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

III & IV Semester Scheme and Syllabus

(2025 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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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 – 2025 Scheme

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III Semester **Academic Year: 2026-27**

S.No	Course Category and Course Code		Course Title	TD/ PSB	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
					L	T	P	S					
1.	ASC	B25MEE301	Transform calculus, Fourier series and Probability Distributions (Common to ECE & EEE)	Maths	**42**	**28**	**0**	**50**	**50**	**50**	**100**	**3**	**4**
2.	PCC	B25EE302	Electrical Machines - I	EE	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
3.	IPCC	B25EE303	Analog and Linear Integrated Circuits	EE	**42**	**0**	**28**	**50**	**50**	**50**	**100**	**3**	**4**
4.	PCC	B25EE304	Electric Circuit Analysis	EE	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
5.	PCC	B25EE305	Measurements and Instrumentation	EE	**42**	**0**	**0**	**48**	**50**	**50**	**100**	**3**	**3**
6.	PCCL	B25EEL306	Electrical Machines – I Lab	EE	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
7.	AEC	B25EEL307	Measurements and InstrumentationLab	EE	**0**	**0**	**28**	**2**	**50**	**50**	**100**	**3**	**1**
8.	SDC	B25EEP308	Community / Societal Project	EE	**0**	**0**	**0**	**30**	**50**	**50**	**100**	**3**	**1**
9.	NCMC	B25MAD309	Additional Mathematics-I	Maths	**42**	**0**	**0**	**0**	**100**	**-**	**100**	**-**	**PP**
10.	NCMC	B25NSK310A/ B/C/D/E	National Service Scheme /National Cadet Corps / Physical Education Yoga /Music	HSS	**0**	**0**	**0**	**28**	**100**	**-**	**100**		**PP**
11.	SEC	B25SKL300	Skill Laboratory	Concerned Dept.	**0**	**0**	**30**	**0**	**100**	**-**	**100**	**-**	**1**
								TOTAL	**700**	**400**	**1100**		**21**

ASC: Applied Science Courses, BSC: Basic Science Course, HSMC: Humanities Studies and 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, SDC: Skill Development Course, L: Lecture, T: Tutorial, P: Practical, S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, XX: Programme Code (EC, CS, IS etc.,), Y: A/B/C/D**,** K: Indicates Common Course to all the streams of Engineering

NSS / NCC / PE / Yoga / Music: All students are required to register for any one of the following courses: National Service Scheme/National Cadet Corps/Physical Education/Yoga/ Music - with the respective course coordinator during the first week of the third semester. College shall submit Continuous Internal Evaluation (CIE) marks for each semester based on the activities completed by students under these selected courses. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga. Activities shall be conducted over two semesters (III&IV), and successful completion of the registered course/or courses along with the required CIE score is mandatory for the award of the degree. Institutions must ensure that events are appropriately scheduled and reflected in the semester-wise calendar for NSS, PE, Music, and Yoga activities.
These courses shall not be considered for the calculation of SGPA or CGPA and for vertical progression. However, completion of course(s) is compulsory for degree eligibility.

The courseB25XX307Y – Ability Enhancement Course Laboratory can be offered either as a single compulsory course. Alternatively, the course B25XX307Y - Ability Enhancement Course Laboratory shall be offered as multiple elective options under the course codesB25XX307Y (where Y =A/B/C/D)

HOD **Dean-Academics** **Principal**

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Scheme of Teaching and Examinations – 2025 Scheme

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

IV Semester **Academic Year: 2026-27**

S. No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Semester				Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	CIE Marks	SEE Marks	Total marks	SEE Duration in hours	
					L	T	P	S					
1.	PCC	B25EE401	Electrical Machines – II	EE	42	28	0	50	50	50	100	3	4
2.	PCC	B25EC402	Electromagnetic Field Theory (Common to ECE & EEE)	EE	42	28	0	50	50	50	100	3	4
3.	IPCC	B25EE403	Microcontrollers (Common to EEE & RA)	EE	42	0	28	50	50	50	100	3	4
4.	PCC	B25EE404	Transmission and Distribution	EE	42	0	0	48	50	50	100	3	3
5.	BSC	B25BEK405	Biology for Engineers	EE	28	0	0	2	50	50	100	2	2
6.	PCCL	B25EEL406	Electrical Machines – II Lab	EE	0	0	28	2	50	50	100	3	1
7.	AEC	B25EEL407	Arduino and Raspberry Pi Lab (Common to EEE& RA)	EE	0	0	28	2	50	50	100	3	1
8.	SDC	B25EEP408	Environmental Science Project	EE	0	0	0	30	50	50	100	3	1
9.	NCMC	B25MAD409	Additional Mathematics - II	Maths	42	0	0	0	100	-	100	-	PP
10.	NCMC	B25NSK410A/ B/C/D/E	National Service Scheme /National Cadet Corps / Physical Education Yoga /Music	HSS	0	0	0	28	100	-	100		PP
11	SEC	B25SKL400	Skill Laboratory	Concerned Dept.	0	0	30	0	100	-	100	-	1
								TOTAL	700	400	1100		21

ASC: Applied Science Courses, BSC: Basic Science Course, HSMC: Humanities Studies and 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, SDC: Skill Development Course, L: Lecture, T: Tutorial, P: Practical, S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation, PP/NP: Pass/Not Pass, XX: Programme Code (EC, CS, IS etc.,), Y: A/B/C/D**,** K: Indicates Common Course to all the streams of Engineering

NSS / NCC / PE / Yoga / Music: All students are required to register for any one of the following courses: National Service Scheme/National Cadet Corps/Physical Education /Yoga/ Music - with the respective course coordinator during the first week of the third semester.

Colleges shall submit Continuous Internal Evaluation (CIE) marks for each semester based on the activities completed by students under the selected course. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga. Activities shall be conducted over two semesters (III and IV), and successful completion of the registered course/or courses along with the required CIE score is mandatory for the award of the degree. Institutions must ensure that events are appropriately scheduled and reflected in the semester-wise calendar for NSS, PE, Music, and Yoga activities.

These courses shall not be considered for the calculation of SGPA or CGPA and for vertical progression. However, completion of course(s) is compulsory for degree eligibility.

The course **B25XX407Y** – Ability Enhancement Course Laboratory can be offered either as a single compulsory course. Alternatively, the course **B25XX407Y** - Ability Enhancement Course Laboratory shall be offered as multiple elective options under the course codes **B25XX407Y** (where Y =A/B/C/D)

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions.

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

Semester-III

Transform Calculus, Fourier series and Probability Distributions

Category: ASC
(Common to EEE, ECE)

Course Code	:	**B25MEE301**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1	To learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series
2	To analyze signals in terms of Fourier transforms and z transforms.
3	To analyze problems by applying Partial Differential Equations.
4	To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
5	To understand the random process for use in communication engineering.

Module-1	**No. of Hours**
Fourierseries: Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period $2\pi$and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Triangle and half range expansions, Practical harmonic analysis, and variation of periodic current. **Self-study:** Typical waveforms, complex form of Fourier series.	14
Module-2	**No. of Hours**
FourierTransforms and z-transforms: Infinite Fourier transforms Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Initial value and final value theorems, Inverse z-transform and applications to solve difference equations. Self Study: Initial value and final value theorems, problems. **Self-study:** Convolution theorems of Fourier Transforms.	14
Module 3	**No. of Hours**
Partial Differential Equations(PDE): Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation, Solution of separation of variables.	14
Module-4	**No. of Hours**
Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson, normal distributions, Exponential distributions, -problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. **Self-study:** Test of hypothesis for means, single proportions only.	14
Module-5	**No. of Hours**
Two dimensional Random variables: Joint probability mass function, Marginal probability function, conditional probability function. Random Process: Classification of random process, description of random process, stationary random process – first order, second order and Strict-sense stationary processes, Autocorrelation and Cross- correlation functions. **Self-study:** Joint density function, marginal density function, conditional probability density function, covariance, correlation coefficient. **Application:** Bayesian network.	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing, and field theory.
CO2	Use Fourier transforms to analyze problems in solving continuous-time signals.
CO3	Applying Partial Differential Equations.
CO4	Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field.
CO5	Demonstrate the random process for use in communication engineering.

Text Books	
1.	B.S.Grewal: "Higher Engineering Mathematics", Khanna publishers,44thEd.2018
2.	E.Kreyszig:"Advanced Engineering Mathematics", John Wiley & Sons,8thEd.(Reprint),2016
Reference Books	
1.	V. Ramana: "Higher Engineering Mathematics", McGraw-Hill Education, 11thEdition.
2.	Dr.D S Chandrasekhar: "Engineering Mathematics-I", Prism, 8th Edition.
3.	Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education (India) Pvt. Ltd, 2015.

Web links and Video lectures (e-Resources)

1. https://nptel.ac.in/courses/12286025
2. VTUEDUSATPROGRAMME –20
3. http://www.class-central.com/subject/math(MOOCs)

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

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

Semester-III					
Electrical Machines - I **Category: PCC**					
Course Code	:	**B25EE302**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

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

Course Learning Objective is	
1.	To understand the principles, construction, and operation of transformers, DC generators, and synchronous generators.
2.	To analyze performance characteristics using equivalent circuits, phasor diagrams, and EMF equations.
3.	To evaluate losses, efficiency, voltage regulation, and testing methods of electrical machines.
4.	To study parallel operation, connections, and control methods of transformers and alternators.
5.	To apply theoretical concepts for solving numerical and practical machine problems.

Module– 1	**No. of Hours**
Single phase Transformers: Necessity of transformer, principle of operation, Types and construction, EMF equation, equivalent circuit, Operation of practical transformer under no-load and on-load with phasor diagrams. Losses and methods of reducing losses, efficiency and condition for maximum efficiency. **Test on Transformers:** Polarity test, Sumpner's test. Open circuit and Short circuit tests, equivalent circuit parameters. Predetermination of efficiency, voltage regulation and its significance. (Simple Numerical).	9
Module– 2	**No. of Hours**
Three-phase Transformers: Introduction, Constructional features of three-phase transformers. Transformer connection for three phase operation– star/star, delta/delta, star/delta, delta/star and V–V connection, comparative features. **Parallel Operation of Transformers:** Necessity of Parallel operation, conditions for parallel operation– Single phase and three phase. Load sharing in case of similar and dissimilar transformers. Numerical.	9
Module– 3	**No. of Hours**
Auto transformers and Tap changing transformers: Introduction to autotransformer-copper economy, equivalent circuit, no load and on load tap changing transformers. Numerical. Three-Winding Transformers & Cooling of Transformers: Three-winding transformers. Cooling of transformers. **DC Generator**: Principle of operation, constructional details, induced EMF expression, types of generators, armature reaction, and load characteristics. Commutation, types of Commutation.	8
Module– 4	**No. of Hours**
Synchronous Generators: Types, Construction, working principle, Characteristics, Armature windings, winding factors, E.M.F equation, Harmonics and Harmonics Minimization, Parameters of Armature winding, Armature reaction Concept of Synchronous Reactance and Impedance, Equivalent Circuit of Alternator. **Synchronous Generators Analysis**: Voltage Regulation of an alternator,phasor diagram of an alternator, Voltage Regulation and load characteristics of an Alternator, Synchronization of Synchronous Generators, Methods of Synchronization, Synchronizing power.	8
Module– 5	**No. of Hours**
Synchronous Generators Analysis: Parallel operation of Two Alternators, V Curves of a synchronous Generator, Two Reaction Theory, Determination of X_d and X_q using slip Test. **Synchronous Generators (Methods of Determining Regulation and Performance)**:Voltage Regulation by Direct loading, EMF Method and MMF Method, , short circuit ratio and its significance, Capability curves, Hunting and Dampers.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the operation and construction of transformers, DC generators, and synchronous generators.
CO2	Analyze machine performance using equivalent circuits and phasor diagrams.
CO3	Compute efficiency, losses, and voltage regulation using standard test data.
CO4	Examine parallel operation, load sharing, and synchronization of electrical machines.
CO5	Interpret machine characteristics and stability aspects such as V-curves, armature reaction, and commutation.

Text Books	
1.	Electric Machines, D. P. Kothari, et al, 4th Edition, 2011
2.	Electric Machines, AshfaqHussain, DhanpatRai& Co, 2nd Edition, 2013.

Reference Text Books	
1.	Electric Machines, Mulukuntla S. Sarma, at el, Cengage, 1st Edition, 2009.
2.	Electrical Machines, Drives and Power systems, Theodore Wildi, Pearson, 6th Edition, 2014.

Web links and Video lectures (e-Resources)
• **www.nptel.ac.in**

ASSESSMENT STRUCTURE:
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**	**40 (Average of Best two Assessments)**	**50**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
AAT	**Any Two Assessments as per regulations**	**20**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE):

4. The Question paper for each course contains two parts, Part – A and Part – B.
5. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
6. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-III					
Analog and Linear Integrated Circuits **Category: IPCC**					
Course Code	:	**B25EE303**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand the operation and applications of diodes and Bipolar Junction Transistors (BJT), including biasing techniques, amplifier configurations, and multistage amplifiers.
2.	To analyze different types of power amplifiers, their working principles, efficiency, and distortion characteristics.
3.	To study the construction, characteristics, and biasing of FET and MOSFET, and to understand feedback concepts and the operation of various oscillator circuits.
4.	To understand the fundamentals of operational amplifiers and their applications in signal processing, including converters, comparators, and waveform generation circuits.
5.	To analyze active filters and DC voltage regulators, including design and applications of Butterworth filters and IC regulators.

Module– 1	**No. of Hours**
Diode Applications - Clipping circuits, Clamping Circuits: Bipolar Junction Transistor (BJT): Transistor characteristics, transistor as an amplifier, CB, CE, CC configurations, the operating point, BJT Biasing: Fixed bias ,Collector to base Bias , voltage divider bias, bias compensation, Stability, CE amplifier response, gain bandwidth product, Emitter follower, RC coupled amplifier, two cascaded CE and multistage CE amplifiers.	9
Module– 2	**No. of Hours**
Power Amplifiers: Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Class C and Class D amplifiers.	9
Module– 3	**No. of Hours**
Junction Field Effect Transistor (FET): FET Construction, Principle of Operation, VI Characteristics, MOSFET- Depletion and Enhancement MOSTET, FET biasing. **Feedback and Oscillator Circuits:** Feedback concepts, Feedback connection types, Oscillator operation, RC Phase shift oscillator, Wein bridge oscillator, Tuned Oscillator circuit, Crystal oscillator.	9
Module – 4	**No. of Hours**
Operational Amplifier: Introduction to Op-amp, inverting and non-inverting configuration **Op amp Application Circuits:** Basic comparator, zero crossing detector, voltage to current converter with grounded load, current to voltage converter, A stable and Mono stable Multi vibrators using IC-555. Precision half wave & full wave rectifiers limiting circuits, clamping circuits, peak detectors, sample & hold circuits. **Signal processing circuits:** A/D & D/A Converters: Basics, R–2R D/A Converter, successive approximation ADC	9
Module– 5	**No. of Hours**
Active Filters: First & Second order high pass & low pass Butterworth filters. Band pass filters, Band stop filters, all pass filters **DC Voltage Regulators:** Voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 & LM337 Integrated circuits regulators	9

LABORATORY

Sl. No	List of experiments
1.	To construct and observe clipping and clamping circuits for different configurations
2.	To construct and find bandwidth of RC coupled amplifier
3.	To conduct an experiment on a given JFET and obtain 1)Drain Characteristics 2) Transfer Characteristics
4.	To construct and check oscillation frequency for RC phase shift oscillator.
5.	Design and realize to analyse the frequency response of an op – amp amplifier under Inverting and non - inverting configuration for a given gain.
6.	Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector.
7.	Design and realization of R – 2R ladder DAC.
8.	Voltage to Current Converter
9.	Precision HW and FW Rectifiers
10.	Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and filters for a given cut off frequency/frequencies to verify the frequency response characteristic.
11.	Design and verify an IC 555 timer based pulse generator for the specified pulse.
12.	Designing of Fixed voltage power supply (voltage regulator) using IC regulators 78 series and 79 series

Course Outcomes: At the end of the course, the students will be able to	
CO1	Analyze diode circuits and BJT characteristics, biasing methods, and amplifier configurations for electronic circuit design.
CO2	Evaluate the performance of various power amplifiers and analyze efficiency and distortion in practical circuits.
CO3	Understand and apply FET/MOSFET concepts, feedback techniques, and oscillator circuits in electronic systems.
CO4	Apply operational amplifier concepts to design signal processing circuits such as converters, comparators, and waveform generators.
CO5	Design and analyze active filters and voltage regulator circuits using ICs for stable electronic applications.
Text Books	
1.	Analog Electronic Circuits: A simplified approach by U.B. Mahadevaswamy, Pearson Education India, 2010
2.	Operational Amplifiers and Linear ICs David A. Bell Oxford 3rd Edition

Reference Text Books	
1.	Op-Amps and Linear Integrated Circuits Ramakant A Gayakwad Pearson 4thEdition
2.	David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any One Assessment as per Regulations	20	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks	10	25
	Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.
5. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
6. 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	1	-	–	–	–	–	–	2
CO2	3	3	2	2	-	–	–	–	–	–	2
CO3	3	3	2	2	1	–	–	–	–	–	2
CO4	3	3	3	2	2	–	–	–	–	–	2
CO5	3	3	3	2	2	–	–	–	–	–	2

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

Semester-III					
Electric Circuit Analysis **Category: PCC**					
Course Code	:	**B25EE304**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To familiarize the basic laws, source transformations, theorems and the methods of analyzing electrical circuits.
2.	To explain the use of network theorems and the concept of resonance.
3.	To familiarize the analysis of three-phase circuits, two port networks and networks with non- sinusoidal inputs.
4.	To explain the importance of initial conditions, their evaluation and transient analysis of R-L and R-C circuits.
5.	To impart basic knowledge on network analysis using Laplace transforms.

Module– 1	**No. of Hours**
Active and passive elements, Concept of ideal and practical sources. star – delta transformation. Analysis of networks by (i) Network reduction method (ii) Mesh and Node voltage methods for ac and DC circuits with independent and dependent sources. Concept of Super-Mesh and Super node analysis Duality.	9
Module– 2	**No. of Hours**
Super Position theorem, Thevenin's theorem, Norton's theorem, and Maximum p o w e r transfer theorem. Analysis of networks (only with independent AC and D C sources).	9
Module– 3	**No. of Hours**
Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance Analysis of coupled circuits– Single Tuned circuits	8
Module– 4	**No. of Hours**
Laplace transformation definition, LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions, periodic functions. Waveform synthesis. Initial and Final value theorems. Transient response of RL, RC and RLC circuits using Laplace transform for Source free, Step input and Sinusoidal input.	8
Module– 5	**No. of Hours**
Unbalanced Three Phase Systems: Analysis of three phase systems, calculation of real and reactive Powers and analysis as applicable to star/delta connected load. Two Port networks: Definition, Open circuit impedance, Short circuit admittance, h-parameters and Transmission parameters and their evaluation for simple circuits.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the basic concepts, basic laws and methods of analysis of DC and AC networks.
CO2	Solve complex electric circuits using network theorems.
CO3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
CO4	Synthesize typical waveforms using Laplace transformation.
CO5	Solve unbalanced three phase systems and also evaluate the performance of two port networks.

Text Books	
1.	Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition,2014.
2.	Circuits Theory (Analysis and synthesis), Chakrabarti A, DhanpatRai& Sons, New Delhi, 2020.

Reference Text Books	
1.	Network Analysis, M.E. Vanvalkenburg, Pearson, 3rd Edition,2014.
2.	Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku, McGraw Hill, 5th Edition, 2013.

Web links and Video lectures (e-Resources)
• **https://nptel.ac.in/courses/12286025** • **http://www.class-central.com/subject/math(MOOCs)**

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-III					
Measurements and Instrumentation **Category: PCC**					
Course Code	:	**B25EE305**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course learning Objective is	
1.	To understand the significance and methods of Measurements, elements of generalized measurement system and errors in measurements
2.	To measure resistance, inductance, capacitance by use of different bridges
3.	To study the construction, working and characteristics of various instrument transformers
4.	To work the knowledge of electronic instruments
5.	To provide the working knowledge of display devices and recording devices

Module– 1	**No. of Hours**
Measurements and Measurement systems: Introduction, significance and methods of Measurements, Instruments and measurement systems, Mechanical, electrical and electronic instruments. Classification of instruments. Types of Instrumentation systems, information and signal processing. Elements of generalised measurement system. Input-output configurations of measuring instruments and measurement systems. Methods of correction for interfering and modifying inputs, errors in measurements, Accuracy and precision.	9
Module– 2	**No. of Hours**
Measurement of Resistance, Inductance and capacitance: Wheatstone bridge-sensitivity analysis, limitations, kelvin's double bridge, Max wells bridge, Desauty's bridge, schering Bridge, source and detectors, minimization of AC bridge errors, Hay's bridge , Anderson's bridge (Derivations and Numerical as applicable).	9
Module– 3	**No. of Hours**
Instrument Transformers: Introduction, Use of Instrument transformers. Current transformer (CT)- Relationships in CT, Errors in CT, characteristics of CT, causes and reduction of errors in CT, Potential transformer (PT)- Relationships in PT, Errors in PT, characteristics of PT, reduction of errors in PT. **Data Acquisition System (DAS):** Introduction	8
Module– 4	**No. of Hours**
Electronic and Digital Instruments: Introduction. Essentials of electronic instruments, Advantages of electronic instruments. Electronic multi meters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM and Successive - approximation DVM. Principle of working of electronic energy meter (with block diagram), extra features offered by present day meters and their significance in billing.	8
Module– 5	**No. of Hours**
Force, Pressure, Humidity, and Moisture Sensors: Force sensor- Strain gauge, Semiconductor straingauge, Strain gauge accelerometers, Pressure sensors- Mechanical pressure sensors, Piezor esistive pressure sensor, Capacitive pressure sensor, Resistive humidity sensor, capacitive moisture sensors, Thermal conduction moisture sensors**.** **Sensors in Modern Communication Systems:** Role of sensors in modern telecommunication systems (5G/6G, IoT, WSNs), Reconfigurable sensors, Terahertz and Photonic Sensors, Quantum sensors and optical sensors and its role in secure 6G communication	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the significance and methods of Measurements, elements of generalised measurement system and errors in measurements.
CO2	Measure the resistance, inductance and capacitance by different methods.
CO3	Explain the construction, working and characteristics of various instrument transformers.
CO4	Explain the working of different electronic and digital instruments.
CO5	Apply the working knowledge of sensors and modern communication.

Text Books	
1.	Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Co, 10th Edition
2.	Nathan Ida, Sensors, Actuators, and Their Interfaces: A Multidisciplinary Introduction, 2nd ed., IET Publications, 2014.

Reference Text Books	
1.	Electrical and Electronic Measurements and Instrumentation, R.K. Rajput, S Chand, 5th Edition, 2012
2.	Electrical Measuring Instruments and Measurements, S.C. Bhargava, BS Publications, 2013
3.	Modern Electronic Instrumentation and Measuring Techniques, Cooper D and A.D. Heifrick, Pearson, First Edition, 2015
4.	Electronic Instrumentation and Measurements, David A Bell, Oxford University, 3rd Edition, 2013
5.	A Course in Electronics and Electrical Measurements and Instrumentation, J. B. Gupta, Katson

Web links and Video lectures (e-Resources)
• www.nptel.ac.in • https://www.eeweb.com/

ASSESSMENT STRUCTURE:
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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-III					
Electrical Machines – I Lab **Category: PCCL**					
Course Code	:	**B25EEL306**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To perform experimental tests on transformers and rotating electrical machines to study their characteristics.
2.	To conduct pre-determination, load, and performance tests to evaluate efficiency, voltage regulation, losses, and load sharing.
3.	To model and simulate electrical machines and power system characteristics using MATLAB/Simulink/ Simscape.

Sl. No	**List of Experiments**
1.	Open Circuit and Short circuit tests on single phase step up or step down transformer and pre-determination of (i) Efficiency and regulation (ii) Calculation of parameters for equivalent circuit
2.	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.
3.	Direct Load Test on a Single-Phase Transformer.
4.	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load.
5.	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.
6.	Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection
7.	Separation of hysteresis and eddy current losses in single phase transformer.
8.	Investigate the voltage and current ratios of a multi-tapped transformer and verify the ideal transformer ratio
9.	Voltage regulation of an alternator by EMF and MMF methods.
10.	Direct load test on three phase synchronous generator to determine efficiency and regulation
11.	Model transformer in Simscape for Automatic Voltage Regulation.
12.	Simulate power angle curve of generator in MATLAB.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Perform standard tests on transformers, alternators, and synchronous machines and obtain their characteristics.
CO2	Determine efficiency, voltage regulation, losses, and load sharing using experimental and pre-determination methods.
CO3	Model and simulate machine performance and stability characteristics using software tools.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

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

CO-PO Mapping

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

Level3 –High, Level2–Moderate, Level1 -Low

Semester-III					
Measurements and Instrumentation Lab **Category: AEC**					
Course Code	:	**B25EEL307**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To introduce measurement fundamentals, types of instruments, generalised measurement system and error analysis.
2.	To explain the working of instrument transformers, data acquisition systems, electronic and digital measuring instruments including energy meters and op-amp based circuits
3.	To describe the principles and applications of force, pressure, humidity and moisture sensors and their role in modern instrumentation and communication systems

Sl. No	**List of Experiments**
1.	Measurement of low resistance using Kelvin's double bridge.
2.	Measurement of earth resistance using Megger.
3.	Measurement of inductance using Maxwell Inductance-Capacitance bridge & determination of Q-factor
4.	Measurement of capacitance using De-Sauty's bridge & determination of dissipation factor.
5.	Adjustment & calibration of 1-phase energy meter
6.	Inverting, non-inverting using op -amps b) RC phase shift oscillator using op amps
7.	Measurement of strain and force using a strain gauge.
8.	Measurement of pressure using a piezoresistive pressure sensor
9.	Measurement of relative humidity using a resistive humidity sensor
10.	Measurement of moisture content using a capacitive moisture sensor

Course Outcomes: At the end of the course, the students will be able to	
CO1	Measure and analyse resistance, inductance and capacitance using standard bridge circuits (Kelvin, Maxwell, De-Sauty) and determine instrument accuracy.
CO2	Calibrate and test single-phase energy meters, design and verify inverting/non-inverting amplifiers and RC phase shift oscillators using op-amps.
CO3	Measure physical parameters (strain, force, pressure, humidity and moisture) using appropriate transducers and sensors, plot characteristic curves and evaluate sensitivity

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

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

CO-PO Mapping

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

Level3 –High, Level2–Moderate, Level1 -Low

Semester-IV					
Electrical Machines – II **Category: PCC**					
Course Code	:	**B25EE401**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understanding of construction, working principles, and characteristics of DC, induction, and synchronous motors.
2.	To analysis of torque, speed, losses, efficiency, and performance of electrical motors using mathematical relations and characteristics.
3.	To study of starting, speed control, and testing methods of DC and induction motors.
4.	To examine special motors and their applications in industrial and modern control systems.
5.	To develop problem-solving ability through numerical analysis of motor performance.

Module– 1	**No. of Hours**
DC Motors: Construction and working principle. Back E.M.F and its significance, Torque equation, Classification, Characteristics of shunt, series & compound motors, Speed control of shunt motor, Application of motors. **Losses and Efficiency**- Losses in DC motors, power flow diagram, efficiency, condition for maximum efficiency. **Testing of DC Motors: Direct & indirect methods of testing of DC motors**- Swinburne's test, Field's test, merits and demerits of tests. (numerical as applicable)	14
Module– 2	**No. of Hours**
Three Phase Induction Motors: Concept and generation of rotating magnetic field, Principle of operation, construction, classification and types; squirrel-cage, slip-ring. Slip and its significance, Torque equation, torque-slip characteristic covering motoring, generating and braking regions of operation, Maximum torque, (numerical as applicable)	14
Module– 3	**No. of Hours**
Performance of Three-Phase Induction Motor: Phasor diagram of induction motor on no-load and on load, equivalent circuit, losses, efficiency, No-load and blocked rotor tests. Performance of the motor from the equivalent circuit. Cogging and crawling. High torque rotors-double cage and deep rotor bars. Induction motor working as induction generator, construction and working of doubly fed induction generator. (numerical as applicable)	14
Module– 4	**No. of Hours**
Starting and Speed Control of Three-Phase Induction Motors: Necessity of starter. Direct on line, Star-Delta, and autotransformer starting. Rotor resistance starting. Speed control by frequency. Single-Phase Induction Motor: Double revolving field theory and principle of operation. Construction and operation of split-phase, capacitor start and capacitor run and shaded pole motors. Comparison of single-phase motors and applications. (numerical as applicable)	14
Module– 5	**No. of Hours**
Synchronous Motor: Principle of operation, phasor diagrams, torque and torque angle, effect of change in load, effect of change in excitation. V and inverted V curves. Synchronous condenser, Other Motors: Construction and operation of Universal motor, AC servomotor, Linear induction motor, PMSM, SRM and BLDC	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the operating principles and construction of DC, induction, and synchronous motors.
CO2	Analyze torque–speed characteristics and performance parameters of DC and induction motors.
CO3	Evaluate losses, efficiency, and testing methods of DC and induction motors.
CO4	Apply starting and speed control techniques for DC and induction motors
CO5	Interpret synchronous motor behaviour and special motor applications such as BLDC, PMSM, SRM, and servomotors.

Text Books	
1.	Electric Machines, D. P. Kothari, I. J. Nagrath, McGraw Hill, 4th edition, 2011
2.	Theory of Alternating Current Machines, Alexander Langsdorf, McGraw Hill, 2nd Edition, 2001

Reference Text Books	
1.	Electrical Machines, Drives and Power systems, Theodore Wildi, Pearson, 6th Edition, 2014
2.	Electrical Machines, M.V. Deshpande, PHI Learning, 2013

Web links and Video lectures (e-Resources)
• **www.nptel.ac.in**

ASSESSMENT STRUCTURE:
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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-IV					
Electromagnetic Field Theory **Category: PCC** **(Common to ECE,EEE)**					
Course Code	:	**B25EC402**	CIE	:	50 Marks
Teaching Hours L :T : P : S	:	42:28:0:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3 Hrs

Course Learning Objective is	
1.	To prepare students with fundamental knowledge of electrostatics.
2.	To introduce the concepts and laws related to static magnetic fields.
3.	To equip students with a basic foundation in Maxwell's Equations.
4.	To introduce the concept of Wave propagation in various mediums.

Module– 1	**No. of Hours**
Electrostatics: Introduction, Review of vector calculus, Coordinate systems. Coulomb's Law in Vector Form, Electric Field Intensity, Electric Flux Density.	14
Module– 2	**No. of Hours**
Electrostatics (Contd.): Gauss Law –Applications- Charge distributions-line, surface, volume. Divergence of a vector and Divergence theorem, Maxwell's First equation (Electrostatics)Energy expended or work done in moving a point charge in an Electric field, The line integral, Electric current – Current density – continuity equation for current.	14
Module– 3	**No. of Hours**
Magnetostatics: Poisson's and Laplace's equation, Examples of the solution of Laplace's equation, Steady Magnetic field, Biot-Savart's law, Ampere's Circuital law, Curl & Stokes Theorem, Magnetic flux, Magnetic flux density.	14
Module– 4	**No. of Hours**
Time Varying Field: Force On A Moving Charge, Force on differential current elements, Force between differential current elements, Numerical problems, Magnetic Boundary conditions, Numerical problem, Faraday's law, Displacement current, Limitations of Ampere's law, Maxwell's equations.	14
Module– 5	**No. of Hours**
Uniform Plane Wave: Uniform Plane Wave: Wave propagation in free space, Wave Propagation in Dielectric, Conducting Media, Poynting theorem and Wave power, Propagation in Good Conductors.	14

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply the concept of electrostatics to measure Electric Force, Field Intensity, Flux density, Total charge.
CO2	Understand the concepts of Laplace & Poisson's Equation, and the applications of Electrostatics.
CO3	Apply the concept of magneto-statics to measure Magnetic Force, Field Intensity, Flux density Vector magnetic Potential and Boundary conditions.
CO4	Apply Maxwell's Equations on Time varying field problems.
CO5	Assess the Wave propagation in various mediums.

Text Books	
1.	"Engineering Electromagnetics", William H HaytJr, J.A. Buck, 9thEdition, Tata McGraw Hill, 2006, Special Indian Edition 2014.
2.	'Principles of Electromagnetics", Matthew N. O. Sadiku, S. V. Kulkarni, 6thEdition, Oxford University Press, 2007, 6thImpression 2018.

Reference Books	
1.	"Electromagnetic waves and radiating systems", Edward C Jordan, Keith G Balmain,2ndEdition PHI, 2005.
2.	"Electromagnetics and Applications" John D. Kraus, 2ndEdition
3.	"Elements of Engineering Electromagnetics" NannapaneniNarayanaRao, 6thEdition, Pearson Education.
4.	"Principles of Electromagnetics", Sadiku and Kulkarni, 6th Edition Oxford University Press 2015.

Web links and Video lectures (e-Resources)
1. https://nptel.ac.in/courses/108106073/
2. http://qeee.in/coursepack/generate_books/generated_books/1975/

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping

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

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

Semester-IV					
Microcontrollers **Category: IPCC** **(Common to EEE & R&A)**					
Course Code	:	**B25EE403**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:28:50	SEE	:	50 Marks
Total Hours/Semester	:	120	Total	:	100 Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To learn the basic structure, memory, registers, flags, I/O ports, and interfacing features of the 8051 microcontrollers.
2.	To gain skills in writing and running 8051 assembly programs using arithmetic, logic, and control instructions.
3.	To learn how to program the 8051 in C for data handling, I/O control, and timer applications.
4.	To understand serial communication, interrupts, and how to connect 8051 with devices like motors.
5.	To get an overview of ARM processor architecture, types, and its role in embedded systems

Module– 1	**No. of Hours**
Introduction to Digital Fundamentals: Number Systems, Boolean Algebra, Logic Gates, Encoders, Decoders, Multiplexers, and Flip-Flops. **8051 Microcontroller Basics**: Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pin diagram of 8051, Interfacing with External ROM And RAM. 8051 Addressing Modes.	9
Module– 2	**No. of Hours**
8051 Assembly Programming, Addressing Modes and Memory Interfacing: Introduction to 8051 assembly programming, assembling and running an 8051 program, data types and assembler directives, arithmetic and logic instructions, jump, loop and call instructions, I/O port programming, addressing modes of 8051, and interfacing with external ROM and RAM.	9
Module– 3	**No. of Hours**
8051 Programming in C: Data types and time delay in 8051C, IO programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, accessing code ROM space in 8051C, Data serialization using 8051C **8051 Timer Programming in C:** Programming 8051 timers, Counter programming, Programming timers 0 and 1 in 8051 C.	8
Module– 4	**No. of Hours**
8051 Serial Port Programming in Assembly and C: Basics of serial communication, 8051 connections to RS232, 8051 serial port programming in assembly, serial port programming in 8051 C. **8051 Interrupt Programming in Assembly and C:** 8051 interrupts, Programming timer, external hardware, serial communication interrupt, Interrupt priority in 8051/52, Interrupt programming in C. **Interfacing 8051**: Interfacing of 8051 to DC motor and Stepper motor	8
Module– 5	**No. of Hours**
ARM Processor Fundamentals: Introduction to ARM - ARM Architecture - Operation and control – ARM Processor and Microcontroller Families - List and comparison of ARM cores and ARM cortex – Embedded system hardware and software.	8

LABORATORY

Sl. No	List of Experiments
1.	ALP to do Arithmetic Operations: addition ,subtraction, multiplication and division
2.	ALP to find the sum of first 10 integer numbers.
3.	ALP to find the largest number
4.	ALP to arrange the numbers in ascending and descending order
5.	ALP to exchange data
6.	ALP to complement a data byte
7.	ALP to perform hexa decimal up counter and down counter
8.	ALP to perform BCD up counter and down counter
9.	Program to generate delay
10.	Stepper motor interface.
11.	DC motor interface
12.	Study of ARM evaluation system

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the architecture, internal memory structure, special function registers, and addressing modes of the 8051 microcontroller to support embedded system development.
CO2	Develop and simulate assembly language programs for the 8051 microcontroller using arithmetic, logic, jump, loop, call, and I/O instructions.
CO3	Write and execute C programs for the 8051 microcontroller to perform data processing, delay generation, I/O control, data conversion, and code memory access
CO4	Implement serial communication, interrupt handling, and peripheral interfacing such as DC and stepper motors using both assembly and C programming for the 8051.
CO5	Explain the fundamentals of ARM processors, including architecture, core families, and the role of hardware and software in embedded systems.

Text Books	
1.	The 8051 Microcontroller and Embedded Systems Using Assembly and C, Muhammad Ali Mazadi, Pearson, 2nd Edition, 2008.
2.	Microprocessor and Interfacing – Programming and Hardware, Hall D. V., Tata McGraw-Hill Publishing Company Limited, 3rd Edition, 2008.
3.	ARM Architecture Reference Manual, Edited by David Seal, Addison-Wesley, 2nd Edition, 2001. The definitive reference for the ARM architecture definition.

Reference Text Books	
1.	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, 8051 Microcontroller and Embedded Systems using Assembly and C Programming.
2.	Kenneth Ayala, The 8051 Microcontroller, Cengage Learning, 3rd Edition, 2005.
3.	William Hohl, ARM Assembly Language: Fundamentals and Techniques, CRC Press.

Web links and Video lectures (e-Resources)
• https://archive.nptel.ac.in/courses/106/105/106105193/

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any One Assessment as per Regulations	20	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks	10	25
	Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are not allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.
4. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.
5. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
6. 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	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-

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

Semester-IV					
Transmission and Distribution **Category: PCC**					
Course Code	:	**B25EE404**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	42:0:0:48	SEE	:	50 Marks
Total Hours/Semester	:	90	Total	:	100 Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand the structure and components of electrical power systems, including generation, transmission, and distribution networks, and explain the significance of high-voltage transmission, sag, and insulators
2.	To understand and compute the inductance and capacitance parameters of transmission lines under various configurations using GMR and GMD concepts
3.	To analyze the performance of transmission lines using models and parameters such as regulation, efficiency, ABCD constants, and the Ferranti effect
4.	To understand the phenomenon of corona and evaluate its impact, along with the construction, characteristics, and specifications of underground cables
5.	To understand and evaluate AC distribution systems, analyze the reliability and quality of distribution networks, and assess the impact of system limitations

Module– 1	**No. of Hours**
Introduction to Power System: Structure of electric power system: generation, transmission and distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains. A brief introduction to types of supporting structures and line conductors- Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice. **Overhead Line Insulators:** A brief introduction to types of insulators, material used- porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns.	9
Module– 2	**No. of Hours**
Line Parameters: Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Capacitance of composite – conductor, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines.	9
Module– 3	**No. of Hours**
Performance of Transmission Lines: Classification of lines – short, medium and long. Current and voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.	8
Module– 4	**No. of Hours**
Corona: Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona. **Underground Cable:** Types of cables, constructional features, insulation resistance, thermal rating, charging current, grading of cables – capacitance and inter-sheath. Dielectric loss. Comparison between ac and DC cables. Limitations of cables. Specification of power cables.	8
Module– 5	**No. of Hours**
Distribution: Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated loads. Effect of disconnection of neutral in a 3 phase four wire system. **Reliability and Quality of Distribution System:** Introduction, definition of reliability, failure, probability concepts, limitation of distribution systems, power quality, Reliability aids.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the structure of electric power systems and analyze the role of high-voltage transmission, insulators, and sag calculations.
CO2	Compute and analyze transmission line parameters such as inductance and capacitance for different conductor configurations using GMR and GMD.
CO3	Analyze and evaluate the performance of short, medium, and long transmission lines using appropriate equivalent circuit models and ABCD constants.
CO4	Understand the causes and effects of corona, and apply knowledge to analyze and evaluate the construction and grading of underground cables.
CO5	Analyze primary and secondary distribution systems, and evaluate the reliability and power quality of distribution networks under different load conditions.

Text Books	
1.	A Course in Electrical Power, Sony Gupta and Bhatnagar, DhanpatRai
2.	Principles of Power System, V.K. Mehta, Rohit Mehta, S. Chand, 1st Edition 2013

Reference Text Books	
1.	Power System Analysis and Design, J. Duncan Gloverat el, Cengage Learning, 4th Edition 2008
2.	Electrical power Generation, Transmission and Distribution, S.N. Singh, PHI, 2nd Edition,2009
3.	Electrical Power, S.L. Uppal, Khanna Publication

ASSESSMENT STRUCTURE:

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	40 (Average of Best two Assessments)	50
	Internal Assessment2	50		
	Internal Assessment3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The Question paper for each course contains two parts, Part – A and Part – B.
2. Part – A consists of **Short Answer Questions** (2 Marks/1 mark) for 20 marks covering the complete syllabus and it is compulsory. Multiple Choice Questions are allowed.
3. Part – B consists of 10 questions, two questions of 16 marks (with max. of 3 sub questions) from each module with internal choice. Students shall answer five full questions, selecting one full question from each module.

CO-PO Mapping:

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

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

Semester-IV					
Electrical Machines – II Lab **Category: PCCL**					
Course Code	:	**B25EEL406**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course learning Objective is	
1.	Perform tests on DC machines and study control methods to determine their performance characteristics.
2.	Conduct pre-determination and load tests on DC and induction machines to evaluate performance
3.	Conduct performance tests on induction and synchronous machines and analyze their characteristics.

Sl. No	**List of the experiments**
1.	Load test on DC shunt motor to draw speed–torque and horse power–efficiency characteristics.
2.	Speed control of DC shunt motor by armature and field control.
3.	Swinburne's Test on DC motor.
4.	Regenerative test on DC shunt machines.
5.	Load test on three phase induction motor.
6.	No-load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram. Determination of performance parameters at different load conditions.
7.	Load test on induction generator.
8.	Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
9.	Conduct suitable tests to draw thee equivalent circuit of single phase induction motor and determine performance parameters.
10.	Conduct an experiment to draw V and Inverted V curves of synchronous motor at no load and load conditions.
11.	Analyze current and load torque of DC Shunt Motor using Simscape
12.	Model 3-phase induction motor using MATLAB and Simulink

Course Outcomes: At the end of the course, the students will be able to	
CO1	Perform tests and control DC machines to obtain their performance characteristics.
CO2	Conduct pre-determination and load tests on DC and induction machines and analyze results.
CO3	Test induction and synchronous machines and plot their performance curves.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

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

CO-PO Mapping

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

Level3 –High, Level2–Moderate, Level1 -Low

Semester-IV					
Arduino and Raspberry Pi Lab **Category: AEC** **(Common to EEE & R&A)**					
Course Code	:	**B25EEL407**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:28:2	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand interfacing of basic I/O devices (LEDs, buzzers, buttons) with Arduino/Raspberry Pi
2.	To understand sensor interfacing (temperature, humidity, current, distance, analog sensors) and data acquisition
3.	To understand actuator control using relays, motors, and real-time clock integration

Sl. No	**List of Experiments**
1.	i) To interface LED/Buzzer with Arduino and write a program to 'turn ON' LED for 1 sec after every 2 seconds. ii) To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to 'turn ON' LED when push button is pressed or at sensor detection.
2.	i) To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings. ii) To interface OLED with Arduino and write a program to print temperature and humidity readings on it.
3.	To interface motor using relay with Arduino and write a program to 'turn ON' motor when push button is pressed.
4.	To interface Bluetooth with Arduino and write a program to send sensor data to Smartphone using Bluetooth.
5.	To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when '1'/'0' is received from Smartphone using Bluetooth.
6.	Write a program to interface an analog sensor (e.g., potentiometer or temperature sensor) with Arduino and display the analog values on the Serial Monitor.
7.	To interface a Real-Time Clock (DS3231/DS1307) module with Arduino and write a program to display the current date and time on the Serial Monitor.
8.	Write a program to measure an analog voltage (0–5V) using Arduino and display the measured voltage on the Serial Monitor.
9.	Interface a current sensor (e.g., ACS712) with Arduino and write a program to measure and display the current flowing through a load on the Serial Monitor.
10.	To interface a DC motor through a relay module with Arduino/ Raspberry Pi and write a Python program to turn ON the motor when a push button is pressed.
11.	Interface an ultrasonic sensor (HC-SR04) with Arduino/ Raspberry Pi and write a program to measure and display the distance in centimeters on the Serial Monitor.
12.	Write a python program on Raspberry Pi to upload temperature and humidity data to thing speak cloud.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Understand the interfacing and control of digital devices such as LEDs and buzzers using Arduino.
CO2	Understand sensor interface to acquire and display data from temperature, humidity, distance, voltage, and current sensors.
CO3	Design motor and relay-based actuation systems using sensor input for automation and control.
CO4	Analyze communication techniques for exchanging data with smartphones and cloud servers using Bluetooth and IoT.

ASSESSMENT STRUCTURE FOR LABORATORY:

- The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage.
- For both CIE and SEE, the student is required to conduct Two experiments
- To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.
- To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks. A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

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

CO-PO Mapping

COs / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	–	2	1	–	–	–	–	–	–
CO2	2	3	2	2	1	–	–	–	–	–	–
CO3	1	2	3	2	3	–	–	–	–	–	–
CO4	1	2	3	2	3	–	–	–	–	–	–

Level3 –High, Level2–Moderate, Level1 –Low

Semester-III					
Community Project / Societal Project (Project Based Learning) **Category: SDC**					
Course Code	:	**B25EEP308**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:0:30	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is

Rapid urbanization, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses within the scope of a one-semester project.

Course outcome (Course Skill Set): At the end of the course, the student will be able to:

1. Identify and analyse societal problems through field interaction and technical assessment.
2. Develop skills in **project planning, field survey, data collection, implementation**, documentation and reporting.
3. Formulate feasible engineering problem statements and solutions considering practical constraints and sustainability aspects.
4. Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
5. Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.
6. Demonstrate teamwork and communication skills while interacting with technical and non-technical stakeholders and reflect on project impact on society.

Sustainable Development Goals: The faculty shall encourage students to undertake community projects that align with and contribute towards satisfying the National Board of Accreditation (NBA) Criterion 3.6, namely, Evidence of Addressing Sustainable Development Goals (SDGs), which is a major emphasis of the United Nations (UN).

Methods for project identification:

Students may identify the project topic using one or more of the following methods:

• Interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.

• Review of issues highlighted in print and electronic media, and social networks (WhatsApp, Facebook, X, Instagram, etc.).

• After selecting a broad topic, students shall collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and then define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:

The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project title	Measurable engineering outcome	Mapped POs	SDGs
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13
3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy	PO1, PO2, PO3, PO4,	SDG 7, SDG 9,

		generation and payback.	PO5, PO10	SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban greening projects	Prepare greening plan, identify planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
17	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 9, SDG 12
18	Human rights awareness with legal systems	Prepare and deliver an awareness module and assess increase in legal awareness and access-to-rights understanding.	PO6, PO7, PO8, PO9, PO10	SDG 5, SDG 10, SDG 16
19	Use of application / application program	Build or demonstrate a useful community app and measure usability, adoption, or efficiency improvement.	PO1, PO3, PO4, PO5, PO9, PO10	SDG 9, SDG 11, SDG 17
20	House tax collection through digital media	Develop a simple digital workflow or awareness support and measure improvement in compliance, convenience, or response time.	PO2, PO3, PO4, PO5, PO10, PO11	SDG 9, SDG 11, SDG 16

Suggested Learning Resources: Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.

2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):
• NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
• NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
• Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in • Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
• YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
• American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

Teaching Learning Process: The suggested TLP for Community / Societal Project is as follows;

Week	Teaching–Learning Activity	Faculty Role	Student Activity	Output
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objectiveformulation	Review and refine problem statement	Prepare problem statement, scope, andobjectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck

15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

ASSESSMENT STRUCTURE:

A. Continuous Internal Evaluation (CIE) – 50 marks

• Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.

• CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totalling 50 marks:

CIE pass requirement:

• A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.

• Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE)

• Examination duration: 3 hours.

• Maximum examination marks: 100

• The SEE shall be conducted batch-wise by a committee of three faculties: project guide, one faculty from the same department and one from a different department.

SEE pass requirement and overall passing rule:

• For a pass in SEE, a student shall secure minimum 35 marks out of 100.

• For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry /community	**8**	Problem is clearly identified with strong evidence of societal relevance and well-defined scope.	Problem is relevant and scope is clear with adequate supporting evidence.	Problem defined but justification or evidence is weak.	Problem unclear or not relevant; little/no supporting evidence.
Formation of problem statement; Engineering approach, innovation & feasibility	**10**	Problem statement is precise; approach is sound, innovative and clearly feasible.	Problem statement adequate; approach feasible with minor gaps.	Problem statement partial; approach feasibility is marginal.	Problem statement missing or approach not feasible.
Interaction with stakeholders; Data collection, analysis & interpretation	**8**	Thorough stakeholder engagement; data collection is comprehensive; analysis is well interpreted.	Good engagement; data and analysis adequate with minor gaps.	Limited engagement; data incomplete and analysis superficial.	Little/no stakeholder contact; insufficient or no data/ analysis.
Project documentation; Clarity, organization & problem solving demonstrated	**10**	Documentation is complete, well organized, analytical, and shows strong problem-solving.	Documentation complete and clear with some analytical content.	Documentation basic with omissions; problem-solving limited.	Documentation missing/poorly organized; no clear problem-solving

Communication & Presentation skills	**6**	Presentation is confident, structured, and answers queries fully; visuals effective.	Presentation clear and satisfactory; responds to most queries.	Presentation acceptable but lacks clarity or confidence; weak responses	Presentation poor or absent; unable to respond.
Contribution & Benefit to society (impact, sustainability)	**8**	Clear, demonstrable societal benefit and sustainability; realistic path to implementation.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear societal benefit; sustainability not well addressed.	No evident benefit or sustainability; project not community-oriented.

SEE Rubric — Semester End Examination (Enter marks out of 100; scaled to 50 later):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry /community	**16**	Problem is clearly identified with strong evidence of societal relevance and well-defined scope.	Problem is relevant and scope is clear with adequate supporting evidence.	Problem defined but justification or evidence is weak.	Problem unclear or not relevant; little/no supporting evidence.
Formation of problem statement; Engineering approach, innovation & feasibility	**20**	Problem statement is precise; approach is sound, innovative and clearly feasible.	Problem statement adequate; approach feasible with minor gaps.	Problem statement partial; approach feasibility is marginal.	Problem statement missing or approach not feasible.
Interaction with stakeholders; Data collection, analysis & interpretation	**16**	Thorough stakeholder engagement; data collection is comprehensive; analysis is well interpreted.	Good engagement; data and analysis adequate with minor gaps.	Limited engagement; data incomplete and analysis superficial.	Little/no stakeholder contact; insufficient or no data/ analysis.
Project documentation; Clarity, organization & problem solving demonstrated	**20**	Documentation is complete, well organized, analytical, and shows strong problem-solving.	Documentation complete and clear with some analytical content.	Documentation basic with omissions; problem-solving limited.	Documentation missing/poorly organized; no clear problem-solving
Communication & Presentation skills	**12**	Presentation is confident, structured, and answers queries fully; visuals effective.	Presentation clear and satisfactory; responds to most queries.	Presentation acceptable but lacks clarity or confidence; weak responses	Presentation poor or absent; unable to respond.
Contribution & Benefit to society (impact, sustainability)	**16**	Clear, demonstrable societal benefit and sustainability; realistic path to implementation.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear societal benefit; sustainability not well addressed.	No evident benefit or sustainability; project not community-oriented.

Semester III					
Additional Mathematics – I **Category: NCMC** (Common to all disciplines of Engineering)					
Course Code	:	B25MAD309	CIE	:	100 Marks
Teaching Hours L : T : P: S	:	42:0:0:0	SEE	:	--
Total Hours	:	42	Total	:	100 Marks
Credits		PP	SEE Duration	:	--

Course Objective is
1. To Develop the knowledge of solving engineering problems of multivariable and algebraic series.
2. To Provide insight into applications of complex numbers and vector algebra.
3. To Apply the fundamentals of Vector differentiation.
4. To Familiarize the importance of Integral calculus.
5. To provide compressive understand of first order and first-degree differential equations.

Module-1	No. of Hours
Successive differentiation-problems. Taylor's & Maclaurin's series expansions-problems. Partial Differentiation: Euler's theorem (without Proof)-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians -Problems.	**9**
Module-2	No. of Hours
Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof), Problems. Vector Algebra: Scalar and vectors. Addition, subtraction and multiplication of vectors- Dot and Cross products, problems. Scalar triple product, Problems.	**8**
Module-3	No. of Hours
Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.	**8**
Module-4	No. of Hours
Review of elementary integral calculus. Reduction formulae for $sin^n x$, $cos^n x$ (without proof)-problems. Double and triple integrals-Simple problems.	**9**
Module-5	No. of Hours
Introduction-solutions of first order and first-degree differential equations: Variable separable method, Homogeneous differential equations, linear differential equations. Exact differential equations.	**8**

Course Outcomes: At the end of the course, the students will be able to	
CO1	Use derivatives and partial derivatives to calculate the rate of change of multivariate functions.
CO2	Apply concepts of complex numbers and vector algebra to analyse the problems arising in that area.
CO3	Analyse position, velocity and acceleration in two and three dimensions of vector-valued functions.
CO4	Learn techniques of integration including the evaluation of double and triple integrals.
CO5	Identify and solve first-order ordinary differential equations.
Text Books	
1	B.S.Grewal:"Higher Engineering Mathematics", Khanna publishers,44thEd.2018
2	E.Kreyszig:"Advanced Engineering Mathematics", John Wiley & Sons,8thEd.(Reprint),2016
Reference Text Books	
1	H. K. Dass, " Advanced Engineering Mathematics" S. Chand publication. 4. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6" Edition, 2. McGraw
2	C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6" Edition, 2. McGraw
3	B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 208.

Web links and Video lectures (e-Resources)
1. https://nptel.ac.in/courses/12286025 2. VTU EDUSAT PROGRAMME – 20 3. http://www.class-central.com/subject/math(MOOCs)

Assessment Details both (CIE only)

The weightage of continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of maximum marks (40 marks out of 100).
The CIE may comprise Assessment tests, assignments, quizzes or other academic activities, as decided by the concerned teacher. The distribution of marks among these activities shall be determined by the course teacher. The total marks awarded for all CIE activities shall be 100 marks.

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**80 (Average of Best two Assessments)**	**100**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
AAT	**Any One Assessments as per regulations**	**20**	**20**	
Total Marks				**100**

CO-PO Mapping

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

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

Semester-IV					
Biology for Engineers **Category: BSC** (Common to all disciplines of Engineering)					
Course Code	:	**B25BEK405**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	28:0:0:32	SEE	:	50 Marks
Total Hours/Semester	:	60	Total	:	100 Marks
Credits	:	2	SEE Duration	:	2Hrs

Course Learning Objective is	
1.	To study the concepts and types of artificial intelligence.
2.	To Demonstrate basic machine learning methods for regression, classification and clustering.
3.	To understand real-world applications across different disciplines.
4.	To make use of prompt engineering techniques to interact with generative AI tools.
5.	To study recent trends in artificial intelligence and machine learning.

Module– 1	**No. of Hours**
Introduction to Biology: The cell (as an information-processing unit): the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells (inspiration for regenerative bioelectronics) and their application. Importance of special biomolecules: Enzymes, vitamins and hormones. (Classification with one example each, Properties and functions)	6
Module– 2	**No. of Hours**
Biomolecules and Their Applications: DNA/RNA for bio-computing and molecular electronics, Forensics – DNA fingerprinting, lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).	6
Module– 3	**No. of Hours**
Human Organ Systems and Bio Designs: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems).	5
Module– 4	**No. of Hours**
Nature-Bioinspired Materials and Mechanisms: Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train).	6
Module– 5	**No. of Hours**
Trends Bioengineering: Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioremediation and Bio mining. Medical imaging technologies—X-ray, CT, MRI and Ultrasound (overview);	5

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.	Engineering with Biology- Fundamentals and Applications, 2nd Edition, S. Fatima, R. S. Deshpande, M. Ziaullah, MahanteshMattada, Santosh Nejakar and Sadashiv Halbhavi, Najekar Publications, 2026

Reference 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
3.	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011 Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
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	

ASSESSMENT STRUCTURE:

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 40marks 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**	**40**	**50**
	Internal Assessment2	**50**	**(Average of Best two Assessments)**	
	Internal Assessment3	**50**		
AAT	**Any Two Assessments as per Regulations**	**20**	**10**	
SEE	**Semester End Examination**	**50**	**-**	**50**
Grand Total				**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	PO10	PO11
CO1	1	1	-	-	1	-	-	-	1	-	1
CO2	1	1	-	-	1	-	-	-	1	-	1
CO3	1	1	-	-	1	-	-	-	1	-	1
CO4	1	1	-	-	1	-	-	-	1	-	1
CO5	1	1	-	-	1	-	-	-	1	-	1

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

Semester-IV					
Environmental Science Project (Project Based Learning) **Category: SDC**					
Course Code	:	**B25EEP408**	CIE	:	50 Marks
Teaching Hours L : T : P : S	:	0:0:0:30	SEE	:	50 Marks
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	1	SEE Duration	:	3 Hrs

Course Learning Objective is

The Environmental Science Project is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real issues such as climate change, pollution, biodiversity, resource use, soil erosion, and thermal comfort, using field surveys, case studies, data collection, audits, and analysis to develop feasible and sustainable solutions. Students may work individually or in groups of up to four, including interdisciplinary topics, and assessment is based on the prescribed rubrics.

Course outcome (Course Skill Set): At the end of the course, the student will be able to:

1. Identify and analyse environmental problems through field interaction and technical assessment.
2. Develop skills in project planning, field survey, data collection, implementation, documentation and reporting.
3. Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects.
4. Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions.
5. Exhibit multidisciplinary learning and problem-solving ability based on collected data, user feedback and baseline conditions.
6. Demonstrate teamwork and communication skills while interacting with technical and non-technical stakeholders and reflect on project impact on society.

Sustainable Development Goals: The faculty shall encourage students to undertake community projects that align with and contribute towards satisfying the National Board of Accreditation (NBA) Criterion 3.6, namely, Evidence of Addressing Sustainable Development Goals (SDGs), which is a major emphasis of the United Nations (UN).

Methods for project identification:

Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

List of Project Topics and Engineering Outcomes:

The following structured sequence of activities is to be carried out during the semester:

Sl. No.	Project title	Measurable engineering outcome	Mapped POs	SDGs
1	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 6, SDG 11, SDG 12
2	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.	PO2, PO3, PO4, PO6, PO8, PO10	SDG 11, SDG 12, SDG 13
3	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
4	Biogas generation and	Estimate organic waste availability, size	PO1, PO2,	SDG 7,

	power generation	a small biogas system, and document expected gas output or energy yield.	PO3, PO4, PO5, PO10	SDG 11, SDG 12
5	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 7, SDG 9, SDG 11
6	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.	PO1, PO2, PO3, PO4, PO10, PO11	SDG 7, SDG 9, SDG 10
7	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction	PO1, PO2, PO3, PO4, PO6, PO10	SDG 6, SDG 9, SDG 11
8	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.	PO2, PO3, PO4, PO6, PO7, PO8	SDG 3, SDG 6, SDG 11, SDG 12
9	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
10	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.	PO2, PO6, PO7, PO8, PO9, PO10	SDG 2, SDG 3, SDG 11
11	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.	PO2, PO3, PO6, PO8, PO9, PO10	SDG 3, SDG 11, SDG 17
12	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.	PO2, PO3, PO4, PO5, PO6, PO10	SDG 3, SDG 11, SDG 13
13	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.	PO2, PO3, PO6, PO7, PO8, PO10	SDG 11, SDG 12, SDG 13
14	Urban greening projects	Prepare greening plan, identify planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.	PO2, PO3, PO4, PO6, PO7, PO11	SDG 11, SDG 13, SDG 15
15	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 9
16	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.	PO1, PO2, PO3, PO4, PO5, PO10	SDG 2, SDG 6, SDG 12
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18	Human rights awareness with legal systems	Prepare and deliver an awareness module and assess increase in legal awareness and access-to-rights understanding.	PO6, PO7, PO8, PO9, PO10	SDG 5, SDG 10, SDG 16

19	Use of application / application program	Build or demonstrate a useful community app and measure usability, adoption, or efficiency improvement.	PO1, PO3, PO4, PO5, PO9, PO10	SDG 9, SDG 11, SDG 17
20	House tax collection through digital media	Develop a simple digital workflow or awareness support and measure improvement in compliance, convenience, or response time.	PO2, PO3, PO4, PO5, PO10, PO11	SDG 9, SDG 11, SDG 16

Textbooks:

1. Phadke, N. D., Community Engagement and Social Innovation, Oxford University Press, New Delhi.
2. Garg, N. R., Project-Based Learning in Engineering Education, Pearson India Education, Services, Noida.
3. Gupta, A. and P. Singh, Service Learning and Community Projects, McGraw-Hill, Education (India), New Delhi.
4. Wilson, G., Practical Guide to Community Development Projects, Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

• NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
• NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
• Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in • Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
• YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
• American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

Teaching Learning Process: The suggested TLP for Community / Societal Project is as follows;

Week	Teaching–Learning Activity	Faculty Role	Student Activity	Output
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objectiveformulation	Review and refine problem statement	Prepare problem statement, scope, andobjectives	Approved problem statement
5	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6	Project planning and role assignment	Help teams organize tasks, timeline, and	Plan activities, divide roles, and prepare	Work plan / Gantt chart

		responsibilities	schedule	
7	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

Continuous Internal Evaluation (CIE) – 50 marks

• Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.

• CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totalling 50 marks:

• A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.

• Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

A. Semester End Examination (SEE)

• Examination duration: 3 hours. Maximum examination marks: 100

• The SEE shall be conducted batch-wise by a committee of three faculties: project guide, one faculty from the same department and one from a different department.

• For a pass in SEE, a student shall secure minimum 35 marks out of 100.

• For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric — Continuous Internal Evaluation (Total 50 marks):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry /community	**8**	Problem is clearly identified with strong evidence of societal relevance and well-defined scope.	Problem is relevant and scope is clear with adequate supporting evidence.	Problem defined but justification or evidence is weak.	Problem unclear or not relevant; little/no supporting evidence.
Formation of problem statement; Engineering approach, innovation & feasibility	**10**	Problem statement is precise; approach is sound, innovative and clearly feasible.	Problem statement adequate; approach feasible with minor gaps.	Problem statement partial; approach feasibility is marginal.	Problem statement missing or approach not feasible.
Interaction with stakeholders; Data collection, analysis & interpretation	**8**	Thorough stakeholder engagement; data collection is comprehensive; analysis is well interpreted.	Good engagement; data and analysis adequate with minor gaps.	Limited engagement; data incomplete and analysis superficial.	Little/no stakeholder contact; insufficient or no data/ analysis.
Project documentation; Clarity, organization & problem solving demonstrated	**10**	Documentation is complete, well organized, analytical, and shows strong problem-solving.	Documentation complete and clear with some analytical content.	Documentation basic with omissions; problem-solving limited.	Documentation missing/poorly organized; no clear problem-solving
Communication & Presentation skills	**6**	Presentation is confident, structured, and answers queries fully; visuals effective.	Presentation clear and satisfactory; responds to most queries.	Presentation acceptable but lacks clarity or confidence; weak responses	Presentation poor or absent; unable to respond.
Contribution & Benefit to society (impact, sustainability)	**8**	Clear, demonstrable societal benefit and sustainability; realistic path to implementation.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear societal benefit; sustainability not well addressed.	No evident benefit or sustainability; project not community-oriented.

SEE Rubric — Semester End Examination (Enter marks out of 100; scaled to 50 later):

Criterion	Weight (marks)	Excellent (Full marks)	Good	Fair	Needs Improvement
Problem identification & Relevance to society/industry /community	**16**	Problem is clearly identified with strong evidence of societal relevance and well-defined scope.	Problem is relevant and scope is clear with adequate supporting evidence.	Problem defined but justification or evidence is weak.	Problem unclear or not relevant; little/no supporting evidence.
Formation of problem statement; Engineering approach, innovation		Problem statement is precise; approach is sound, innovative and	Problem statement adequate; approach	Problem statement partial; approach feasibility is	Problem statement missing or approach not

& feasibility	**20**	clearly feasible.	feasible with minor gaps.	marginal.	feasible.
Interaction with stakeholders; Data collection, analysis & interpretation	**16**	Thorough stakeholder engagement; data collection is comprehensive; analysis is well interpreted.	Good engagement; data and analysis adequate with minor gaps.	Limited engagement; data incomplete and analysis superficial.	Little/no stakeholder contact; insufficient or no data/ analysis.
Project documentation; Clarity, organization & problem solving demonstrated	**20**	Documentation is complete, well organized, analytical, and shows strong problem-solving.	Documentation complete and clear with some analytical content.	Documentation basic with omissions; problem-solving limited.	Documentation missing/poorly organized; no clear problem-solving
Communication & Presentation skills	**12**	Presentation is confident, structured, and answers queries fully; visuals effective.	Presentation clear and satisfactory; responds to most queries.	Presentation acceptable but lacks clarity or confidence; weak responses	Presentation poor or absent; unable to respond.
Contribution & Benefit to society (impact, sustainability)	**16**	Clear, demonstrable societal benefit and sustainability; realistic path to implementation.	Benefit plausible; sustainability considered with minor gaps.	Limited or unclear societal benefit; sustainability not well addressed.	No evident benefit or sustainability; project not community-oriented.

Semester IV					
Additional Mathematics –II **Category: NCMC** (Common to all disciplines of Engineering)					
Course Code	:	**B25MAD409**	CIE	:	100 Marks
Teaching Hours L : T : P: S	:	42:0:0:0	SEE	:	--
Total Hours	:	42	Total	:	100 Marks
Credits		PP	SEE Duration	:	--

Course Learning Objective is	
1	To Compute the solution by applying the acquired knowledge of linear algebra to the problems of engineering applications.
2	To Develop the knowledge of solving differential equations and their applications in engineering.
3	To introduce the concept of basic probability theory with practical application in engineering and social life situations.
4	To Develop the knowledge of numerical methods and apply them to solve algebraic and Transcendental equations.
5	To Develop the knowledge of numerical methods and apply them to solve differential equations.

Module-1	No. of Hours
Introduction, Rank of a matrix by elementary row operations, Consistency of system of linear equations, Solution by Gauss Elimination method. Eigenvalues and eigenvectors of a square matrix. Problems.	9
Module-2	No. of Hours
Linear homogeneous/non homogeneous differential equations of second and higher-order with constant coefficients. Solution by using the inverse differential operator method. [Particular Integrals restricted to $(x)= e^{ax}$, sinax/ cosax, x^n .	9
Module 3	No. of Hours
Introduction, Sample space and Events, Axioms of Probability. Addition and Multiplication theorem. Conditional Probability. Independent events. Baye's theorem, Problems.	8
Module-4	No. of Hours
Finite differences, Interpolation/extrapolation using Newton's forward and Backward difference formulae (No derivation), Problems. Solution of polynomial and transcendental equations by Newton–Raphson and Regula–Falsi methods (no derivation), Problems. Numerical Integration: Simson's 1/3 rd rule and 3/8 rule, problems.	8
Module-5	No. of Hours
Numerical solution of first-order ordinary differential equations: Taylor's series method, Modified Euler's method, Runge-Kutta method of order 4, Milne's predictor-corrector method. Problems.	8

Course Outcomes: At the end of the course, the students will be able to	
CO1	Test for consistency and solve the system of linear equations.
CO2	Solve higher order differential equations.
CO3	Apply elementary probability theory and solve related problems.
CO4	Acquiring the knowledge of interpolation and solution of transcendental equations..
CO5	Acquiring the knowledge of numerical solution of differential equations.
Text Books	
1	Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2	Peter Bruce, Andrew Bruce & Peter Gedeck "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition 2020.
Reference Text Books	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2	B. S. Grewal "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3	G Haribaskaran "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest

	Edition, 2006

Web links and Video lectures (e-Resources)
1. https://nptel.ac.in/courses/12286025 2. VTU EDUSAT PROGRAMME – 20 3. http://www.class-central.com/subject/math(MOOCs)

Assessment Details both (CIE Only)

The weightage of continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of maximum marks (40 marks out of 100).
The CIE may comprise Assessment tests, assignments, quizzes or other academic activities, as decided by the concerned teacher. The distribution of marks among these activities shall be determined by the course teacher. The total marks awarded for all CIE activities shall be 100 marks.

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	**Internal Assessment1**	**50**	**80 (Average of Best two Assessments)**	**100**
	Internal Assessment2	**50**		
	Internal Assessment3	**50**		
AAT	**Any One Assessments as per regulations**	**20**	**20**	
Total Marks				**100**

CO-PO Mapping

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

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

Semester-III/IV					
National Service Scheme **Category: NCMC**					
Course Code	:	**B25NCK310A/410A**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	0:0:30:0	SEE	:	--
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	--

Course objectives: National Service Scheme (NSS) will enable the students to:	
1.	Understand the community in general in which they work.
2.	Identify the needs and problems of the community and involve them in 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 in general.

Syllabus	**30 Hours**
I. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. **II.** Waste management– Public, Private and Govt organization. **III.** Setting of the information imparting club for women leading to contribution in social and economic issues. **IV.** Water conservation techniques – Role of different stakeholders– Implementation. **V.** Preparing an actionable business proposal for enhancing the village income and approach for implementation. **VI**. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. **VII.** Developing Sustainable Water management system for rural areas and implementation approaches. **VIII.** Contribution to any national level initiative of Government of India. Forex. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. **IX**. Spreading public awareness under rural outreach programs.(minimum5 programs). **X**. Plantation and adoption of plants. Know your plants. **XI**. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). **XII**. Govt. school Rejuvenation and helping them to achieve good infrastructure.	

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl. No	Topic	Group Size	Location	Activity Execution	Reporting	Evaluation of the Project
1	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / community area/ College campus etc….	Site selection /proper consultation/ Continuous monitoring/ Information board		
2	Waste management– Public, Private and Govt organization.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Site selection /proper consultation/ Continuous monitoring/ Information board		

3	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus etc.	Group selection/ pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
4	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	site selection / proper consultation/ Continuous monitoring/ Information board		
5	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Group selection/pro per consultation/ Continuous monitoring/ Information board		
6	Helping local schools to achieve good results and enhance their enrolment in Higher/technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School selection/proper consultation/ Continuous monitoring/ Information board		
7	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	site selection/proper consultation/ Continuous monitoring/ Information board		
8	Contribution to any national level initiative of Government of India. Ex. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Group selection/pro per consultation/ Continuous monitoring / Information board		
9	Spreading public awareness under rural outreach programs.(minimum5 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Group selection/pro per consultation/ Continuous monitoring / Information board		
10	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Place selection/ proper consultation/ Continuous monitoring / Information board		
11	Organize National integration and	May be individual	Villages/ City Areas / Grama panchayat/	Place selection/ proper consultation/		

	social harmony events /workshops /seminars.	or team	public associations/ Government Schemes officers	Continuous monitoring / Information board		
12	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers	Place selection/ proper consultation/ Continuous monitoring / Information board		

Plan of Action (Execution of Activities For Each Semester)

Sl. No	Practice Session Description
1	Lecture session by NSS Officer
2	Students Presentation on Topics
3	Presentation - 1 , Selection of topic, PHASE - 1
4	Commencement of activity and its progress - PHASE - 2
5	Execution of Activity
6	Execution of Activity
7	Execution of Activity
8	Execution of Activity
9	Execution of Activity
10	Case study based Assessment, Individual performance
11	Sector wise study and its consolidation
12	Video based seminar for 10 minutes by each student At the end of semester with Report.

- In III and IV semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.

Course Learning Outcomes: Upon successful completion of this course, the student will be able to:	
1.	Understand the importance of his / her responsibilities towards society.
2.	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
3.	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
4	Implement government or self-driven projects effectively in the field. CO5:
5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

- Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general.
- **Suggested Learning Resources:**
- 1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
- 2. Government of Karnataka, NSS cell, activities reports and its manual.
- 3. Government of India, nss cell, Activities reports and its manual.

ASSESSMENT STRUCTURE:

This course is having only Continuous Internal Assessment (CIE) marks of 100. A student shall obtain a minimum of 40% marks out of 100 to qualify in the course.

Sl. No	Activity	Max. Marks
1.	Attendance	20
2.	Quizzes /Assignment – 2, each of 25marks	50
3.	Report/ Participation Certificate	30
Total		**100**

Semester-III/IV					
National Cadet Corps Category: NCMC					
Course Code	:	**B25NCK310B/410B**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	0:0:30:0	SEE	:	--
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	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

ASSESSMENT STRUCTURE:

This course is having only Continuous Internal Assessment (CIE) marks of 100. A student shall obtain a minimum of 40% marks out of 100 to qualify in the course.

Sl. No	Activity	Max. Marks
1.	Attendance	20
2.	Quizzes /Assignment – 2, each of 25marks	50
3.	Report/ Participation Certificate	30
Total		**100**

Semester-III/IV					
Physical Education **Category: NCMC**					
Course Code	:	**B25NCK310C/410C**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	0:0:30:0	SEE	:	--
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	--

ourse Outcomes: At the end of the course, the student will be able to	
1.	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2.	Familiarization of health-related Exercises, Sports for overall growth and development
3.	Create a foundation for the professionals in Physical Education and Sports
4.	Participate in the competition at regional/state / national / international levels.
5.	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.
6	Understand and practice of Traditional Games

Syllabus	**30 Hours**

I. Orientation

1. Lifestyle
2. Health & Wellness
3. Pre-Fitness test.

II. General Fitness & Components of Fitness

1. Warming up (Free Hand exercises)
2. Strength – Push-up / Pull-ups
3. Speed – 30 Mtr Dash

III. Specific games (Any one to be selected by the student)

1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.

IV. Ethics and Moral Values

1. Ethics in Sports
2. Moral Values in Sports and Games

V. Specific Games (Any one to be selected by the student)

1. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass.
2. Athletics (Track Events) – Any event as per availability of Ground.

VI. Role of Organisation and administration

ASSESSMENT STRUCTURE:

This course is having only Continuous Internal Assessment (CIE) marks of 100. A student shall obtain a minimum of 40% marks out of 100 to qualify in the course.

Sl. No	Activity	Max. Marks
1.	Attendance	20
2.	Quizzes /Assignment – 2, each of 25marks	50
3.	Report/ Participation Certificate	30
Total		**100**

Semester-III/IV					
YOGA **Category: NCMC**					
Course Code	:	**B25NCK310D/410D**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	0:0:30:0	SEE	:	--
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	--

Course Learning Objective is	
1.	Introduce students to the origin, history, philosophy, and fundamental concepts of Yoga.
2.	Familiarize students with the different schools of Yoga, its aims, objectives, and the importance of prayer in Yogic practice.
3.	Develop awareness of the rules, regulations, and safety precautions to be followed during Yogic practices.
4	Enable students to learn and practice Suryanamaskara and selected Yogasanas with proper techniques for improving physical and mental well-being.
5	Promote a healthy lifestyle by encouraging regular Yogic practice, correcting misconceptions about Yoga, and fostering positive health, self-discipline, and overall wellness.

Syllabus	**30 Hours**
I. Introduction of Yoga: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, Aim and Objectives of yoga, **II. Prayer:** importance of prayer Brief introduction of yogic practices for Yogic practices for common man to promote positive health, **III. Rules and regulations**: Rules to be followed during yogic practices by practitioner Suryanamaskara: Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds, **IV. Misconceptions of yoga**: Yoga its misconceptions, Difference between yogic and non yogic practices **V. Different types of Asanas-1:** Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana, Sitting 1. Padmasana, 2. Vajrasana, Standing 1. Vrikshana, 2. Trikonasana, Prone line 1. Bhujangasana, 2. Shalabhasana, Supine line 1. Utthitadvipadasana, 2. Ardhahalasana I. Patanjali's Ashtanga Yoga: Patanjali's Ashtanga Yoga, its need and importance. Suryanamaskar12 count 4 rounds. **VI. Different types of Asanas-2**: Sitting 1. Sukhasana, 2. Paschimottanasana, Standing 1. Ardhakati Chakrasana, 2. Parshva Chakrasana, Prone line 1. Dhanurasana Supine line 1. Halasana, 2. Karna Peedasana **VII. Kapalabhati**: Meaning, importance and benefits of Kapalabhati. 40 strokes/min 3 rounds **VIII. Pranayama**: 1. Suryanuloma –Viloma, 2. Chandranuloma-Viloma, 3-Suryabhedana, 4-Chandra Bhedana,	

Course Learning Outcomes: Upon successful completion of this course, the student will be able to:	
1.	Explain the origin, history, philosophy, objectives, and different schools of Yoga, along with its role in promoting holistic health and well-being.
2.	Understand and apply the rules, regulations, and ethical practices associated with Yogic exercises, including the significance of prayer and Suryanamaskara.
3.	Demonstrate the correct techniques of selected Yogasanas, such as sitting, standing, prone, and supine postures, while observing appropriate precautions.
4	Analyze the physical, mental, and therapeutic benefits of Yogic practices and distinguish between authentic Yogic practices and common misconceptions about Yoga.
5	Adopt Yoga as a regular lifestyle practice to enhance physical fitness, mental wellness, discipline, and overall quality of life.

Text books:

1. George Feuerstein : the yoga Tradition (its history, literature, philosophy and practice)
2. Sri Ananda: The complete Book of yoga Harmony of Body and Mind (Orient paper Backs: Vision Books Pvt.Ltd..1982.
3. B.K.S lyenkar: Light on the Yoga sutras of Patanjali (Haper Collins Publications India Pvt.Ltd.New Delhi.)
4. Science of Divinity and Realization of Self Vethathiri Publication, (6-11) WCSC, Erode

Reference books / Manuals:

1. Principles and Practice of Yoga in Health Care, Publisher: Handspring Publishing Limited. ISBN:9781909141209, 978190914209
2. Basavaraddi I V: Yoga in School Health, MDNIY New Delhi. 2009
3. Dr. HR. Nagendra: Yoga Research and application (Vivekanada Kendra Yoga Prakashana Bengalore)
4. Dr. Shirley Telles: Glimpses of Human Body (Vivekanda Kendra Yoga Prakashana Bengalore).

ASSESSMENT STRUCTURE:

This course is having only Continuous Internal Assessment (CIE) marks of 100. A student shall obtain a minimum of 40% marks out of 100 to qualify in the course.

Sl. No	Activity	Max. Marks
1.	Attendance	20
2.	Quizzes /Assignment – 2, each of 25marks	50
3.	Report/ Participation Certificate	30
Total		**100**

Semester-III/IV					
MUSIC **Category: NCMC**					
Course Code	:	**B25NCK310E / 410E**	CIE	:	100 Marks
Teaching Hours L : T : P : S	:	0:0:30:0	SEE	:	--
Total Hours/Semester	:	30	Total	:	100 Marks
Credits	:	PP	SEE Duration	:	--

Course Learning objectives: The course Will enable the students to:	
1.	Identify the major traditions Of Indian music. through notations and aurally.
2.	Analyse the compositions with respect to musical and lyrical content
3.	Demonstrate an ability to use music technology appropriately in a variety of setting.

Syllabus	**30 Hours**
I. 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, Lay-a, Raga Talau Mela. **II. Compositions:** Introduction to the types of composition in Carnatic Music. Geethe, lath i, Swara, Swarajathi, Varna, Krithi. and Thillana, Notation System. **III. Composers:** Biography and contributions Of purandaradasa. Thyagaraja, Mysoro Vasudevacharya. **IV**. **Music Instruments**: Classification and construction of string instruments, Wind instrutnents. E*rcussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instrum ents **V**. **Abhyasa Gana:** Singing the swara exercises (Sarale Varase Only). dotation 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	
Course Learning Outcomes: Upon successful completion of this course, the student will be able to:	
1.	Discuss the Indian system Of music and relate it to Other genres (Cognitive domain)
2.	Experience the emotions Of and develop empathy (AffRtive Domain)
3.	Ressond to queries on various patterns in a composition (Psycho Motor Domain)

ASSESSMENT STRUCTURE (CIE Only):

This course is having only Continuous Internal Assessment (CIE) marks of 100. A student shall obtain a minimum of 40% marks out of 100 to qualify in the course.

Sl. No	Activity	Max. Marks
1.	Attendance	20
2.	Quizzes /Assignment – 2, each of 25marks	50
3.	Report/ Participation Certificate	30
Total		**100**

Text Books

1. Vldushi Vasantha Madhavi, “Theory of Music” Prism Publication, 2007
2. T Sachidevi and T Sharadha “Karnataka Sangeetha Dharpana” Vol. 1 (English). Shreenivaas Prakaashana, 2018

References:

1. Lakshminarayana Subramaniam. Viji Subramanaim. -Classical Music of India: A Practical Guigee, Tranquer, 2018.