and other optimization methods, Application to specific HEV design parameters (e.g., motor size), Optimization for performance, fuel efficiency, and cost.	
Unit –IV	**8 Hrs**
Connected and Autonomous HEVs: Vehicle-to-infrastructure (V2X) communication and its benefits, Real-time traffic data, route optimization, and eco-driving features, Cybersecurity and privacy considerations. **Autonomous HEVs:** Levels of autonomy and their impact on HEV design, Challenges of integrating autonomous driving features into HEVs, Ethical considerations and safety regulations. **Case Studies:** In-depth analysis of specific connected or autonomous HEV projects (e.g., Waymo self-driving taxi with hybrid drivetrain), Discussion of technical achievements, challenges faced, and future potential.	
Unit –V	**8 Hrs**
HEV Market Trends and Future Outlook: Global and regional market trends for HEVs, Key drivers and challenges impacting HEV adoption, Consumer preferences and market segmentation. Policy and Regulations: Government policies and regulations promoting HEVs (e.g., tax credits, fuel economy standards), Impact of policies on market development and technology advancement. Future Outlook: Emerging technologies with potential to transform HEVs (e.g., solid-state batteries, advanced sensors), Long-term vision for the future of HEVs and their role in sustainable transportation.	

Experiential Learning: Students will propose and develop a plan for a future HEV design, considering technical feasibility, market potential, and societal impact.

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the fundamental principles and operation of hybrid electric vehicles (HEVs), including key components, architectures, and their impact on efficiency and emissions.
CO 2	Analyze the performance and design trade-offs of different HEV architectures, considering factors like fuel efficiency, emissions, cost, and drivability
CO 3	Critically evaluate emerging technologies for HEVs (e.g., supercapacitors, fuel cells, connected/autonomous features) and assess their potential impact on the future of transportation.
CO 4	Develop and present a comprehensive plan for a future HEV design, considering technical feasibility, market potential, and societal impact.

Reference Books	
1.	Martin Westbrook, "**Hybrid Electric Vehicles: Principles and Applications",** Wiley-Blackwell, 3rd Edition, 2021, ISBN: 978-1-119-62431-9.
2.	Mehrdad Ehsani, Yimin Gao, and Ali Emadi**, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design",** CRC Press, 3rd Edition, 2018, ISBN: 978-1-4822-8498-7.
3.	Davide Delprat, Daniel-Alexandre Murgovski, and Alessandro Tribioli, "**Design Optimization of Electric Vehicles: A Review of Literature and Best Practices",** John Wiley & Sons, 2022, ISBN: 978-1-119-60542-5.
4.	Daniel J. Graham, "**Cooperative, Connected, and Automated Vehicles: Technology, Implementation, and Impact",** CRC Press, 2nd Edition, 2018, ISBN: 978-1-4987-5405-7.
5.	John Danaher, "**The Ethics of Artificial Intelligence",** John Wiley & Sons, 2nd Edition, 2022, ISBN: 978-1-119-70058-2.
6.	Francis Ingram, "**Electric Vehicles and the Future of the Grid",** Routledge, 2022, ISBN: 978-1-032-10534-5.

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

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

Semester: VII						
ARTIFICIAL INTELLIGENCE IN SMARTGRID **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE74HD		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Overview of Smart Grids: Evolution, architecture, and components. **Smart Grid Communication and Data Flow**: IoT in smart grids, data acquisition, communication protocols. **Basics of Artificial Intelligence**: Definitions, scope, and relevance of AI in smart grid applications. **AI Techniques for Smart Grids**: Overview of machine learning (ML), deep learning (DL), and reinforcement learning (RL). **Applications of AI in Smart Grids**: Load forecasting, fault detection, and demand-side management. **Case Studies**: Successful AI deployments in smart grids.	
Unit – II	**09 Hrs**
Data Analytics in Smart Grids: Types of data (load, energy, weather), data preprocessing, and cleaning **Machine Learning Techniques for Forecasting**: Regression, time-series analysis, and neural networks **Load and Price Forecasting Models**: Short-term and long-term forecasting models **Renewable Energy Generation Forecasting**: Wind and solar energy prediction models **Demand Response and Prediction Techniques**: Adaptive demand response, peak load prediction, and consumption patterns	
Unit –III	**09 Hrs**
Optimization in Smart Grids: Introduction to optimization methods for grid efficiency and cost reduction **Linear Programming and Genetic Algorithms**: Basics and applications in power system optimization **Optimization for Power Quality and Loss Minimization**: Reducing technical losses, voltage control, and power factor correction **Renewable Energy and Storage Optimization**: Optimizing energy dispatch from renewables and energy storage integration **AI-driven Control Strategies for EV Charging**: Scheduling and load balancing for EV charging stations in microgrids	
Unit –IV	**09 Hrs**
Automated Control in Smart Grids: Supervisory control and data acquisition (SCADA) systems **AI in Fault Detection and Self-Healing Mechanisms**: Anomaly detection, fault diagnosis, and grid resiliency **Reinforcement Learning for Grid Control**: Basics of RL, applications for grid stabilization, voltage regulation **Smart Inverters and Control of Distributed Energy Resources (DERs)**: Role of AI in managing DERs in real-time **Power Quality Management**: Voltage regulation, harmonic analysis, and mitigation using AI	
Unit –V	**09 Hrs**
AI for Renewable Energy Integration and Microgrids: Managing distributed generation, forecasting, and demand response **Microgrid Design for EV-friendly Smart Grids**: AI for optimal EV charging scheduling in microgrids with renewables **Cybersecurity in Smart Grids**: AI applications for intrusion detection and grid security **Blockchain and AI Integration in Energy Trading**: Smart contracts, peer-to-peer energy trading, and	

data privacy **Case Studies and Future Trends**: Real-world AI applications in smart grids, exploring the future of AI-enabled smart grid technology

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the foundational concepts of smart grids and the role of artificial intelligence in enhancing grid operations and efficiency.
CO 2	Apply data analytics and machine learning techniques to forecast energy demand, predict renewable generation, and optimize load management in smart grids.
CO 3	Utilize optimization and control algorithms to enhance power quality, grid stability, and effective integration of renewable energy and electric vehicles in microgrid environments.
CO 4	Design and evaluate AI-based intelligent control systems for fault detection, self-healing, and real-time automation in smart grid systems, demonstrating problem-solving skills in real-world scenarios.

Reference Books	
1.	Kevin Warwick, Arthur Ekwue, Rag Aggarwal, "Artificial Intelligence Techniques in Power Systems", Institution of Engineering and Technology(IET), 1st Edition, 1997, ISBN,:978-0852968970.
2.	Fereidoon Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press Inc., 1st Edition, 2011, ISBN: 978-0123864529.
3.	J. Han, M. Kamber, J. Pei, "Data Mining. Concepts and Techniques", Third edition, Morgan Kaufman, 3rd Edition, 2011, ISBN: 978-0123814791

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

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

Semester: VII						
DISTRIBUTED GENERATION AND MICROGRID **Category: Professional Elective Course** **(Theory)**						
Course Code	**:**	21EE74HE		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3Hours**

Unit-I	**8 Hrs**
DISTRIBUTED GENERATION: Energy Sources and their availability -trends in energy consumption, conventional and non-conventional energy sources – review of solar photovoltaic – wind energy systems – fuel cells, energy storage systems: batteries – ultra capacitors – fly wheels – captive power plants. Distributed generation – concept and topologies, renewable energy in distributed generation. IEEE 1547 Standard for interconnecting distributed generation to electric power systems – DG installations – siting and sizing of DGs – optimal placement – regulatory issues.	
Unit – II	**8 Hrs**
MICROGRIDS: Concept of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control.	
Unit –III	**8 Hrs**
MODELING OF CONVERTERS: Introduction – Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC Inverters, Pulse Width Modulation Methods, Micro grid of Renewable Energy Systems- DC/DC Converters in Green Energy -Pulse Width Modulation -Sizing of an Inverter for Microgrid Operation, Sizing of a Rectifier for Microgrid Operation, The Sizing of DC/DC Converters for Micro grid.	
Unit –IV	**8 Hrs**
CHALLENGES IN MICROGRIDS: Microgrid economics, Cyber security in micro grids, Stability aspects of microgrids, Fault analysis in Networked Micro grids. Protection issues, anti-islanding schemes: passive, active and communication based techniques Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions.	
Unit –V	**X Hrs**
ISSUES IN GRID INTEGRATION OF DISTRIBUTED ENERGY RESOURCES: Basic requirements of grid interconnections – operational parameters – voltage, frequency and THD limits – grid interfaces – inverter based DGs and rotary machines based DGs – reliability, stability and power quality issues on grid integration – impact of DGs on protective relaying and islanding issues in existing distribution grid. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyse the distribution generation and modelling the converter
CO 2	Analyse the challenges in Microgrid
CO 3	Design the converter for grid integration system with conventional and non-conventional energy sources
CO 4	Develop the strategies for power system security and PQ issues

Reference Books	
1.	Voltage Source Converters in Power Systems: Modeling, Control and Applications, AmirnaserYezdani, and Reza Iravani, IEEE John Wiley Publications 2.
2.	Power Switching Converters: Medium and High Power", Dorin Neacsu, CRC Press, Taylor &Francis, 2006
3.	Solar Photo Voltaics, Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009
4.	Fuel Cell Handbook, EG&G Technical Services, Inc, US Dept of Energy, seventh edition, 2004

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

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

Semester: VII						
UNMANNED AERIAL VEHICLES **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21AS75IA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Introduction to Unmanned Aerial Vehicles (UAVs): History of UAVs, Need of unmanned aerial systems, Overview of UAV Systems-System Composition, Classes and Missions of UAVs-Classification of UAVs based on size, range and endurance, Applications, Examples of UAVs	
Unit – II	**11 Hrs**
Aerodynamics & Propulsion aspects of UAVs: Basic Aerodynamic Equations, Air foils, lift, drag, moments, Aircraft Polar, The Real Wing and Airplane, Induced Drag, Total Air-Vehicle Drag, Flapping Wings, Rotary wings. **Propulsion:** Thrust Generation and basic thrust equation, Sources of Power for UAVs- Piston, Rotary, Gas turbine engines, electric or battery powered UAVs.	
Unit –III	**08 Hrs**
Airframe of UAVs: Mechanic loading, basics of types of load calculation and structural engineering, Material used for UAV (general introduction), FRP and methods of usage in UAV, Testing of FRP specimens for UAV, selection criteria for structure, Types of structural elements used in UAV their significance and characteristics, Methods of manufacturing UAV structure.	
Unit –IV	**10 Hrs**
Payloads for UAVs: Barometers, Accelerometer, Magnetometer, RADAR and range finder, Non-dispensable and dispensable Payloads- Optical, electrical, weapon, imaging payloads.	
Unit –V	**08 Hrs**
Mission Planning and Control: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand the role of UAVs in the current generation for diverse applications ranging from commercial to military purposes
CO 2	Apply the fundamental concepts of Aerospace Engineering to Design a UAV for a particular Mission and application
CO 3	Evaluate the performance of UAV with a perspective of Aerodynamics, Propulsion, Structures for a given Mission
CO 4	Critically appraise and optimize the performance of the UAV for a given Mission profile

Reference Books	
1.	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2020 edition
2.	V.N. Shukla's Constitution of India by Prof (Dr.) Mahendra Pal Singh (Revised) Edition: 13th 2017, Reprinted with Supplement 2021
3.	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN -13:978-9351452461
4.	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400

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

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

Semester: VII						
HEALTHCARE ANALYTICS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21BT75IB		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

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

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Comprehend Bioinformatics Tools: Understand and effectively utilize various bioinformatics tools and databases for sequence and structure analysis.
CO 2	Investigate and apply innovative sequencing technologies and analytical methods to solve complex biological questions and advance research in genomics and molecular biology.
CO 3	Analyze Next-Generation Sequencing: Proficiency in NGS technologies, including data quality assessment and read processing techniques and handle big data.
CO 4	Apply bioinformatics tools to model and simulate various biological processes, leveraging gene prediction programs including both ab initio and homology-based approaches.

Reference Books	
1.	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2020 edition.
2.	V.N. Shukla's Constitution of India by Prof (Dr.) Mahendra Pal Singh (Revised) Edition: 13th 2017, Reprinted with Supplement 2021.
3.	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN -13:978-9351452461
4.	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400

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

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

Semester: VII						
SUSTAINABILITY AND LIFE CYCLE ANALYSIS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21CH75IC		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction to sustainability: Introduction to Sustainability Concepts and Life Cycle Analysis, Material flow and waste management, Chemicals and Health Effects, Character of Environmental Problems	
Unit – II	**09 Hrs**
Environmental Data Collection and LCA Methodology: Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology. – Goal, Definition.	
Unit –III	**09 Hrs**
Life Cycle Assessment: Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Benefits and Drawbacks. **Wet Biomass Gasifiers:** Introduction, Classification of feedstock for biogas generation, Biomass conversion technologies: Photosynthesis, Biogas generation, Factors affecting bio-digestion, Classification of biogas plants, Floating drum plant and fixed dome plant their advantages and disadvantages.	
Unit –IV	**09 Hrs**
Design for Sustainability: Green Sustainable Materials, Environmental Design for Sustainability. **Dry Biomass Gasifiers:** Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems:	
Unit –V	**09 Hrs**
Case Studies: Odor Removal for Organics Treatment Plant, Bio-methanation, Bioethanol production. Bio fuel from water hyacinth.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand the sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society.
CO 2	Identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues.
CO 3	Apply scientific method to a systems-based, trans-disciplinary approach to sustainability
CO 4	Formulate appropriate solutions based on scientfic research, applied science, social and economic issues.

Reference Books	
1.	Sustainable Engineering Principles and Practice, Bavik R Bhakshi, 2019, Cambridge University Press, ISBN - 9781108333726.
2.	Environmental Life Cycle Assessment , Olivier Jolliet, Myriam Saade-Sbeih, Shanna Shaked, Alexandre Jolliet, Pierre Crettaz , 1st Edition, CRC Press, ISBN: 9781439887660 .
3.	Sustainable Engineering: Drivers, Metrics, Tools, and Applications, Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams, 2019, John Wiley & Sons , ISBN-9781119493938

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

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

Semester: VII						
ADVANCES IN CORROSION SCIENCE AND MANAGEMENT **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21CM75ID		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Basics of corrosion: Introduction: Galvanic series, Pilling-Bedworth ratio, Types: Galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, erosion corrosion, stress corrosion, season cracking, hydrogen embrittlement, bacterial corrosion. **Corrosion in different engineering materials:** Concrete structures, duplex, stainless steels, ceramics, composites.	
Unit – II	**09 Hrs**
Corrosion mechanism: Electrochemical theory of corrosion, Crevice corrosion-mechanism of differential aeration corrosion, mixed potential theory for understanding common corrosion of metals and alloys. **Thermodynamics of Corrosion:** Pourbaix diagram and its importance in metal corrosion and its calculation for Al, Cu, Ni and Fe.	
Unit –III	**09 Hrs**
Effects of corrosion: The direct and indirect effects of corrosion, economic losses, Indirect losses -Shutdown, contamination, loss of product, loss of efficiency, environmental damage, Importance of corrosion prevention in various industries, corrosion auditing in industries, corrosion map of India. Corrosion issues in specific industries-power generation, chemical processing industries, oil and gas Industries, corrosion effect in electronic industry.	
Unit –IV	**09 Hrs**
Corrosion Testing and monitoring: Introduction, classification. Purpose of corrosion testing, materials, specimen. Surface preparation, measuring and weighing. Types of testing, lab, pilot plant and field tests. Measurement of corrosion rate, weight loss method, CPR numericals, Electrochemical methods, Tafel extrapolation. Linear polarization method.	
Unit –V	**09 Hrs**
Corrosion Control: Principles of corrosion prevention, material selection, design considerations, control of environment- decrease in velocity, passivity, removal oxidizer, Inhibitors and passivators, coatings- organic, electroplating of Copper, Nickel and Chromium, physical vapor deposition-sputtering, Electroless plating of Nickel.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand the causes and mechanism of various types of corrosion
CO 2	Apply the knowledge of chemistry in solving issues related to corrosion.
CO 3	Analyse and interpret corrosion with respect to practical situations.
CO 4	Develop practical solutions for problems related to corrosion.

Reference Books	
1.	Corrosion Engineering, M.G, Fontana, 3rd Edition, 2005, Tata McGraw Hill, ISBN: 978-0070214637.
2.	Principles and Prevention of Corrosion, D. A Jones, 2nd Edition, 1996, Prentice Hall, ISBN: 978-0133599930.
3.	Design and corrosion prevention, Pludek, 1978, McMillan, ISBN: 978-1349027897
4.	Introduction to metal corrosion, Raj Narain, 1983, Oxford &IBH, ISBN: 8120402995.

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 adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VII						
PROMPT ENGINEERING **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21CS75IE		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction to Prompt Engineering Raise of Context Learning, Prompts, Prompt Engineering, LLM Settings, Basics of prompting, Elements of a Prompt, Settings for Prompting Language Model, General Tips for Designing Prompts, Designing Prompts for Different Tasks: few examples of common tasks using different prompts- Text Summarization, Information Extraction, Question Answering, Text Classification, Conversation/Role Playing, Code Generation, Reasoning	
Unit – II	**09 Hrs**
Techniques for Effective Prompts Techniques designed to improve performance on complex tasks - Zero-Shot Prompting, Few-shot prompting, Chain-of-thought (CoT) prompting, Zero-Shot CoT, Self-Consistency, Knowledge Generation Prompting, Program-aided Language Model (PAL), ReAct, Directional Stimulus Prompting	
Unit –III	**09 Hrs**
Best Practices in Prompt Engineering **Tools & IDEs** **Capabilities include:** Developing and experimenting with prompts, Evaluating prompts. Versioning and deploying prompts; Advanced prompting techniques: advanced applications with LLMs LLMs and external tools/APIs -- LLMs with External Tools; Data-augmented Generation – Steps, External Data, QA with sources, Summarization using sources	
Unit –IV	**09 Hrs**
Applications of Prompt Engineering: **LLM Applications:** Function Calling with LLMs - Getting Started with Function Calling, Function Calling with GPT-4, Function Calling with Open-Source LLMs. **Function Calling Use Cases:** Conversational Agents, Natural Language Understanding, Math Problem Solving, API Integration, Information Extraction.	
Unit –V	**09 Hrs**
Opportunities and Future Directions: Model safety, Prompt Injection, Prompt Leaking, Jail Breaking; Reinforcement Learning from Human Feedback (RLHF) -- Popular examples: aClaude (Anthropic), ChatGPT (OpenAI), **Future directions:** Augmented LMs, Emergent ability of LMs, Acting / Planning - Reinforcement Learning, Multimodal Prompting, Graph Prompting	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	**Demonstrate an understanding of prompt engineering principles** including how prompt structure and phrasing impact the performance of AI models.
CO 2	**Design and implement effective prompts-** to create and apply prompts for various natural language processing (NLP) tasks, such as text generation, summarization, and translation, using AI models.
CO 3	**Critically evaluate the effectiveness of prompts -** assess the quality and performance of prompts in terms of accuracy, coherence, and relevance, identifying areas for improvement.
CO 4	**Apply prompt engineering techniques in real-world scenarios -** use prompt engineering strategies to address practical problems in domains such as education, healthcare, and business, demonstrating the applicability of AI-driven solutions.
CO 5	**Collaborate on projects involving prompt engineering -** work effectively in teams to design, implement, and evaluate prompt-based solutions, showcasing their ability to contribute to complex AI-related projects.

Reference Books	
1.	Unlocking the Secrets of Prompt Engineering: Master the art of creative language generation to accelerate your journey from novice to pro , Gilbert Mizrahi, Jan 2024, 1st Edition, Packt Publishing, ISBN-13:978-1835083833
2.	Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, May 2024, O'Reilly Media, Inc.,ISBN: 9781098153434
3.	Prompt Engineering for LLMs, John Berryman, Albert Ziegler, O'Reilly Media, Inc. Dec 2024, ISBN: 9781098156152
4.	The Art of Asking ChatGPT for High-Quality Answers_ A Complete Guide to Prompt Engineering, Ibrahim John , Nzunda Technologies Limited, 2023, ISBN-13: 9781234567890
5.	Programming Large Language Models with Azure Open AI: Conversational programming and prompt engineering with LLMs, Francesco Esposito, Microsoft Pr, 1st Edition, April 2024,ISBN-13: 978-0138280376

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

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

Semester: VII						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21CV75IF		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring:** Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration**.**	
Unit – II	**09 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit:** Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence	
Unit –III	**09 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	
Unit –IV	**09 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	
Unit –V	**09 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Diagnose the distress in the structure understanding the causes and factors.
CO 2	Understand safety aspects, components and materials used in Structural Health Monitoring.
CO 3	Assess the health of structure using static field methods and dynamic field tests.
CO 4	Analyse behaviour of structures using remote structural health monitoring

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

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

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

Semester: VII						
WEARABLE ELECTRONICS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21EC75IG		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39 L		**SEE Duration**	**:**	3Hours

Unit-I	**07 Hrs**
Introduction: world of wearable (WOW), Role of wearable, The Emerging Concept of Big Data, The Ecosystem Enabling Digital Life, Smart Mobile Communication Devices, Attributes of Wearables, Taxonomy for Wearables, Advancements in Wearables, Textiles and Clothing, Applications of Wearables. [Ref 1: Chapter 1.1]	
Unit – II	**08 Hrs**
Wearable Bio and Chemical Sensors: Introduction, System Design, Microneedle Technology, Sampling Gases, Types of Sensors, Challenges in Chemical Biochemical Sensing, Sensor Stability, Interface with the Body, Textile Integration, Power Requirements, Applications: Personal Health, Sports Performance, Safety and Security, Case studies. [Ref 1: Chapter 2.1]	
Unit –III	**07 Hrs**
Wearable Textile: Conductive fibres for electronic textiles: an overview, Types of conductive fibre, Applications of conductive fibres, Bulk conductive polymer yarn, Bulk conductive polymer yarn, Techniques for processing CPYs, Wet-spinning technique, Electrospinning technique, case studies, Hands on project in wearable textile: Solar Backpack, LED Matrix wallet. [Ref 2: Chapter 1,2] &. [Ref 3: Chapter 6,9]	
Unit –IV	**08 Hrs**
Energy Harvesting Systems: Introduction, Energy Harvesting from Temperature Gradient, Thermoelectric Generators, Dc-Dc Converter Topologies, Dc-Dc Converter Design for Ultra-Low Input Voltages, Energy Harvesting from Foot Motion, Ac-Dc Converters, Wireless Energy Transmission, Energy Harvesting from Light, Case studies. [Ref 1: Chapter 4.1]	
Unit –V	**08 Hrs**
Wearable antennas for communication systems: Introduction, Background of textile antennas, Design rules for embroidered antennas, Integration of embroidered textile surfaces onto polymer substrates, Characterizations of embroidered conductive, textiles at radio frequencies, RF performance of embroidered textile antennas, Applications of embroidered antennas. [Ref 2: Chapter 10]	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Describe the different types and wearable sensors, textile, energy harvesting systems and antenna
CO 2	Analysis measurable quantity and working of wearable electronic devices.
CO 3	Determine & interpret the outcome of the wearable devices and solve the design challenges
CO 4	Analyse and Evaluate the wearable device output parameter in real time scenario or given problem statement.

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

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

Semester: VII						
E-MOBILITY **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21EE75IH		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**07 Hrs**
E-Mobility: A Brief History of the Electric Powertrain, Energy Sources for Propulsion and Emissions, The Advent of Regulations, Drive Cycles, BEV Fuel Consumption, Range, Carbon Emissions for Conventional and Electric Powertrains, An Overview of Conventional, Battery, Hybrid, and Fuel Cell Electric Systems, A Comparison of Automotive and Other Transportation Technologies. Vehicle Dynamics: Vehicle Load Forces, Vehicle Acceleration, Simple Drive Cycle for Vehicle Comparisons	
Unit – II	**08 Hrs**
Batteries: Batteries Types and Battery Pack, Lifetime and Sizing Considerations, Battery Charging, Protection, and Management Systems, Battery Models, Determining the Cell/Pack Voltage for a Given Output\Input Power, Cell Energy and Discharge Rate. **Battery Charging:** Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charging Standards and Technologies, SAE J1772, Wireless Charging, The Boost Converter for Power Factor Correction.	
Unit –III	**07 Hrs**
Battery Management System: BMS Definition, Li-Ion Cells, Li-Ion BMSs, Li-Ion Batteries, BMS Options: Functionality, CCCV Chargers, Regulators, Balancers, Protectors, Functionality Comparison, Technology, and Topology. Measurement: Voltage, Temperature, Current, Management: Protection, Thermal Management, Balancing, Distributed Charging, Evaluation, External Communication: Dedicated analog and digital wires.	
Unit –IV	**08 Hrs**
Electric Drive train: Overview of Electric Machines, classification of electric machines used in automobile drivetrains, modelling of electric machines, Power Electronics, controlling electric machines, electric machine and power electronics integration Constraints. **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.	
Unit –V	**08 Hrs**
Charger Classification and standards: classification based on charging, levels (region-wise), modes, plug types, standards related to: connectors, communication, supply equipments, EMI/EMC. **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 **Communications, Supporting Subsystems:** In vehicle networks- CAN	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Analyse the basics of electric and hybrid electric vehicles, their architecture, technologies and modelling.
CO 2	Discuss and implement different energy storage technologies used for electric vehicles and their management system.
CO 3	Analyze various electric drives and its integration techniques with Power electronic circuits suitable for electric vehicles.
CO 4	Design EV Simulator for performance evaluation and system optimization and understand the requirement for suitable EV charging infrastructure.

Reference Books	
1.	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, 1st Edition, 2018, Wiley, ISBN 9781119063667.
2.	Battery Management system for large Lithium Battery Packs, Davide Andrea, 1st Edition, 2010, ARTECH HOUSE, ISBN-13 978-1-60807-104-3.
3.	Hybrid Vehicles from Components to System, F. BADIN, Ed, 1st Edition, 2013, Editions Technip, Paris, ISBN 978-2-7108-0994-4.
4.	Modern Electric Vehicle Technology C.C. Chan and K.T. Chau, 1st Edition, 2001, Oxford university press, ISBN 0 19 850416 0.

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 adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
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3 & 4	Unit 2: Question 3 or 4	**16**
5 & 6	Unit 3: Question 5 or 6	**16**
7 & 8	Unit 4: Question 7 or 8	**16**
9 & 10	Unit 5: Question 9 or 10	**16**
	TOTAL	**100**

Semester: VII						
PROGRAMMABLE LOGIC CONTROLLER'S AND APPLICATIONS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21EI75IJ		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**07 Hrs**
Introduction: Introduction to Industrial Automation, Historical background, Different parts and types of Industrial automation, Block diagram of PLC, PLC Versus Other types of Controls, PLC Product Application Ranges, Fixed and Modular I/O Hardware PLC Operation: Binary Data representation, Input and output status files for modular PLC, Addressing concept.	
Unit – II	**08 Hrs**
PLC Hardware: The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications **Input and Output modules:** Brief overview of Discrete and Analog input modules, Discrete and TTL/Relay output modules	
Unit –III	**07 Hrs**
Basics of PLC Programming: Processor memory organization, Program scan, PLC programming languages, Basic Relay Instruction, Bit or relay instructions, NO, NC, One Shot, Output latching software, negated Output and Internal Bit Type instructions, mode of operations	
Unit –IV	**08 Hrs**
Special programming Instructions: Timer and Counter Instructions: On delay and Off delay and retentive timer instructions, PLC Counter up and down instructions, combining counters and timers. **Program Control &Data manipulation Instructions:** Data handling instructions, Sequencer instructions, Programming sequence output instructions.	
Unit –V	**08 Hrs**
SCADA & DCS Building Block of SCADA System, Hardware structure of Remote Terminal Unit, Block diagram of Distributive Control System **Case Studies:** Bottle filling system, Material Sorter. Elevator, Traffic control, Motor sequencers, Piston extraction and retraction using timers and counters.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand the basic concepts of PLC's and SCADA techniques.
CO 2	Apply the programming concepts to interface peripheral.
CO 3	Analyze and evaluate the automation techniques for industrial applications.
CO 4	Develop a system for automation application.

Reference Books	
1.	Programmable Logic controllers, Frank D. Petruzella, Mc Graw hill, 4th Edition, ISBN:9780073510880, 2017.
2.	Introduction to Programmable Logic Controllers, Garry Dunning, CENGAGE Learning, 3rd Edition, 2017, ISBN: 978-8131503027.
3.	Industrial Control and Instrumentation, Bolton W, Universities Press, 6th Edition, 2006. ISBN 978-0128029299.
4.	Computer Based Industrial control, Krishna Kant, PHI Publishers, 2nd Edition, 2010. ISBN 978-8120339880.

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 adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
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2	Unit 1: (Compulsory)	**16**
3 & 4	Unit 2: Question 3 or 4	**16**
5 & 6	Unit 3: Question 5 or 6	**16**
7 & 8	Unit 4: Question 7 or 8	**16**
9 & 10	Unit 5: Question 9 or 10	**16**
	TOTAL	**100**

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21ET75IK		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**07 Hrs**
Earth's environment: Atmosphere, ionosphere, Magnetosphere, Van Allen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. Launch Vehicles: Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.	
Unit – II	**08 Hrs**
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability, Payloads, Classification of satellites. Satellite structure: Satellite Communications, Transponders, Satellite antennas.	
Unit –III	**07 Hrs**
Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques**. Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Telemedicine, Satellite navigation, GPS.	
Unit –IV	**08 Hrs**
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. Metrology: Weather forecast (Long term and Short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.	
Unit –V	**08 Hrs**
Space Missions: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and International space Missions. **Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Interspace communication systems.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Explain various Orbital Parameters, Satellite Link Parameters, Propagation considerations and Radar systems.
CO 2	Apply the concepts to determine the parameters of satellite, performance of radar and navigation systems.
CO 3	Analyze the design issues of satellite and its subsystems, radars and navigation systems.
CO 4	Evaluate the performance of the satellite systems and its parameters, radar and navigation systems

Reference Books	
1.	Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN- 10:0415465702.
2.	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN: 9788120324015.
3.	Satellite Communication, Timothy Pratt, John Wiley, 1986 ISBN: 978-0-471- 37007 -9, ISBN 10: 047137007X.
4.	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.

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

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

Semester: VII						
MOBILE APPLICATION DEVELOPMENT **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21IS75IL		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

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

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of Android application and its architecture.
CO 2	Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications.
CO 3	Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools.
CO 4	Create innovative applications, understand the economics and features of the app marketplace by offering the applications for download.

Reference Books	
1.	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN:13 978-0134171494
2.	AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3.	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4.	Professional Android2ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898

5.	BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1
6.	AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

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

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

Semester: VII						
PROJECT MANAGEMENT **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21IM75IM		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction: Project, Project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge. **Generation and Screening of Project Ideas:** Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value.	
Unit – II	**09 Hrs**
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Organizational influences & Project life cycle:** Organizational influences on project management, project state holders & governance, project team, project life cycle.	
Unit –III	**09 Hrs**
Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase. **Project Quality management:** Plan quality management, perform quality assurance, control quality.	
Unit –IV	**09 Hrs**
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Scheduling:** Project implementation scheduling, Effective time management, Different scheduling techniques, Resources allocation method, PLM concepts. Project life cycle costing.	
Unit –V	**09 Hrs**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand the fundamental concepts of project management and its relationship with organizational strategy, operations management, and business value.
CO 2	Apply techniques for generating, screening, and evaluating project ideas, considering factors such as net present value and project rating index.
CO 3	Create Work Breakdown Structures (WBS), utilization of PERT/CPM for developing project schedule, alongside requirement collection, scope definition, scope validation, and scope control.
CO 4	Develop skills in project integration, quality, risk management, and scheduling, enabling effective project planning, execution, monitoring, and control.

Reference Books	
1.	Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2.	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3.	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
4.	Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

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

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

Semester: VII						
SUPPLY CHAIN ANALYTICS **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21IM75IN		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction: Supply Chain, Supply Chain Management, Business Analytics, Supply Chain Analytics. **Data-Driven Supply Chains and Intro to Python:** Data and its value in SCM, Data Source in Supply Chains, Big Data, Introduction to Python (Concepts only).	
Unit – II	**09 Hrs**
Data Manipulation: Data Manipulation, Data Loading and Writing, Data Indexing and Selection, Data Merging and Combination, Data Cleaning and Preparation, Data Computation and Aggregation, Working with Text and Datetime Data (Concepts only).	
Unit –III	**09 Hrs**
Customer Management: Customers in Supply Chains, Understanding Customers, Building a Customer-Centric SC, Cohort Analysis, RFM Analysis, Clustering Algorithms (Concepts only). **Supply Management:** Procurement in Supply Chains, Supplier Selection, Supplier Evaluation, Supplier Relationship Management, Supply Risk Management, Regression Algorithms (Concepts only).	
Unit –IV	**09 Hrs**
Warehouse and Inventory Management: Warehouse Management, Inventory Management, Warehouse Optimization, Classification Algorithms (Concepts only). **Demand Management:** Demand Management, Demand Forecasting, Time Series Forecasting, Machine Learning Methods (Concepts only).	
Unit –V	**09 Hrs**
Logistics Management: Logistics Management, Modes of Transport in Logistics, Logistics Service Providers, Global Logistics Management, Logistics Network Design, Route Optimization (Concepts only).	
Experiential Learning: **Data Visualization:** Data Visualization in Python, creating a Figure in Python, formatting a Figure, Plotting Simple Charts, Plotting with Seaborn, Geographic Mapping with Basemap, Visualizing Starbucks Locations. Python programming for various algorithms applied to supply chain processes and modelling included in the five units of the syllabus.	

Course Outcomes: After completing the course, the students will be able to:	
CO 1	Understand supply chain concepts, systemic and strategic role of SCM in global competitive environment.
CO 2	Evaluate alternative supply and distribution network structures using optimization models.
CO 3	Develop optimal sourcing and inventory policies in the supply chain context.
CO 4	Select appropriate information technology frameworks for managing supply chain processes.

Reference Books	
1.	Kurt Y. Liu, Supply Chain Analytics - Concepts, Techniques and Applications, Palgrave – Macmillan, Springer Nature Switzerland AG, 2022, ISBN 978-3-030-92224-5 (eBook)
2.	Işık Biçer, Supply Chain Analytics - An Uncertainty Modeling Approach, 2023, Springer Texts in Business and Economics, Springer Nature Switzerland AG, e-ISSN 2192-4341, e-ISBN 978-3-031-30347-0
3.	Supply Chain Management – Strategy, Planning & Operation, Sunil Chopra, Peter Meindl & D V Kalra, 6th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2.
4.	Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135–5

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

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

Semester: VII						
NUCLEAR ENGINEERING **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21ME75IO		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction to Nuclear Engineering Historical Development of Nuclear Engineering, Overview of Nuclear Energy Applications, Nuclear Physics Fundamentals: Atomic Structure and Nuclear Models: Nuclear Forces and Interactions, Nuclear Reactions and Cross-sections, Types of Nuclear Reactions: Fission and Fusion Reactions, Neutron-Induced Reactions, Applications in Power Generation and Industry, Nuclear Power Generation: Basic Principles of Nuclear Reactors, Types of Nuclear Reactors, Radiation Basics, Types of Radiation (Alpha, Beta, Gamma), Radioactive Decay and Decay Chains, Units of Radioactivity and Radiation Measurement	
Unit – II	**09 Hrs**
Nuclear Reactors Types of Nuclear Reactors, Reactor Components and Their Functions, Nuclear Reactor Kinetics and Control, Neutron Interactions and Transport, Neutron Moderation and Absorption, Reactor Kinetics and Dynamics, Specific Types of Nuclear Reactor, Light Water Reactors: Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR), Heavy Water Reactors: Canada Deuterium Uranium (CANDU), Gas-Cooled Reactors: Gas-Cooled Reactor and Fast Breeder Reactor (and HTGR), Liquid Metal-Cooled Reactors (LMFR).	
Unit –III	**09 Hrs**
Nuclear Fuel Cycle Introduction to the Nuclear Fuel Cycle: Importance of Fuel Cycle Management, Uranium Mining and Ore Processing, Types of Uranium Deposits, Mining Methods and Processing Techniques, Environmental and Health Considerations, Uranium Enrichment and Fuel Fabrication: Enrichment Technologies (Centrifugation, Gaseous Diffusion), Fuel Fabrication Processes, Quality Control and Safety Measures, Nuclear Reactors and Fuel Utilization: Fuel Assembly Design and Composition.	
Unit –IV	**09 Hrs**
Radiation Protection and Safety Basics of Ionizing Radiation, Types of Ionizing Radiation, Interaction of Radiation with Matter, Units of Radiation Measurement, Biological Effects of Radiation, Deterministic and Stochastic Effects, Acute and Chronic Radiation Effects, Risk Assessment and Dose, Response Relationships, Radiation Dose Assessment: External and Internal Dosimetry, Radiation Monitoring Devices, Occupational and Public Dose Limits, Radiation Safety Measures:, Emergency Response and Contingency Planning: Emergency Procedures and Drills, Communication Strategies During Radiation Incidents.	
Unit –V	**09 Hrs**
Environmental and Societal Aspects **Environmental Impact Assessment:** Life Cycle Analysis of Nuclear Energy, Impact of Uranium Mining and Fuel Cycle Operations, Radioactive Waste Management and Environmental Considerations, Societal Perceptions and Attitudes, Factors Influencing Public Perception. **Ethical Considerations:** Principles of Ethics in Nuclear Engineering, Nuclear Energy and Social Justice, Ethical Dilemmas in Nuclear Technology, Nuclear Energy and Climate Change: Carbon Footprint of Nuclear Power.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand nuclear physics: grasp atomic structure, nuclear models, and the forces driving nuclear interactions
CO 2	Evaluate various reactor types and advanced concepts, applying kinetics and controls to ensure safe and efficient nuclear reactor analysis and design.
CO 3	Examine the nuclear fuel cycle from mining to recycling, assess environmental impact and safety, and promote responsible, sustainable practices throughout.
CO 4	Apply ionizing radiation principles for safety measures; integrate communication and regulatory compliance into emergency response plans effectively.

Reference Books	
1.	Bodansky, D. (2007). "Nuclear Energy: Principles, Practices, and Prospects." Springer. ISBN-13: 978-0387261994.
2.	Lamarsh, J. R., & Baratta, A. J. (2001). "Introduction to Nuclear Engineering." Prentice Hall. ISBN-13: 978-0201824988.
3.	Duderstadt, J. J., & Hamilton, L. J. (1976). "Nuclear Reactor Analysis." John Wiley & Sons. ISBN-13: 978-0471223634.
4.	Knoll, G. F. (2008). "Radiation Detection and Measurement." John Wiley & Sons. ISBN-13: 978-0470131480

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO	**CONTENTS**	**MARKS**
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	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: VII						
COGNITIVE PSYCHOLOG **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21HS75IQ		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Fundamentals & current trends in cognitive psychology: Definition, Emergence of cognitive psychology, Cognitive development theories and perspectives; Current status and trends in cognitive Psychology. Research methods in cognitive psychology- goals of research. Distinctive research method. Current areas of research in cognitive psychology, (Educational application, marketing and advertisement).	
Unit – II	**09 Hrs**
Basic cognitive processes: Sensation and Perception: Sensory receptors and Brain, The constancies, pattern recognition, Modularity, Imagery: Characteristics of Imagery, Cognitive maps. Attention and Information processing: Nature and Types, Theories and models of attention. Neuropsychological studies of Attention. Consciousness: – meaning, Modern Theories and Contemporary Research of Consciousness.	
Unit –III	**09 Hrs**
Reasoning, Creativity and Problem-Solving: Reasoning definition, types, influencing factors. Creativity-definition, steps involved in creative process, obstacles involved in creativity, enhancing techniques of creativity. Metacognition: Problem-solving, steps in problem solving, types, methods, obstacles, and aids of problem-Solving. Concept of Design Thinking	
Unit –IV	**09 Hrs**
Psycholinguistics: Definition, characteristics of language, theories - Chomsky. Structure of Language (Properties), Stages in Language Development, Neurological Language. Comprehension and Production. Bilingualism, Multilingualism and Learning disability.	
Unit –V	**09 Hrs**
Cognitive Neuroscience: Definition and emergence of cognitive neuroscience, Scope of Neuroscience, structure and functions of Brain, Brain Plasticity, Intelligence and Neuroscience. Meta-cognitive strategies. Artificial intelligence, Robotics, Models on Information Processing.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Describe the basic theories, principles, and concepts of cognitive psychology as they relate to behaviours and mental processes.
CO 2	Define learning and compare and contrast the factors that cognitive, behavioural, and Humanistic theorists believe influence the learning process.
CO 3	Develop understanding of psychological attributes such as reasoning, problem solving creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO 4	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.

Reference Books	
1.	Sterberg R.J and Sternberg Karin(2012) Cognitive Psychology 6th Edition Woods worth Cenguage Learning
2.	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.
3.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
4.	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India

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

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3 & 4	Unit 2: Question 3 or 4	**16**
5 & 6	Unit 3: Question 5 or 6	**16**
7 & 8	Unit 4: Question 7 or 8	**16**
9 & 10	Unit 5: Question 9 or 10	**16**
	TOTAL	**100**

Semester: VII						
PRINCIPLES AND PRACTICES OF CYBER LAW **Category: Institutional Electives-II Group I** **(Theory)**						
Course Code	**:**	21HS75IR		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3Hours

Unit-I	**09 Hrs**
Introduction - Origin and meaning of Cyberspace; Introduction to Indian Cyber Law, Distinction between Cyber Crime and Conventional Crime, Cyber Criminals and their Objectives, Kinds of Cyber Crime & Cyber Threats, challenges of cybercrimes, Overview of General Laws and Procedures in India. **Cyber Jurisdiction** - Concept of Jurisdiction, Jurisdiction in Cyberspace, Issues and concerns of Cyberspace Jurisdiction in India, International position of Cyberspace Jurisdiction, Judicial interpretation of Cyberspace Jurisdiction. **Activities:** Case Studies and Practical Applications	
Unit – II	**09 Hrs**
Information Technology Act: A brief overview of Information Technology Act 2000, IT Act 2000 vs. IT Amendment Act 2008, Relevant provisions from Indian Penal Code, Indian Evidence Act, Bankers Book Evidence Act, Reserve Bank of India Act, etc. **Electronic Signature and Digital Signature** - Meaning & Concept of Relevance of Signature, Handwritten signature vs Digital Signature, Technological Advancement and development of signature, Digital Signature: IT Act, 2000, Cryptography, Public Key and Private Key, Public Key Infrastructure Electronic Signature vs. Digital Signature, E-Commerce under IT Act 2000, Issues and challenges of E-Commerce. **Activities:** Case Studies and Practical Applications	
Unit –III	**09 Hrs**
Data Protection and Privacy Concerns in Cyberspace - Need to protect data in cyberspace, Types of data, Legal framework of data protection, Data protection bill -an overview, GDPR, Concept of privacy, Privacy concerns of cyberspace, Constitutional framework of privacy, Judicial interpretation of privacy in India. **Data Privacy and Data Security**- Defining data, meta-data, big data, non- personal data. Data protection, Data privacy and data security, Data protection regulations of other countries- General Data Protection Regulations (GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues. **Activities**: Case Studies and Practical Applications	
Unit –IV	**09 Hrs**
IP Protection Issues in Cyberspace Copyright Issues in Cyberspace- Copyright infringement in digital environment. Indian legal protection of copyright in cyberspace. **Trademark Issues in Cyberspace -** Domain Name Vs Trademark, Domain Name dispute and Related Laws, Different Form of Domain in Cyberspace. **Patent Issues in Cyberspace** - Legal position on Computer related Patents - Indian Position on Patents. **Activities:** Case Studies and Practical Applications	
Unit –V	**09 Hrs**
Digital Forensics - Computer Forensics, Mobile Forensics, Forensic Tools ,Anti-Forensics **Cyber Crime & Criminal Justice Agencies** - Cyber Crime Cells, Cyber Crime Appellate- Cyber Crime Investigation, Investigation Procedure - FIR - Charge Sheet	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
CO 2	Build in Depth Knowledge of Information Technology Act and Legal Frame Work of Right to Privacy, Data Security and Data Protection.
CO 3	Identify the bone of contentions of cybercrime investigation techniques, evaluate problem-solving strategies, and develop science-based solutions.
CO 4	Develop an Understanding of the Relationship Between E-Commerce and Cyberspace.

Reference Books	
1.	Cyber Law by Dr. Pavan Duggal Publisher: LexisNexis, ISBN-10: 8196241070, ISBN-13: 978-8196241070.
2.	Introduction to Information Security and Cyber Laws by Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla ASIN: 9351194736, Publisher: Dreamtech Press, ISBN-10: 9789351194736, ISBN-13: 978-9351194736.
3.	Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, 1st Edition, ISBN: 9788131250709.
4.	Cyber Laws, Justice Yatindra Singh, 6th Edition, Vol. 1, ISBN : 9789351437338.

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 adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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3 & 4	Unit 2: Question 3 or 4	**16**
5 & 6	Unit 3: Question 5 or 6	**16**
7 & 8	Unit 4: Question 7 or 8	**16**
9 & 10	Unit 5: Question 9 or 10	**16**
	TOTAL	**100**

Semester: VII						
SUMMER INTERNSHIP **Category: Practical**						
Course Code	**:**	21EE76I		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	0:0:2		**SEE**	**:**	100 Marks
Total Hours	**:**	04		**SEE Duration**	**:**	3Hours

GUIDELINES

1. The duration of the internship shall be for a period of ***6/8 weeks*** on full time basis after VI semester final exams and before the commencement of VII semester.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective UG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7. The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summary of the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills acquired during internship
    - References & Annexure

Course Outcomes:

After going through the internship, the student will be able to:

CO1: Apply Engineering and Management principles

CO2: Analyze real-time problems and suggest alternate solutions

CO3: Communicate effectively and work in teams

CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews. The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments.	25 Marks
Review - II	Importance of resource management, environment and sustainability, presentation skills and report writing	25 Marks

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

Scheme of Evaluation for SEE	
Particulars	**%Marks**
Project Synopsis (Initial Writeup)	10%
Project Demo/Presentation	30%
Methodology and Results Discussion	30%
Project Work Report	10%
Viva-voce	20%
Total	100

Semester: VII						
MINOR PROJECT **Category: Practical**						
Course Code	**:**	21EE77P		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	0:0:2		**SEE**	**:**	100 Marks
Total Hours	**:**	04		**SEE Duration**	**:**	3Hours

GUIDELINES

1. The minor project is to be carried out individually or by a group of students. (maximum of 4 members and minimum of 3 students).
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a current topic that will use the technical knowledge of their program of study after detailed literature survey.
4. The project should result in system/module which can be demonstrated, using the available resources in the college.
5. The CIE evaluation will be done by the committee constituted by the department. The committee shall consist of respective guide & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The final copy of the report should be submitted after incorporation of any modifications suggested by the evaluation committee.

The minor-project tasks would involve:

1. Carrying out the Literature Survey of the topic chosen.
2. Understand the requirements specification of the minor-project.
3. Detail the design concepts as applicable through appropriate functional block diagrams.
4. Commence implementation of the methodology after approval by the faculty.
5. Conduct thorough testing of all the modules developed and carry out integration testing.
6. Demonstrate the functioning of the minor project along with presentations of the same.
7. Prepare a project report covering all the above phases with proper inference to the results obtained.
8. Conclusion and Future Enhancements must also be included in the report.
9. The students are required to submit the report in the prescribed format provided by the department.

Course Outcomes:

After going through the minor project the student will be able to:

CO1: Interpreting and implementing the project in the chosen domain by applying the concepts learnt.

CO2: The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any of the domains in his / her future career.

CO3: Appling project life cycle effectively to develop an efficient product.

CO4: Produce students who would be equipped to pursue higher studies in a specialized area or carry out research work in an industrial environment.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in three review phases. The evaluation criteria shall be as per the rubrics given below:

Review Phase	Activity	Weightage
Phase-I	Synopsis submission, approval of the selected topic, Problem definition, Literature review, formulation of objectives, methodology	10 Marks
Phase - II	Mid-term evaluation to review the progress of implementation, design, testing and result analysis along with documentation	15 Marks
Phase -III	Submission of report, Final presentation and demonstration	25 Marks

Scheme for Semester End Evaluation (SEE):

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

Scheme of Evaluation for SEE	
Particulars	**%Marks**
Project Synopsis (Initial Writeup)	10%
Project Demo/Presentation	30%
Methodology and Results Discussion	30%
Project Work Report	10%
Viva-voce	20%
Total	100

Semester: VIII						
MAJOR PROJECT **Category: Practical**						
Course Code	**:**	21EE81P		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	0:0:12		**SEE**	**:**	100 Marks
Total Hours	**:**	24		**SEE Duration**	**:**	3Hours

GUIDELINES

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
2. The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program.
- Each student in the team must contribute towards the successful completion of the project.
- The project may be carried out In-house / Industry / R & D Institution. The project work is to be carried out by a team of two to four students, in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process, the student can work independently.
- The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.
- In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.

Project Topic Selection:

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

Students can select courses in NPTEL from the discipline of Humanities and Social Sciences, Management, Multidisciplinary and Design Engineering. The course chosen could be either of 4w/8w/12w duration. The students need to enrol for a course, register for the exam and submit the e-certificate to the department, as and when it is released by NPTEL. The same will be considered as one of the components during project evaluation of phase 2 and phase 5.

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- Weekly Activity Report (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of Industry project, during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course Outcomes:

After going through the major project the student will be able to:

CO1: Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.

CO2: Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.

CO3: Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.

CO4: Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

Scheme of Continuous Internal Evaluation (CIE):

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

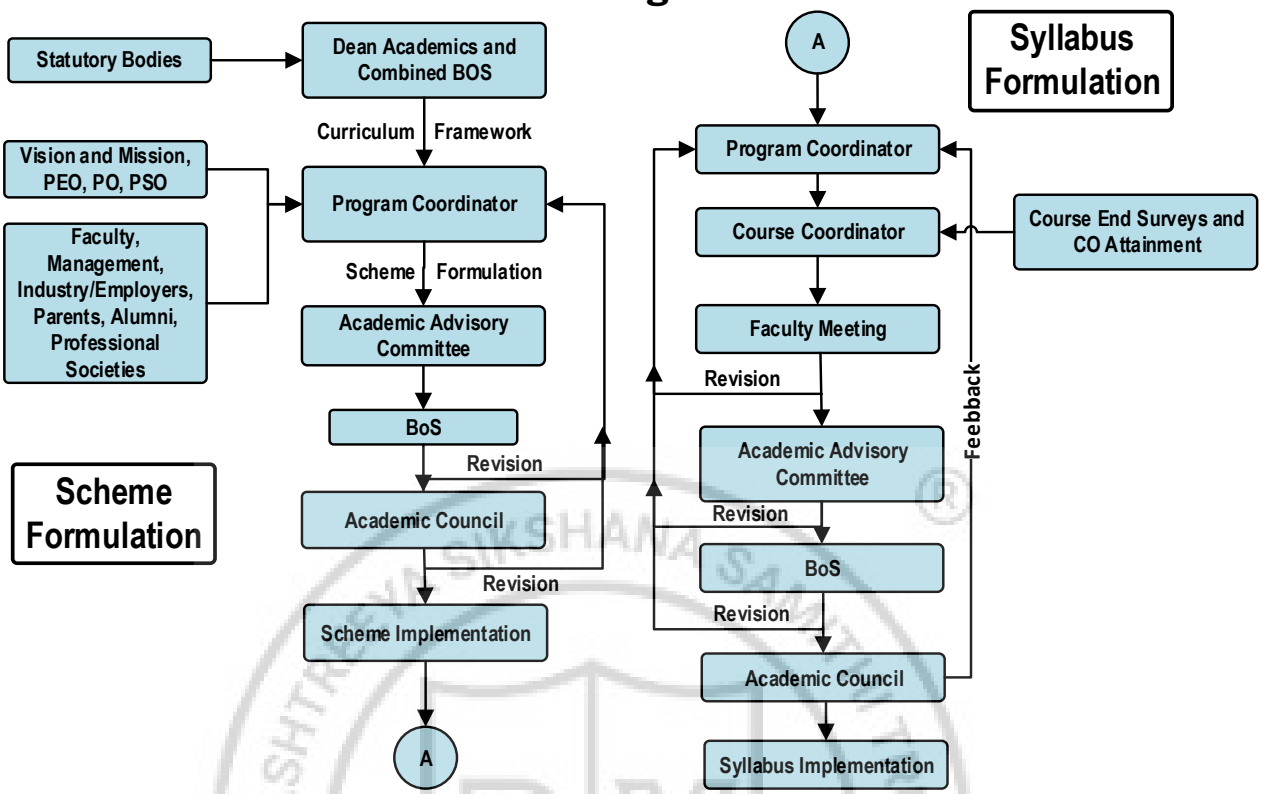
1. Selection of the topic and formulation of objectives	10%
2.Design and Development of Project methodology	25%
3.Execution of Project	25%
4.Presentation, Demonstration and Results Discussion	30%
5.Report Writing & Publication	10%

Scheme for Semester End Evaluation (SEE):

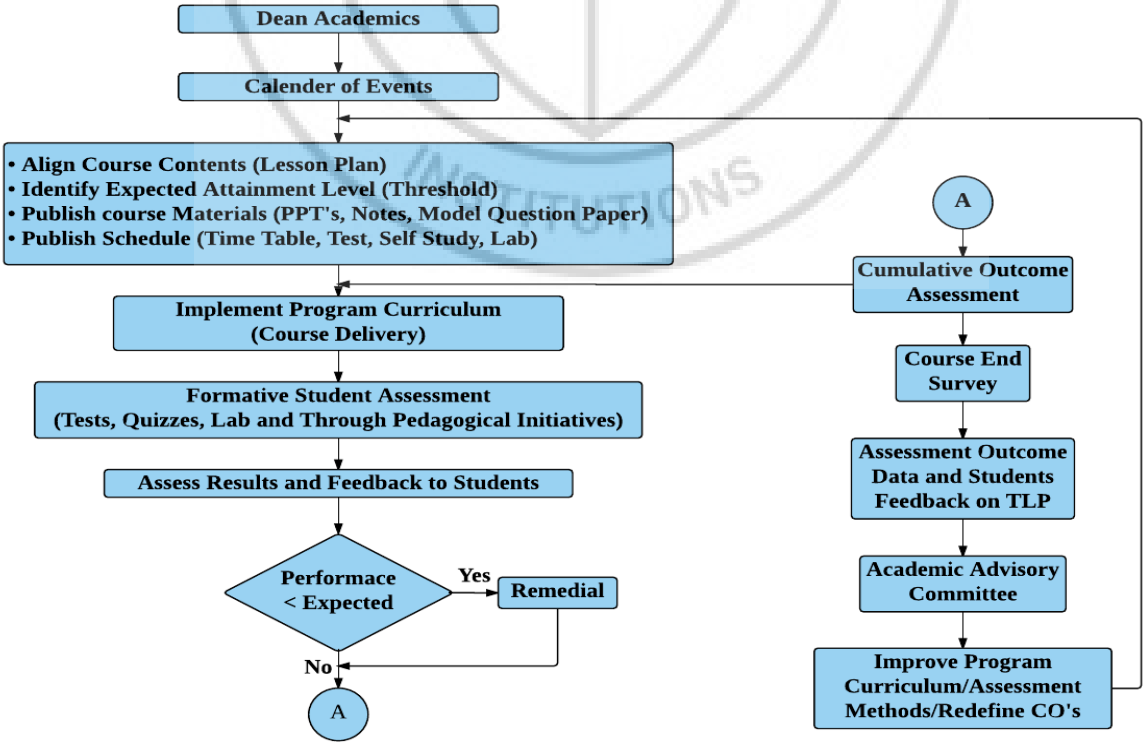
The following are the weightages given during Viva Examination.

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

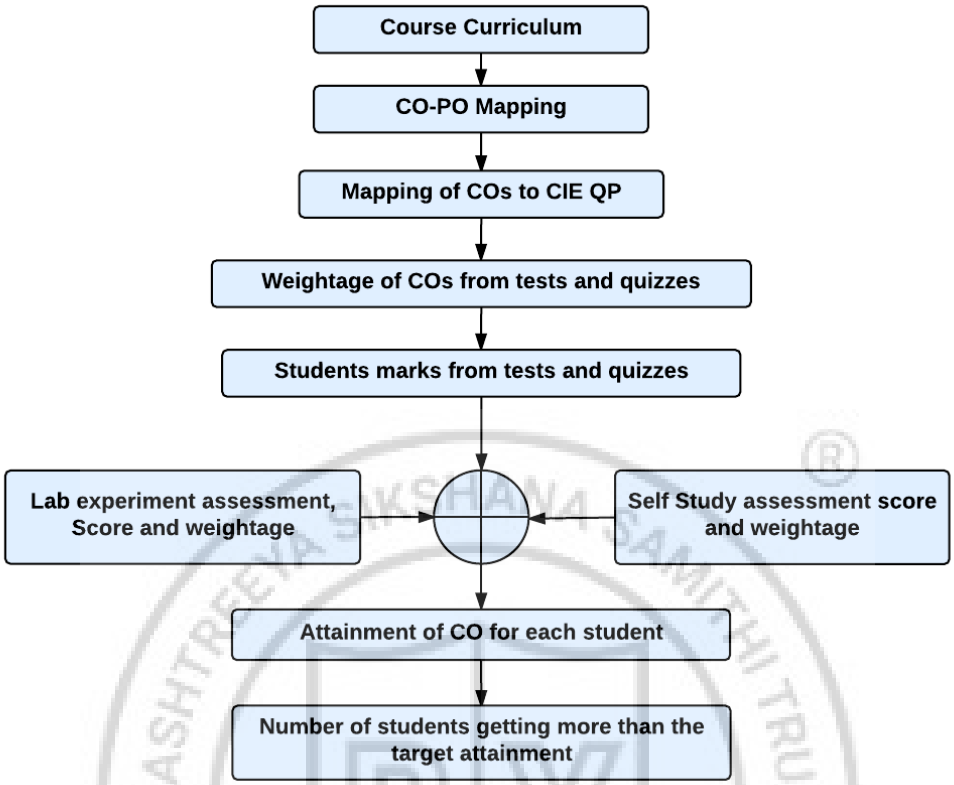
Curriculum Design Process



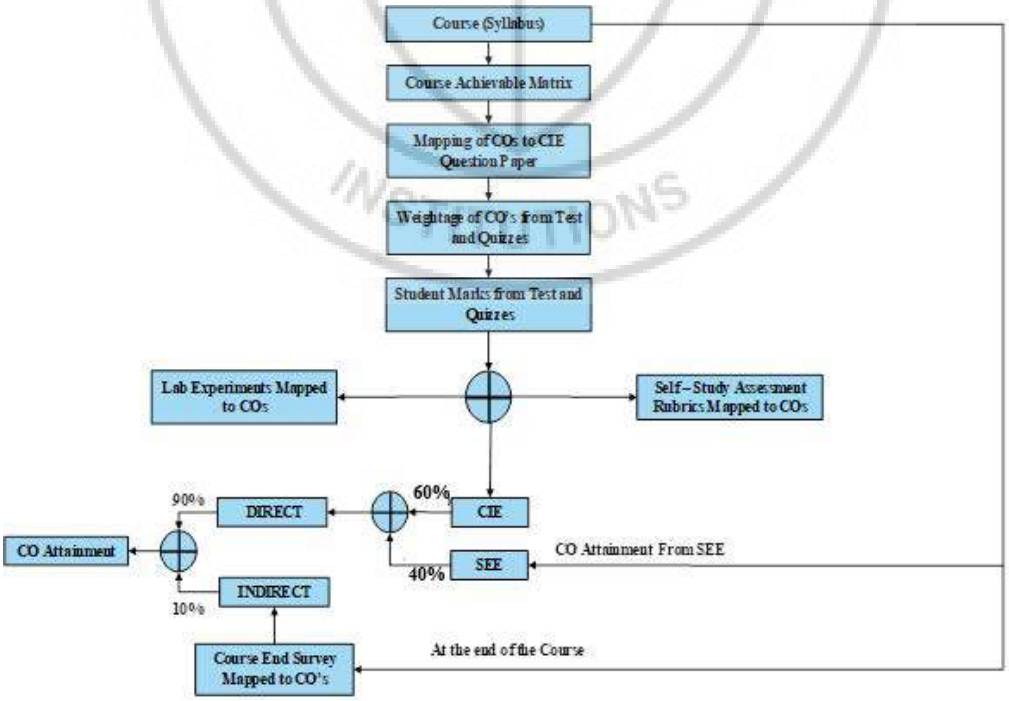
Academic Planning and Implementation



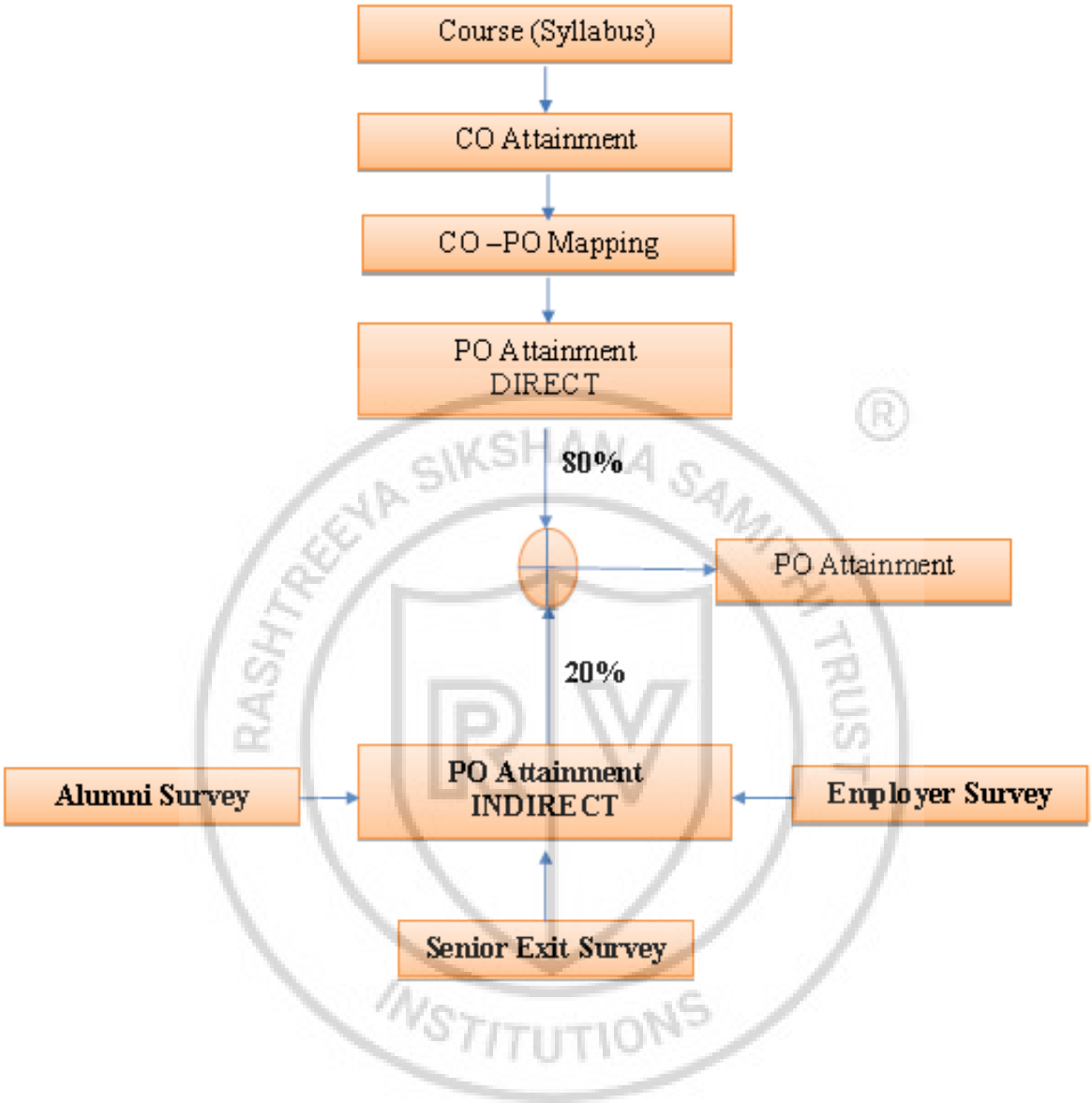
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



KNOWLEDGE & ATTITUDE PROFILE

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

PROGRAM OUTCOMES (POs)

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

INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation