MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074

Electrical & Electronics Engineering

V & VI Semester Scheme and Syllabus

(2024 Scheme)

VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

Electrical & Electronics Engineering

DEPARTMENT VISION

To be a center of excellence in Electrical and Electronics Engineering education and research, fostering innovation, entrepreneurship, and sustainable technologies to serve societal and industrial needs in a rapidly evolving global landscape.

DEPARTMENT MISSION

1. To impart high-quality education in Electrical and Electronics Engineering through a dynamic curriculum, experiential learning, and cutting-edge laboratory facilities, fostering academic excellence and professional competence.
2. To promote research, innovation, and industry collaboration by encouraging students and faculty to engage in interdisciplinary projects, pursue patents, and address real-world engineering challenges.
3. To instill ethical values, environmental consciousness, and lifelong learning in students, preparing them to be responsible engineers, entrepreneurs, and leaders who contribute meaningfully to society and sustainable development.

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, modeling, 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 modeling 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, 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)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO I: Graduates will succeed in industry or pursue higher education, applying strong fundamentals and modern tools to practical engineering needs.

PEO II: Graduates will be competent professionals with leadership, communication skills, ethical values, and concern for environmental and societal well-being.

PEO III: Graduates will apply new knowledge to design electrical systems, solve engineering problems, and pursue lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-1: Apply advanced electrical and electronics engineering principles, modern technologies, and analytical models to solve real-world engineering problems effectively.

PSO-2: Demonstrate professional communication and presentation skills to effectively articulate technical concepts, emerging technologies, and engineering solutions.

PSO-3: Develop innovative, industry-oriented solutions by applying engineering knowledge, creativity, and employability skills to address societal and industrial challenges.

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9.	B24EE643	Product Engineering and Design	50
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MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Scheme of Teaching and Examinations -2024 Scheme

Outcome based Education (OBE) and Choice Based Credit System (CBCS) Effective from the Academic Year 2026-27

V Semester

S. No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Self-Learning	CIE Marks	SEE Duration in Hrs	SEE Marks	Total Marks	
					L	T	P	S					
1.	HSMC	B24EC501	Technological Innovation Management and Entrepreneurship (Common to ECE & EEE)	EE/EC	3	0	0	3	50	3	50	100	3
2.	IPCC	B24EE502	Digital signal Processing (Common to ECE & EEE)	EE	3	0	2	3	50	3	50	100	4
3.	PCC	B24EE503	Power Electronics	EE	2	2	0	2	50	3	50	100	3
4.	PCC	B24EE504	Electrical Machine Design	EE	2	2	0	2	50	3	50	100	3
5.	PCCL	B24EE505L	Power Electronics Laboratory	EE	0	0	2	0	50	3	50	100	1
6.	PEC	B24EE56X	Professional Elective Course - I	EE	3	0	0	3	50	3	50	100	3
7.	BSC	B24BEK507	Biology for Engineers	EE / Che	2	0	0	2	50	2	50	100	2
8.	AEC	B24EE58X	Ability Enhancement Course Lab - V	EE	0	0	2	0	50	3	50	100	1
9.	NCMC	B24NCK59X	NSS / NCC / PE / Yoga / Music	HSS	2	0	0	0	100	-	-	100	PP
10.	NCMC	B24ESK510	Environmental Science and E-Waste Management	EE / CV	2	0	0	0	100	-	-	100	PP
11.	SDC	B24EEP511	Mini-Project	EE	0	0	4	0	50	3	50	100	2
								TOTAL	650		450	1100	22

BSC: Basic Science Course, HSMC: Humanity Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PEC: Professional Elective Course, SDC- Skill Development Course, L: Lecture, T: Tutorial, P: Practical S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: Indicates common course to all the streams of engineering, PP/NP: Pass/ Not Pass, YY: Programme Code (EC, CS, IS etc.,), X: 1/2/3/4.

Professional Elective Courses (PEC) - I			
B24EE561	Special Electrical Machines	B24EE562	Fundamentals of Electric Vehicles
B24EE563	Biomedical Instrumentation	B24EE564	Introduction to Smart Grid
Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – V			
B24EE581	Energy Audit and Management Lab	B24EE582	Computer Aided Electrical drawing lab
B24EE583	IoT Applications in Engineering Lab	B24EE584	MATLAB Programming and Simulation Lab
Non-Credit Mandatory Courses (NCMC)			
B24NCK591	National Service Scheme	B24NCK592	National Cadet Corps
B24NCK593	Physical Education	B24NCK594	Yoga
B24NCK595	Music		

National Service Scheme /National Cadet Corps/Physical Education/Yoga/Music: All the students have to register the same course namely National Service Scheme (NSS), National Cadet Corps (NCC), Physical Education (PE), Yoga (YOG) and Music (MUS) during the first week of III/IV/V/VI semesters. However, the option is given to students to change the activity. He/she may opt for the change of the course in ensuing semester. If the student is opting new course in V semester first time, he/she may take the basic modules from the syllabus to complete and if they repeat the same course in ensuing semester, subsequent modules can be offered.

These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A PEC is intended to enhance the depth and breadth of educational experience in the engineering and technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of student's strength for offering a professional elective is 10. However, this condition shall not be applicable to cases where the admission to the programme is less than 10 students.

HoD **Dean-Academics** **Principal**

VI Semester

S. No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Self-Learning	CIE Marks	SEE Duration Hrs	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC	B24EE601	Control Systems	EE	2	2	0	2	50	3	50	100	3
2.	IPCC	B24EE602	Power System Analysis and Stability	EE	3	0	2	3	50	3	50	100	4
3.	PEC	B24EE63X	Professional Elective Course- II	EE	3	0	0	3	50	3	50	100	3
4.	OEC	B24EE64X	Open Elective Course - I	Any Dept	3	0	0	3	50	3	50	100	3
5.	PCCL	B24EE605L	Control Systems Lab	EE	0	0	2	0	50	3	50	100	1
6.	AEC	B24RMK606	Research Methodology and IPR	EE	1	0	0	1	50	1	50	100	1
7.	SDC	B24PRJ607	Capstone Project work: Phase - I	EE	0	0	4	0	100	-	-	100	2
8.	AEC	B24EE68X	Ability Enhancement Course Lab – VI	EE	0	0	2	0	50	3	50	100	1
9.	NCMC	B24NCK69X	NSS / NCC / PE / Yoga / Music	HSS	2	0	0	0	100	-	-	100	PP
10.	HSMC	B24IKK610	Indian Knowledge System	EE	2	0	0	0	100	-	-	100	PP
								TOTAL	600		400	1000	18

HSMC: Humanity Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PEC: Professional Elective Course, OEC: Open Elective Course, SDC- Skill Development Course, L: Lecture, T: Tutorial, P: Practical S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: Indicates common course to all the streams of engineering, PP/NP: Pass/ Not Pass, YY: Programme Code (EC, CS, IS etc.,), X: 1/2/3/4

Professional Elective Courses (PEC) - II			
B24EE631	Utilization of Electrical Power	B24EE632	Design of Electric Vehicle
B24EE633	PLC and SCADA	B24EE634	Artificial Intelligence in Power System
Open Elective Course (OEC)- I			
B24EE641	Green Energy Resources	B24EE642	Embedded Systems
B24EE643	Product Engineering and Design	B24EE644	Electrical System Estimation and Costing
Ability Enhancement Course (AEC) – VI			
B24EE681	Basics of VHDL Lab	B24EE682	Fundamentals of Robotics lab
B24EE683	Ladder logic programming Lab	B24EE684	Electric Vehicle Simulation Laboratory
Non Credit Mandatory Course (NCMC)			
B24NCK691	National Service Scheme	B24NCK692	National Cadet Corps
B24NCK693	Physical Education	B24NCK694	Yoga
B24NCK695	Music		

PROJECT WORK: **Phase – I:** The objective of the Project work is (i) To encourage independent learning and the innovative attitude of the students. (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills. (iii) To impart flexibility and adaptability. (iv) To inspire team working. (v) To expand intellectual capacity, credibility, judgment and intuition. (vi) To adhere to punctuality, setting and meeting deadlines. (vii) To install responsibilities to oneself and others. (viii)To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE Procedure for Project Work: The CIE marks shall be awarded by a committee consisting of the Head of the concerned department and two senior faculty members of the department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the evaluation of the **Project Work Report, Project Reviews and Viva-Voce.** The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the Institution. The SEE marks awarded for the project work shall be based on the evaluation of **Project Demonstration, Project Presentation and Viva-Voce** in the ratio 20:60:20.

Open Elective Courses: Students belonging to a particular stream of Engineering are not entitled to the open electives offered by their parent department. However, they can opt for an elective offered by other departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Mentor. The minimum number of students' for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

HoD **Dean-Academics** **Principal**

Semester-V					
Technological Innovation Management and Entrepreneurship **Category: HSMC** **(Common to ECE & EEE)**					
Course Code	:	**B24EC501**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand basic skills of Management
2.	To understand the need for Entrepreneurs and their skills.
3.	To identify the Management functions and Social responsibilities.
4.	To understand economic development, creativity and Innovation.
5.	To understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding.

Module – 1	**No. of Hours**
Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession. **Planning:** Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making.	9
Module – 2	**No. of Hours**
Organizing: Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; **Staffing**-Need and Importance**,** Recruitment and Selection Process. **Directing and Controlling:** Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication –Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process.	9
Module – 3	**No. of Hours**
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance. **Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur ,Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship **.**	9
Module-4	**No. of Hours**
Modern Small Business Enterprises: Role of Small Scale Industries, Impact of Globalization and WTO on SSIs, Concepts and definitions of SSI Enterprises, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Ancillary Industry and Tiny Industry (Definition only). **Idea Generation and Feasibility Analysis-** Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities.	9
Module – 5	**No. of Hours**
Business Model & Business Plan: Meaning and importance of business models, Scope and need of a business plan, Financial, Marketing, HR, and Production/Service plans, Formats of business plans (traditional vs. pitch deck),Reasons why business plans fail. **Financing Model:** Advanced methods of **financial opportunity identification and evaluation** Comparative analysis of **banking and non-banking financing sources.** Role of **development**	9

financial institutions and support agencies in entrepreneurship. **Venture Capital:** stages of funding, risk assessment, and entrepreneur–investor relationship. Evaluation of **government funding schemes** for startups and MSMEs. Financial planning for **pre-launch, launch, and post-launch stages.** Legal and procedural aspects of **business licensing and registration.** Critical analysis of **challenges and difficulties in starting an enterprise.** Case-based study on **startup financing failures and success factors.**	

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business.
CO2	Describe the functions of Managers, Entrepreneurs and their social responsibilities.
CO3	Understand the components in developing a business plan, along with the integration of CSR-Corporate Social Responsibility.
CO4	Describe the importance of small scale industries in economic development and institutional support to start a small scale industry and understand the concepts of Creativity and Innovation and Identification of Business Opportunities.
CO5	Understand about various sources of funding and institutions supporting entrepreneurs.

Text Books	
1.	Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.
2.	Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.

Reference Text Books	
1.	Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.
2.	Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2012.
3.	Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30**	**50**
	Internal Assessment-2	**50**	**(Average of Best two Assessments)**	
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	3	1	-	-	1	1
CO2	2	2	-	-	-	2	1	-	-	2	1
CO3	1	1	-	-	-	1	2	-	-	2	1
CO4	1	1	-	-	-	1	2	-	-	1	1
CO5	1	1	-	-	-	1	2	-	-	1	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester-V					
Digital signal Processing **Category: IPCC**					
Course Code	:	**B24EE502**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:2:3	SEE	:	50 Marks
Total Hours	:	45+30	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To explain basic signals, their classification, basic operations on signals, sampling of analog signals, and the properties of the systems.
2.	To explain the convolution of signals in continuous and discrete time domain and the properties of impulse response representation.
3.	To explain the computation of Discrete Fourier Transform of a sequence by direct method, Linear transformation Method and using Fast Fourier Transformation Algorithms.
4.	To explain design of IIR all pole analog filters and transform them into digital filter using Impulse Invariant and Bilinear transformation Techniques and to obtain their Realization.
5.	To explain design of FIR filters using Window Method and Frequency Sampling Method and to obtain their Realization.

Module – 1	**No. of Hours**
Signals, systems and signal processing: classification of signals, Basic Operations on Signals, Basic Elementary Signals, properties of systems, concept of frequency in continuous and Discrete time signals, sampling of analog signals, Sampling theorem.	9
Module – 2	**No. of Hours**
Z-Transform- Introduction to Z-transform- Properties of Z-transform- Inverse Z-transform **Discrete Fourier Transforms (DFT): Introduction** to DFT, definition of DFT and its inverse, matrix relation to find DFT and IDFT, properties of DFT- linearity, circular time shift, circular frequency shift, circular folding, symmetry of real valued sequences, real even and odd sequences, multiplication of two DFTs – the circular convolution, circular correlation,	9
Module – 3	**No. of Hours**
Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of DFT (FFT algorithms), Radix-2 FFT algorithm for the computation of DFT and IDFT – decimation-in-time and decimation-in-frequency algorithms.	9
Module – 4	**No. of Hours**
IIR filter design: Classification of analog filters, frequency transformation, Design of Butterworth filters, low pass, high pass, band pass and band stop filters, Design of Chebyshev filters, design of Butterworth and Chebyshev filters using bilinear transformation and Impulse invariance method, Representation of IIR filters using direct form one and two, series form and parallel form.	9
Module – 5	**No. of Hours**
FIR filter design: Introduction to FIR filters, symmetry and antisymmetric FIR filters, design of linear phase FIR filters using rectangular, Bartlett, Hamming, Hanning and Blackman windows. Representation of FIR filters using direct form and lattice structure.	9

LABORATORY

Practical Component of IPCC (12 Experiments)

Sl. No.	**Name of the Experiments**
1	Program to generate the following discrete time signals: a) Unit sample sequence b) Unit step sequence c) Exponential sequence d) Sinusoidal sequence e) Random sequence
2	Program to perform the following operations on signals: a) Signal addition b) Signal multiplication c)

	Scaling d) Shifting e) Folding
3	Program to perform convolution of two given sequences (without using built-in function) and display the signals.
4	Consider a causal system: y(n) = 0.9y(n−1) + x(n). a) Determine H(z) and sketch its pole-zero plot. b) Plot |H(e^jω)| and ∠H(e^jω). c) Determine the impulse response h(n).
5	Computation of N-point DFT of a given sequence (without using built-in function) and plot the magnitude and phase spectrum.
6	Using the DFT and IDFT, compute the following for any two given sequences: a) Circular convolution b) Linear convolution
7	Verification of linearity property, circular time shift property, and circular frequency shift property of DFT.
8	Develop decimation-in-time radix-2 FFT algorithm without using built-in functions.
9	Design and implementation of digital low-pass FIR filter using a window to meet the given specifications.
10	Design and implementation of digital high-pass FIR filter using a window to meet the given specifications.
11	Design and implementation of digital IIR Butterworth low-pass filter to meet the given specifications.
12	Design and implementation of digital IIR Butterworth high-pass filter to meet the given specifications.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Discuss classification and basic operations that can be performed on both continuous and discrete time signals and to understand sampling theorem.
CO2	Evaluate Discrete Fourier Transform of a sequence, to understand the various properties of DFT and signal segmentation using overlap and overlap add method.
CO3	Evaluate Discrete Fourier Transform of a sequence using decimation in time and decimation in frequency methods.
CO4	To design Butterworth and Chebyshev IIR digital filters and to represent the filters using different methods and to represent IIR filter using different methods.
CO5	To design FIR filters using windows method and frequency sampling method and to represent FIR filters using direct method and lattice method.

Text Books	
1.	Introduction to Digital Signal Processing, Jhonny R. Jhonson, Pearson 1st Edition, 2016.
2.	Digital Signal Processing – Principles, Algorithms, and Applications, Jhon G. Proakis Dimitris G. Manolakis, Pearson, 4th Edition, 2007.

Reference Text Books	
1.	Digital Signal Processing, A. NagoorKani, McGraw Hill, 2nd Edition, 2012.
2.	Digital Signal Processing, Shaila D. Apte, Wiley, 2nd Edition, 2009.
3.	Digital Signal Processing, Ashok Amberdar, Cengage, 1st Edition, 2007.
4.	Digital Signal Processing, Tarun Kumar Rawat, Oxford, 1st Edition, 2015.

Web links and Video lectures (e-Resources):
1. http://www.freebookcentre.net/Electronics/DSP-Books
2. https://www.electronicsforu.com/special/cool-stuff-misc/8-free-digital-signal-processing-ebooks

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the

academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30** (Average of Best Two Assessments)	**50/2 = 25**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	Any One Assessments as per regulations	**20**	**20**	
Laboratory	**Lab conduction & Record**	Evaluating each expt. for 10 marks.	**05**	**25**
	Internal Test	**50**	**20**	
Total Marks				**50**
SEE	**Semester End Examination**	**100**	**50**	**50**
Total marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.
8. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	2	–	–	–	–	–	1
CO2	3	3	2	2	2	–	–	–	–	–	1
CO3	3	3	2	2	2	–	–	–	–	–	1
CO4	3	2	3	2	2	–	–	–	–	–	1
CO5	3	2	3	-	2	–	–	–	–	–	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester - V					
Power Electronics **Category: PCC**					
Course Code	:	**B24EE503**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	2:2:0:2	SEE	:	50 Marks
Total Hours	:	55	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics.
2.	To explain power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
3.	To explain the techniques for design and analysis of single-phase diode rectifier circuits.
4.	To explain different types of Thyristors, their gate characteristics and gate control requirements.
5.	To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.

Module – 1	**No. of Hours**
Introduction: Applications of Power Electronics, Ideal Characteristics of switches Characteristics of practical devices; Specifications of Switches, control characteristics of power devices, Types of Power Electronic Circuits, Peripheral Effects, Intelligent Modules. **Power Diodes:** Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes**,** Freewheeling diodes with RL load. **Diode Rectifiers:** Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load, Single-Phase Full-Wave Rectifier with RL Load.	11
Module – 2	**No. of Hours**
Power Transistors: Introduction, Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, Power MOSFETs – Steady State Characteristics, Switching Characteristics, IGBTs; BJT Base Drive, MOSFET Gate Drive, Isolation of Gate and Base Drives, Pulse transformers and Optocouplers.	11
Module – 3	**No. of Hours**
Thyristors: Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn- On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection, Thyristor Firing Circuits, Unijunction Transistor.	11
Module – 4	**No. of Hours**
Controlled Rectifiers: Introduction, Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single phase half wave circuit with RLE Load, Single-Phase, Full Converters with RLE Load, Single-Phase Dual Converters, Principle of operation of Three- Phase dual Converters. **AC Voltage Controllers:** Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Three- Phase Full-Wave Controllers.	11
Module – 5	**No. of Hours**
DC-DC Converters: Introduction, principle of step-down chopper with R and RL load; principle of step-up chopper with R load, Control strategies, buck-boost converters, performance parameters, DC-DC converter classification. **DC-AC Converters:** Introduction, principle of operation single phase bridge inverters, performance parameters, three phase bridge inverters, 180° Conduction mode, voltage control of single-phase inverters, Harmonic reductions, Current source inverters.	11

Course Outcomes: At the end of the course, the students will be able to	
CO1	To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.

CO2	To explain the techniques for design and analysis of single phase diode rectifier circuits.
CO3	To explain different power transistors, their steady state and switching characteristics and limitations.
CO4	To explain different types of Thyristors, their gate characteristics and gate control requirements.
CO5	To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.

Text Books	
1.	Power Electronics: Circuits Devices and Applications, Mohammad H Rashid, Pearson 4th Edition, 2014.
2.	Power Electronics, P.S. Bimbhra, Khanna Publishers, 5th Edition, 2012.

Reference Text Books	
1.	Power Electronics: Converters, Applications and Design, Ned Mohan et al, Wiley 3rd Edition, 2014.
2.	Power Electronics, Daniel W Hart, McGraw Hill, 1st Edition, 2011
3.	Elements of Power Electronics, Philip T Krein, Oxford, Indian Edition, 2008.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	1	–	–	–	–	–	1
CO2	3	3	2	–	2	–	–	–	–	–	1
CO3	3	2	–	–	2	–	–	–	–	–	1
CO4	3	2	–	–	2	–	–	–	–	–	1
CO5	3	3	3	2	3	2	–	1	1	2	2

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester -V					
Electrical Machine Design **Category: PCC**					
Course Code	:	**B24EE504**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	2:2:0:2	SEE	:	50 Marks
Total Hours	:	55	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand design factors, limitations, modern trends, manufacturing methods, and material properties of electrical machines.
2.	To derive output equations of DC machines and design magnetic circuits and field windings.
3.	To derive output equations of transformers and analyze performance and cooling requirements.
4.	To derive output equations of induction motors and design stator and rotor circuits.
5.	To derive output equations of synchronous machines and analyze short-circuit ratio and performance.

Module – 1	**No. of Hours**
Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques. **Electrical Engineering Materials**: Desirability's of Conducting Materials, Comparison of Aluminum and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel.	11
Module – 2	**No. of Hours**
Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap.	11
Module – 3	**No. of Hours**
Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings. No load current Design of Tank and Cooling (Round and Rectangular) Tubes.	11
Module – 4	**No. of Hours**
Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	11
Module – 5	**No. of Hours**
Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non salient Pole Rotors. Magnetic Circuit and Field Winding	11

Course Outcomes: At the end of the course, the students will be able to	
CO1	Identify design limitations, modern trends, manufacturing methods, and material properties of electrical machines.
CO2	Derive output equations and design field windings and magnetic circuits of DC machines.
CO3	Derive transformer output equations and estimate cooling, no-load current, and leakage reactance.
CO4	Develop induction motor output equations and design stator and rotor circuits.
CO5	Formulate synchronous machine output equations and design salient and non-salient pole alternators.

Text Books	
1.	A course in Electrical Machine Design, A. K. Sawhney, Dhanpat Rai, 6th Edition, 2013.
2.	Performance and Design of Alternating Current Machines, M.G. Say, 3 rd Edition, 2002, CBS Publisher

Reference Text Books	
1.	Design of Electrical Machines, V N Mittle, 5 th Edition, 2002, N C Jain Publication
2.	Design Data Handbook, A. Sanmugasundaram Et al, New Age International, 1st Edition, 2011.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weight age of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	2	-	-	-	-	-	1
CO2	3	3	3	2	1	-	-	-	-	-	1
CO3	3	3	2	2	1	-	1	-	-	-	1
CO4	3	3	3	2	1	-	-	-	-	-	1
CO5	3	3	3	2	1	-	-	-	-	-	1

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester-V					
Power Electronics Laboratory **Category:** PCCL					
Course Code	:	**B24EE505L**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To conduct experiments on semiconductor devices to obtain their static characteristics. To study different methods of triggering the SCR
2.	To study the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
3.	To control the speed of a DC motor, universal motor and stepper motors.
4.	To study single phase full bridge inverter connected to resistive load.

Sl. No.	**List of the experiment**
1	Study of static characteristics of SCR
2	Study of static characteristics of MOSFET and IGBT
3	Study of V–I characteristics of TRIAC
4	SCR turn-on circuit using synchronized UJT relaxation oscillator
5	SCR digital triggering circuit for single-phase controlled rectifier and AC voltage regulator
6	Single-phase controlled full-wave rectifier with R, RL, RLE loads with and without freewheeling diode
7	AC voltage controller using TRIAC–DIAC combination with R and R–L loads
8	Speed control of DC motor using single-phase semi-converter
9	Speed control of stepper motor
10	Speed control of universal motor using AC voltage regulator
11	Speed control of separately excited DC motor using MOSFET/IGBT chopper
12	Single-phase MOSFET/IGBT based PWM inverter

Course Outcomes: At the end of the course, the students will be able to	
CO1	Obtain static characteristics of semiconductor devices to discuss their performance.
CO2	Trigger the SCR by different methods
CO3	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
CO4	Control the speed of a DC motor, universal motor and stepper motors.
CO5	Verify the performance of single phase full bridge inverter connected to resistive load.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	2	2	–	–	–	–	–	1
CO2	3	2	2	2	3	–	–	–	–	–	1
CO3	3	3	2	2	3	1	–	–	–	–	1
CO4	3	3	3	2	3	2	–	1	1	2	2
CO5	3	3	2	2	3	1	–	–	–	1	2

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester -V					
Special Electrical Machines **Category: PEC-I**					
Course Code	:	**B24EE561**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To provide knowledge of the construction, operating principles, control methods, and performance of stepper motors.
2.	To introduce the construction, operation, and control of switched reluctance motors and brushless permanent magnet DC motors.
3.	To develop understanding of the construction, operation, control, and performance of permanent magnet synchronous motors and synchronous reluctance motors.
4.	To familiarize students with the operating principles and applications of single-phase special electrical machines and servo motors.
5.	To expose students to the construction, operation, control, and applications of linear electrical machines and permanent magnet axial flux machines.

Module – 1	**No. of Hours**
Introduction: Stepper Motor: Introduction, Variable Reluctance Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor, Other Types of Stepper Motor, Windings in Stepper Motors, Torque Equation, Characteristics of Stepper Motor, Open – loop Control of Stepper Motor, Closed – loop Control of Stepper Motor, Microprocessor – Based Control of Stepper Motor, Applications of Stepper Motor.	9
Module – 2	**No. of Hours**
Switched Reluctance Motor (SRM): Construction, Principle of Working, Basics of SRM Analysis, Constraints on Pole Arc and Tooth Arc, Torque Equation and Characteristics, Power Converter Circuits, Control of SRM, Rotor Position Sensors, Current Regulators, Microprocessor – Based Control of SRM, Sensorless Control of SRM. **Permanent Magnet DC Motor and Brushless Permanent Magnet DC Motor**: Permanent Magnet DC (PMDC) motor, Brushless Permanent Magnet DC (BLDC) Motors	9
Module – 3	**No. of Hours**
Permanent Magnet Synchronous Motor (PMSM): Construction, Principle of Operation, EMF Equation, Torque Equation, Phasor Diagram, Circle Diagram, Comparison of Conventional and PMSM, Control of PMSM, Applications. **Synchronous Reluctance Motor (SyRM)**: Constructional of SyRM, Working, Phasor Diagram and Torque Equation, Control of SyRM, Advantages and Applications	9
Module – 4	**No. of Hours**
Single Phase Special Electrical Machines: AC series Motor, Repulsion Motor, Hysteresis Motor, Single Phase Reluctance Motor, Universal Motor. **Servo Motors**: DC Servo Motors, AC Servo Motors	9
Module – 5	**No. of Hours**
Linear Electric Machines: Linear Induction Motor, Linear Synchronous Motor, DC Linear Motor, Linear Reluctance Motor, Linear Levitation Machines. **Permanent Magnet Axial Flux (PMAF) Machines**: Comparison of Permanent Radial and Axial Flux Machines, Construction of PMAF Machines, Armature Windings, torque and EMF Equations of PMAF, Phasor Diagram, Output Equation, Pulsating Torque And its Minimisation, Control and Applications of PMAF	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze the construction, performance, control techniques, and applications of stepper motors.
CO2	Describe and analyze the operating principles and control strategies of switched reluctance motors and BLDC motors.
CO3	Analyze the operation, control methods, and performance characteristics of permanent magnet synchronous motors and synchronous reluctance motors.

CO4	Describe the operating principles and applications of single-phase special machines and servo motors.
CO5	Analyze the operation, control, and applications of linear electrical machines and permanent magnet axial flux machines.

Text Books	
1.	Special Electrical Machines, E.G. Janardanan, PHI, 1 st Edition 2014.
2.	Special Electrical Machines, K Venkataratham, University Press, 2009

Reference Text Books	
1.	Brushless Permanent Magnet and Reluctance Motor Drives, T J E Miller, Clerendon Press, Oxford, 1989.
2.	Permanent Magnet and Brushless DC Motors, Kenjo T and Nagamori S, Clerendon Press, Oxford, 1985
3.	

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	2	-	-	-	-	-	-
CO2	3	2	2	-	2	-	1	-	-	-	-
CO3	3	2	2	-	2	-	1	-	-	-	-
CO4	3	1	1	-	1	-		-	-	-	-
CO5	3	2		-	2	-	1	-	-	-	-

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester -V					
Fundamentals Of Electric Vehicles **Category: PEC-I**					
Course Code	:	**B24EE562**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand working of Electric Vehicles and recent trends.
2.	To analyze different power converter topology used for electric vehicle application.
3.	To develop the electric propulsion unit and its control for application of electric vehicles.
4.	To design converters for battery charging and explain transformer less topology.

Module – 1	**No. of Hours**
Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.	9
Module – 2	**No. of Hours**
Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Supercapacitors.	9
Module – 3	**No. of Hours**
Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.	9
Module – 4	**No. of Hours**
Design of Electric and Hybrid Electric Vehicles: Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design.	9
Module – 5	**No. of Hours**
Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the working of electric vehicles and recent trends.
CO2	Analyze different power converter topology used for electric vehicle application.
CO3	Develop the electric propulsion unit and its control for application of electric vehicles.
CO4	Design converters for battery charging and explain transformer less topology.

Text Books	
1.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S.Gay and Ali Emadi, CRC Press, 2005
2.	I. Husain, Electric and Hybrid Vehicles: Design Fundamentals. Boca Raton, FL, USA: CRC Press, 2003.
Reference Text Books	
1.	S. S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles. New York, NY, USA: Springer, 2013.
2.	C. C. Chan and K. T. Chau, Modern Electric Vehicle Technology. Oxford, U.K.: Oxford University Press, 2001.
3.	C. Mi, M. A. Masrur, and D. W. Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives. Hoboken, NJ, USA: Wiley, 2011.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

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

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester - V					
Biomedical Instrumentation **Category: PEC-I**					
Course Code	:	**B24EE563**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the fundamentals of biomedical instrumentation, biomedical signal sources, and basic medical instrumentation systems.
2.	To understand bioelectric signals (ECG, EEG, EMG) and the principles of electrodes used for biomedical signal acquisition.
3.	To explain the working principles and applications of diagnostic instruments such as ECG, EEG, EMG, and patient monitoring systems.
4.	To study the methods used for measurement of physiological parameters including blood pressure, respiration rate, blood flow, and cardiac output.
5.	To familiarize students with therapeutic biomedical instruments and patient safety standards in medical equipment.

Module – 1	**No. of Hours**
Fundamentals of Biomedical Instrumentation: Sources of biomedical signals, Basic Medical Instrumentation system, Performance requirements of medical instrumentation systems. PC based medical instruments, General constraints in design of biomedical instrumentation systems. **Bioelectric Signals and Electrodes:** Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG, Recording electrodes: Electrode – Tissue interface, polarization, skin contact- impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	9
Module – 2	**No. of Hours**
Electrocardiograph: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multi- channel ECG machine. **Electroencephalograph:** Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG. Electromyography, Biofeedback instrumentation.	9
Module – 3	**No. of Hours**
Patient Monitoring System: Bedside patient monitoring systems, Central monitors, Measurement of heart rate Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Definition of oximeter & Pulse oximeter. **Blood Pressure Measurement:** Introduction, Indirect methods of blood pressure measurement: Korotkoff's method, Rheographic method, differential auscultatory technique, Oscillometric technique. **Measurement of Respiration Rate:** Impedance pneumography, CO2 method of respiration rate measurement, Apnoea detectors.(Text book 1)	9
Module – 4	**No. of Hours**
Blood Flow Measurement: Electromagnetic blood flow meter- Principle and Square wave electromagnetic flowmeter. Doppler shift blood flow velocity meter, Blood flow measurement by Doppler imaging. **Cardiac Output Measurement:** Measurement of continuous cardiac output derived from the aortic pressure waveform, ultrasound method. **Cardiac Pacemakers and Defibrillators:** Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Power sources for Implantable pacemaker. Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator.	9
Module – 5	**No. of Hours**
Therapeutic Instruments: Cardiac-assist devices, Pump oxygenators, Total artificial heart, Hemodialysis, Lithotripsy, Ventilators, Infant incubators, Drug infusion pumps, Ambulatory and Implantable Infusion systems, Anesthesia Machines, Electrosurgical unit. **Patient Safety:** Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the fundamentals of biomedical instrumentation systems, analyze bioelectric signals (ECG, EEG, EMG), and describe the principles and applications of biomedical electrodes used for signal recording.
CO2	Explain the principles and applications of ECG, EEG, EMG, and biofeedback instrumentation.
CO3	Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods.
CO4	Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO measurement, respiration measurements and their implementation
CO5	Recognize the therapeutic methods of treatment and the associated instrumentation. Identify and judge patient safety issues related to biomedical instrumentation.

Text Books	
1.	Handbook of Biomedical Instrumentation-R. S. Khandpur, , Tata McGraw-Hill. 2nd Edition, 2003

Reference Text Books	
1.	Principles of applied biomedical instrumentation- Lesely Cromwell & others., John Wiley and sons. 2nd Edition, 1989
2.	2. Encyclopedia of medical devices and instrumentation-J. G. Webster, John Wiley, 1999

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	2	-	-	-	-	-	1
CO2	3	2	1	-	2	-	-	-	-	-	1
CO3	3	2	-	2	1	-	-	-	-	-	1
CO4	3	2	2	2	2	-	-	-	-	-	1
CO5	2	1	1	-	1	2	3	-	-	-	2

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester -V					
Introduction to Smart Grid **Category: PEC-I**					
Course Code	:	**B24EE564**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand the basic concept of smart grid, attributes of Smart Grid
2.	To describe the over view of the perfect power system configuration
3.	To know about DC power delivering systems, data centres and information technology loads
4.	To educate the importance of Technology Alternatives in smart Grid
5.	To understand the Dynamic energy systems in Smart Grid
6.	To describe the overview of Demand side planning and evaluation.

Module – 1	**No. of Hours**
Introduction: Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, attributes of the smart grid. **Smart Grid to Evolve a Perfect Power System:** Introduction, overview of the perfect power system configurations, device level power system, building integrated power systems, distributed power systems, fully integrated power system.	9
Module – 2	**No. of Hours**
DC Distribution and Smart Grid: AC Vs. DC sources, benefits of and drives of DC power delivery systems, powering equipment and appliances with DC, data centers and information technology loads, potential future work and research **Intelligrid Architecture for the Smart Grid:** Introduction, launching intelligrid, intelligrid today, smart grid vision based on the intelligrid architecture.	9
Module – 3	**No. of Hours**
Dynamic Energy Systems Concept: Smart energy efficient end use devices, smart distributed energy resources, advanced whole building control systems, integrated communications architecture, energy management, role of technology in demand response, current limitations to dynamic energy management, distributed energy resources, overview of a dynamic energy management, key characteristics of smart devices, key characteristics of advanced whole building control systems, key characteristics of dynamic energy management system.	9
Module – 4	**No. of Hours**
Efficient Electric End Use Technology Alternatives: Existing technologies ,lighting, space conditioning, indoor air quality, domestic water heating, hyper efficient appliances, ductless residential heat pumps and air conditioners, variable refrigerant flow air conditioning, heat pump water heating, hyper efficient residential appliances, data center energy efficiency, LED street and area lighting, industrial motors and drives, equipment retrofit and replacement, process heating, cogeneration, thermal energy storage, industrial energy management programs, manufacturing process, electro - technologies, residential, commercial and industrial sectors.	9
Module – 5	**No. of Hours**
Demand side planning: Introduction, Selecting Alternatives, Issues Critical to the Demand-side Issues Critical to the Demand-side, The Utility Planning Process, Demand-side Activities, Alternatives that Are Most Beneficial. **Demand-Side Evaluation:** Levels of Analysis. General Information Requirements, Context, Transferability, Data Requirement, Cost/Benefit Analysis, Program Interaction.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the concept of Smart grid and need of smart grid.
CO2	Outline the benefits and drivers of DC Power delivery system.
CO3	Summarize the Intelligrid Architecture for the smart grid.
CO4	Explain the Efficient Electric End-use Technology Alternatives.
CO5	Discuss Demand side planning and Evaluation.

Text Books	
1.	Clark W. Gellings, *The Smart Grid: Enabling Energy Efficiency and Demand Side Response*, 3rd Edition, CRC Press, 2013.

Reference Text Books	
1.	Janaka Ekanayake et al., Smart Grid: Technology and Applications, Wiley, 2012.
2.	James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley IEEE Press, 2012.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	2	2	-	-	-	-	-	1
CO2	3	2	1	-	2	-	-	-	-	-	1
CO3	3	2	-	2	1	-	-	-	-	-	1
CO4	3	2	2	2	2	-	-	-	-	-	1
CO5	2	1	1	-	1	2	-	3	-	-	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester-V					
Energy Audit and Management Lab **Category: AEC-V**					
Course Code	:	**B24EE581**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To enable students to **perform experiments and practical programs independently**, with flexibility in time, pace, and location.
2.	To develop skills to **conduct energy audits** for buildings, industries, or organizations using **Scilab**, and evaluate system behavior safely.
3.	To train students to **identify and propose energy-saving measures** considering **technical and economic feasibility**.

	Energy Audit Project
	Students shall select real time project/audit with the approval of the guide. The following shall be considered by the students and guide while auditing. (1) **Building and Utility Data Analysis**: The main purpose of this step is to evaluate the characteristics of the energy systems and the patterns of energy use for the premises considered. The premises characteristics can be collected from the architectural/ mechanical/electrical drawings and/or from consultation/discussions with premises operators. The energy use patterns can be obtained from a compilation of utility bills over a period. (2**) Walk-Through Survey**: This step should identify potential energy savings measures. The results of this step are important since they determine if the building warrants any further energy auditing work. Some of the tasks involved in this step are • Identify the customer's concerns and needs • Check the current operating and maintenance procedures • Determine the existing operating conditions of major energy use equipment (lighting, HVAC systems, motors, etc.) • Estimate the occupancy, equipment, and lighting (energy use density and hours of operation). (3)**Baseline for Building Energy Use**: The main purpose of this step is to develop a base-case model that represents the existing energy use and operating conditions for the building. This model will be used as a reference to estimate the energy savings due to appropriately selected energy conservation measures. Evaluation of Energy-Saving Measures: In this step, a list of cost-effective energy conservation measures is determined using both energy savings and economic analysis.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Collect and analyze energy consumption data for buildings, industries, or organizations
CO2	Perform comparative evaluation of energy usage with and without audits, and assess system behavior safely.
CO3	Recommend and plan energy-saving measures effectively, considering cost and efficiency, and apply systematic analytical skills.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	3	–	–	–	–	–	2
CO2	3	2	2	1	3	1	–	–	–	–	2
CO3	3	3	3	2	3	2	–	–	–	–	2

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester-V					
Computer Aided Electrical Drawing Lab **Category: AEC-V**					
Course Code	:	**B24EE582**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To develop the ability to draw and interpret winding diagrams of DC and AC machines, including single-layer, double-layer, lap, and wave windings.
2.	To enable students to construct and analyze integral and fractional slot, double-layer, three-phase windings of electrical machines.
3.	To develop skills to draw and analyze single-line diagrams of generating stations, substations, and receiving stations.

Sl. No	**List of the experiment**
	PART A
1.	Developed Winding Diagrams of D.C. Machines: Simplex single layer armature Lap windings
2.	Developed Winding Diagrams of D.C. Machines: Simplex double layer armature Lap windings.
3.	Developed Winding Diagrams of D.C. Machines: Simplex single layer armature Wave windings
4.	Developed Winding Diagrams of D.C. Machines: Simplex double layer armature Wave windings
5.	Developed Winding Diagrams of A C Machines single layer Lap winding.
6.	Developed Winding Diagrams of A C Machines single layer wave winding.
7.	Integral and Fractional Slot Double Layer Three Phase Lap and Wave Windings
	PART B
8.	Draw the single line diagram of generating stations
9.	Draw a single line diagram of Substations.
10.	Draw a single line diagram of receiving stations.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Prepare and interpret winding diagrams of DC and AC machines for different configurations.
CO2	Design and construct integral and fractional slot, double-layer three-phase windings accurately.
CO3	Draw and analyze single-line diagrams of generating stations, substations, and receiving stations for power system understanding.

Text Books	
1	Electrical Drafting, S F Devalapur, 2006, Eastern Book Promoters

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	3	–	–	–	–	–	2
CO2	3	2	2	1	3	1	–	–	–	–	2
CO3	3	3	3	2	3	2	–	–	–	–	2

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester-V					
Iot Applications in Engineering Lab **Category: AEC-V**					
Course Code	:	**B24EE583**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To provide hands-on experience in programming and interfacing the ESP32 with sensors, actuators, and communication modules for IoT applications.
2.	To enable students to design and implement IoT systems using Bluetooth, Wi-Fi, and cloud platforms for real-time monitoring and control.
3.	To develop problem-solving, integration, and project implementation skills through practical IoT-based mini projects.

Sl. No.	**List of the experiment**
1.	LED Blink using bluetooth
2.	ESP32 local Webserver
3.	Interfacing esp32 board and DHT11 sensor
4.	Interfacing esp32 board and DHT11 sensor with Thing speak server
5.	Web based Weather Station with ESP32 and DHT11 Sensor
6.	Interfacing esp32 board and DHT11 sensor with Telegram
7.	Temperature and Humidity Monitoring with Adafruit IO
8.	LED control using Remote XY
9.	Interfacing esp32 board and DHT11 sensor with Blynk
10.	Bluetooth controlled Robot using ESP32
11.	Wi-Fi Controlled Robot Car
12.	Interfacing Relay module to demonstrate Bluetooth based home automation application.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Program the ESP32 microcontroller to perform basic control and monitoring tasks using Bluetooth and Wi-Fi communication.
CO2	Interface sensors such as DHT11 and actuators like LEDs, relays, and motors with the ESP32 for IoT applications.
CO3	Design and implement IoT-based monitoring systems using cloud platforms such as ThingSpeak, Blynk, Adafruit IO, and Telegram.
CO4	Develop web-based and mobile app–based user interfaces for real-time data visualization and device control.
CO5	Implement and demonstrate end-to-end IoT solutions for automation and robotic control applications

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	3	–	–	–	–	–	2
CO2	3	2	2	1	3	1	–	–	–	–	2
CO3	3	3	3	2	3	2	–	–	–	–	2
CO4	2	2	2	1	3	1	–	–	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester- V					
MATLAB Programming and Simulation Lab **Category: AEC-V**					
Course Code	:	**B24EE584**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the fundamentals of MATLAB programming, including arrays, control structures, plotting, scripts, and functions.
2.	To study numerical methods such as curve fitting, numerical integration, differentiation, and solution of linear and nonlinear equations using MATLAB.
3.	To apply MATLAB and Simulink tools for solving and analyzing basic engineering problems in circuits, control systems, mechanics, and power systems.

Sl. No.	**List of the experiment**
1.	1. Introduction to MATLAB Programming: Basics of MATLAB Programming, array operations in MATLAB, loops and execution of control, working with files: Scripts and functions, plotting and programming output, examples.
2.	Numerical Methods and their applications: Curve Fitting: Straight line fit, Polynomial fit.
3.	Numerical Integration and Differentiation: Trapezoidal method, Simpson method.
4.	Linear and Nonlinear Equations: Eigen values, Eigen vectors, Solution of linear algebraic equations using Gauss Elimination and LU decomposition, Solution of nonlinear equation in single variable using Gauss-Siedal and Newton-Raphson method.
5.	Ordinary Differential Equations: Introduction to ODE's, Euler's method, second order Runga Kutta method, MATLAB ode45 algorithm in single variable and multivariables. Transforms: Discrete Fourier Transforms.
6.	6. Application of MATLAB to analyse problems in basic engineering mechanics, mechanical vibrations, control system, statistics and dynamics of different circuits. MATLAB Simulink: Introduction to MATLAB Simulink, Simulink libraries, development of basic models in Simscape Power Systems.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Use MATLAB programming constructs to perform mathematical computations, data visualization, and file handling.
CO2	Apply numerical methods and transforms using MATLAB to solve linear, nonlinear, and differential equations.
CO3	Analyze engineering problems using MATLAB and Simulink in areas such as circuits, control systems, vibrations, and power systems.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

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

Level 3 – High, Level 2 – Moderate, Level 1 –Low

Semester -V					
Mini - Project **Category: SDC**					
Course Code	:	**B24EEP511**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:4:0	SEE	:	50 Marks
Total Hours	:	60	Total	:	100 Marks
Credits	:	2	SEE Duration	:	3 Hrs

Mini-Project Work Evaluation:

Mini Project is a hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small applications etc. Based on the ability/abilities of the student/s and recommendations of the supervisor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project: (i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the **Project Reviews, Project report and Viva-Voce in the ratio of 60:20:20**. The marks awarded for the project report shall be the same for all the batches mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

CIE Evaluation: The CIE marks awarded for the Mini-project, shall be based on the evaluation of the **Project Reviews, Project report and Viva-Voce in the ratio of 60:20:20**. The marks awarded for the project report shall be the same for all the batches mates.

SEE Evaluation: SEE for project work will be conducted by the two examiners appointed by the Principal / CoE. The SEE marks awarded for the project work shall be based on the evaluation of **Write-up, Presentation Skills, Project Demonstration and Viva-Voce** in the ratio of 20:60:20

Rubrics for Mini-Project

Sl. No	Criteria	Scale of Assessment		
		Satisfactory (0-5)	**Good (6-8)**	**Excellent (9-10)**
1	Objective, Existing method with proposed method	Incomplete justification to the objectives proposed; Steps are mentioned but unclear; without justification to objectives	Good justification to the objectives; Methodology to be followed is specified but detailing is not done	All objectives of the proposed work are well defined. Steps to be followed to solve the defined problem are clearly specified.
2	Analysis/Description of the project	Incomplete explanation of the key concepts and in-sufficient description of the technical requirements of the project	Complete explanation of the key concepts but in-sufficient description of the technical requirements of the project	Complete explanation of the key concepts and strong description of the technical requirements of the project
3	Result Analysis	All defined objectives are achieved. Modules are working well in isolation and properly demonstrated Modules of project are not	All defined objectives are achieved. Each module working well and properly demonstrated. Integration of all modules	All defined objectives are achieved. Each module working well and properly demonstrated All modules of project are

		properly integrated.	not done and system working is not very satisfactory.	well integrated and system working is accurate
4	Project Report	Project report is according to the specified format but some mistakes. In-sufficient references	1. Project report is according to the specified format. References are appropriate but not mentioned well.	Project report is according to the specified Format. References are appropriate and well mentioned
5	Queries	Lacks sufficient knowledge and awareness	Fair knowledge and awareness related to the project.	Extensive knowledge and awareness related to the project

Semester - VI					
Control Systems **Category: PCC**					
Course Code	:	**B24EE601**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	2:2:0:2	SEE	:	50 Marks
Total Hours	:	55	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To analyze and model electrical and mechanical system using analogous systems.
2.	To formulate transfer functions using block diagram and signal flow graphs.
3.	To analyze the transient and steady state time response.
4.	To illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.
5.	To formulate transfer function using state space, ability to determine system stability using controllability and observability.

Module – 1	**No. of Hours**
Introduction to control systems: Introduction, classification of control systems. Mathematical models of physical systems: Modeling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for Deriving transfer functions, servomotors, gear trains.	11
Module – 2	**No. of Hours**
Block diagram: Elements of Block Diagram, Block diagram of a closed loop system, Block diagram reduction techniques, procedure for block diagram reduction to find transfer function. Numerical. **Signal flow graphs:** Construction of signal flow graphs, definition of some important terms, basic properties of signal flow graph, Mason's gain formula, signal flow graph algebra, Numerical	11
Module – 3	**No. of Hours**
Time Domain Analysis: Introduction, Standard test signals, time response of first order systems, time response of second order systems, Time response specifications, steady state errors and error constants. **Routh Stability criterion**: BIBO stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems, relative stability analysis. Numerical	11
Module – 4	**No. of Hours**
Root locus: Introduction, root locus concepts, construction of root loci, rules for the construction of root locus. Numerical **Frequency domain analysis:** Introduction, Co-relation between time and frequency response– 2^{nd} order systems only. **Bode plots:** Basic factors G(iw)/H(jw), General procedure for constructing Bode plots, computation of gain margin and phase margin. Numerical.	11
Module – 5	**No. of Hours**
Control Systems – Compensators: Introduction, Phase-Lead Compensator, Phase Lag Compensator, Lead-Lag Compensator. **State space model**- Concepts of State, State variable and State model, Transfer Function from State Space Model, State Transition Matrix and its Properties, Eigen values controllability and observability.	11

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze and model electrical and mechanical system using analogous system.
CO2	Formulate transfer functions using block diagram and signal flow graphs.
CO3	Analyze the stability of control system, ability to determine transient and steady state time response.
CO4	Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.
CO5	Formulate transfer function using state space, ability to determine system stability using controllability and observability.

Text Books	
1.	Control Systems, Anand Kumar PHI 2ndEdition,2014

Reference Text Books	
1.	Automatic Control Systems, Farid Golnaraghi, Benjamin C.Kuo Wiley 9thEdition,2010.
2.	Control Systems Engineering, Norman S.Nise, Wiley 4 thEdition,2004
3.	Modern Control Systems, Richard C D orfetal, Pearson 11thEdition,2008
4	Control Systems, Principles and Design, M.Gopal, McGawHill 4 thEdition,2012

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	-	-	-	-	-	1
CO2	3	2	2	2	2	-	-	-	-	-	1
CO3	3	3	2	2	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	2

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester- VI					
Power System Analysis and Stability **Category: IPCC**					
Course Code	:	**B24EE602**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:2:3	SEE	:	50 Marks
Total Hours	:	45+30	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the per unit system and explain its advantages and computation and concept of one line diagram and its implementation in problems.
2.	To explain analysis of symmetrical faults on synchronous machine and simple power system and selection of circuit breaker.
3.	To explain symmetrical components and construction of sequence network of power system.
4.	To explain the analysis of synchronous machine and simple power systems for different unsymmetrical faults using symmetrical components.
5.	To discuss the dynamics of synchronous machine and analyse power system stability.

Module – 1	**No. of Hours**
Representation of Power System Components: Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Representation of Loads, Numerical.	9
Module – 2	**No. of Hours**
Symmetrical Fault Analysis: Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine (On No Load), Short Circuit of a Loaded Synchronous Machine, Selection of Circuit Breakers, Numerical.	9
Module – 3	**No. of Hours**
Symmetrical Components: Introduction, Symmetrical Component Transformation, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System, Numerical.	9
Module – 4	**No. of Hours**
Unsymmetrical Fault Analysis: Introduction, Symmetrical Component analysis of unsymmetrical faults, Single Line-to-Ground (LG) Fault, Line-to-Line (LL) Fault, Double Line-to-Ground (LLG) Fault, Open Conductor Faults, Numerical.	9
Module – 5	**No. of Hours**
Power System Stability: Introduction, Dynamics of a Synchronous Machine, Power Angle Equation, Steady State Stability, Transient Stability, Equal Area Criterion, Numerical. Numerical Solution of Swing Equation.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand one-line diagram, per unit system & construct per unit impedance diagram of power system.
CO2	Analyse three phase symmetrical faults on power system and understand selection of circuit breaker rating.
CO3	Discuss and Analyse unbalanced phasors using sequence components and construct corresponding sequence networks.
CO4	Explore different types of unbalanced faults and their implications on power systems.
CO5	Inspect dynamics of synchronous machine and determine the power system stability.

LABORATORY

Practical Component of IPCC (12 Experiments)

Sl. No	**Name of the experiments**
1.	Write a program to draw power angle curves for salient and non-salient pole synchronous machines, reluctance power, excitation, EMF and regulation.
2.	Write a program to calculate Sag of a transmission line for i)Poles at equal height ii)Poles at unequal height

3.	Write a program to determine the efficiency, Regulation, ABCD parameters for short and long transmission line and verify AD-BC=1.
4.	Write a program to determine the efficiency, Regulation and ABCD parameters for medium transmission line for Π- configuration and verify AD-BC=1.
5.	Write a program to determine the efficiency, Regulation and ABCD parameters for medium transmission line for T- Configuration and verify AD-BC=1.
6.	Write a program to calculate sequence components of line voltages given the unbalanced phase voltages.
7.	Write a program to calculate the sequence components of line currents, given the unbalanced phase currents in a three phase 3-wire system.
8.	Write a program to calculate the sequence components of line currents, given the unbalanced phase currents in a three phase 4 wire system.
9.	Determination of fault currents and voltages in a single transmission line for i) Single Line to Ground Fault. ii)Line to Line Fault iii) Double Line to Ground Fault Using suitable simulating software package.
10.	Determination of fault currents and voltages in a single transmission line for Three phase Fault Using suitable simulating software package.
11.	Write a program to obtain critical disruptive voltage for various atmospheric and conductor conditions.
12.	Write a program to evaluate transient stability of single machine connected to infinite bus.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Model the power system components &construct per unit impedance diagram of power system.
CO2	Analyze three phase symmetrical faults on power system.
CO3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.
CO4	Analyze various unsymmetrical faults on power system.
CO5	Examine dynamics of synchronous machine and determine the power system stability.

Text Books	
1.	Modern Power System, D. P. Kothari, McGraw Hill, 4th Edition, 2011.

Reference Text Books	
1.	Elements of Power System, William D. Stevenson Jr, McGraw Hill, 4th Edition, 1982.
2.	Power System Analysis and Design, J. Duncan Gloveretal, Cengage, 4th Edition, 2008.
3.	Power System Analysis, Hadi Sadat, McGraw Hill,1stEdition,2002.

Web links and Video lectures (e-Resources):
https://nptel.ac.in/courses/108104051

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30** (Average of Best Two Assessments)	**50/2 = 25**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	Any One Assessments as per regulations	**20**	**20**	
Laboratory	**Lab conduction & Record**	Evaluating each expt. for 10 marks.	**05**	**25**
	Internal Test	**50**	**20**	

Total Marks				**50**
SEE	**Semester End Examination**	**100**	**50**	**50**
Total marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.
8. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	2	2	-	-	-	-	-	1
CO2	3	3	2	2	2	2	1	-	-	-	1
CO3	3	3	-	3	2	-	-	-	-	-	1
CO4	3	3	2	2	2	2	-	-	-	-	1
CO5	3	3	2	3	2	2	1	-	-	-	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Utilization of Electrical Power **Category: PEC-II**					
Course Code	:	**B24EE631**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce the principles and applications of electric heating and electric welding.
2.	To explain the laws of electrolysis and the processes involved in extraction, refining, and electro-deposition of metals
3.	To present the fundamentals of illumination, including laws of illumination, electric lamps, and lighting schemes.
4.	To develop the ability to analyze and design interior and exterior lighting systems, including factory, flood, and street lighting
5.	To provide knowledge of electric traction systems, including speed–time curves, traction motors, control, braking methods, power supply systems, and basics of electric and hybrid electric vehicles.

Module – 1	**No. of Hours**
Heating and welding: Electric Heating, Resistance ovens, Radiant Heating, Induction Heating, High frequency Eddy Current Heating, Dielectric Heating, The Arc Furnace, Heating of Buildings, Air – Conditioning, Electric Welding, Modern Welding Techniques. Electrolytic Electro – Metallurgical Process: Ionization, Faraday's Laws of Electrolysis, Definitions, Extraction of Metals, Refining of Metals, Electro Deposition.	9
Module – 2	**No. of Hours**
Illumination: Introduction, Radiant Energy, Definitions, Laws of Illumination, Polar Curves, Photometry, Measurement of Mean Spherical Candle Power by Integrating Sphere, Illumination Photometer, Energy Radiation and luminous Efficiency, electric Lamps, Cold Cathode Lamp, Lighting Fittings, Illumination for Different Purposes, Requirements of Good Lighting.	9
Module – 3	**No. of Hours**
Electric Traction Speed - Time Curves and Mechanics of Train Movement: Introduction, Systems of Traction, Systems of electric Traction, Speed - Time Curves for Train Movement, Mechanics of Train Movement, Train Resistance, Adhesive Weight, Coefficient of Adhesion. **Motors for Electric traction**: Introduction, Series and Shunt Motors for Traction Services, Two Similar Motors (Series Type) are used to drive a Motor Car, Tractive Effort and Horse Power, AC Series Motor, Three Phase Induction Motor.	9
Module – 4	**No. of Hours**
Braking: Introduction, Regenerative Braking with Three Phase Induction Motors, Braking with Single Phase Series Motors, Mechanical braking, Magnetic Track Brake, Electro – Mechanical Drum Brakes. **Electric Traction Systems and Power Supply**: System of Electric Traction, AC Electrification, Transmission Lines to Sub - Stations, Sub – Stations, Feeding and Distribution System of AC Traction Feeding and Distribution System for DC Tramways, Electrolysis by Currents through Earth, Negative Booster, System of Current Collection, Trolley Wires.	9
Module – 5	**No. of Hours**
Electric Vehicles: Configurations of Electric Vehicles, Performance of Electric Vehicles, Tractive Effort in Normal Driving, Energy Consumption. Hybrid Electric Vehicles: Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Identify and compare different methods of electric heating and welding.
CO2	Apply the laws of electrolysis to explain metal extraction, refining, and electro-deposition processes.
CO3	Apply the laws of illumination to classify lamps and design interior and exterior lighting systems.
CO4	Analyze electric traction systems, including speed–time curves and mechanics of train movement.
CO5	Analyze traction motors, their control and braking methods, and power supply systems used in electric traction.

Text Books	
1.	**A Text Book on Power System Engineering**, A. Chakrabarti et al, Dhanpat Rai and Co, 2nd Edition, 2010.
2.	**Modern Electric, Hybrid Electric, and Fuel Cell Vehicles**: Fundamentals Theory, and Design, (Chapters 04 and 05 for module 5), Mehrdad Ehsani et al, CRC Press, 1st Edition, 2005.

Reference Text Books	
1.	**Utilization, Generation and Conservation of Electrical Energy**, Sunil S Rao, Khanna Publishers, 1st Edition, 2011
2.	**Utilization of Electric Power and Electric Traction**, G.C. Garg, Khanna Publishers, 9th Edition, 2014.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	1	-		-	-	-	-
CO2	3	2	1	-	1	-	1	-	-	-	
CO3	3	3	2	-	1	-	1	-	-	-	-
CO4	3	3	2	-	1	-	1	-	-	-	-
CO5	3	3	2	-	1	-	1	-	-	-	-

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Design of Electric Vehicle **Category: PEC-II**					
Course Code	:	**B24EE632**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To familiarize with power electronic components configuration to review the drive cycles and requirements of EVs
2.	To expose the utilization of different motors used in Electric Vehicle
3.	To learn the methods for analyzing the behaviour of nonlinear control systems.
4.	To inculcate the knowledge to design and analyze power converters suitable for EV
5.	To design and analyse the transfer function of DC-DC converter used in EV

Module – 1	**No. of Hours**
Electric Vehicle Dynamics: Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.	9
Module – 2	**No. of Hours**
Motors for Electric Vehicles: Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.	9
Module – 3	**No. of Hours**
Basics of Simulation in Control Systems: Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model	9
Module – 4	**No. of Hours**
Modeling of Dc-Dc Converters: Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter	9
Module – 5	**No. of Hours**
Power Stage Transfer Functions of Dc – Dc Converters: Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Assess the various parameters in dynamics of electric vehicles.
CO2	Apply controls of different motors for drive system efficiency.
CO3	Apply linear quadratic optimal controllers for scalar systems, and evaluate design parameters influence the closed-loop system properties.
CO4	Design and analyze closed loop Power converters for EV.
CO5	Analyze power electronics circuits and losses occurring in practice.

Reference Text Books	
1.	Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
2.	Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications
3.	Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1st Edition, Cengage learning.
4.	Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1st Edition.

5.	Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.
6.	Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021, 1st Edition.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester - VI					
PLC and SCADA **Category: PEC-II**					
Course Code	:	**B24EE633**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand PLC hardware components, operating modes, and basic programming.
2.	To develop basic PLC wiring diagrams and ladder logic programs.
3.	To explain the operation of various PLC program control instructions.
4.	To understand data transfer, data compare instructions, and basic PLC closed-loop control.

Module – 1	**No. of Hours**
Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, PLCs versus Computers, PLC Size and Application. **PLC Hardware Components:** The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs) **Basics of PLC Programming**: Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Entering the Ladder Diagram, Modes of Operation.	9
Module – 2	**No. of Hours**
Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, 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.	9
Module – 3	**No. of Hours**
Programming Counters: Counter Instructions, Up-Counter, 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	9
Module – 4	**No. of Hours**
Data Manipulation Instructions: Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs, Numerical Data I/O Interfaces, Closed-Loop Control. **Math Instructions:** Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction, Division Instruction, Other Word-Level Math Instructions, File Arithmetic Operations	9
Module – 5:	**No. of Hours**
Sequencer and Shift Register Instructions: Mechanical Sequencers, Sequencer Instructions, Sequencer Programs, Bit Shift Registers, Word Shift Operations. **Process Control, Network Systems, and SCADA:** Types of Processes, Structure of Control Systems, On/Off Control, PID Control, Motion Control, Data Communications, Supervisory Control and Data Acquisition (SCADA).	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.
CO2	Develop Fundamental PLC Wiring Diagrams and Ladder Logic Programs
CO3	Describe the operation of different program control instructions.
CO4	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system
CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of

	control systems and communication between the processes.

Text Books	
1.	Programmable Logic Controllers, Frank D Petruzella, McGraw Hill, 4th Edition, 2011

Reference Text Books	
1.	Programmable Logic Controllers an Engineer's Guide, E A Parr Newnes, 3rd Edition, 2013
2.	Introduction Programmable Logic Controllers, Gary Dunning, Cengage, 3rd Edition, 2006

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	3	–	–	–	–	–	1
CO2	3	2	2	–	3	1	–	–	–	–	1
CO3	3	3	3	1	3	2	–	1	–	–	2
CO4	3	2	3	–	3	1	–	1	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Artificial Intelligence in Power System **Category: PEC-II**					
Course Code	:	**B24EE634**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand the fundamental concepts, history, evolution, and significance of Artificial Intelligence, along with current trends and industrial applications.
2.	To analyze the structure and working of Artificial Neural Networks, including perceptron models, learning mechanisms, and their applications in power system engineering.
3.	To explain and apply Fuzzy Logic principles, including fuzzy sets, fuzzification, inference mechanisms, and defuzzification techniques for solving engineering problems.
4.	To understand the principles and operations of Genetic Algorithms
5.	To apply AI techniques such as ANN, Fuzzy Logic, Expert Systems, and Genetic Algorithms to solve real-world power system

Module – 1	**No. of Hours**
Artificial Intelligence: History and Applications Introduction, Intelligence, Communication, Learning, Artificial Intelligence, History, Early Works, Importance, Definitions, Programming Methods, Techniques, Growth of AI, AI and Industry, Current Trends in Applied AI.	9
Module – 2	**No. of Hours**
Artificial Neural Network: difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Power System.	9
Module – 3	**No. of Hours**
Fuzzy Logic: Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences, Fuzzy Implication and Algorithms, Defuzzification Methods, Centre of Area Defuzzification, Centre of Sums Defuzzification.	9
Module – 4	**No. of Hours**
Genetic Algorithms: Fundamentals, History, working principal, genetic modeling, encoding, fitness function, Genetic operators: reproduction, cross over, mutation, Similarities and differences between GA and traditional methods; Unconstrained and constrained optimization using Genetic Algorithm.	9
Module – 5	**No. of Hours**
Application of AI in Power Systems: Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Describe fundamental understanding of the history of artificial intelligence (AI) and its foundations.
CO2	Describe fundamental understanding of applications of AI techniques to power system.
CO3	Describe the methodology of fuzzy logic to power system
CO4	Describe the methodology of genetic algorithms to power system.
CO5	Demonstrate application of Artificial Intelligence techniques in power system.

Reference Text Books	
1.	N. P. Padhy, “Artificial Intelligence and Intelligent Systems, OXFORD University Press
2.	S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications”, PHI New Delhi.
3	Kalyanmoy Deb “Optimization for Engineering Design”, PHI publication.
4	Kevin Warwick, Arthur Ekwue, R. Agrawal “Artificial intelligence techniques in power systems”, IET.
5	K. Warwick, A. Ekwue and R. Aggarwal Artificial Intelligence Techniques in Power Systems, IEEE Power Engineering Series.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

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CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	–	–	2	–	–	–	–	–	–
CO2	3	2	1	–	3	–	–	–	–	–	–
CO3	2	3	2	–	3	–	–	–	–	–	–
CO4	2	3	2	–	3	–	–	–	–	–	–
CO5	2	3	3	2	3	–	–	–	1	1	–

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Green Energy Resources **Category: OEC-I**					
Course Code	:	**B24EE641**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To Understand the Conventional and non-conventional energy resources.
2.	To impart knowledge on solar and wind energy harvesting in various forms and its technologies.
3.	To explore the processes in bioenergy conversion system and other renewable energy sources.
4.	To Familiarize the concept of distributed generation and installation.
5.	To Analyze the impact of grid integration of Renewable energy sources.

Module – 1	**No. of Hours**
Introduction: Energy scenario: global and national energy scenario. Renewable Energy potential: Global and national. Classification of RE technologies: Stand alone, grid connected and hybrid - Renewable Energy Scenario in India and around the World - Role of energy in economic development and social transformation, Government policies and schemes to promote renewable energy implementations.	9
Module – 2	**No. of Hours**
Solar And Wind Energy: Solar Radiation - Measurements of Solar Radiation - Flat Plate and Concentrating Collectors - Solar heating and cooling techniques - Solar thermal plant - Solar Photovoltaic - Solar Cells and Modules-Types- factors affecting solar power generation - Solar PV Applications- Wind Data and Energy Estimation - site selection - wind resource assessment - Types of Wind Energy Systems - factors influencing wind - wind shear - Safety and Environmental factors.	9
Module – 3	**No. of Hours**
Bio energy and Other Renewable Energy Sources: Biomass resources and their classification - biomass direct combustion-biomass gasifiers - Biomass conversion processes - Biogas plants - Digesters - Ethanol production - Biodiesel - Cogeneration - Electricity generation through biomass and biogas Systems-Hydropower - Types, site selection, construction.-Geothermal energy - site selection, geothermal power plants. Hydrogen energy storage system - Fuel cell - types - construction and applications	9
Module – 4	**No. of Hours**
Distributed Generations (Dg): Concept of distributed generations-topologies-selection of sources– Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems- Energy Storage elements: Batteries, ultra-capacitors, flywheels- capacitive power plants.	9
Module – 5	**No. of Hours**
Challenges With Grid Integration: Requirements for grid interconnection- limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability-stability and power quality issues.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze the energy scenario and its impact on economic and social development.
CO2	Analyze the performance of different solar and wind energy systems with various measuremen techniques and factors affecting them.
CO3	Apply the energy conversion techniques in bioenergy and other renewable energy systems.
CO4	Assess the impact of optimal DG placement in distribution networks.
CO5	Analyze the grid integration with conventional and non-conventional energy resources

Reference Text Books	
1.	D.P Kothari, K. C Singal, Rakesh Ranjan, Renewable energy sources and emerging technologies, PHI Learning Pvt. Ltd 2013.
2.	S.P Sukhatme, J.K Nayak, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2014.
3.	G.N. Tiwari, Solar Energy - Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2012.
4.	Solanki, Solar Photovoltaics: Fundamental Technologies and Applications, Prentice-Hall of India Pvt.Limited, 3rd Edison, 2015.
5.	Priscila Goncalves Vasconcelos Sampaio & Mario Orestes Aguirre Gonzalez, "Photovoltaic solar energy: Conceptual framework", Renewable and Sustainable Energy Reviews Volume 74, July 2017.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	-	2	2	-	3
CO2	3	2	2	2	-	3	-	2	2	-	3
CO3	2	-	2	2	-	3	-	2	2	-	3
CO4	2	-	2	2	-	3	-	2	2	-	3
CO5	3	2	-	-	-	3	-	2	2	-	3

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Embedded Systems **Category: OEC-I**					
Course Code	:	**B24EE642**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To introduce topics of Embedded System design
2.	To understand Characteristics & attributes of Embedded System
3.	To Introduce the concept of Embedded System Software and Hardware development
4.	To develop RTOS based Embedded system design

Module – 1	**No. of Hours**
Introduction: Embedded Systems and general-purpose computer systems, history, classifications, applications and purpose of embedded systems. **Core of Embedded Systems:** Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little-endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components.	9
Module – 2	**No. of Hours**
Characteristics and quality attributes of embedded systems: Characteristics, Operational and non-operational quality attributes, application specific embedded system - washing machine, domain specific – automotive.	9
Module – 3	**No. of Hours**
Hardware Software Co design and Program Modelling: Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools	9
Module – 4	**No. of Hours**
Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages Embedded System Development Environments: Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/decompliler, Simulators, Emulators and Debugging	9
Module – 5	**No. of Hours**
Real-time Operating System(RTOS) based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain characteristics of Embedded System design.
CO2	Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS.
CO3	Analyse embedded system software and hardware requirements.
CO4	Develop programming skills in embedded systems for various applications.
CO5	Design basic embedded system for real time applications.

Text Books	
1.	Shibu K V, “Introduction to Embedded Systems”, Second Edition, McGraw Hill Education.
2.	Alexander G, James M. Conard, Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller, Micrium press, USA, Reprinted by S.P Printers, 2011
3	Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. PIC Microcontroller and Embedded Systems, Pearson Education, 2008.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	–	–	–	1	–	–	–	–	1
CO2	3	1	–	1	3	–	–	–	–	–	2
CO3	3	3	2	1	2	–	–	–	–	–	1
CO4	3	2	2	1	3	–	–	–	–	–	2
CO5	3	3	3	2	3	1	–	1	1	2	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester -VI					
Product Engineering and Design **Category: OEC-I**					
Course Code	:	**B24EE643**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand the basic concepts of engineering design
2.	To apply the techniques for collecting customer needs
3.	To apply decision theory for evaluation methods
4.	To select the most viable design concepts based on criteria.
5.	To analyze the user-friendly products

Module – 1	**No. of Hours**
Introduction Of Product Development: Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products – establishing markets- market segments- relevance of market research.	9
Module – 2	**No. of Hours**
Customer Needs : Identifying customer needs –voice of customer –customer populations- hierarchy of human needs- need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics- competitive benchmarking- quality function deployment- house of quality-product design specification-case studies.	9
Module – 3	**No. of Hours**
Creative Thinking: Creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design.	9
Module – 4	**No. of Hours**
Decision Making: Decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture	9
Module – 5	**No. of Hours**
Industrial Design: Human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the fundamentals of engineering design and the product development process.
CO2	Identify and analyze customer needs using appropriate need-gathering techniques and quality function deployment.
CO3	Apply creative thinking and systematic design methods to generate product design concepts.
CO4	Evaluate and select suitable design concepts using decision-making tools and concept selection methods.
CO5	Apply industrial design principles considering human factors, environmental aspects, prototyping, testing, and cost analysis.

Reference Text Books	
1.	Anita Goyal, Karl T. Ulrich, Steven D. Eppinger, *Product Design and Development*, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN: 007-14679-9.
2.	Clive L. Dym, Patrick Little, *Engineering Design: A Project-Based Introduction*, 3rd Edition, 2009, John Wiley & Sons, ISBN: 978-0-470-22596-7.
3.	George E. Dieter, Linda C. Schmidt, *Engineering Design*, 4th Edition, 2009, McGraw-Hill International Edition, ISBN: 978-007-127189-9.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

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CO1	3	2	2	–	–	1	–	–	–	–	–
CO2	2	3	2	1	–	1	–	–	–	1	–
CO3	2	3	3	2	1	–	–	–	–	–	1
CO4	3	3	3	2	2	–	–	–	–	–	1
CO5	2	2	3	2	2	2	1	1	1	1	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester - VI					
Electrical System Estimation and Costing **Category: OEC-I**					
Course Code	:	**B24EE644**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	3:0:0:3	SEE	:	50 Marks
Total Hours	:	45	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand electrical estimation and costing principles.
2.	To learn wiring and earthing systems.
3.	To study lighting systems and illumination concepts.
4.	To develop skills in wiring estimation and load calculation.
5.	To apply estimation techniques for electrical installations.

Module – 1	**No. of Hours**
General principles of estimating: Estimating – purpose of estimating and costing – catalogues – market survey and source selection - determination of required quantity of materials – determination of cost material and labour. **Wiring systems:** Introduction – Systems of distribution of electrical energy – methods of wiring – systems of wiring – choice of wiring systems.	9
Module – 2	**No. of Hours**
Earthing Systems: Earthing – Points to be earthed – Factors influencing earth resistance – methods od reducing Earth resistance – Design data on earth electrodes – Methods of earthing – determination of size of earth wire and earth plate – Effects of electric current on Human body – Measurement of earth resistance.	9
Module – 3	**No. of Hours**
Lighting schemes and calculations: Types of lighting circuits – Various circuit diagrams – Two way switching – Aspects of good lighting service – Types of lighting schemes – Filament Lamps- Gas filled Lamps – Fluorescent Tubes - LED lamp – Compact Fluorescent lamp (CFL) – comparison between LED and CFL – terms used in illumination – laws of illumination.	9
Module – 4	**No. of Hours**
Estimation of lighting schemes: Design of lighting schemes - Factory lighting – Public lighting installations: Classification – General principles – Design – Selection of equipment - Street lighting – Methods of lighting calculations.	9
Module – 5	**No. of Hours**
Internal wiring estimation: General rules for wiring – determination of number of points – determination of total load – determination of sub circuits – determination of ratings of main switch and distribution board – determination of size of conductor – layout – simple problems.	9

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the principles of electrical estimation, costing methods, and selection of materials for electrical installations.
CO2	Analyze different wiring and earthing systems and select suitable methods for safe electrical installations.
CO3	Apply illumination laws and lighting concepts to design basic domestic and industrial lighting schemes.
CO4	Estimate electrical loads, determine conductor sizes, and prepare layouts for internal wiring installations.
CO5	Prepare simple estimation and costing reports for residential, commercial, and public electrical installations.

Text Books	
1.	Electrical installation estimating & Costing – J.B.Gupta, S.K.Kataria& sons.
2.	Electrical design estimating and costing – K.B.Raina & S.K.Bhattacharya, NewAge International (P) Limited publishers.

Reference Text Books	
1.	Power System Analysis and Design – Dr.B.R.Gupta, S.Chand Publications
2.	Electrical Estimating methods – Wayne J.Del Pico, Wiley Publishers

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	3	–	–	–	–	–	1
CO2	3	2	2	–	3	1	–	–	–	–	1
CO3	3	3	3	1	3	2	–	1	–	–	2
CO4	3	2	3	–	3	1	–	1	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 - High, Level 2 - Moderate, Level 1 – Low

Semester- VI					
Control Systems Lab **Category: PCCL**					
Course Code	:	**B24EE605L**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To draw the speed torque characteristics of AC and DC servo motor.
2.	To determine the time and frequency reposes of a given second order system.
3.	To design and analyze Lead, Lag and Lag–Lead compensators for given specifications. and write a script files to plot root locus, bode plot, to study the stability of the system
4.	To study the feedback control system and to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
5	To simulate and write a script files to plot root locus, bode plot, to study the stability of the system

Sl. No.	**Title of the program / list of the experiment**
1	Speed – torque characteristic of a two - phase A.C. servomotor.
2	Speed torque characteristic of a D.C. servomotor
3	Experimental determination of frequency response of a second -order system and evaluation of frequency domain specifications
4	To design passive RC lead compensating network for the given specifications, viz, the maximum Phase lead and the frequency at which it occurs and to obtain the frequency response. Experimental determination of transfer functions of a lead compensating network
5	To design passive RC lag compensating network for the given specifications, viz, the maximum Phase lag and the frequency at which it occurs and to obtain the frequency response. Experimental determination of transfer functions of a lag compensating network
6	Experiment to draw the frequency response characteristics of the lag–lead compensator network and determination of its transfer function. Experimental determination of transfer functions of a lag-lead compensating network
7	To simulate a typical second order system and determine step response and evaluate time Response specifications. To evaluate the effect of adding poles and zeros on time response of second order system.
8	Experiment to draw synchro pair characteristics
9	Construction of root locus of transfer function and verification by simulation.
10	Determination of phase margin and gain margin of a transfer function by Bode Plots and verification by simulation.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze the performance characteristics of AC and DC servomotors used in control applications.
CO2	Design and study passive RC lead, lag, and lag–lead compensator networks for given performance specifications.
CO3	Simulate and analyze the time-domain response characteristics of first and second-order control systems and evaluate performance specifications.
CO4	Analyze system stability using Root Locus techniques and evaluate the characteristics and applications of synchro systems.
CO5	Determine frequency-domain characteristics, gain margin, phase margin and stability of control systems using frequency response techniques and software tools.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	–	–	–	–	–	2
CO2	3	3	3	2	2	–	–	–	–	–	2
CO3	3	3	2	3	3	–	–	–	–	–	2
CO4	3	3	2	3	3	–	–	–	–	–	2
CO5	3	3	2	3	3	–	–	–	–	–	3

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester-VI					
Basics of VHDL lab **Category: AEC-VI**					
Course Code	:	**B24EE681**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To provide hands-on experience in designing and simulating basic digital circuits using VHDL
2.	To enable students to implement and verify combinational and sequential logic circuits
3.	To develop practical skills in hardware description, simulation, debugging, and real-time verification of digital systems.

Sl. No.	**Title of the program / list of the experiment**
1	To develop VHDL code for a Full Adder using Half Adders using simulation tool
2	To develop VHDL code for a 16-to-1 Multiplexer using 4-to-1 Multiplexers using simulation tool
3	To develop VHDL code for 1-to-2 and 1-to-4 Demultiplexer
4	To develop VHDL code for BCD to 7-Segment Display
5	To develop VHDL code for Encoders and Decoders
6	To develop VHDL code for 4-to-2 Priority Encoder
7	To develop VHDL code for Code Converters
8	To develop VHDL code for Flip-Flops
9	To develop VHDL code for Shift Registers
10	To develop VHDL code for Moore Finite State Machine using simulation tool
11	To develop VHDL code for Mealy Finite State Machine using simulation tool
12	To develop VHDL code for Binary Counter (Up/Down Counter) using simulation tool

Course Outcomes: At the end of the course, the students will be able to	
CO1	Develop and simulate VHDL code for basic combinational logic circuits such as adders, multiplexers, and demultiplexers.
CO2	Design and implement VHDL models for encoders, decoders, code converters, and display interfacing circuits.
CO3	Develop VHDL code for sequential circuits including flip-flops, shift registers, and counters.
CO4	Design and implement Moore and Mealy finite state machines using VHDL.
CO5	Verify and implement VHDL-based digital designs and analyze their functional correctness.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	2	2	–	–	–	–	–	1
CO2	3	2	2	2	3	–	–	–	–	–	1
CO3	3	3	2	2	3	1	–	–	–	–	1
CO4	3	3	3	2	3	2	–	1	1	2	2
CO5	3	3	2	2	3	1	–	–	–	1	2

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester-VI					
Fundamentals of Robotics lab **Category: AEC-VI**					
Course Code	:	**B24EE682**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To provide hands-on experience in interfacing motors, sensors, and communication modules using Arduino/ESP32 for robotic applications.
2.	To enable students to design and implement basic mobile robots using wired and wireless control techniques.
3.	To develop problem-solving and system integration skills through practical robotic experiments and demonstrations.

Sl. No.	**List of the experiment**
1	PWM speed control of DC motor using L293D / L298 motor driver
2	Direction control of DC motor using H-bridge motor driver
3	Interfacing servo motor and angular position control
4	Interfacing ultrasonic sensor for distance measurement
5	Obstacle detection robot using ultrasonic sensor
6	Line follower robot using IR sensors
7	Bluetooth controlled robot using HC-05 / ESP32 Bluetooth
8	Wi-Fi controlled robot using ESP32 web server / mobile app
9	IR remote controlled robot using IR receiver
10	Fire detection robot using flame sensor and buzzer / motor control
11	Object counting robot using IR sensor
12	Voice controlled robot using Bluetooth and mobile application

Course Outcomes: At the end of the course, the students will be able to	
CO1	Interface and control DC motors and servo motors using appropriate motor driver circuits.
CO2	Interface and use sensors such as ultrasonic, IR, and flame sensors for robotic perception and decision-making.
CO3	Design and implement autonomous robotic systems such as obstacle detection and line follower robots.
CO4	Develop wireless-controlled robots using Bluetooth, Wi-Fi, IR remote, and voice control techniques.
CO5	Integrate hardware and software components to build and demonstrate functional robotic systems using Arduino/ESP32.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	3	–	–	–	–	–	1
CO2	3	2	2	–	3	1	–	–	–	–	1
CO3	3	3	3	1	3	2	–	1	–	–	2
CO4	3	2	3	–	3	1	–	1	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester- VI					
Ladder logic programming Lab **Category: AEC-VI**					
Course Code	:	**B24EE683**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To understand the Fundamentals of Programmable Logic Controllers (PLCs)
2.	To develop Skills in PLC Hardware Configuration and Troubleshooting
3.	To master PLC Programming Techniques
4.	To apply PLC Programming to Real-World Control Systems
5.	To integrate Advanced PLC Functions in Automation Systems

Sl. No.	**Title of the program / list of the experiment**
1.	Study of various logic execution using ladder diagram
2.	Interfacing of Lamp & button with PLC for ON & OFF Operation. Verify all logic gates
3.	Develop Ladder diagram to design multiplexer
4.	Study & implementation of Up Counter & Down Counter in PLC
5.	Study & implementation of ON & OFF delay timer in PLC
6.	Application of timers in Traffic signal
7.	Implementation of Arithmetic instructions in PLC
8.	Implementation of Compare instructions in PLC
9.	Temperature control using timer
10.	PLC based temperature sensing using RTD.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand PLC I/O interfacing and ladder logic basics.
CO2	Implement logic gates and multiplexer using ladder diagrams.
CO3	Develop PLC programs using counters and timers.
CO4	Apply arithmetic and compare instructions in PLC.
CO5	Design PLC-based applications like traffic signal and temperature control.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	3	–	–	–	–	–	1
CO2	3	2	2	–	3	1	–	–	–	–	1
CO3	3	3	3	1	3	2	–	1	–	–	2
CO4	3	2	3	–	3	1	–	1	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 – High, Level 2 – Moderate, Level 1 -Low

Semester-VI					
Electric Vehicle Simulation Laboratory **Category: AEC-VI**					
Course Code	:	**B24EE684**	CIE	:	50 Marks
Teaching Hours L:T:P:S	:	0:0:2:0	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To model and simulate electric vehicle subsystems (motor, battery, powertrain) using MATLAB/Simulink.
2.	To design and implement control strategies (PI/PID, IMC, state-space, observers) for EV components.
3.	To analyze performance and dynamic behavior of EV systems and evaluate controller effectiveness.

Sl. No	**Name of the Programs / List of the experiments**
1.	Basic MATLAB Script for Electric Vehicle Speed vs Time Plot
2.	Simulation of Battery Voltage and State of Charge (SoC) in MATLAB
3.	MATLAB Script to Model Vehicle Resistive Forces (Aerodynamic, Rolling)
4.	Simulation of Simple DC Motor Model for EV Drive (MATLAB ODE)
5.	MATLAB Program for Torque-Speed Characteristics of a Motor
6.	MATLAB Script for Battery Pack Performance (Voltage vs Load)
7.	MATLAB Simulation of Regenerative Braking Energy Recovery
8.	MATLAB Simulation of Vehicle Acceleration under Constant Torque
9.	Script to Plot Energy Consumption for a Given Driving Cycle
10.	MATLAB Program for Simple DC-DC Converter (Voltage Regulation)
11.	MATLAB Script for State Space Model of EV Longitudinal Dynamics
12.	MATLAB Simulation of Vehicle Range Estimation

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply MATLAB/Simulink tools to model and simulate core EV subsystems including motors, powertrain, and batteries.
CO2	Design, tune, and implement appropriate controllers (PI/PID, IMC, state-space, observers) for EV dynamic systems.
CO3	Analyze and interpret simulation results to assess performance, efficiency, and control effectiveness of EV systems.

ASSESSMENT DETAILS BOTH (CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (CIE)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	**Lab Conduction & Record**	**Evaluating each expt. for 10 marks**	**20**	**50**
	Laboratory Test -1	**50**	**15**	
	Laboratory Test -2	**50**	**15**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE)

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	–	3	–	–	–	–	–	1
CO2	3	2	2	–	3	1	–	–	–	–	1
CO3	3	3	3	1	3	2	–	1	–	–	2
CO4	3	2	3	–	3	1	–	1	1	–	2
CO5	3	3	3	2	3	2	–	1	1	2	3

Level 3 – High, Level 2 – Moderate, Level 1 -Low

MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074

Common Courses

V & VI Semester

UG – B.E (2024 Scheme)

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Semester-V					
Biology for Engineers **Category: BSC** **(Common to All)**					
Course Code	:	**B24BEK507**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	2:0:0:2	SEE	:	50 Marks
Total Hours	:	30	Total	:	100 Marks
Credits	:	2	SEE Duration	:	2 Hrs

Course Learning Objective is	
1.	To familiarize the students with the basic biological concepts and their engineering applications.
2.	To enable the students with an understanding of biodesign principles to create novel devices and structures.
3.	To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4.	To motivate the students to develop interdisciplinary vision of biological engineering.

Module– 1	**No. of Hours**
Introduction to Biology: The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. **Biomolecules:** Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones.	6
Module– 2	**No. of Hours**
Application of Biomolecules: Carbohydrates in cellulose-based water filters production, PHA and PLA in bio plastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production.	6
Module– 3	**No. of Hours**
Adaptation of Anatomical Principles for Bioengineering Design: Brain as a CPU system. Robotic arms for prosthetics. Engineering solutions for Parkinson's disease. Eye as a Camera system, bionic eye. Heart as a pump system, pace makers, defibrillators. Lungs as purification system, Heart-lung machine. Kidney as a filtration system, dialysis systems.	6
Module– 4	**No. of Hours**
Nature-Bioinspired Materials and Mechanisms: Echolocation, Photosynthesis. Bird flying, Lotus leaf effect, Shark skin, Kingfisher beak. Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).	6
Module– 5	**No. of Hours**
Trends in Bioengineering: DNA origami and Biocomputing, Bioprinting techniques and materials. Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete. Biomining.	6

Course Outcomes: At the end of the course, the students will be able to	
CO1	Elucidate the basic biological concepts via relevant industrial applications and case studies.
CO2	Evaluate the principles of design and development, for exploring novel bioengineering projects.
CO3	Corroborate the concepts of biomimetics for specific requirements.
CO4	Think critically towards exploring innovative biobased solutions for socially relevant problems.

Text Books	
1.	Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2.	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022

Web links and Video Lectures (E-Resources)
• https://nptel.ac.in/courses/121106008 • https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009

• https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006 • https://www.coursera.org/courses?query=biology	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	
1.	Group Discussion of Case studies.
2.	Model Making and seminar/poster presentations.
3.	Design of novel device/equipment like Cellulose-based water filters, Filtration system.

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**30**	**50**
	Internal Assessment2	**50**	**(Average of Best two**	
	Internal Assessment3	**50**	**Assessments)**	
AAT	**Any Two Assessments as per Regulations**	**20**	**20**	
SEE	**Semester End Examination**	**50**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE):

1. The Question paper shall be set for 50 marks and duration of SEE is 2 Hours.
2. Two questions of 10 marks (with minimum two sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Mention COs, POs, Bloom's Taxonomy levels in the question paper.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO8	PO11
CO1	1	-	-	-	-	1	1	-	1	1	1
CO2	1	-	-	-	-	1	-	1	-	1	1
CO3	1	-	-	-	-	1	-	1	-	1	1
CO4	1	-	-	-	-	1	2	-	2	1	1
CO5	1	-	-	-	-	1	2	2	1	2	1

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester-V					
Environmental Science and E-Waste Management **Category: NCMC** **(Common to All)**					
Course Code	:	**B24ESK510**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	2:0:0:0	SEE	:	-
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	-

Course Learning Objective is	
1.	To identify the major challenges of environment issues.
2.	To develop skills, critical thinking and demonstrate socio-economic skills for Environmental protection.
3.	To analyze the impact of issues w. r. t. waste management.

Module– 1	**No. of Hours**
Ecosystem and Sustainability: Ecosystems: Structure of Ecosystem, Types: Forest, Desert, Wetlands, Riverine, Oceanic ecosystems. **Sustainability:** 17SDG targets and possible actions.	6
Module– 2	**No. of Hours**
Natural Resources and Energy: Natural Resources: Water resources-Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water. **Energy:** Different types of energy, Conventional sources & Non-Conventional sources of energy, solar energy. Wind energy, Hydrogen as an alternative energy.	6
Module– 3	**No. of Hours**
Environmental Pollution: Water Pollution, Noise pollution, Air pollution (Sources, Impacts, Preventive measures and public Health Aspects. **Global Environmental Concerns (Concept, policies and case-studies):** Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.	6
Module– 4	**No. of Hours**
Waste management: Solid Waste Management, types and sources, functional elements of SWM, Biomedical Waste Management-Sources, Characteristics. **Environmental Legislation:** Solid Waste Management Rules, 2016, Biomedical Waste Management Rules, 2016.	6
Module– 5	**No. of Hours**
E-Waste Management: E-waste; composition and generation. Global context in e-waste; E-Waste pollutants, E-waste hazardous properties, Effects of pollutant (E-waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E Waste management. E-waste (Management and Handling) Rules, 2011; and E-waste (Management) Rules, 2022-Salient Features and its implications.	6

Course Outcomes: At the end of the course, the students will be able to	
CO1	Comprehend the principles of ecology and environmental issues pertaining to air, land and water on a global scale.
CO2	Acquire observation skills for solving problems related to the environment.
CO3	Conduct survey to describe the realities of waste management system.

Text Books	
1.	S M Prakash, "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018.
2.	Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009.

Reference Text Books	
1.	Benny Joseph (2005), "Environmental Studies" , Tata McGraw – Hill Publishing Company Limited.
2.	Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi.

Web links and Video Lectures (e-Resources):	
1.	https://www.youtube.com/playlist?list=PLXTQoJ3yDR1Tp9O8R7RZGmm_GdheHqM2w
3.	https://sdgs.un.org/goals
4.	https://kspcb.karnataka.gov.in/waste-management/biomedical-waste
5.	E Waste (Management) Rules, 2022: https://kspcb.karnataka.gov.in/sites/default/files/inlinefiles/ E%20Waste%20%28Management%29%20Rules%2C%202022.pdf

ASSESSMENT DETAILS (CIE only)

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (40 marks out of 100).

CONTINUOUS INTERNAL EVALUATION (MCQs)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**50 (Average of Best two Assessments)**	**100**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per Regulations**	**50**	**50**	
Total Marks				**100**

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	0	0	0	0	3	2	0	0	0	0
CO2	0	0	0	0	0	1	1	0	0	0	1
CO3	0	0	0	0	0	2	2	0	0	0	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

Semester-V					
Research Methodology & IPR (RMIPR) **Category: AEC**					
Course Code	:	**B24RMK606**	CIE	:	50 Marks
Teaching Hours L:T: P : S	:	1 : 0 : 0 : 3	SEE	:	50 Marks
Total Hours/Semester	:	15	Total	:	100 Marks
Credits	:	1	SEE Duration	:	1 Hours

Course Learning Objective is	
1.	To understand the fundamentals of research, types of research methodologies, and ethical practices involved in engineering research.
2.	To develop the ability to conduct effective literature review, technical reading, and identify research gaps for problem formulation.
3.	To design research methodologies, apply appropriate sampling techniques, and perform data collection and hypothesis testing.
4.	To analyze, interpret, and present research findings through structured technical reports and research papers using standard tools and formats.
5.	To understand Intellectual Property Rights (IPR), patenting processes, and their role in innovation, society, and sustainable development.

Module – 1	**No. of Hours**
Introduction to Research & Research Methodology: Meaning, Objectives of Engg. Research & Characteristics of good research, Research Methods v/s Research Methodology, Types of engineering research, Descriptive v/s Analytical, Applied v/s Fundamental, Quantitative v/s Qualitative, Conceptual v/s Empirical, Research, Criteria of good research, Developing a research plan, Ethics & plagiarism in Engineering Research with Research Practice for different types of Research Misconducts, Case Study and Practice Sessions	3
Module – 2	**No. of Hours**
Literature Review and Technical Reading: What is literature review or survey, New & Existing Knowledge, Bibliographic Databases, Search Engines, Google & Google Scholar, Effective Search, Conceptualizing Research Reviews, Gaps in research, Critical and Creative Reading, Taking Notes While Reading, Defining research problems, Datasheets, Importance of literature review in defining a problem, Primary and secondary sources of info - Review articles, treatise, monographs, papers from conferences & journals, case-studies, reports, patents, web and net searching ; Identifying gap areas from literature review, Citations, Acknowledgments, Case Studies and Practice sessions.	3
Module – 3	**No. of Hours**
Research Design and Methods: Research design, Basic Principles, Need for research design, Features of good design, Development of Models, Developing a research plan, Exploration, Description, Diagnosis, Simulation and Experimentations, Determining experimental and sample designs, Sampling design, Steps in sampling design, Characteristics of a good sample design, Types of sample designs, Measurement and scaling techniques, Methods of data collection, Collection of primary & secondary data, Data collection instruments, Hypothesis - Basic Concepts, Testing of hypotheses, flow diagram for hypotheses testing, Case Study and Practice Sessions.	3
Module – 4	**No. of Hours**
Technical Report & Paper Writing: Interpretation and report writing, Techniques of interpretations, Structure and components of scientific reports, Different steps in the report preparation – Layout, organization, structure and language of the report, Illustrations and tables with result analysis (simulation or experimentation), Types of reports, technical reports, project reports (mini & major) and research thesis, Research tools for writing, Conclusions, Future works, Flow of a research article, Research paper writing for conference & journals, text-books, Case Study and Practice Sessions.	3
Module – 5	**No. of Hours**
IPRs & Copyrights: Intellectual Property, what are patents & copyrights in IP? Role of IP in the Economic and Cultural Development of the Society, IP Governance, Invention and Creativity, Importance and Protection of Intellectual Property Rights (IPRs), A brief summary of - Patents, Monographs, Copyrights ©, Registered Firms ®, Trademarks ™, Industrial Designs (Design Patent,	3

Utility Patent, Granted Patent, Commercialized Patent) – Indian &Foreign Patents, Steps in Patenting — Application and Procedures with Searches, Case Study and Practice Sessions.	

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain research fundamentals, methodologies, and ethical practices in engineering research.
CO2	Perform literature review, identify research gaps, and formulate research problems.
CO3	Design research experiments, collect data, and apply hypothesis testing methods.
CO4	Analyze results and prepare technical reports and research papers.
CO5	Apply IPR concepts including patents, copyrights, and trademarks in research and innovation.

Research Papers & Technical References (Web-links & Video Resources)

- IEEE Xplore – https://ieeexplore.ieee.org
- Scopus – https://www.scopus.com
- Science Direct – https://www.sciencedirect.com
- Google Scholar – https://scholar.google.com
- Research Gate – https://www.researchgate.net

ASSESSMENT DETAILS (BOTH CIE AND SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CONTINUOUS INTERNAL EVALUATION (MCQs)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	30 (Average of Best two Assessments)	50
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Two Assessments as per regulations	20	20	
SEE	Semester End Examination	50		50
Total Marks				100

SEMESTER END EXAMINATION (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	1	-	-	2	-	-	-	2
CO2	3	3	-	2	1	-	1	1	1	-	2
CO3	2	3	3	3	2	-	1	2	-	-	2
CO4	2	2	3	3	3	-	1	2	3	1	2
CO5	1	1	-	-	1	3	3	1	2	2	2

L = Low (**1**), M = Medium (**2**), H = High (**3**) - Blank = No significant mapping correlation levels

Semester - VI					
Capstone Project Work: Phase - I **Category: SDC**					
Course Code	:	**B24PRJ607**	CIE	:	100 Marks
Teaching Hours L:T:P:S	:	0:0:4:0	SEE	:	-
Total Hours	:	60	Total	:	100 Marks
Credits	:	2	SEE Duration	:	-

Capstone Project: Phase -I and Phase - II

The Capstone project is a comprehensive, year-long project carried out in two phases during **6th and 7th** semesters of the undergraduate program. It integrates knowledge and skills acquired from multiple courses and disciplines to address a complex, real-world problem.

This project provides students with an opportunity to apply scientific principles, engineering methodologies, and technological tools to conceive, design, implement and evaluate an engineering solution.

It serves as a culminating academic experience to demonstrate program outcomes, including problem-solving ability, teamwork, communication skills, and practical application of engineering principles. Students can take up project individually or in a group not exceeding 4 students. The group may have students from the same discipline and drawn from different disciplines.

Types of Capstone Projects: Capstone projects undertaken for one year may fall into one or more of the following categories:

a) Research-Oriented Projects :
   • Focus on investigating new concepts, theories, or technologies.
   • Aim to generate new knowledge or contribute to academic research.

b) Experimental/Analytical Projects
   • Based on laboratory or field experiments to validate a hypothesis or study a phenomenon.
   Simulation/ Modelling Projects
   • Including detailed data collection, analysis, and interpretation.
   • Use computational tools to model, simulate, and predict system behavior.
   • Reduce the need for physical prototyping in the initial stages.

c) Industrial/Industry-Sponsored Projects
   • Carried out in collaboration with an industry partner.
   • Address real-world engineering problems faced by the organization.

d) Interdisciplinary/Multidisciplinary Projects
   • Combine knowledge and techniques from multiple engineering domains or other fields such as management, medicine, or environmental sciences.

e) Entrepreneurial/Innovation Projects
   • Focus on product or service innovation with potential for commercialization.

- Phase I Evaluation: Capstone Project Phase-I shall have only Continuous Internal Evaluation (CIE).
- In case disciplinary capstone project, the CIE shall be conducted by the Departmental Project Review Committee, which consists of a Senior Professor, the Project Guide, and one additional faculty member appointed by the principal for projects within the parent discipline.
- For Interdisciplinary Projects, the Project Review Committee will consist of one Senior Professor, the department and interdepartmental Project Guides and one faculty member from a department related to the interdisciplinary project. The committee members are appointed by the principal of the college.
- Phase I evaluation shall be based on rubrics designed to measure graduate attributes defined by NBA. Successful completion of Phase-I allows the student to proceed to Phase-II.
- Phase II Evaluation: CIE of Phase shall be evaluated as indicated with phase -I evaluation. The SEE shall be conducted by two examiners. The assessment shall be based on rubrics designed to measure graduate attributes.

Review #	**Agenda**	**Assessment**	**Review Assessment Weightage**
Review1	Project Synopsis / Proposal Evaluation	Rubric R1	15
Review2	Mid-Term Project Evaluation	Rubric R2	30
Review3	End Semester Project Evaluation	Rubric R3	30
Review4	Project Report Evaluation	Rubric R4	15
Review5	Evaluation by Guide	Rubric R5	10
Continuous Internal Evaluation (CIE)			100
Total Marks			100

Rubric #R1: Project Synopsis / Proposal Evaluation Maximum Marks: 15

		Excellent (5 Marks)	Good (4 Marks)	Average (3 Marks)	Acceptable (2 Marks)	Unacceptable (1 Marks)
a	**Identification of Problem Domain and Detailed Analysis**	Detailed and extensive explanation of the purpose and need of the project	Good explanation of the purpose and need of the project	Average explanation of the purpose and need of the project	Moderate explanation of the purpose and need of the project	Minimal explanation of the purpose and need of the project
b	**Study of the Existing Systems and Feasibility of Project Proposal**	Detailed and extensive explanation of the specifications and the limitations of the existing systems	Collects a great deal of information and good study of the existing systems	Moderate study of the existing systems; collects some basic information	Explanation of the specifications and the limitations of the existing systems not very satisfactory; limited information	Minimal explanation of the specifications and the limitations of the existing systems; incomplete information
c	**Objectives and Methodology of the Proposed Work**	All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified	Good justification to the objectives; Methodology to be followed is specified but detailing is not done	Incomplete justification to the objectives proposed; Steps are mentioned but unclear; without justification to objectives	Only Some objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are not specified properly	Objectives of the proposed work are either not identified or not well defined; Incomplete and improper specification

Rubric #R2: Mid-term Project Evaluation Maximum Marks: 30

		Level of Achievement				
		Excellent(10)	**Good (8)**	**Average(6)**	**Acceptable(4)**	**Unacceptable (2)**
a	**Design Methodology**	• Division of problem in to modules and good selection of computing framework. • Appropriate design methodology and properly justification.	• Division of problem into modules and good selection of computing frame work. • Design methodology not properly justified.	• Division of problem into modules but in appropriate selection of computing framework. • Design methodology not defined properly.	• Partial division of problem into modules and inappropriate selection of computing framework. • Design methodology not defined properly.	• Modular approach not adopted. • Design methodology not defined.
b	**Planning of Project Work and Team Structure**	• Time frame properly specified and being followed. • Appropriate distribution of project work.	• Time frame properly specified and being followed. • Distribution of project work inappropriate.	• Time frame properly specified, but not being followed. • Distribution of project work un-even.	• Time frame properly specified, but not being followed. • Un-even distribution of Project work and no synchronization.	• Time frame not properly specified. • In-appropriate distribution of project work.

c	**Demonstration and Presentation**	• Objectives achieved as per time frame. • Contents of presentations are appropriate and well arranged. • Proper eye contact with audience and clear voice with good spoken language.	• Objectives achieved as per time frame • Contents of presentations are appropriate but not well arranged Satisfactory demonstration, clear voice with good spoken language but eye contact not proper	• Objectives achieved as per time frame. • Contents of presentations are appropriate but not well arranged. • Presentation not satisfactory and average demonstration	• Objectives not achieved as per time frame. • Contents of presentations are not appropriate. • Eye contact with few people and unclear voice.	• No objectives achieved. • Contents of Presentations are not appropriate and not well delivered. • Poor delivery of presentation.

Rubric #R3: End Semester Internal Project Evaluation Maximum Marks: 30

		Excellent(10)	Good (8)	Average(6)	Acceptable(4)	Unacceptable (2)
a	**Incorporation of Suggestions**	Changes are made as per modifications suggested during midterm evaluation and new innovations added	Changes are made as per modifications suggested during mid-term evaluation and good justification	All major changes are made as per modifications suggested during midterm evaluation	Few changes are made as per modifications suggested during midterm evaluation	Suggestions during mid-term evaluation are not incorporated
b	**Project Demonstration**	• All defined objectives are achieved. • Each module working well and properly demonstrated. • All modules of project are well integrated and system working is accurate.	• All defined objectives are achieved. • Each module working well and properly demonstrated. • Integration of all modules not done and system working is not very satisfactory.	• All defined objectives are achieved. • Modules are working well in isolation and properly demonstrated. • Modules of project are not properly integrated.	• Some of the defined objectives are achieved. • Modules are working well in isolation and properly demonstrated • Modules of project are not properly integrated.	• Defined objectives are not achieved. • Modules are not in proper working form that further leads to failure of integrated system.
c	**Presentation**	• Contents of presentations are appropriate and well delivered. • Proper eye contact with audience and clear voice with good spoken language	• Contents of presentations are appropriate and well delivered. • Clear voice with good spoken language but less eye contact with audience	• Contents of presentations are appropriate but not well delivered . • Eye contact with few people and unclear voice	• Contents of presentations are not appropriate. • Eye contact with few people and unclear voice	• Contents of presentations are not appropriate and not well delivered . • Poor delivery of presentation

Rubric #R4: Project Report Evaluation Maximum Marks: 15

Level of Achievement						
		Excellent(5)	**Good (4)**	**Average(3)**	**Acceptable(2)**	**Unacceptable (1)**
a	**Project Report**	• Project report is according to the specified format. • References and citations are appropriate and well mentioned.	• Project report is according to the specified format. • References and citations are appropriate but not mentioned well.	• Project report is according to the specified format but some mistakes. • In-sufficient references and citations.	• Project report is not fully according to the specified format. • In-sufficient references and citations	• Project report not prepared according to the specified format. • References and citations are not appropriate
b	**Description of Concepts and Technical Details**	• Complete explanation of the key concepts. • Strong description of the technical requirements of the project.	• Complete explanation of the key concepts. • In-sufficient description of the technical requirements of the project.	• Complete explanation of the key concepts but little relevance to literature. • In-sufficient description of the technical requirements of the project.	• All key concepts are not explained and very little relevant to literature. • In-sufficient description of the technical requirements of the Project.	• Inappropriate explanation of the key concepts. • Poor description of the technical requirements of the project.
c	**Conclusion and Discussion**	• Results are presented in very appropriate manner • Project work is well summarized and concluded. • Future extensions in the project are well specified.	• Results are presented in good manner. • Project work summary and conclusion not very appropriate. • Future extensions in the project are specified.	• Results presented are not much Satisfactory. • Project work summary and conclusion not very appropriate. • Future extensions in the project are specified.	• Results presented are not much satisfactory. • Project work summary and conclusion not very appropriate. • Future extensions in the project are not specified.	• Results are not presented properly. • Project work is not summarized and concluded. • Future extensions in the project are not specified.

Rubric #R5: Evaluation by Guide Maximum Marks: 10

Level of Achievement				
		Excellent (5)	**Satisfactory(3)**	**Unsatisfactory(2)**
a	**Self-Motivation, Determination and Regularity**	• Approaches the project with self-motivation and follows it through to completion. • Reports to the guide regularly and consistent in work.	• Completes the project but sometimes lacks self-motivation. • Reports to the guide but lacks consistency	• Lacks self-motivation and determination. • Irregular in attendance and in consistent in work.
b	**Working with in a Team & Technical Knowledge and Awareness related to the Project**	• Collaborates and communicates in a group situation and integrates the views of others. • Extensive knowledge related to the project.	• Exchanges some views but requires guidance to collaborate with others. • Fair knowledge related to the project	• Makes little or no attempt to collaborate in a group situation. • Lack sufficient knowledge.

Semester-VI					
Indian Knowledge Systems **Category: HSMC** **(Common to All)**					
Course Code	:	**B24IKK610**	CIE	:	100 Marks
Teaching Hours L:T:P:S	:	2:0:0:0	SEE	:	-
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	-

Course Learning Objective is	
1.	To Understand the knowledge on basics of research and its types.
2.	To Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
3.	To learn Ethics in Engineering Research.
4.	To Discuss the concepts of Intellectual Property Rights in engineering.

Module– 1	**No. of Hours**
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.	6
Module– 2	**No. of Hours**
Literature Review and Technical Reading: New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. **Attributions and Citations:** Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	6
Module– 3	**No. of Hours**
Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India. **Patents:** Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting. **Process of Patenting:** Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Can a Worldwide Patent be Obtained? Do I Need First to File a Patent in India? Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models.	6
Module– 4	**No. of Hours**
Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases. **Trademarks:** Eligibility Criteria. Who Can Apply for a Strademark? Acts and Laws.	6

Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company v/s. Bisleri International Pvt. Ltd.	
Module– 5	**No. of Hours**
Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co. **Geographical Indications:** Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India. **Case Studies on Patents.** Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. **IP Organizations In India. Schemes and Programmes**	6

Course Outcomes: At the end of the course, the students will be able to	
CO1	To know the meaning of engineering research.
CO2	To know the procedure of the literature Review and Technical Reading.
CO3	To understand the fundamentals of the patent laws and drafting procedure.
CO4	Understanding the copyright laws and subject matters of copyrights and designs.
CO5	Understanding the basic principles of design rights.

Text Books	
1.	Dr. Santosh M Nejakar, Dr. Harish Bendigeri "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24.
Reference Text Books	
1.	David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4
2.	Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

ASSESSMENT DETAILS (CIE only)
The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (40 marks out of 50).

CONTINUOUS INTERNAL EVALUATION (MCQs)

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment-1**	**50**	**30 (Average of Best two Assessments)**	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Two Assessments as per regulations**	**20**	**20**	
SEE	**Semester End Examination**	**50**	**50**	**50**
Total Marks				**100**

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	0	0	0	0	3	2	0	0	0	0
CO2	0	0	0	0	0	1	1	0	0	0	1
CO3	0	0	0	0	0	2	2	0	0	0	2

Level 3 - High, Level 2 - Moderate, Level 1 - Low

SEMESTER-V & VI					
NATIONAL SERVICE SCHEME (NSS) **Category: NCMC**					
Course Code	:	B24NCK591/691	CIE	:	100 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	---
Total Hours	:	50	Total	:	100 Marks
Credits	:	--	SEE Duration	:	--

Course Objectives	
1.	Understand the community in which they work
2.	Identify the needs and problems of the community and involve the min problem-solving
3.	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems
4.	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes
5.	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony

CONTENT	**No. of Hours**
1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management–Public, Private and Govt. organization. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques–Role of different take holders–Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India.Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum 5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events/ workshops / seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure. **NOTE:** Students have to take up any one activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same. Compulsorily students have to attend one camp. CIE will be evaluated based on their presentation, approach and implementation strategies.	50

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the importance of his/her responsibilities towards society.
CO2	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.

CO-PO Mapping

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

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

SEMESTER-V & VI NATIONAL CADET CORPS (NCC) Category: NCMC					
Course Code	:	B24NCK592/692	CIE	:	100 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	--
Total Hours	:	50	Total	:	100 Marks
Credits	:	--	SEE Duration	:	--

Course Objectives	
1.	To develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit, and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance, and dignity of labour in the cadets.
2.	To create a pool of organized, trained, and motivated youth with leadership qualities from all walks of life, who will serve the Nation regardless of which career they choose
3.	To provide a conducive environment to motivate young Indians to choose the Armed Forces as a career

Content	No. of Hours
Unit 1. Personality Development: Group Discussions - Change your Mindset, Public Speaking. **Unit 2.LeadershipDevelopment:** Case Studies– APJ Abdul Kalam, DeepaMalik, Maharana Pratap, N Narayan Murthy etc. **Unit 3. Disaster management:** Disaster Management Capsule, Organization, Types of Disasters, Essential Services, Assistance, Civil Defense Organization. **Unit 4.Adventure:**AdventureActivities **Unit 5. Border & Coastal Areas:** History, Geography &Topography of Border/ Coastal Areas. **Unit 6. Drill:** Arm Drill, Rifle ke saath Savdhan, Vishram aur Aram se, Rifle ke saath Parade Paraur Saj, Riflekesaath Visarjan, LineTod, Bhumi Shastra aur Uthao Shastra, BagalShastra aur Baju Shastra. **Unit 7.WeaponTraining**: Short Range firing. **Unit 8.MapReading:**SettingofMap,FindingsNorthandOwnPosition **Unit 9.Field Craft & Battle Craft:** Observation, Camouflage, Concealment. **Unit 10. Obstacle Training:** Obstacle training - Introduction, Safety-measures, Benefits. Obstacle Course- Straight balance, Clear Jump, Gate Vault, Zig- Zag Balance, High Wall	50

SEMESTER-V & VI					
PHYSICAL EDUCATION(PE) **Category: NCMC**					
Course Code	:	B24NCK593/693	CIE	:	100 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	--
Total Hours	:	--	Total	:	100 Marks
Credits	:	--	SEE Duration	:	--

Semester	Course
III	Fitness Components Kabaddi / KhoKho
IV	Athletics Volleyball Throw ball
V	Athletics Football / Hockey
V	Athletics Cricket / Base ball
VI	Athletics Netball / Basketball
VI	Individual Games Handball / Badminton

Notes:

- One Hour of Lecture is equal to 1 Credit
- One Hour of Tutorial is equal to1 Credit (Except Languages)
- Two Hours of Practical is equal to 1 Credit
- SEE: Semester End Examination
- CIE: Continuous Internal Examination
- L+T+P: Lecture + Tutorial + Practical

Guideline for Athletic and Sports

Semester & Course Code	Course Title	Content	No. of Hours
3rd Semester B24NCK393	**Fitness Components** Speed Strength Endurance Agility Flexibility	Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. ***Practical Components: Speed, Strength, Endurance, Flexibility, and Agility*** **KABADDI** **A. Fundamental skills** ➢ Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. ➢ Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. ➢ Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretations and duties of the officials.**	Total-32 hours 2 hours / week
	Kho kho	**A. Fundamental skills** ➢ Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul. ➢ Skills in running: Chain Play, Ring play and Chain & Ring mixed play. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretations and duties of the officials.**	
	Kabaddi	**A. Fundamental skills** 1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line. 2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques. 3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense. 4. Game practice with application of Rules and Regulations. **B. Rules and their interpretations and duties of the officials**	

4th Semester **B24NCK493**	**Athletics** **Track-**Sprints **Jumps-**Long Jump **Throws-**Shot Put	**Track Events** ➢ Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. ➢ Acceleration with proper running techniques. ➢ Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. **Long Jump**: Approach Run, Take-off, Flight in the air (Hang Style / Hitch Kick) and Landing **Shot put:** Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique)	Total-32 hours 2 hours / week
	Volleyball	**A. Fundamental skills** Service: Under arm service, Side arm service, Tennis service, Floating service. Pass: Under arm pass, Over head pass. Spiking and Blocking. Game practice with application of Rules and Regulations **B. Rules and their interpretation and duties of officials.**	
	Throw ball	**A. Fundamental skills** Overhand service, Side arm service, two hand catching, one hand overhead return, side arm return. **B. Rules and their interpretations and duties of officials**	

5th Semester **B24NCK593**	**<u>Athletics</u>** **Track-11**0&400 Meters Hurdles **Jumps-**High Jump **Throws-**Discuss Throw	**110 Meters and 400 Meters:** Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles Crouch start (its variations) use of Starting Block. Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. **High jump**: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. **Discus Throw**: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).	

5th Semester **B24NCK593**	Football	**A. Fundamental Skills** ➢ Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. ➢ Trapping: Trapping-the Rolling ball, and the Bouncing ball with sole of the foot. ➢ Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. ➢ Heading: In standing, running and jumping condition. ➢ Throw-in: Standing throw-in and Running throw-in. ➢ Feinting: With the lower limb and upper part of the body. ➢ Tackling: Simple Tackling, Slide Tackling. ➢ Goal Keeping: Collection of Ball, Ballclearance-kicking, throwing and deflecting. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	Total-32 hours 2 hours / week
	Hockey	**A. Fundamental Skills** ➢ Passing: Short pass, Long pass, push pass, hit ➢ Trapping. ➢ Dribbling and Dozing. ➢ Penalty stroke practice. ➢ Penalty corner practice. ➢ Tackling: Simple Tackling, Slide Tackling. ➢ Goal Keeping, Ball clearance-kicking, and deflecting. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	
	Athletics **Track**-Relays **Jumps**-Triple Jump **Throws**-Javelin Throw	**Relay Race**: Starting, Baton Holding / Carrying, Baton Exchange in between zone, and Finishing. **Triple Jump**: Approach Run, Take-off, Flight in the Hop, Step, Jump and Landing. **Javelin Throw**: Grip, Carry, and Recovery (3/5 Impulse stride). Release.	Total-32 hours 2 hours / week
	CRICKET	**A. Fundamental Skills** ➢ Batting-Forward Defense Stroke, Backward Defense Stroke, Off Drive, On Drive, Straight Drive, Cover Drive, Square Cut. ➢ Bowling-Out-swing, In-swing, Off Break, Leg Break and Googly. ➢ Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short Throw, Long Throw, Throwing on the Turn. ➢ Wicket Keeping **B. Rules and their interpretation and duties of officials.**	

	BASEBALL	**A. Fundamental Skills** Player Stances–walking, extending walking, L stance, cat stance. Grip – standard grip, choke grip. Batting – swing and bunt. Pitching. Baseball: Slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball. **B. Rules and their interpretation and duties of officials.**	

6th Semester **B24NCK693**	**Athletics** Combined Events-Heptathlon & Decathlon **Jumps**- Pole Vault **Throws**-Hammer Throw	Combined Events: Heptathlon all the7 events Decathlon: All10Events **Pole Vault**: Approach Run, Planting the Pole, Take-off, Bar Clearance and Landing. **Hammer Throw**: Holding the Hammer, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).	Total-32 hours 2 hours / week
	Basketball	**A. Fundamental Skills** ➢ Passing: Two hands Chest Pass, Two hands Bounce Pass, One hand Base ball Pass, Side arm Pass, Overhead Pass, Hook Pass. ➢ Receiving: Two hand receiving, one hand receiving, Receiving in stationary position, receiving while jumping and Receiving while Running. ➢ Dribbling: How to start dribble, drop dribble, High Dribble, Low Dribble, Reverse Dribble, Rolling Dribble. ➢ Shooting: Lay-up shot and its variations, one hand set shot, two hands jump shot, Hook shot, Free Throw. ➢ Rebounding: Defensive rebound and Offensive rebound. ➢ Individual Defence: Guarding the player with the ball and without the ball, pivoting. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	
	Netball	**A. Fundamental skills** ➢ Catching: one handed, two handed, with feet grounded and in flight. ➢ Throwing (Different passes and their uses): One hand passes (shoulder, high shoulder, underarm, bounce, lob), two hand passes (Push, overhead and bounce). ➢ Footwork: Landing on one foot, landing on two feet, Pivot, Running pass. ➢ Shooting: One hand, forward step shot, and back ward step shot.	

		➢ Techniques of free dodge and sprint, sudden sprint, sprint and stop, sprinting with change at speed. ➢ Defending: Marking the player, marking the ball, blocking, inside the circle, outside the circle. Defending the circle edge against the passing. ➢ Intercepting: Pass and shot. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	
	Individual games Shuttle Badminton	**A. Fundamental skills** ➢ Basic Knowledge: Various parts of the Racket and Grip. ➢ Service: Short service, Long service, Long-high service. ➢ Shots: Over head shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	Total-32 hours 2 hours / week
	Table Tennis	**A. Fundamental skills** ➢ Basic Knowledge: Various parts of the Racket and Grip (Shake Hand & Pen Hold Grip). ➢ Stance: Alternate & Parallel. ➢ Push and Service: Backhand & Forehand. ➢ Chop: Backhand & Forehand. ➢ Receive: Push and Chop with both Backhand & Forehand. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	
	Hand ball	**A. Fundamental skills** ➢ Catching, Throwing and Ball control, ➢ Goal Throws: Jump shot, Center shot, Dive shot, Reverse shot. ➢ Dribbling: High and low. ➢ Attack and counter attack, simple counter attack, counter attack from two wings and center. ➢ Blocking, Goal Keeping and Defensive skills. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	
	Ball Badminton	**A. Fundamental skills** ➢ Basic Knowledge: Various parts of the Racket and Grip. ➢ Service: Short service, Long service, Long-high service. ➢ Shots: Over head shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash. ➢ Game practice with application of Rules and Regulations. **B. Rules and their interpretation and duties of officials.**	

REFERENCES

1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et al. Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P. N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey, H. C. Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Of fences for winning basketball, Parker Publishing Co., New York. 13 Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
13. Sally Kus, Coaching Volleyball Successfully, Human Kinetics.
14. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
15. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata

SEMESTER-V & VI					
YOGA Category: NCMC					
Course Code	:	B24NCK594/694	CIE	:	100 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	--
Total Hours	:	--	Total	:	100 Marks
Credits	:	--	SEE Duration	:	--

Semester	Course
III Semester	1) Introduction of Yoga, Aim and Objectives of yoga, Prayer 2) Brief introduction of yogic practices for common man 3) Rules and regulations 4) Misconceptions of yoga 5) Suryanamaskara 6) Different types of Asanas a. Sitting b. Standing c. Prone line d. Supine line
IV Semester	1) Patanjali's Ashtanga Yoga 2) Suryanamaskara 3) Different types of Asanas a. Sitting b. Standing c. Prone line d. Supine line 4) Kapalbhati 5) Pranayama
V Semester	1) Patanjali's Ashtanga Yoga 2) Surya namaskara 3) Different types of Asanas a. Sitting b. Standing c. Proneline d. Supineline 4) Kapalbhati 5) Pranayama

	1) Patanjali's Ashtanga Yoga 2) Suryanamaskara 3) Different types of Asanas a. Sitting b. Standing c. Prone line d. Supine line 4) Kapalbhati 5) Pranayama
VI Semester	1) Patanjali's Ashtanga Yoga 2) Suryanamaskara 3) Different types of Asanas a. Sitting b. Standing c. Prone line d. Supine line 4) Kapalbhati 5) Pranayama
	1) Patanjali's AshtangaYoga 2) Suryanamaskara 3) Different types of Asanas a. Sitting b. Standing c. Prone line d. Supine line 4) Kapalbhati 5) Pranayama 6) Shat Kriyas

Notes:

- One Hour of Lectureisequalto1Credit
- One Hour of Tutorial is equal to 1Credit (Except Languages)
- Two Hours of Practical is equal to 1Credit
- SEE: Semester End Examination
- CIE: Continuous Internal Examination
- L+T+P: Lecture + Tutorial + Practical

Guidelines for Yoga Syllabus

Semester & Course Code	Course Title	Content	No. of Hours
3rd Semester B24NCK394	Introduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer	Total-32 hours 2 hours / week
	Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health	
	Rules and regulations	Rules to be followed during yogic practices by practitioner	
	Misconceptions of yoga	Yoga its misconceptions, Difference between yogic and non yogic practices.	
	Suryanamaskara	Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds	
	Different types of Asanas Sitting ➢ Padmasana ➢ Vajrasana Standing ➢ Vrikshana ➢ Trikonasana Prone line ➢ Bhujangasana ➢ Shalabhasana Supine line ➢ Utthitadvipadasana ➢ Ardhahalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana.	

4th Semester **B24NCK494**	Patanjali's Ashtanga Yoga ➢ Yama ➢ Niyama	Patanjali's Ashtanga Yoga its need and importance. Yama: Ahimsa, satya, asteya, brahmacarya, aparigraha. Niyama: shoucha, santosh, tapa, svaadhyaya, Eshvara pranidhan	Total-32 hours 2 hours / week
	Suryanamaskara	Suryanamaskar 12 count, 4 rounds	
	Different types of Asanas Sitting ➢ Sukhasana ➢ Paschimottanasana Standing ➢ Ardhakati Chakrasana ➢ Parshva Chakrasana Prone line ➢ Dhanurasana Supine line ➢ Halasana ➢ Karna Peedasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana.	
	Kapalabhati	Meaning, importance and benefits of Kapalabhati. 40 strokes/min, 3 rounds	
	Pranayama ➢ Suryanuloma–Viloma ➢ Chandranuloma-Viloma ➢ Suryabhedana ➢ ChandraBhedana ➢ Nadishodhana	Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama	

5th Semester **B24NCK594**	Ashtanga Yoga ➢ Asana ➢ Pranayama	Patanjali's Ashtanga Yoga its need and importance.	Total-32 hours 2 hours / week
	Suryanamaskara	Suryanamaskar 12 count, 6 rounds	
	Different types of Asanas Sitting ➢ Ardha Ushtrasana ➢ Vakrasana Standing ➢ Urdhva Hastothanasana ➢ Hastapadasana Prone line ➢ Padangushtha Dhanurasana Supine line ➢ Sarvangasana ➢ Chakraasana	Asana, Need, importance of Asana. Different types. Asana its meaning by name, technique, precautionary measures and benefits of each asana.	
	Kapalabhati	Revision of practice 50 strokes/min, 3 rounds	
	Pranayama ➢ Surya Bhedana ➢ Ujjayi	Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, Precautionary measures and benefits of each Pranayama.	
	Ashtanga Yoga ➢ Pratyahara ➢ Dharana	Patanjali's Ashtanga Yoga its need and importance.	Total-32 hours 2 hours / week
	Suryanamaskara	Revisionofpractice12count, 8 rounds	
	Different types of Asanas Sitting ➢ AakarnaDhanurasana ➢ YogamudrainPadmasana Standing ➢ ParivrittaTrikonasana ➢ Utkatasana Prone line ➢ PoornaBhujangasana/	Asana, Need, importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana.	

	Rajakapotasana Supine line ➢ Navasana/Noukasana ➢ Pavanamuktasana		
	Kapalabhati	Revision of practice 60 strokes/min, 3 rounds	
	Pranayama ➢ Sheetali ➢ Sheektari	Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama	

6th Semester **B24NCK694**	Ashtanga Yoga ➢ Dhyana (Meditation) ➢ Samadhi	Patanjali's Ashtanga Yoga its need and importance.	Total-32 hours 2 hours / week
	Suryanamaskara	Revision of practice 12count, 10rounds.	
	Different types of Asanas Sitting ➢ Vibhakta Paschimottanasana ➢ Yogamudra inVajrasana Standing ➢ Parshvakonasana ➢ Ekapadbaddhapadmottanasana Prone line balancing ➢ Mayurasana Supine line ➢ Sarvangasana ➢ Setubandhasana ➢ Shavasanaa (Relaxation poisture)	Asana, Need, Importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana.	
	Kapalabhati	Revision of practice 80 strokes/min, 3 rounds	

	Pranayama ➢ Bhastrika ➢ Bhramari	Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, Precautionary measures and benefits of each Pranayama.	
	Suryanamaskara	Revision of practice 12count, 12 rounds.	Total-32 hours 2 hours / week
	Different types of Asanas Sitting ➢ Bakasana ➢ Hanumanasana ➢ Ekapada Rajakapotasana Standing ➢ Vatayanasana ➢ Garudasana ➢ Natarajasana Balancing ➢ Sheershasana Supine line ➢ 1.Setubandha Sarvangasana ➢ Shavasanaa (Relaxation poisture)	Asana, Need, importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana.	
	Kapalabhati	Revision of practice 100 strokes/min, 3 rounds.	
	Pranayama ➢ Nadishodhana ➢ Ujjai ➢ Bhramari	Revision of practices	
	ShatKriyas ➢ Jalaneti & sutraneti ➢ Nouli (only for men) ➢ Sheetkarma Kapalabhati	Meaning, Need, importance of Shatkriya. Different types. Meaning by name, technique, precautionary measures and benefits of each Kriya	

Book for Reference:

- Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
- Tiwari, O P: Asana Why and How

- Ajitkumar: Yoga Pravesha (Kannada)
- Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
- Swami Satyananda Saraswati: Surya Namaskar (BiharSchoolofyoga,Munger)
- Nagendra H R: The art and science of Pranayama
- Tiruka: Shatkriyegalu (Kannada)
- Iyengar B K S: Yoga Pradipika (Kannada)
- Iyengar B K S: Light on Yoga (English)

SEMESTER-V & VI					
MUSIC Category: NCMC					
Course Code	:	B24NCK595/695	CIE	:	100 Marks
Teaching Hours L : T : P	:	1:0:0	SEE	:	--
Total Hours	:	--	Total	:	100 Marks
Credits	:	--	SEE Duration	:	--

Course Objectives	
1.	Identify the major traditions of Indian music, both through notations and aurally.
2.	Analyze the compositions with respect to musical and lyrical content
3.	Demonstrate an ability to use music technology appropriately in a variety of setting.

Module – 1	No. of Hours
Preamble: Contents of the curriculum intend to promote music as language to develop an analytical, Creative, and intuitive Understanding. For this the student must experience music through study and direct participation in improvisation and composition. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Laya, Raga Tala, Mela.	3
Module – 2	**No. of Hours**
Compositions: Introduction to the types of composition in Carnatic Music- Geethe, Jath i, Swara, Swarajathi, Varna, Krithi, and Thillana, Notation System.	3
Module – 3	**No. of Hours**
Composers: Biography and contributions of Purandaradasa, Thyagaraja, Mysoro Vasudevacharya.	3
Module – 4	**No. of Hours**
Music Instruments: Classification and construction of string instruments, wind instrurments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instrum ents	3
Module – 5	**No. of Hours**
Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in M alahari, and one jathi Swara, One Krithi in a Mela raga	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Discuss the Indian system of music and relate it to other genres (Cognitive DOmain)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

Text Books	
1.	Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2.	T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana- Vol. 1 (English), Shreenivaas Prakaashana, 2018.

Reference Text Books	
1.	Lakshminarayana Subramaniam, Viji Subramanaim, "Classical Music of India: A Practical Guige", Tranqueber 2018.
2.	R. Rangaramanuja Ayyangar, "History of South Indian (Carnatic) Music", Vipanci Charitable Trust; Third edition, 2019.
3.	Ethel Rosenthal, "The Story of Indian Music and Its Istruments: A Study of the Present and a Record of the Past", Pilgrims Publishing, 2007.
4.	Carnatic Music, National Institute of Open Schooling, 2019.