Lokmanya Tilak Jankalyan Shikshan Santha's

Lokmanya Tilak College of Engineering

Sector 4, Vikas Nagar, Koparkhairane, Navi Mumbai 400709

An Autonomous Institute Affiliated to University of Mumbai

Department of Electrical Engineering

CURRICULUM STRUCTURE

For

SECOND YEAR ENGINEERING

(BASED ON NEP 2020)

w.e.f.A.Y. 2025-26

Approved by Board of Studies on 05/04/2025

Approved by Academic Council on15/04/2025

Department of Electrical Engineering

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Preface

Lokmanya Tilak College of Engineering (LTCE) is founded by a Nagpur-based trust known as Lokmanya Tilak Jankalyan Shikshan Sanstha (LTJSS). The Sanstha was established in 1983, by Honourable Dr. Satish Chaturvedi. At present, there are 28 educational institutes run by the Sanstha in Nagpur. The Sanstha derives its philosophy from the magnanimous mathematician, educationist, social reformer Lokmanya Bal Gangadhar Tilak, who dedicated his life for the cause of Swaraj. Lokmanya Tilak College of Engineering was established in 1994, approved by the All-India Council for Technical Education, New Delhi, recognised by the Govt. of Maharashtra, accredited by NAAC with 'A' grade and is affiliated to the University of Mumbai. Within the span of 30 years of its inception, LTCE has grown leaps and bounds in terms of popular courses being offered at U.G., P.G.and Ph.D. level. Four of its branches viz., Computer, Mechanical, Electrical and Electronics and Telecommunications Engg. have been accredited by NBA. The Institute runs the Under-graduate Programmes in Mechanical Engineering, Computer Engineering, Electronics & Telecommunication Engineering, Electrical Engineering, Computer Science & Engineering (Data Science), Computer Science & Engineering (Artificial Intelligence & Machine Learning) and Computer Science & Engineering (IoT & Cyber Security Including Blockchain Technology). Institute also offers Doctoral Programmes in Mechanical Engineering and Computer Engineering. LTCE stands steadfast in its mission of continuing efforts for the betterment of its students and society.

The National Education Policy 2020, recently implemented by the Government of India, envisions providing quality education to all young people, with the primary goal of nurturing well-rounded, thoughtful, and creative individuals. NEP 2020 also emphasizes the importance of developing character, ethical values, constitutional principles, intellectual curiosity, scientific temper, creativity, and other related virtues. The Government of Maharashtra has instructed autonomous colleges to update their curriculum and begin implementing the National Education Policy (NEP) 2020. We are fully committed to ensuring the effective and meaningful adoption of NEP 2020 in its true essence. At "Lokmanya Tilak College of Engineering", the holistic development of learners has always been our top priority and central focus. LTCE embraced the NEP philosophy as early as 2022 wherein we have introduced the concept of Honors and Minors programs on emerging fields as per the guidelines of University of Mumbai and in 2024, we proudly graduated our first batch under this holistic curriculum. The autonomous curriculum for 2024-28 is structured in line with the recommendations of NEP 2020, AICTE, and UGC. It now includes courses in emerging technologies and multidisciplinary areas to ensure relevance to industry and practical applications. Greater focus has been placed on experiential learning to move away from rote memorization.

Sd/-	Sd/-	Sd/-
Dr. Chandrakant M. Wankhade	**Dr. Sheeba P. S.**	**Dr. Subhash K. Shinde**
BoS Chairman, Electrical Engineering	**Dean, Academics & Research**	**Principal**

Illustrative Semester wise Credit distribution structure for Four Year UG Engineering Program – One Major, One Multidisciplinary Minor as per Maharashtra State Govt. Resolution:

Courses		Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
Basic Science Course	BSC/ESC	6-8	8-10							14-18
Engineering Science Course		8-10	4-6							12-16
Programme Core Course (PCC)	Program Courses		2	8-10	8-10	10-12	8-10	4-6	4-6	44-56
Programme Elective Course (PEC)						4	8	2	6	20
Multidisciplinary Minor (MD M)	Multidisciplinary Courses			2	2	4	2	2	2	14
Open Elective (OE) Other than a particular program				4	2	2				8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	2	2		2		2			8
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	2			2					4
Entrepreneurship/Economics/ Management Courses				2	2					4
Indian Knowledge System (IKS)			2							2
Value Education Course (VEC)				2	2					4
Research Methodology	Experiential Learning Courses								4	4
Comm. Engg. Project (CEP)/Field Project (FP)				2						2
Project									4	4
Internship/ OJT								12		12
Co-curricular Courses (CC)	Liberal Learning Courses	2	2							4
Total Credits (Major)		**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**20-22**	**160-176**

Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
2 Hr. Practical (P) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit

Credit Requirements for Award of Degree:

a) A total of 167 credits are required for a student to be eligible for the award of an **Undergraduate Degree in Engineering**, including a Multi-Disciplinary Minor, in accordance with the Government of Maharashtra GR dated 04/06/2024.

b) A student shall be eligible for the award of an **Undergraduate Degree** with **Honours/Minor** in Emerging Areas upon earning an additional **18 credits**.

Multiple Exits:

Students will have the flexibility to enter a programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.

Level	Exit After Semester	Minimum Credits Required	LTCE Credits	Qualification Title	Additional Credit requirements
4.5	II (First Year)	40	44	One Year UG Certificate in relevant discipline	**8 credits** through Skill-based vocational courses (4 Credits) and Internship/ Apprenticeship/ Project (4 Credits).
5.0	IV (Second Year)	80	86	Two Years UG Diploma in relevant discipline	**8 credits** through Skill-based vocational courses (4 Credits) and Internship/ Apprenticeship/ Project (4 Credits).
5.5	VI (Third Year)	120	127	Three Years B. Voc.in the relevant Discipline	**8 credits** through Skill-based vocational courses (4 Credits) and Internship/ Apprenticeship/ Project (4 Credits).
6.0	VIII (Fourth Year)	160	167	B.Tech. in major discipline with multidisciplinary minor	-----
6.0	VIII (Fourth Year)	160+18= 178	167+18= 185	**B.Tech. in major discipline with double minor (Multidisciplinary and Emerging minor)**	--------

Distribution of Credits:

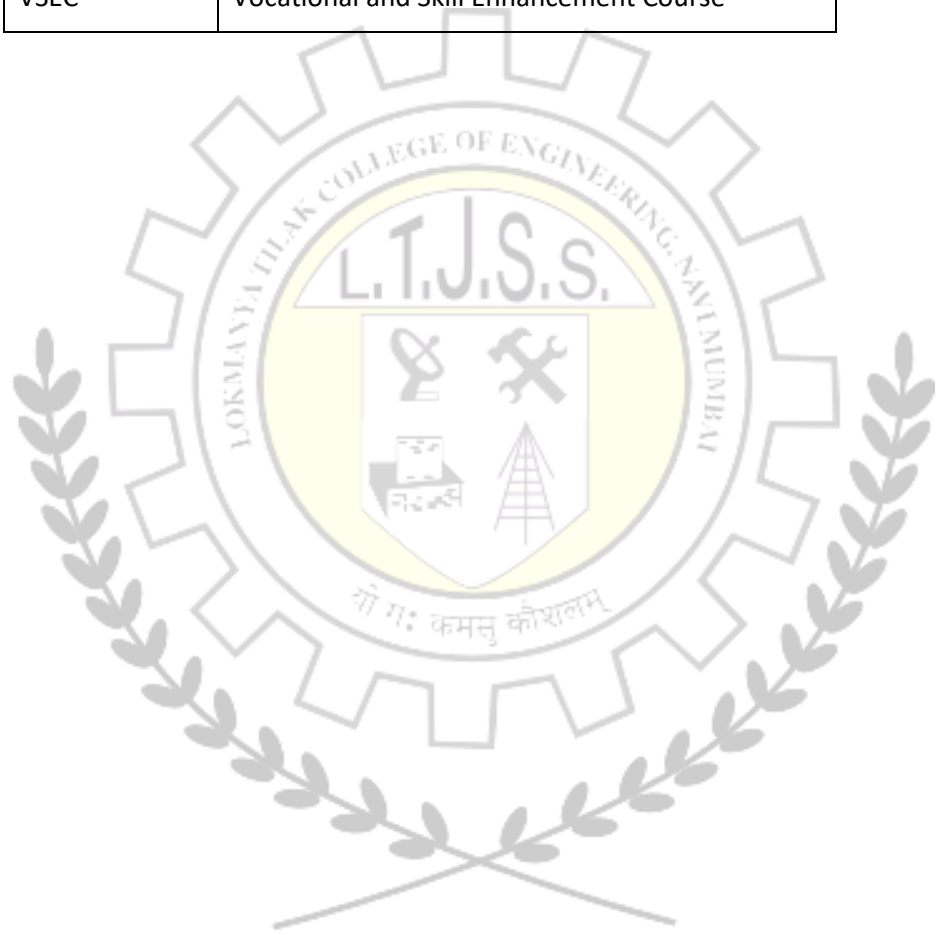
Type of Course	Course Code	No. of Credits as per Maharashtra Govt.	No. of credits as per LTCE
Basic Science Course	BSC	14-18	**16**
Engineering Science Course	ESC	12-16	**14**
Programme Core Course	PCC	44-56	**49**
Programme Elective Course	PEC	20	**19**
Multidisciplinary Minor	MDM	14	**14**

Open Elective (OE) Other than a particular program	OE	8	**08**
Vocational and Skill Enhancement Course	VSEC	8	**10**
Ability Enhancement Course (AEC -01, AEC-02)	AEC	4	**03**
Entrepreneurship/Economics/ Management Courses	EEMC	4	**04**
Indian Knowledge System (IKS)	IKS	2	**02**
Value Education Course (VEC)	VEC	4	**04**
Research Methodology	ELC	4	**03**
Comm. Engg. Project (CEP)/Field Project (FP)	ELC	2	**02**
Project	ELC	4	**04**
Internship/ OJT	ELC	12	**12**
Co-curricular Courses (CC)	CC	4	**03**
Total Credits (Major)		**160-176**	**167**
Total Credits (Major+Honors/Minors)		**178-194**	**167+18=185**

Abbreviations:

AEC	Ability Enhancement Course
AEL	Ability Enhancement Laboratory
BSC	Basic Science Course
BSL	Basic Science Laboratory
CEP	Common Engineering Project
CC	Co-curricular courses
CIE	Continuous Internal Evaluation
ESC	Engineering Science Course
ESE	End Semester Exam
ESL	Engineering Science Laboratory
IKS	Indian Knowledge System
L	Lecture

MDM	Multidisciplinary Minor
MSE	Mid Semester Exam
OE	Open Elective
P	Practical
PCC	Programme Core Course
PCL	Programme Core Laboratory
PEC	Programme Elective Course
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course



Department of Electrical Engineering

Second Year Engineering Scheme: Semester III (w.e.f. AY 2025-26)

Course Code	Course Name	Teaching Scheme		Credit Assigned		Total Credits	Examination Scheme					
							Internal Assessment		End Semester Exam		Oral &/ Practical	Total Marks
		L	P	L	P		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)	Marks	Duration (Hrs)		
EEESC301	Mathematics for Electrical Engineering-I	3	--	3	-	3	20	20	60	2	-	100
EEPCC301	Electrical Measurement and Measuring Instruments	3	--	3	-	3	20	20	60	2	-	100
EEPCC302	Circuit Theory	3	--	3	-	3	20	20	60	2	-	100
OE301x	Open Elective Course 1	3	--	3	-	3	20	20	60	2	-	100
EEMC301	Entrepreneurship & Financial Management	2	--	2	-	2	20	20	60	2	-	100
VEC301	Environment & Sustainability	2	--	2	-	2	-	50	-	-	-	50
EEVSEC301	AppliedElectrical Engineering and PCB DesignFabrication Lab	-	2*+2	-	2	2	-	25	-	-	25	50
EEPCL301	Electrical Measurement and Measuring Instruments Lab	-	2	-	1	1	-	25	-	-	25	50
EEPCL302	Circuit Theory Lab/Simulation Lab1	-	2	-	1	1	-	25	-	-	25	50
Total		**16**	**08**	**16**	**4**	**20**	**100**	**225**	**300**	**10**	**75**	**700**

*Two hours of practical class to be conducted for full class as Theory Lecture.

OE301x: Open Elective Course I	**OE3011**: Biology for Engineers	**OE3012**: Indian Constitution and Governance	**OE3013**: Human Psychology	**OE3014**: Disaster Management and Mitigation

Department of Electrical Engineering

Second Year Engineering Scheme: Semester IV (w.e.f. AY 2025-26)

Course Code	Course Name	Teaching Scheme		Credit Assigned		Total Credits	Examination Scheme					
							Internal Assessment		End Semester Exam		Oral &/ Practical	Total
		L	P	L	P		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)	Marks	Duration (Hrs)		
EEPCC401	Mathematics for Electrical Engineering-II (Signal System)	3	-	3	--	3	20	20	60	2	-	100
EEPCC402	Analog and Digital integrated circuit	3	-	3	--	3	20	20	60	2	-	100
EEPCC403	Electromagnetic Field and Waves	3	-	3	--	3	20	20	60	2	-	100
EEMDM401	MDM-I	3	-	3	--	3	20	20	60	2	-	100
OE401x	Open Elective-II	2	-	2	--	2	20	20	60	2	-	100
EEMC401	Digital Business Management	2	-	2	--	2	-	50	-	-	-	50
VEC401	Business Communication Skills	-	2*+2	-	2	2	-	25	-	-	-	25
EEPCL402	Analog and Digital integrated circuit Lab	-	2	-	1	1	-	25	-	-	25	50
EEPCL403	Electromagnetic Field and Waves Lab	-	2	-	1	1	-	25	-	-	25	50
EEMDML401	MDM Lab I	-	2	-	1	1	-	25	-	-	--	25
EECEP401	Mini Project 1	-	2	-	1	1	-	25			25	50
Total		**16**	**12**	**16**	**06**	**22**	**100**	**275**	**300**	**10**	**75**	**750**

* Two hours of practical class to be conducted for full class as Theory Lecture.

OE401x: Open Elective Course II	**OE4011**: Human Resource Management	**OE4012**: Corporate and Cyber Laws	**OE4013**: Stock Market and Personal Finance	**OE4014**: Nutrition Literacy and Health

Multidisciplinary Minor (MDM) (14 Credits

Semester	Computer Engineering (CE)	Electronics & Telecommunication Engineering (ET)	Artificial Intelligence & Robotics (AR)	Internet of Things (IT)	Mechanical Engineering (ME)	Electrical Engineering (EE)
IV	**CEMDM401:** Data Structure and Algorithms	**ETMDM401:** Microprocessor and Microcontroller	**ARMDM401:** Artificial Intelligence	**ITMDM401:** Internet of Things and Applications	**MEMDM401:** Basics of Mechanical Engineering	**EEMDM401:** Elements of Electrical System
	CEMDML401 : Data Structure and Algorithms Lab	**ETMDML401:**Microprocessor and Microcontroller Lab	**ARMDML401:** AI Lab	**ITMDML401** : Internet of Things Lab	**MEMDML401** :Mechanical Engineering Lab	**EEMDML401:** Elements of Electrical System Lab
V	**CEMDM501:** Database Management System	**ETMDM501:**Digital Communication & Sensor Technology	**ARMDM501:** Robotics	**ITMDM501:** Sensors, Actuators and Transducers	**MEMDM501:** Conventional & Renewable Energy Sources	**EEMDM501:** Special Machines and Smart grid
	CEMDML501 :Database Management System Lab	**ETMDML501:**Digital Communication & Sensor Technology Lab	**ARMDML501:**Robotics Lab	**ITMDML501** : Sensors, Actuators and Transducers Lab	**MEMDML501** :Renewable Energy Sources Lab	**EEMDML501:** Special Machines and Smart grid Lab
VI	**CEMDM601:** AI & Soft Computing	**ETMDM601:**Digital Image Processing	**ARMDM601:** Industrial Automation	**ITMDM601:** Microcontrollers and Application	**MEMDM601:** Automobile System	**EEMDM601:** Electric Vehicle Technology
	CEMDML601 :AI & Soft Computing Lab	**ETMDML601:**Digital Image Processing Lab	**ARMDML601:**Automation Lab	**ITMDML601** : Microcontrollers Lab	**MEMDML601** :Automobile Lab	**EEMDML601:** Electric Vehicle Technology Lab
VII	**CEMDML701** :Web Design Lab	**ETMDML701:**Mobile Computing Lab	**ARMDML701:**Predictive Maintenance Lab	**ITMDML701** : PLC and SCADA Lab	**MEMDML701** :3D Printing Lab	**EEMDML701:** Design Management Auditing of Electrical System Lab

Open Elective Courses (OE) (8 Credits)

Semester	Course Code	Course Name
III	OE3011	Biology for Engineers
	OE3012	Indian Constitution and Governance
	OE3013	Human Psychology
	OE3014	Disaster Management and Mitigation
IV	OE4011	Human Resource Management
	OE4012	Corporate and Cyber Laws
	OE4013	Stock Market and Personal Finance
	OE4014	Nutrition Literacy and Health
VIII	OE8011	Intellectual Property Rights (IPR) and Patents
	OE8012	Risk Management
	OE8013	Economics for Engineers
	OE8014	Innovation and Startups

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Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEESC301	Mathematics for Electrical Engineering-I	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2	To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3	To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.
4	To understand the basics of Linear Algebra and its applications
5	To use concepts of vector calculus to analyze and model engineering problems.
Course Outcomes: Learners will be able to	
1	Apply the concept of Laplace transform to solve the real integrals in engineering problems
2	Apply the concept of inverse Laplace transform of various functions in engineering problems.
3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems
4	Find orthogonal trajectories and analytic function by using basic concepts of complex variables
5	Illustrate the use of matrix algebra to solve the engineering problems.
6	Apply the concepts of vector calculus in real life problems.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Laplace Transform** 1.1 Definition of Laplace transforms, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like exponential, sinusoidal, hyperbolic sinusoidal functions and time domain functions for t>=0. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem,	07	CO1

	Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation		
	Self Learning Topic: **Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function**		
02	**Inverse Laplace Transform**	07	CO2
	2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transforms. 2.3 Inverse Laplace transform using Convolution theorem (without proof).		
	Self-Learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.		
03	**Fourier Series**	08	CO3
	3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and 2l. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series.		
	Self-Learning Topics: **Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform of functions.**		
04	**Complex Variables-I**	06	CO4
	4.1 Function f(z) of complex variable, limit, continuity and differentiability of f(z)Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in Cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function f(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories		
	Self-Learning Topics: **Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.**		
05	**Linear Algebra: Matrix Theory**	06	CO5
	5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix		

	Self-Learning Topics: **Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices.**		
06	**Vector Differentiation and Integral** 6.1 Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof) 6.2 Properties of vector field: Solenoidal and irrotational (conservative) vector fields 6.3 Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics: Gauss' divergence Theorem and applications of Vector calculus**	**08**	CO6

Text Books:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced engineering mathematics, H.K. Das, S. Chand, Publications

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
3. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
4. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series
5. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
6. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series

Internal Assessment (40 Marks) :

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEPCC301	**Electrical Measurements and Measuring Instruments**	20	20	60	1	2	100	

Prerequisite:	
Course Objectives: The course aims to	
1	To describe the fundamental measurement principles, analog and digital measuring instruments.
2	To get acquainted with measurements of unknown electrical parameters using AC/DC bridges and potentiometers.
3	To get familiar with measurement of non-electrical parameters using various transducers and sensors.
4	To illustrate describe various Signal conditioning and advanced measuring instruments.
Course Outcomes: Learners will be able to	
1	Comprehending the principles of measurement and various measuring instruments.
2	Describe various types of analog measuring instruments for measurement of electrical quantities.
3	Apply the concepts of balancing of AC, DC Bridges for measurement of unknown electrical parameters.
4	Illustrate the working of various types of transducers for measurement of non-electrical quantities.
5	Describe various types of digital measuring instruments for the measurement of electrical quantities.
6	Illustrate various Signal conditioning and advanced measuring instruments.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction** 1.1 Introduction to measurement. 1.2 Static Characteristics. 1.3 Dynamic Characteristics. 1.4 Types of errors in measurement and mitigation techniques. **Self Learning Topic:** Statistical Treatment of Error Data	03	**CO1**
02	**Analog Measurement of Electrical Quantities and Instrument Transformer** **Analog Instruments:** 2.1 Classification and principles of operation. 2.2Operating forces, Control and damping System. **Analog Measurements:** 2.3 Extension of range of ammeter and voltmeter. 2.4 Electrodynamometer type wattmeter. 2.5 Electrodynamometer type Power factor meter. 2.6 Low Power Factor Meter. 2.7 Static Phase Sequence detectors. 2.8 Single Phase Induction Type Energy Meter. **Instrument Transformer:** 2.9 Current Transformer (CT), Potential Transformer (PT). 2.10 Ratios and Burden. Error Reduction. 2.11 Measurement of power using CT PT. **Self Learning Topic:** Testing Of Instrument Transformer.	09	**CO2**
03	**AC-DC Bridges and Potentiometer** **AC, DC Bridges:** 3.1Measurement of Medium resistance: Wheatstone bridge. 3.2 Measurement of Low resistance: Kelvins Double bridge. 3.3 Measurement of Earth Resistance: Earth tester. 3.4 Measurement of Insulation Resistance: Megger (Ratio Meter). 3.5 Measurement of Inductance: Maxwell's bridge. 3.6 Measurement of Capacitance: Schering bridge. **Potentiometer Applications:** 3.7 Calibration of ammeter, Voltmeter. 3.8 Calibration of Watt-meter using potentiometer. **Self Learning Topic:** Heaviside Mutual Inductance Bridge, Wien Bridge. Transformer Ratio Bridge.	06	**CO3**
04	**Measurement of Non-electrical Quantities** **Transducers:** 4.1 Classification, Characteristics and Selection. 4.2 Resistive, Capacitive, inductive, Optical, digital transducers. 4.3 Measurement of temperature:-Resistance Thermometer (RTD), Thermistor, Thermocouple. 4.4 Measurement of displacement: Linear and angular displacement using potentiometer, LVDT. 4.5 Measurement of pressure: Piezoelectric, strain-gauge, capacitive and inductive type. 4.6 Measurement of speed: Inductive and Hall Effect sensor. **Self Learning Topic: I**nterfacing, Transducer Circuit Performance.	09	**CO4**

05	**Digital Measurement of Electrical Quantities** 5.1 Generalized Block Diagram Of Digital Instruments. 5.2 Digital Voltmeter (Ramp Type), Ammeter. 5.3 Multi-Meter, Digital Frequency Meter. 5.4 Digital Tachometer, Digital Megger. 5.5 Digital Storage Oscilloscope. **Self Learning Topic:** Current Sensor (ACS712), Voltage Sensor (B25).	06	**CO5**
06	**Signal conditioning and Advanced Measuring Instruments** 6.1 Signal conditioning. 6.2 Basics Signal Conditioning Circuits (Amplifier, Attenuation, Filter, Linearization). 6.3 Data Acquisition System. 6.4 Power Analyzer, Harmonic Analyzer. 6.5 Signal Generator, Q-Meter. **Self Learning Topic:** Probes and Connectors, Smart Sensors Smart Energy Meter	06	**CO6**

Text Books:

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai Publications.
2. H. S. Kalsi, “Electronic Instrumentation”, Third Edition, Tata McGraw Hill Publications..
3. R. K. Rajput, "Electrical and Electronic Measurement and Instrumentation," S. Chand Publications.

References:

1. E.W. Golding & F.C. Widdis, "Electrical Measurements and Measuring Instruments," Wheeler Publishing.
2. Helfric and Cooper, “Modern Electronic Instrumentation and Measurement” Techniques, PHI Publishing
3. Sabrie Soloman, “Sensors Handbook”, Second Edition, McGraw Hill Publishing
4. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

A. Assignment: 5 Marks
B. Quiz/Open book test/Presentation: 10 Marks
C. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weight age.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEPCC302	Circuit Theory	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	To impart the knowledge of various fundamental electrical theorems for analysis of electrical circuits from application point of view
2	To inculcate the problem solving and analysis skills in students.
Course Outcomes: Learners will be able to	
1	Apply network theorems for the analysis of electrical circuits.
2	Obtain the transient and steady-state response of electrical circuits. And Analyse the effect of switching conditions on electrical networks using differential equations and Laplace Theorem
3	Analyse electrical network using graph theory..
4	Develop and analyse transfer function model of system using two port network parameters.
5	Analyse time domain behaviour from pole zero plot.
6	Synthesize passive one-port networks using standard Foster and Cauer forms.

Module	Detailed Contents	Hrs.	CO Mapping
01	**DC and AC Circuit Analysis** With DC Dependent Sources: 1.1 Mesh analysis, Super mesh analysis, Nodal analysis,Super node analysis, Source transformation and Source shifting. Superposition theorem, Thevenin's theorems and Norton's theorem and Maximum power transfer theorem; 1.2 With AC Sources: Magnetic coupling, Mesh analysis, Nodal analysis, Superposition theorem, Thevenin's theorems, Norton's theorem, Maximum power transfer theorem and Reciprocity theorem.	09	CO1

	Self-learning Topics: **All theorem and related numerical with independent sources.**		
02	**First and Second Order Circuits Using Laplace Transforms** 2.1Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits. 2.2 Initial and final conditions in network elements, forced and free response, time constants, 2.3 steady state and transient state response **Self-Learning Topic: Laplace transform, initial and final condition of inductor and capacitor.**	**09**	**CO2**
03	**Graph Theory and Network Topology:** 3.1 Introduction, Graph of network 3.2 Tree, Co-tree, Loop incidence matrix, Cut set matrix, Tie set matrix and Loop current matrix, Number of possible tree of a graph. 3.3 Analysis of network equilibrium equation and Principle of duality.	**04**	**CO3**
04	**Two port parameters:** 4.1 Open circuit, short circuit, transmission and hybrid Parameters. 4.2 relationships between parameter sets 4.3 reciprocity and symmetry conditions. 4.4 parallel connection of two port networks, cascade connection of two-port networks.	**06**	**CO4**
05	**Network Functions- Poles and Zeros:** 5.1 Network functions for one port and two port networks. 5.2 Driving point and transfer functions. 5.3 Ladder network, General network. 5.4 Poles and zeros of network functions, restrictions on Pole and zero locations for driving point functions and Transfer functions. 5.5 Time domain behavior from pole - zero plot.	**08**	**CO5**
06	**Network Synthesis:** 6.1Network Synthesis: Concept of Realization. 6.2Hurwitz property,properties of positive real functions, Synthesis of R-L, R-C and L-C Network. 6.3 Foster(I and II) and Cauer (I and II)forms.	**06**	**CO6**

Text Books:

1. M. E. Van Valkenburg, “Network Analysis, 3rd Edition”, PHI Learning.
1. D. Roy Choudhury, “Networks and Syste”, 2nd Edition, New Age International.
2. M. E. Van Valkenburg,“Linear Circuits”, Prentice Hall.
3. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
4. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999

References:

1. F. F. Kuo, “Network Analysis and Synthesis,” John Wiley and sons.
2. N Balabanian and T.A. Bickart, “Linear Network Theory: Analysis,Properties, Design and Synthesis”, Matrix Publishers.
3. C. L.Wadhwa, “Network Analysis and Synthesis”, New Age International.
4. B. Somanathan Nair, “Network Analysis and Synthesis”, Elsevier Publications.
5. Kuo F.F. ‘‘Network Analysis and Synthesis”,2nd Ed.,Wiley India.,2008.
6. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE	--	Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
EEVSEC301	Applied Electrical Engineering and PCB Design-Fabrication Lab	-	25	25	-	-	50	--

Course Objectives: The course aims to	
1	Impart the knowledge of electrical installation on institute campus.
2	Develop the skill set to work on real-life projects and its design.
3	Develop the ability to repair and maintain electrical equipment/ appliances
4	Develop the required skill set to design, develop and assemble the PCB using the CAD Tools
Course Outcomes: Learners will be able to	
1	Identify various electrical LV/HV substations, supply equipments and their network.
2	Identify and use different low voltage protective switchgears along with residential /industrial wiring practices.
3	Illustrate the understanding of Repair and maintenance of common electrical appliances.
4	Illustrate the use of PCB CAD tools and their features for the practical designs.
5	Design the schematic, board layout for simple, moderately complex and complex circuits.
6	Fabricate and assemble the PCBs for simple and moderately complex circuits.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Electrical LV/HV Substation and Supply Equipment:** Electrical LV/HV Substation: RMU, Transformer, HV switchgear and panels, LV switchgears and panels, HT metering, LT metering APFC panel, Backup DG sets, UPS, Changeover switchgears, Feeder Pillar, Solar PV Installation. Single line diagram (SLD), Supply Utility service: Electricity bills and details. **Students should study the actual electrical supply system on institute campus; prepare SLD for the network and detailed report on actual**	08	**CO1**

	ratings of the complete system.		
02	**Residential/ Industrial Wiring and switch-gears** Wiring materials, selection of wire, conductor sizing, Cables and cable management Estimation and costing of residential wiring (Simple numerical on wiring of single room); Fire retardant wires. Different switching and protection devices (MCBs/ Fuses/Relays), selection and sizing connection of energy meter and distribution board, wiring standards (IS-732, section 4). (Students should be given demonstration of real life devices and DBs in use). **Students should perform following experiments (Any three)** 1. Identify different types of cables/wires, switches and their uses. 2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage. 3. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring and wiring accessories) 4. Wiring of fluorescent lamps and light sockets (6 A). 5. Wiring of Power circuit for controlling power device (16A socket) 6. Design of Staircase wiring / Go-down wiring / Tunnel wiring 7. Demonstration and measurement of power/energy consumption and repair maintenance of electric iron/mixer grinder/ washing machine/refrigerator/ air conditioner/water heater/geyser/single phase pump/exhaust fan.	10	**CO2**
03	**Repair and Maintenance of House-hold Appliances and Machines** Testing, fault finding, dismantling, assembling and testing after repairs of house hold appliances like standard fan and regulator, BLDC fan, heater, geyser, mixer, washing machine, microwave oven, LED lamps/tubes, Induction Cooker, Air cooler etc. **(Minimum two such appliances must be studied)** Troubleshooting of 1 ph and 3ph transformers and motors **(Minimum one transformer / one motor).** **Self Learning Topics:** Electrical Fire Prevention and Safety in Buildings	10	**CO3**
04	**Type of PCB** Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer) PCB Materials: Standard FR-4 Epoxy Glass, Multifunctional FR-4, Tetra Functional FR-4, NelcoN400-6, BT Epoxy Glass, Teflon , IPC Standard for PCB Materials	06	**CO4**
05	**PCB Development Tools:** Introduction to commercial softwares and open source available like: Proteus, Altium, Eagle, OrCAD, KiCAD , easy EDA etc. Schematic preparation, Selection of Components from standard and special libraries, Components Footprints, net-list, creating new component footprints / library. Updating libraries	08	**CO5**

06	**PCB Artwork Designing, Fabrication and Testing**		
	PCB Layout Designing: Placement and layout of components, Design Rule Check (DRC), Electronic rule checking (ERC); PCB Layers: electrical Layers: top Layer, bottom Layer, board outlines and cut-outs, drilling details, components outlines, text; pads, vias, Tracks, colour of layers; Multilayer PCBs. Rules for track: PCB conducting layer thickness selection, PCB track width calculation, track length, track angle, track joints, track size; manual routing, auto-routing: Setting up Rules, Defining Constraints; Gerber Generation; PCB Fabrication PCB Making, Printing, Etching, Drilling. EMI and EMC issues in PCB designing. **Students should prepare PCBs for at least three projects:** Project should be a moderately complex circuit: Complete schematic,board layout (Single layer), PCB fabrication, component mounting and testing to be completed. Project is required to be carried out by each individual student (not in agroup). For each project a detailed report inclusive of all the schematic, artwork layouts, PCB photos, assembled PCB photos, details of the circuit design and test result etc. must be prepared. Each Project can be carried out based on the following steps: PCB project: Selection of circuit, components, components packages, manufacturer (make), generic components, symbols. (i) Selection of circuit: PCB design practice can be carried out for following circuits: 1. Analog Electrical / Electronic Circuits 2. Linear DC Power Supply 3. Op-amp based Signal Processing circuits 4. Different measurement based on transducers /sensors. 5. Mini Project based on Electrical / Electronic domain 6. Microcontroller circuits etc. (ii) Components selection: Students can design/ select the components from datasheets/ manufacturer catalogues / data-book, online supplier's inventory etc. (iii) Selection of PCB type: PCB material, number of layers, thickness of copper etc. (iv) Prepare the schematic and board layout using the open source CAD tools or Licensed CAD tool available in the lab. (v) Fabricate PCB in the lab using printing, etching and drilling process. (Only two)projects) (vi) Post PCB fabrication process: component mounting, soldering and HardwareTesting. (vii) Prepare the report on overall lab work carried out with schematics, PCB artwork	14	**CO6**

Continuous Internal Evaluation (25 Marks): Minimum 10 experiments should be performed. Minimum 01 from module 1, minimum 03 from module 2, minimum 03 from module 3 and minimum 03 experiments from 4, 5, 6 modules are compulsory for term grant.

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Oral / Practical Evaluation (25 Marks)

Oral examination will be based on entire syllabus of EEVSEC301-Vocational & Skill Enhancement Course/Lab

Text Books:

1. J. B. Gupta, Electrical Installation Estimating & Costing, S. K. Kataria & Sons, 2009
2. K B. Bhatia, Electrical Appliances and Devices, Khanna Publications
3. K B. Bhatia, Fundamentals of Maintenance of Electrical Equipments, Khanna Publications.
4. BIS SP 30:National Electrical Code
5. Electricity Act 2003
6. Raina Bhattachraya, Electrical Design Estimating And Costing, New Age International
7. Simon Monk, Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards, 1st Edition, McGraw-Hill Education
8. Matthew Scarpino, Designing Circuit Boards with EAGLE: Make High-Quality PCBs at Low Cost, 1st Edition Prentice Hall.
9. Archambeault and Drewniak James, PCB Design for Real-World EMI Control, Springer Publications

References:

1. P. Horowitz and W. Hill, The Art of Electronics, 3 Edition, Cambridge University Press.

Other Resources:

1. Electronic Packaging and Manufacturing By Prof. A Bhattacharya, Prof. Goutam Chakraborty, IIT Kharagpur
2. Web link- https://nptel.ac.in/courses/112105267

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					
EEPCL301	**Electrical Measurements and Measuring Instruments Lab**	-	25	25	-	-	50	1

Prerequisite:	
Course Objectives: The course aims to	
1	**Provide fundamental knowledge of analog measuring instruments** used for electrical quantity measurement, including their working principles and performance analysis.
2	**Develop an understanding of bridge circuits** and their applications in accurately measuring passive electrical components such as resistance, capacitance, and inductance.
3	**Introduce various sensors and transducers** used for measuring physical parameters and analyze their working principles and characteristics.
4	**To familiarize students with signal processing circuits** used in measurement systems, enabling them to analyze and apply these circuits in instrumentation.
Course Outcomes: Learners will be able to	
1	Illustrate and analyze the working of analog instruments used for measurement of the various electrical quantities.
2	Demonstrate the use of bridges for measurements of values passive electrical components.
3	Illustrate and analyze the working of various sensors, transducers used for measurement of the various physical parameters.
4	Understand and analyses the working signal processing circuits used in measurements and instruments

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	Range Extension of ammeter meters used in electrical measurements.	CO1
02	Range Extension of voltmeter meters used in electrical measurements.	CO1
03	Perform power and power factor measurement in single phase and three phase circuit.	CO1
04	Perform power measurement by two watt meter method.	CO1
05	Measurement current, voltage and power using CT PT.	CO1
06	Measurement of the medium resistance using Wheatstone bridge.	CO2
07	Measurement of the low resistance using Kelvin's double bridge.	CO2

08	Measurement of inductance using Maxwell's bridge.	CO2
09	Measurement of capacitance using Schering's bridge.	CO2
10	Measurement strain by Strain gauge.	CO3
	Measurement of liner displacement by LVDT.	CO3
11	Measurement temperature using thermocouple.	CO3
12	Measurement temperature using thermistor.	CO3
13	Measurement of current by Current Sensor (ACS712).	CO4
14	Measurement of voltage by Voltage Sensor (B25).	CO4
15	Demonstration of Signal Conditioning system.	CO4

Continuous Internal Evaluation (25 Marks): Minimum 10 Experiments are compulsory for term grant.

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Oral & Practical Exam (25 Marks)

An Oral exam will be held based on entire syllabus and practicals.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Duration
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hours
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credit
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					
EEPCL302	Circuit Theory Lab/ Simulation lab	-	25	25	-	-	50	1

Course Objectives: The course aims to	
1	To impart the knowledge of various fundamental electrical theorems for analysis of electrical circuits from application point of view.
2	To inculcate the problem solving and analysis skills in students.
3	To understand the basics of circuit components, their characteristics and responses
4	To reduce the complex network using network topology
Course Outcomes: Learners will be able to	
1	Apply network theorems for the analysis of electrical circuits.
2	Obtain the transient and steady-state response of electrical circuits.
3	Develop and analyze transfer function model of system using two port network parameters.
4	Analyse time domain behaviour from pole zero plot.
5	Analyse electrical network using graph theory.
6	Analyse the effect of switching conditions on electrical networks using differential equations and Laplace Theorem.

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	To verify maximum power transfer theorem for resistive network.	CO1
02	To verify superposition theorem for resistive network.	CO1
03	Determination of z-parameters of given two port networks.	CO4
04	Determination of ABCD parameters of given two port networks.	CO4
05	Determination of h- parameters of given two port networks.	CO4
06	Verification of reciprocity theorem	CO4
07	Verification of Thevenin's theorem by using MATLAB software	CO1

08	Verification of Norton's theorem by using MATLAB software	CO1
09	Experimental determination of time constant of series r-c electric circuits by using MATLAB software	CO2
10	To verify Kirchoff's voltage law (KVL) and Kirchoff's current law (kcl).	CO1
11	To find the voltage across each resistor, branch currents of a given circuit using mesh analysis by using MATLAB software.	CO1
12	RLC circuit analysis	CO2
13	To determine y, z ,h and ABCD parameters of single and cascaded two-port networks experimentally and verify their interrelationships.	CO4
14	To obtain gain value and locations of poles, zeros to plot in s-plane from a given transfer function of a second order system.	CO5
15	To obtain transfer function from the given locations of poles, zeroes and gain value and plot in s-plane	CO5
16	Determine the impulse and step response for type '0', type '1' and type '2' system**s**	CO2
17	Step response of 1st order transfer function	CO5
18	Analyze the transfer function and pole-zero plot of a control system.	CO5

Continuous Internal Evaluation (25 Marks): Minimum 10 experiments should be done for term work.

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Oral & Practical Exam (25 Marks)

An Oral exam will be held based on entire syllabus.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
OEC3011	Biology for Engineers	20	20	60	1	2	100	

Prerequisite: Basic concepts of core sciences like physics, chemistry, and mathematics	
Course Objectives: The course aims to	
1	Familiarize the students with the basic biological concepts and their engineering applications.
2	Enable the students with an understanding of biodesign principles to create novel devices and structures.
3	Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems
4	Motivate the students develop the interdisciplinary vision of biological engineering.
Course Outcomes: Learners will be able to	
1	Understand the biological concepts from an engineering perspective.
2	Understand the artificial systems mimicking human action and collaborate the concepts of biomimetics for specific requirements.
3	Elucidate the basic biological concepts via relevant industrial applications and case studies.
4	Think critically towards exploring innovative biobased solutions for socially relevant problems.
5	Evaluate the principles of design and development, for exploring novel bio-engineering projects.
6	Integrate biological principles for developing next generation technologies.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction of Cell and Bio-Molecules :** Structure and functions of a cell. Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins, lipids. Importance of special biomolecules: Properties and functions of enzymes, vitamins and hormones.	06	**CO1**
02	**Analogy of biological organs** Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease)	10	**CO2**

	Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye) Kidney as a Filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine), Heart as a Pumping system Process: (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, stents, pace makers).		
	Self Learning Topic: CPR techniques. Photosynthesis & solar cells, Xylem & plumbing, Thermoregulation in human body & heat transfer in machine, Defense mechanism in organism, signaling processing in biology and electronics.		
03	**Nature Inspired Materials and Mechanism :**	08	**CO3**
	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). Biomaterials: Types, properties and applications		
	Self Learning Topic: Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).		
04	**Biological Inspired Techniques.**	08	**CO4**
	Bioprinting techniques and materials, Electrical tongue and electrical nose in food science, Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).		
	Self Learning Topic: DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis.		
05	**Bio-Medical Devices**	04	**CO5**
	Diagnostic (X-ray machines, CT scanners and MRI machines.) Therapeutic (ventilators, infusion pumps and pacemakers) , Monitoring (Oximeter, Glucometer,Thermometer, BP monitor) **Implantable** devices and Smart Devices		
06	**Bio-Engineering Applications**	06	**CO6**
	Bio-medical imaging: Principle, types and examples Biosensors: Principle, types and examples Bioprinting: 3D printing of biological tissues and organ engineering and transplanting Artificial Intelligence in biomedical field		

Text Books:

1. Stuart Fox, Krista Rompolski, “Human Physiology”, McGraw-Hill eBook. 16th Edition, 2022
2. Leslie Cromwell, “Biomedical Instrumentation”, Prentice Hall 2011.
3. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., “Biology for Engineers”, Tata McGraw-Hill, New Delhi, 2012.
4. Ibrahim Ozbolat, “3D Bioprinting: Fundamentals, Principles and Applications” Academic Press, 2016.
5. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2018.
6. T Johnson, Biology for Engineers, CRC press, 2011 Molecular Biology and Biotechnology 2nd ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.
7. Dr. U. Satyanarayana Dr. U. Chakrapani, “Biochemestry (with Clinical Concepts & Case Studies)”, Elsevier 4th Edition, New Delhi 2013.

References:

1. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009
2. Molecular Biology by G. Padmanabhan, K. SivaramSastry, C. Subramanyam, 1995, Mac Millan
3. AlbertsEt.Al. The molecular biology of the cell, 6/e, Garland Science, 2014
4. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
5. VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
6. https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
7. https://nptel.ac.in/courses/121106008

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
OE3012	Indian Constitution & Governance	20	20	60	1	2	100	

Prerequisite: Know-how of Indian history and polity	
Course Objectives: The course aims to	
1	Create awareness about Indian Constitution to undergraduate students
2	Give knowledge about the system of government (central and state) and also the fundamental rights and duties enshrined in the Indian Constitution
3	Create awareness about Indian Judiciary, Constitutional Bodies, Regulatory Bodies and Public Policy
4	Give knowledge about important aspects of Governance
Course Outcomes: Learners will be able to	
1	Remember and understand the fundamental Rights and Duties
2	Understand the system of Indian Government
3	Discuss and summarize the Powers and Functions of Central and State Government
4	Explain Indian Judiciary System and Constitutional Bodies
5	Outline the functionalities of various Regulatory Bodies
6	Understand the important aspects of Good Governance

Module	Detailed Contents	Hrs.	CO Mapping
01	**Constitutional Framework** 1.1 Constitutional law as the Supreme law of land 1.2 Historical Background of Indian Constitution 1.3 Making of Indian Constitution 1.4 Salient Features of the Constitution 1.5 Preamble of the Constitution 1.6 Fundamental Rights and Duties 1.7 Directive Principles of State Policy **Self Learning Topic: Sources of the Constitution, Comparison of the**	8	CO1

	Constitutions, Government of India Act, 1935		
02	**System of Indian Government** 2.1 Parliamentary System 2.2 Federal System 2.3 Legislative Relations between the Centre and States 2.4 Inter-State Relations 2.5 Emergency Provisions **Self Learning Topic: Parliament and its Committees**	7	**CO2**
03	**Central (Union) and State Government** 3.1 Election, Qualifications, Oath, Powers and Functions of: 3.2 President and Vice-President 3.3 Prime Minister 3.4 State Governor 3.5 Chief Minister 3.6 Central and State Council of Ministers **Self Learning Topic: Panchayati Raj and Municipalities**	7	**CO3**
04	**Indian Judiciary and associated Constitutional Bodies** 4.1 Supreme Court of India 4.2 State High Court, Sub-ordinate Courts 4.3 Election Commission of India 4.4 Comptroller and Auditor General of India 4.5 Attorney General of India 4.6 Advocate General of the State	8	**CO4**
05	**Regulatory Bodies and Public Policy** Insurance Regulatory and Development Authority (IRDAI) Securities and Exchange Board of India (SEBI) Telecom Regulatory Authority of India (TRAI) Bar Council of India (BCI) All India Council for Technical Education (AICTE) National Policy for Empowerment of Women, National Health Policy National Policy on Skill Development, Education Policy **Self Learning Topic:** Autonomous and Advisory Bodies	7	**CO5**
06	**Important Aspects of Governance** Good Governance, e-Governance Citizen's Charter People's Participation Public Sector Reforms Corporate Governance	5	**CO6**

Text Books:

1. Lawman's Bare Act - The Constitution of India, Kamal Publishers, New Delhi.
2. M Laxmikanth, Indian Polity, 5th Edition, McGraw Hill Education
3. M Laxmikanth, Governance in India, 2nd Edition, McGraw Hill Education
4. Durga Das Basu, Introduction to the Constitution of India, 23rd Edition, LexisNexis

References:

1. https://iipa.org.in/upload/polity1.pdf
2. https://iipa.org.in/upload/polity2.pdf
3. https://cdnbbsr.s3waas.gov.in/s380537a945c7aaa788ccfcdf1b99b5d8f/uploads/2024/07/20240716890312078.pdf

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
OE3013	**Human Psychology**	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	Understand the fundamental concepts and theories of human psychology.
2	Analyse cognitive, emotional, and social development across the human lifespan.
3	Evaluate different psychological approaches to behaviour, perception and learning.
4	Apply psychological principles to real-life scenarios, including workplace and interpersonal relationships.
Course Outcomes: Learners will be able to	
1	Identify key psychological concepts and their relevance in daily life.
2	Understand and analyse cognitive functions like memory, perception and problem-solving.
3	Apply psychological theories to interpret human emotions and behaviour.
4	Examine different personality types and their influence on individual behaviour.
5	Evaluate mental health conditions and discuss various therapeutic approaches.
6	Relate psychology to real-world applications in education, workplace and health.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Psychology** Definition and scope of psychology, importance in daily life, historical perspectives, Functionalism, Psychoanalysis, Behaviourism, Humanism, Cognitive Psychology.	05	**CO1**
02	**Human Cognition & Personality** Sensation & perception, stages of memory (sensory, short-term, long-term), forgetting and memory enhancement techniques, intelligence (IQ, emotional intelligence). Theories of personality	06	**CO2**

	Self-Learning Topic: **Memory Enhancement Techniques and their Effectiveness**		
03	**Emotions & Motivation**	07	**CO3**
	Basic emotions and their role in behaviour, Theories of emotion, Intrinsic vs. extrinsic motivation, major motivation theories, application of motivation in workplace and education.		
	Self-Learning Topic: Case Study on Emotional Intelligence in Leadership and Workplace Productivity.		
04	**Personality & Behavioural Psychology**	08	**CO4**
	Types of personalities, social perception and group behaviour, factors influencing attitude formation, persuasion, leadership styles, social influence (conformity, obedience, compliance), communication and its impact on behaviour. Overview of psychological disorders: Anxiety, Depression, Schizophrenia, OCD.		
	Self-Learning Topic: **The Role of social media in Shaping Human Behaviour and Perceptions.**		
05	**Stress & Well-being**	08	**CO5**
	Theories of stress, impact of stress on physical and mental health, coping mechanisms (problem-focused vs. emotion-focused coping), resilience and positive psychology techniques for well-being.		
	Self-Learning Topic: Meditation, Mindfulness, and Stress Reduction Techniques – A Practical Guide.		
06	**Applications of Psychology**	08	**CO6**
	Role of psychology in workplace settings (Industrial & Organizational Psychology), Human-Computer Interaction, ethical considerations in psychology (confidentiality, informed consent, ethical dilemmas).		
	Self-Learning Topic: **Psychological Factors Influencing Consumer Behaviour and Marketing Strategies**		

Text Books:

1. Psychology, Author: Saundra K. Ciccarelli, J. Noland White, Publisher: Pearson, 6th Edition.
2. Understanding Psychology, Author: Robert S. Feldman, Publisher: McGraw-Hill, 14th Edition.
3. Introduction to Psychology, Author: James W. Kalat, Publisher: Cengage Learning, 11th Edition.

References:

1. https://onlinecourses.nptel.ac.in/noc20_hs28/preview
2. https://www.apa.org/
3. https://positivepsychology.com/

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
OE3014	Disaster Management and Mitigation	20	20	60	1	2	100	

Prerequisite: Require knowledge of Environmental Science concepts	
Course Objectives: The course aims to	
1	Introduce the fundamental concepts of disaster management
2	Understand the causes, impact, and risk analysis of various disasters.
3	Familiarise students with disaster mitigation ,preparedness and response strategies
4	Educate about the role of technology, engineering solutions, and policies in disaster risk reduction
5	Enable students to design and implement disaster management strategies in engineering projects.
Course Outcomes: Learners will be able to	
1	Understand the different types of disasters and their effects on the environment and society
2	Analyse disaster risk and vulnerabilities related to engineering systems
3	Understand structural and non-structural mitigation measures
4	Apply disaster preparedness and response strategies in engineering practices
5	Understand use of recent technologies for disaster mitigation
6	Understand policies ,Governance and legal framework for disaster management

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Disaster management** 1.1 Definition: Disaster, Hazard, Vulnerability, Risk, Direct and Indirect Effects of Disaster 1.2 Types of disasters: Natural (Earthquake, Flood, Cyclone, Drought, Tsunami, Landslides) & Man-Made (Industrial, Chemical, Nuclear, Biological, Fire, Accidents, Terrorism). 1.3 Phases of Disaster Management Cycle (Prevention, Mitigation, Preparedness, Response, Recovery, Rehabilitation). **Self Learning Topic: List some natural and Man-made disasters that**	**08**	**CO1**

	happened in India in the last 5 years.		
02	**Module Title: Risk Assessment and Vulnerability Analysis** 2.1 Hazard Identification and Risk Assessment (HIRA) with objectives, key components, Steps, tools and techniques used. 2.2 Vulnerability and Capacity Assessment (VCA): components and process. 2.3 Disaster Risk Reduction (DRR): Concepts and Approaches 2.4 Community-Based Disaster Risk Reduction (CBDRR): Principles and Key components.	**07**	**CO2**
03	**Disaster Mitigation measures.** 3.1 Structural Mitigation Measures: Earthquake-resistant structures, Cyclone shelters, Flood embankments, Landslide control structures 3.2 Non-Structural Mitigation Measures: Early Warning Systems, Public Awareness and Education, Insurance and Financial Mitigation.	**06**	**CO3**
04	**Disaster Preparedness and Response** 4.1 Preparedness Planning, Incident Command System (ICS), Emergency Operations Centers (EOC), Search and Rescue (SAR) operations, Relief and Rehabilitation measures 4.2 Logistics and Supply Chain in Disaster Management. 4.3 Role of Government, NGOs, Armed Forces, and International Agencies. 4.4 Do's and Don'ts in case of Disaster .	**07**	**CO4**
05	**Applications of Technology in Disaster Management** 5.1 Remote Sensing and GIS Applications. 5.2 Role of Internet and softwares for effective disaster management. 5.3 ICT and Communication Technologies. 5.4 Drones and Unmanned Systems 5.5 Case studies of Technological Interventions. **Self Learning Topic: Roles of Engineers in disaster management and mitigation with examples.**	**07**	**CO5**
06	**Policies, Governance and Legal Framework** 6.1 Paradigm shift in Disaster Management. 6.2 Disaster Management Act, 2005 (India) / Relevant National Acts. 6.3 National Institute of Disaster Management (NIDM), National Disaster Management Authority (NDMA) and State DMAs 6.4 International Frameworks: Sendai Framework, SDGs, Role of Policies in Engineering Practices. 6.5 Case studies on successful Disaster Management strategies.	**07**	**CO6**

Text Books:

1. “Disaster Management" by Harsh K. Gupta
2. "Introduction to International Disaster Management" by Damon P. Coppola
3. "Disaster Management and Preparedness" by Collins Larry M. and Schneid Thomas D.
4. “Disaster Management and Mitigation”, by B.K. Khanna, New India Publishing Agency.
5. “An Introduction to Disaster Management: Principles and Practice”, by Satish Modh.
6. Natural Hazards and Disaster Management, Vulnerability & Mitigation by R B Singh, Rawat Publications.

References:

1. National Disaster Management Authority (NDMA), India: Guidelines on Earthquakes, Floods, Cyclones, Industrial Disasters, Urban Flooding, etc. Available at:https://ndma.gov.in IS Codes for Earthquake Resistant Design (IS 1893, IS 13920).
2. United Nations Office for Disaster Risk Reduction (UNDRR).
3. UNISDR Guidelines and Sendai Framework Documents

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignments/ Case studies: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration(Hrs)		Total Marks	2 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
EEMC301	Entrepreneurship Financial Management	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	Introducestudentstotheconceptsofentrepreneurshipandhelpthemtoidentifyentrepreneurial opportunities.
2	Provide a brief overview of business planning and funding options.
3	Understand the basic concepts of time value of money, returns and risks, working capital and sources of finance.
4	Toprovideoverviewofcapitalbudgeting,capitalstructure,dividendpolicy
Course Outcomes: Learners will be able to	
1	Understandtheconceptoffundamentalentrepreneurship,developanentrepreneurial mindset, and recognize the relevance of entrepreneurship across various industries.
2	Identify and evaluate entrepreneurial opportunities through systematic market research and develop a comprehensive and viable business plan for a startup.
3	Describetheessentialaspectsoffundingandunderstandvarioussourcesoffinance
4	Applytheprinciplesofcapitalstructuretoeffectivelystrategizefundingforstartups.
5	Analyse the concept of capital budgeting and working capital management
6	Evaluate investment, financing, and dividend decisions to optimize business performance and sustainability.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Foundations of Entrepreneurship** **1.1 Understanding entrepreneurship:** Definition, scope, and significance, Key characteristics of successful entrepreneurs, **1.2 Exploring entrepreneurial ecosystems:** Components and impact, 1.3 **Developing an entrepreneurial mindset:** Creativity, risktaking, and resilience, The role of entrepreneurship across industries **Self-Learning Topic: Case study on successful entrepreneurs.**	04	**CO1**
02	**Evaluating Entrepreneurship Opportunities** 2.1 Assessing entrepreneurial opportunities, Market research and feasibility studies, Lean startup methodologies, Elements of business plan, Strategic marketing and sales approaches **Self-Learning topic:** **Understanding the procedure and types of permissions to initiate the startups**.	04	**CO2**
03	**Fundamentals of Funding and Finance** 3.1 Time value of money, return and risk, Stages of financing, Debt, venture capitalandotherformsoffinancing,Sourcesofstartupfunding,Introduction to venture capital andange investors, Crowd funding and bootstrapping overview	04	**CO3**
04	**Capital Structure** **4.1 Determinantsofcapitalstructure:**Keyfactorsinfluencinganentity'sfinancial structure, **4.2 Theories and models of capital structure:** Analyzing various conceptual approaches, **4.3 Traditional and modern theories:** Net Income (NI) Approach, Net Operating Income (NOI) Approach	05	**CO4**
05	**Capital Budgeting and Working Capital Management** **5.1 Introduction to capital budgeting:** Meaning and importance of capital budgeting, Key Inputs for capital budgeting decisions, **5.2 Working capital management:** Meaning and concept of working capital, Importance of working capital management, **5.3 Investment appraisal techniques:** Accounting rate of return (ARR), Payback period & discounted payback period, Net present value(NPV),Profitability index(PI),Internal rate of Return (IRR).	06	**CO5**
06	**Dividend Policy** **6.1 Introduction to dividend policy:** Meaning and significance of dividend policy in financial management, **6.2 Determinants of dividend decisions:** Key factors influencing an entity's dividend policy, **6.3 Overview of dividend policy theories and approaches:** Walter's Model- Relationship between dividend decisions and firm valuation, Gordon's Model- Dividend relevance and its impact on stock prices	05	**CO6**

Text Books:

1. “Entrepreneurship: A Real-World Approach “by Rhonda Abram’s.
2. “Entrepreneurship-Theory, Process Practice”–by Kuratko & Hodgetts, ThompsonSouth-Western Publication.
3. AlexanderOsterwalderandYvesPigneur,“BusinessModelGeneration:AHandbookfor Visionaries, Game Changers, and Challengers”.
4. Indian Financial System, 9" Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
5. FinancialManagement,11hEdition(2015)byI.M.Pandey;Publisher:S.Chand(G/L)& Company Limited, New Delhi.

References:

1. “The Lean Start-up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
2. “FundamentalsofCORPORATEFINANCE”, S.A.Ross,R.W.Westerfield,andB.D.Jordan(11th ed.), McGraw Hill, 2018.
3. https://onlinecourses.nptel.ac.in/noc25_ge11/preview
4. https://nptel.ac.in/courses/127105007
5. https://onlinecourses.nptel.ac.in/noc21_mg93/preview

Internal Assessment (40Marks)

A. Mid Semester Exam(20Marks)

Mid semester examination will be based on 40% to 50% of the syllabus.

Continuous Internal Evaluation (20Marks)

1. Assignment/Casestudy:5Marks
2. Quiz/Open book test/Presentation:10Marks
3. Regularityandattendance:5Marks

End Semester Examination (60Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying20%to30%weightageandthesyllabuscoveredfromMSEtoESEcarrying70%to80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester III

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
VEC301	Environment & Sustainability	NA	50	NA	NA	NA	50	

Prerequisite: Knowledge of Universal human values & geography	
Course Objectives: The course aims to	
1	To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
2	Understand and identify environmental issues relevant to India and global concerns
3	To familiarize the concept of sustainable development goals
4	Familiarize environment related legislations
Course Outcomes: Learners will be able to	
1	Demonstrate an understanding of the basic concepts of the environment, ecosystems, and biodiversity
2	Identify and understand the Global Environmental concerns.
3	Learn & understand the concepts of Biodiversity.
4	Learn & understand the implementation of Environment Management.
5	Understand and apply the concept of Sustainable Development Goals (SDGs) in addressing environmental and socio-economic issues.
6	To Gain knowledge of environment related legislations.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction and Definition of Environment**: 1.1 Significance of Environment Management for contemporary managers, Environmental issues relevant to India, The Energy scenario **Self-Learning Topic: Content of Environment**	06	**CO1**
02	**Module Title: Global Environmental concerns.**	05	**CO2**

	2.1 Global warming-causes, effect, process, Greenhouse effect , Acid Rain, Ozone Depletion, Hazardous Wastes, Energy resources, Endangered life-species, Loss of Biodiversity . Emerging technologies to address Global warming		
	Self-Learning Topic: Various types of Pollutions.		
03	**Module Title: Biodiversity**:	04	**CO3**
	3.1 Ecosystems and interdependence between living organisms, habitats, limiting factors, Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation , hot-spots of biodiversity , threats to biodiversity		
04	**Module Title: Implementation of Environment Management:**	05	**CO4**
	4.1 Role and functions of Government as a planning and regulating agency, NGO, Corporate Environmental practices, AI driven environmental management.		
05	**Module Title: Sustainability Practices & Management:**	05	**CO5**
	5.1 Sustainable practices, Environmental impact assessment, impact analysis, Environmental life cycle analysis, Environmental risk assessment, ecological Sustainable development, Principles of sustainable development, sustainable development goals, economic development & Environment, green growth, AI and Sustainability practices.		
06	**Module Title: General overview of major legislations:**	03	**CO6**
	6.1 Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act.		
	Self-Learning Topic: Indian Constitution		

Text Books:

1. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
2. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press

References:

1. Indian Standard Environmental Management Systems Requirements with Guidance for Use, Bureau of Indian Standards, February 2005.

Continuous Internal Evaluation (50 Marks)

1. Seminar: 10 Marks
2. Field Visit/ NSS activity as case study: 20 Marks
3. Regularity and attendance: 5 Marks
4. Course project & Report (Group activity) : 15 Marks.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEPCC401	**Mathematics for Electrical Engineering-II(Signal System)**	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	Study the line and contour integrals and expansion of complex valued function in a Power series.
2	Understand the basic techniques of statistics for data analysis, Machine learning and AI
3	Study the probability distributions and expectations.
4	Familiarize with the concept sampling theory with its applications.
5	Z-Transforms and Inverse Z-Transforms with its properties.
6	Acquaint with the concepts of vector spaces used in the field of machine learning and Engineering problems.
Course Outcomes: Learners will be able to	
1	Demonstrate the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2	Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3	Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4	Apply the concept of testing hypothesis of small samples using sampling theory to engineering problems.
5	Apply the concept of Z- transformation and inverse in engineering problems.
6	Apply the concept of vector spaces and orthogonalisation process in Engineering Problems.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Complex Integration** 1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiple connected regions (without proof), Cauchy's Integral formula (without proof). 1.2 Taylor's and Laurent's series (without proof). 1.3 Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof). **Self Learning Topic:** **Application of Residue Theorem to evaluate real integrations,**	07	**CO1**
02	**Statistical Techniques** 2.1 Karl Pearson's Coefficient of correlation (r) 2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) 2.3 Lines of regression. 2.4 Fitting of first and second degree curves. **Self Learning Topic:** **Co-variance, fitting of exponential curve**.	07	**CO2**
03	**Probability Distributions** 3.1 Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function. 3.2 Expectation, mean and variance. 3.3 Probability distribution: Poisson & normal distribution. **Self Learning Topic:** **Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.**	07	**CO3**
04	**Sampling Theory** 4.1 Sampling distribution Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 4.2 Students't-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test) 4.3 Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction. 4.4 Analysis of variance: F-test (significant difference between variances of two samples) **Self-learning Topics: Test of significance of large samples, ANOVA: One way classification, Two-way classification (short-cut method).**	07	**CO4**
05	**Z Transform** 5.1 Definition and Region of Convergence, Transform of Standard Functions: {k na k }, {a|k|},{C ak n k+n},{c k sin(αk +β)},{c k sinh αk},{c k cosh αk}. 5.2 Properties of Z Transform: Change of Scale, Shifting Property,	07	**CO5**

	Multiplication, and Division by k, Convolution theorem. 5.3 Inverse Z transform: Partial Fraction Method, Convolution Method		
	Self-learning Topics: Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion		
06	**Linear Algebra: Vector Spaces**	**07**	**CO6**
	4.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy-Schwarz inequality (with proof), Unit vector. 4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors. 4.3 Vector spaces over real field, subspaces.		
	Self Learning Topic: Linear combinations, linear Dependence and Independence, QR decomposition		

Text Books:

1. "Advanced engineering mathematics", H.K. Das, S. Chand, Publications.
2. "Higher Engineering Mathematics", B. V. Ramana, Tata Mc-Graw Hill Publication
3. "Higher Engineering Mathematics", Dr. B. S. Grewal, Khanna Publication

Reference Books :

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEPCC402	Analog and Digital Integrated circuit	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	Understand Bi-junction transistor various configurations and equivalent circuits and its applications.
2	Understand MOSFET construction, characteristics and equivalent circuit.
3	Understand the concept and design of combinational circuits.
4	Understand the concept and design of a sequential circuit.
Course Outcomes: Learners will be able to	
1	Explain the BJT biasing and equivalent circuit for different configurations of BJT
2	Explain FET and MOSFET construction working principle characteristics and small signal modelling of MOSFET
3	Demonstrate the BJT amplifier and oscillators using feedback circuits
4	Demonstrate various applications of Operational amplifier and 555 Timer
5	Explain and Design combinational logic circuits using gates and multiplexers with the help of K-map
6	Explain and Design sequential logic circuits counters and registers using Flip-Flops

Module	Detailed Contents	Hrs.	CO Mapping
01	**Bipolar Junction Transistor:** 1.1 Biasing Circuits: Types, dc circuit analysis, load line, thermal runaway, stability factor analysis, thermal stabilization and compensation. 1.2 Modeling: Small signal analysis of CE configurations with different biasing networks using h-parameter model. Introduction to re-model and hybrid-	08	CO1

	pi model. Amplification. Derivation of expression for voltage gain, current gain, input impedance and output impedance of CC, CB, CE amplifiers, Study of frequency response of BJT amplifiers. **Self Learning: Symbol, Construction, V-I characteristics and configurations of BJT**		
02	**Field Effect Transistors** 2.1 Types of FET, basics of construction and working principles, MOSFET-Types, construction and their characteristics, MOSFET as switch and MOSFET as an amplifier. 2.2 DC circuit Analysis: types of Biasing circuit of MOSFET, DC load line, region of operation (numerical) 2.3 AC circuit analysis: small signal model of MOSFET CS amplifier, derivation of voltage gain, input impedance of MOSFET CS amplifier (numerical).	**06**	**CO2**
03	**Feedback Amplifier** 3.1 Introduction to positive and negative feedback, negative feedback -current, voltage, Series and Shunt type. It's effect on input impedance, output impedance, voltage gain, current gain and bandwidth 3.2 Cascade amplifiers: Types of coupling, effect of coupling on performance of BJT and JFET amplifiers, cascade connection, Darlington-pair 3.3 Positive feedback oscillators, frequency of oscillation and condition for sustained oscillations of a) RC phase shift, b)Wien bridge, c)Hartley/ Colpitts with derivations, crystal Oscillator, UJT relaxation oscillator	**08**	**CO3**
04	**Operational Amplifiers and Applications** 4.1 Basics of an Op-amp, Op-amp parameters, Frequency response Comparator, Voltage follower, design of inverting and non- inverting amp, adder, subtractor, integrator and differentiator, V to I and I to V converter, precision rectifier, Schmitt trigger, sample and hold circuits, clipping and clamping, active filters: LP, HP and BP, Instrumentation amplifier, Optical isolation amplifier 4.2 IC555: Functional block diagram, Application of IC555 4.3 Design of Multivibrator (Monostable and Astable), Linear Voltage Regulators, IC 78xx, 79xx, LM 317	**06**	**CO4**
05	**Combinational Logic Circuit**	**08**	**CO5**

	5.1 Introduction to Logic gates and Boolean Algebra 5.2 K-Maps and their use in specifying Boolean expressions upto 4 variables, Minterm, Maxterm, SOP and POS implementation Implementing logic function using universal gates, Binary Arithmetic circuits: Adders, Subtractors (Half and Full), BCD adder – Subtractor, Carry look ahead adder, Serial adder, , Designing code converter circuit e.g binary to gray, BCD to Seven segment , Multiplexers, De- multiplexers, logic circuit design using multiplexer.		
06	**Sequential Logic Circuits :** 6.1 Comparison of combinational & sequential circuit 6.2 Flip-flops: SR, T, D, JK, Master Slave JK, Converting one flip-flop to another, Use of debounce switch 6.3 Counters: Modulus of counter, Design of Synchronous, Asynchronous counters, Up/Down Counter, Ring counter, Johnson counter, . 6.4 Shift Registers , serial Parallel, universal. **Self Learning** **Analog-to-Digital converter (ADC) – Characteristics and types of ADC – i) Successive approximation, ii) Flash ADC, iii) Dual slope, Serial ADC Basics of Digital to Analog converter (DAC)**	**06**	**CO6**

Text Books:

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuits”, Prentice-Hall of India
2. Millman Halkias, “Electronic Devices and Circuits” 3 rd Edition, Publisher: McGraw Hill Education, New Delhi.
3. Gayakwad Ramakant A, “Op-amps and Linear Integrated Circuits”, Prentice Hall PTR
4. Jain R.P., “Modern Digitals Electronics”, Tata McGraw Hill, 1984
5. Millman and Halkias, “Integrated Electronics”, Tata McGraw Hill

References:

1. Roger L. Tokheim, “Digital Electronics”, Tata McGraw Hill
2. David Bell,“Electronic Devices and Circuits”,5e Oxford University Press
3. Malvino & Leach, “Digital principal and Application”, Tata McGraw Hill, 1991.
4. Thomas Floyd, “Electronic Devices”, Prentice-Hall of India
5. https://onlinecourses.nptel.ac.in/noc21_ee55/preview
6. https://onlinecourses.nptel.ac.in/noc20_ee32/preview

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEPCC403	**Electromagnetic Field and Waves**	20	20	60	1	1	100	

Course Objectives: The course aims to	
1	Implement the knowledge of mathematics and physics.
2	Visualize Electric field and magnetic field and their application in electrical engineering
3	Visualize magnetic field and their application in electrical engineering
4	To understand the material properties.
5	Analyse time varying electric and magnetic fields
6	Formulate electromagnetic wave equation
Course Outcomes: Learners will be able to	
1	Apply knowledge of mathematics and physics in electrical engineering field.
2	Analyze electrostatic fields
3	Apply and analyse magneto-static fields.
4	Analyze the effect of material medium on electric and magnetic field.
5	Analyze and formulate time varying electric and magnetic field
6	Formulate wave equations for Electromagnetic wave propagation in different media.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Vector Calculus:** 1.1 Introduction to Vectors Calculus 1.2 Different Co-ordinate System, Co-ordinate transformation, line, Surface and Volume Integrals 1.3 Expression for gradient, divergence and curl Numericals. **Self Learning Topic:** Cartesian co-ordinate, scalar and vector	**05**	**CO1**
02	**Static Electric Fields**	**12**	**CO2**

	2.1 Coulomb's Law in Vector Form 2.2 Electric Field Intensity, Definition, Principle of Superposition, Electric Field due to point charges, Electric Field due to line charge , Electric Field due to an infinite uniformly charged sheet, Definition and physical interpretation of gradient 2.3 Electric scalar potential 2.4 Relationship between potential and electric field and its application on Surface voltage gradient on conductor. 2.5 Gauss Law, Stokes theorem. Numericals.		
	Self Learning Topic: **Electric field, superposition theorem, Divergence theorem**		
03	**Static Magnetic Fields** 3.1 The Biot-Savart's Law in vector form, Magnetic Field intensity due to a finite and infinite wire carrying a current I, Magnetic field intensity on the axis of a circular loop carrying a current I 3.2 Ampere's circuital law and its application on A solid cylindrical conductor and Infinitely long coaxial transmission line 3.3 Magnetic flux density, Definition and physical Interpretation of Curl 3.4 The Lorentz force equation for a moving charge and its applications on Force on a wire carrying a current I placed in a magnetic field 3.5 Magnetic Vector Potential Numericals **Self Learning Topic: Magnetic field concept**	**08**	**CO3**
04	**Electric and magnetic field in Materials** 4.1 Poisson's and Laplace's equation ,Electric Polarization, 4.2 Current density, Convection current density, Point form of ohm's law 4.3 Continuity equation for current, Capacitance of two parallel plate, Co-axial and Spherical. Numericals	**06**	**CO4**
05	**Time varying Electric and Magnetic Fields** 5.1 Faraday's law, Maxwell's Second Equation in integral form from Faraday's Law, Equation expressed in point form, Displacement current 5.2 Ampere's circuital law in integral form, Modified form of Ampere's circuital law as Maxwell's first equation in integral form, Equation expressed in point form 5.3 Maxwell's four equations in integral form and differential form. Numerical	**06**	**CO5**
06	**Electromagnetic Field Wave** 6.1 Derivation of Wave Equation, Uniform Plane Waves 6.2 Maxwell's equation in phasor form, Wave equation in phasor form. 6.3 Wave equation for conducting medium, Plane wave in Lossy dielectrics (No numericals)	**05**	**CO6**

Text Books:

1. W. Hayt, "Engineering electromagnetic", McGraw Hill, 4th edition, 1987
2. Edminister, "Schaum‟s series in electromagnetic" McGraw Hill publications, 3rd edition, 1986.
3. M.N.O.Sadiku, "Elements of Engineering Electromagnetics" Oxford University Press, 3rd Ed.

4. David K.Cherp, “Field and Wave Electromagnetics” - Second Edition-Pearson Edition
5. Dr B.R.Gupta, “Power System Analysis and Design” S.Chand First edition, 1998

Reference Books::

1. David K.Cherp: “Field and Wave Electromagnetics - Second Edition-Pearson Edition.
2. Website Reference/ Video Courses:
3. NPTEL Course: **Electromagnetic Fields** By Prof. Harishankar Ramachandran, EE
4. N. Narayan Rao, “Elements of Electromagnetic”, PHI publication, 4th edition, 2001.
5. Edminister J.A, “Electromagnetics” , TATA McGraw Hill.

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs.)		Total Marks	2 Hrs.
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
OE4011	Human Resource Management	20	20	60	1	2	100	

Prerequisite: Knowledge in Bbusiness Fundamentals.	
Course Objectives: The course aims to	
1	Develop an understanding of the fundamental concepts, functions and process of Human Resource Management.
2	Obtain the knowledge related to the nature and scope of organizational behaviour and its relevance in Organizational Management.
3	Understand the importance and process of Human resource planning and its applications.
4	Familiarize with various selection procedures and practices related to recruitment, selection and training.
5	Analyze the role of AI and similar technological trends in HR in the digital world.
Course Outcomes: Learners will be able to	
1	Understand the concepts, functions and process of Human Resource Management.
2	Acquire knowledge related to the nature and scope of organizational behavior.
3	Compare and classify concepts of Human resource planning and its applications.
4	Differentiate between various selection procedures and practices related to recruitment, selection and training.
5	Assess the role of AI and similar technological trends in HR in the digital world.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Human Resource Management (HRM)** 1.1 Introduction and Significance of Human Resource Management, Definition, Scope, Features, Importance and Evolution of the concept of HRM, Functions and Objectives of HRM, Principles of HRM, Limitation of HRM, Role and Quality of Human Resource	04	CO1

	Managers, Need for HRM Approach.		
02	**Organizational Behaviour (OB)** 2.1 Introduction and Origin of Organizational Behaviour, Nature, Scope and its relevance to Organizational Effectiveness, Understanding employee behavior, Meaning and Determinants of Personality, Personality Development, Personality Types and assessment of Personality Traits ,Attitude and Behaviour, Group Behaviour , Team Effectiveness,Motivation andTheories of Motivation ,Leadership. **Self-Learning Topic:** **Case studies on topics related to Group behaviour, Motivational Theories**.	**06**	**CO2**
03	**Human Resource Planning (HRP)** 3.1 Concept and Objective of Human Resource Planning, Importance and Process of Human Resource Planning, Challenges and Factors affecting HRP ,Steps and Effective HRP, Job Analysis, Job Description and Job Specification, Role Analysis. **Self-Learning Topic:** **Study and comparison of various Job Descriptions in an organization.**	**06**	**CO3**
04	**Recruitment ,Selection, Performance Management ,Training and Development** **4.1 Recruitment:** Definition, Recruitment policy, Constraints and Challenges of Recruitment, sources and methods of Recruitment, New Approaches to recruitment. **4.2 Selection:** Selection and its Process, Developing effective selection methods including different types of Tests, Interviews and assessments, Induction and Orientation. **4.3 Performance Management :** Internal Mobility, Compensation Management, Fixing of wages, Legislation and objectives of performance appraisal, Learning performance appraisal methods, Understanding the concepts of feedback and coaching, Wages and Benefits, Labour Laws. **4.4 Training and Development:** Objectives, Need, Importance of Training, Training Vs. Development, Systematic Approach to Training, Training Methods, Career Planning, Career Development. **Self-Learning Topic:** **Recent Trends in Recruitment**	**07**	**CO4**
05	**Emerging Trends in HR** 5.1 The evolving role of HR in a digital world, The rise of Remote/Hybrid work, Employee engagement strategies, I in HR, Data analytics in HRM . **Self-Learning Topic: International HRM**	**05**	**CO5**

Text Books:

1. K. Aswathappa, “Human Resource Management: Text and Cases”, McGraw-Hill Publication.
2. Laurie Mullins, “Management & Organizational Behavior”, Pearson Publication.
3. B.P.Singh, “Human Resource Management: Concepts and Practices”, Excel Books Publication.
4. Deepa Gupta,M.Gupta,Karth Gupta, “HR Analytics:The Future of HR”,PHI Learning

References:

1. Raymond Noe, John Hollenbeck, Barry Gerhart, Patrick Wright, “Fundamentals of Human Resource Management”, McGraw-Hill Publication.

2. Venkata Ratnam C. S. & Srivastava B. K., “Personnel Management and Human Resources”, Tata McGraw Hill, New Delhi.

3. P. C. Tripathi, "Personnel and Human Resource Management”, S. Chand & Sons Publication.

Assessments :

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Case Study : 5 Marks
2. Group Activity / Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
OE 4012	Corporate and Cyber Laws	20	20	60	1	2	100	

Prerequisite: Basic Legal Awareness	
Course Objectives: The course aims to	
1	Provide fundamental knowledge of corporate laws
2	Analyse the legal and regulatory framework governing corporate transactions
3	Explore the fundamentals of cyber law and cybersecurity,
4	Examine emerging trends in corporate and cyber laws
Course Outcomes: Learners will be able to	
1	Understand corporate law fundamentals, business entity structures, and corporate governance.
2	Understand legal provisions of the Companies Act, SEBI regulations, CSR laws, and contract laws.
3	Identify cybercrimes, attack methods, and information security risks.
4	Explain cyber law aspects related to e-commerce, IPR, evidence, and criminal law.
5	Analyse IT Act provisions and cybersecurity compliance standards.
6	Evaluate emerging trends in corporate governance, AI regulation, and digital assets laws.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Corporate Laws** 1.1 Concept, Nature, and Scope of Corporate Laws, Legal Personality of Companies, Types of Business Entities (Private, Public, LLP, Sole Proprietorship), Incorporation and Registration of Companies, Lifting or piercing the corporate Veil, Corporate Governance and Ethics. **Self Learning Topic:** **Comparative Study of Corporate Laws Across Countries**	05	CO1
02	**Regulatory Framework for Companies**	06	CO2

	2.1 Overview of the Companies Act, Key Legal Provisions (Formation, Compliance, Penalties), Shareholder Rights & Director Responsibilities, 2.2 Company Act 2013 (Key Provisions). Securities and Exchange Laws (SEBI regulations). Corporate Social Responsibility (CSR) Regulations, 2.3 Contract Law and Business Transactions, Mergers, Acquisitions, and Competition Law		
03	**Introduction to Cybercrime** 3.1 Definition of Cybercrime and information security, Classifications of cybercrime, Planning of Cyber-attacks, Social Engineering, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Identity Theft. **Self Learning Topic:** **Botnets, DoS and DDoS Attacks, SQL Injection, Buffer Overflow.**	**04**	**CO3**
04	**The Concept of Cyberspace** 4.1 E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, 4.2 The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, 4.3 The Criminal Aspect in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking. **Self Learning Topic:** **Global Trends in Cyber Law**	**05**	**CO4**
05	**Indian IT Act&Information Security Standard compliances** 5.1 Penalties, Adjudication and Appeals Under the IT Act2000, IT Act 2008 and its Amendments. 5.2 Compliance Standards: SOX,HIPAA, ISO,NERC, PCI-DSS, NIST **Self Learning Topic:** **GLBA, FISMA**	**05**	**CO5**
06	**Emerging Trends in Corporate and Cyber Laws** 6.1 Environmental, Social, and Governance Compliance, Digital Corporate Governance, Artificial Intelligence (AI) Regulation, Digital Assets and Cryptocurrency Regulations	**03**	**CO6**

Text Books:

1. "Company Law" by Avtar Singh, Eastern Book Company
2. "Indian Corporate Law" by N.D. Kapoor, Sultan Chand & Sons
3. "Business Law Including Company Law" by S.S. Gulshan and G.K. Kapoor
4. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
5. "Cyber Security & Cyber Laws" by Nilakshi Jain & Ramesh Menon.

References/Online Resources:

1. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
2. Cyber Law Emerging Trends and Challenges, Dr. Aditya Tomer, Dr. Harshita Singh & Ms. Garima Wadhwa, Redshine Publication

3. https://www.geeksforgeeks.org/corporate-law/
4. https://www.geeksforgeeks.org/cyber-laws-in-india/

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)
Mid semester examination will be based on 40 % to 50% of the syllabus.
B. Continuous Internal Evaluation (20 Marks)

4. Assignment: 5 Marks
5. Quiz/Open book test/Presentation: 10 Marks
6. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)
End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration(Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
OE4013	Stock Market & Personal Finance	20	20	60	1	2	100	

Prerequisite: Statistical calculations	
Course Objectives: The course aims to	
1	Explain students with knowledge of Securities Market
2	Impart the students to understand the legal frame work of securities Market
3	Empowers the students to have depth knowledge in different segment of stock exchange
4	Build long term personal finance portfolio
Course Outcomes: Learners will be able to	
1	Understand the basic concept of stock market
2	Exercise the Trading on Stock Market
3	Analyze the fundamental and technical aspect of the stock
4	Understand the legal Frame work of Securities Market
5	Calculate the personal financial needs
6	Determine the personal financial goals

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Stock Market and Trading** 1.1 Overview of Stock Market: History, evolution, and types of stock markets. 1.2 Trading Basics: Understanding buying and selling (Entry and Exit form stock), bulls and bears, and market trends. 1.3. Investment Goals and Risk Management: Setting investment objectives, risk tolerance, and asset allocation. 1.4. Stock Market Indices and Sectors: Understanding major stock market indices (e.g., Sensex, Nifty 50, S&P 500, Dow Jones) and sectors (e.g., technology, finance). **Self Learning Topic: Stock brokers in India, fees and charges levied on trader**	04	CO1

02	**Financial Markets and Instruments** 2.1 Types of Financial Markets: Money market, bond market, commodity market, and foreign exchange market. 2.2. Stock Market Instruments: Stocks, bonds, ETFs, mutual funds, and derivatives (options, futures). 2.3 Market Participants: Understanding the roles of investors, traders, brokers, and market makers. 2.4 Trading psychology- A practical approach **Self Learning Topic: Difference between Investor and trader, Difference between Investment and Saving**	**4**	**CO2**
03	**Stock Analysis and Selection** 3.1 Introduction to Technical Analysis: Understanding charts, trends, and patterns. 3.2 Chart Types and Patterns: Line charts, bar charts, candlestick charts, and common patterns (e.g., head and shoulders, triangles). 3.3 Trend Analysis and Indicators: Moving averages, relative strength index (RSI), and other technical indicators. 3.4 Charting Tools and Software: Overview of popular charting platforms (e.g., TradingView, MetaTrader). 3.5 Fundamental Analysis- SMA, EMA, MACD, Bollinger bands, 3.6 Stock analysis through Ratios – P/E ratio, P/B ratio, ROE, EPS, Debt-to-capital ratio, Interest coverage ratio (ICR), Enterprise value to EBIT, Operating margin, Quick ratio **Self Learning Topic: Find the long term stocks, short term stocks in current scenario of market and Explain Why to invest in these stocks.**	**06**	**CO3**
04	**Stock Market regulations** 4.1 SEBI Acts - Securities Contracts (Regulation) Act, 1956, Securities and Exchange Board of India Act, 1992, Depositories Act 1996, Securities Laws (Amendment) Act, The Finance Act. 4.2 Role of SEBI, Stock exchanges, Stock brokers and Investors 4.3Stock market Surveillance – ASM, GSM, ESM, T2T 4.4Investor protection, Investor education, Investor awareness	**04**	**CO4**
	Self Learning Topic: Case study of Stock Market Frauds		
05	**Introduction to Personal Finance** 5.1 Need for Personal Finance Management 5.2 Income tax planning 5.3 Assessment of personal risk profile 5.4 Understanding the Salary slips 5.5 Insurance (Need of Insurance, Separating investment from insurance Life Insurance, Term Insurance, Mediclaim, Property) **Self Learning Topic: Learn and Understand the Union Budget, Global Budget**	**05**	**CO5**

06	**Financial Planning for Engineers** 6.1 Time value of money, Return on Investment, Modes of personal Investment and savings (Gold, bonds, Fixed Deposits, Mutual Funds, Crypto currency, Real estate etc. 6.2 Portfolio building (Personal portfolio components, Self-analysis, Govt and Private Agencies) 6.3Money management (Engineering Students loan, home loan, credit card, Cash) 6.4 Handling the finance in uncertainty and risk – Pandemic, personal, social, professional life **Self Learning Topic: Build your dream portfolio, make your own balance sheet as an engineering student**	**05**	**CO6**

References

1. **How the stock market works, M Becket, Kogan Page, 3rd Edition, 2010 (https://procapital.mohdfaiz.com/books/books-image/mainBook/245114947.pdf)**
2. **The Intelligent Investor, Benjamin Graham, Perfect Bound, eISBN 0-06-058328-2, June 2003 (https://sims.sairam.edu.in/wp-content/uploads/sites/7/2024/03/THE-INTELLIGENT-INVESTOR.pdf)**
3. **How to Make Money in Stocks, William J. O'Neil, 4th edition, 2009(https://tradingpsychologist.in/wp-content/uploads/2023/09/How-to-Make-Money-In-Stocks.pdf)**
4. **Hand Book For Investing & Investor Protection, Dr. Naresh Maheshwari, ICWA New Delhi, January 2011, https://www.farsightshares.com/wp-content/uploads/2019/05/hand_book.pdf**

Web Material

Module	Text Books	References/links
1	**Introduction to Stock Markets, Zerodha**	**https://zerodha.com/varsity/modules/**
2	Technical Analysis**, Fundamental Analysis, Zerodha**	**https://zerodha.com/varsity/module/technical-analysis/**
3	**NCFM Technical Analysis Module, NSE limited**	**https://zerodha.com/z-connect/wp-content/uploads/2014/06/TA_wrkbk.pdf**
4	**Hand Book For Investing & Investor Protection, Dr. Naresh Maheshwari, ICWA New Delhi, January 2011**	https://www.farsightshares.com/wp-content/uploads/2019/05/hand_book.pdf
5	**Financial Education Booklet, SEBI, November 2020**	**https://investor.sebi.gov.in/pdf/downloadable-documents/Financial%20Education%20Booklet%20-%20English.pdf**
6	**Personal Financial Planning, IDOL, University of Mumbai, May 2023**	**https://mu.ac.in/wp-content/uploads/2023/05/M.Com-Sem-IV-Personal-Financial-Planning.pdf**

NPTEL and Swayam Links

1. **Financial Markets, Institutions and Financial ServicesBy Prof. Divya Verma | Guru Gobind Singh Indraprastha University, Delhihttps://onlinecourses.swayam2.ac.in/cec25_mg11/preview**
2. **Financial Institutions and Markets, Dr. Jitendra Mahakud, IIT Kharagpurhttps://archive.nptel.ac.in/courses/110/105/110105121/**

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)
Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

7. Assignment/Paper trading/Dummy trading: 5 Marks
8. Quiz/Open book test/Presentation/Trading Demonstration: 10 Marks
9. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)
End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration(Hrs)		Total Marks	2 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
OE4014	Nutrition Literacy and Health	20	20	60	1	2	100	

Course Objectives: The course aims to	
1	Understand the fundamentals of nutrition and its role in human health.
2	Learn about energy balance and the principles of diet planning.
3	Analyze the impact of nutrition on lifestyle diseases and their prevention.
4	Gain knowledge about food safety, preservation techniques, and quality control.
5	Explore sustainable nutrition practices and advancements in food technology.
6	Understand dietary recommendations for special conditions and future trends in nutrition.
Course Outcomes: Learners will be able to	
1	Understand the fundamental concepts of nutrition, including macronutrients, micronutrients, and their roles in maintaining health.
2	Analyze energy balance, metabolism, and the principles of diet planning for different age groups and lifestyles.
3	Identify the impact of nutrition on common lifestyle diseases and understand preventive measures through diet and lifestyle modifications.
4	Evaluate food safety standards, food labeling, and regulations to promote healthy food choices.
5	Assess the significance of nutritional requirements during different life stages.
6	Apply nutrition literacy principles to enhance personal well-being and spread awareness about balanced diets and healthy eating habits.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Fundamentals of Nutrition** 1.1 Introduction to Nutrition: Definition, Importance, and Scope 1.2 Food Groups and Their Nutritional Value 1.3 Essential Nutrients: Macronutrients and Micronutrients 1.4 Water and Dietary Fiber 1.5 Nutritional Deficiencies: Causes, Symptoms, and Prevention	5	CO1
02	**Energy Balance and Diet Planning**	5	CO2

	2.1 Energy Metabolism: Basal Metabolic Rate (BMR) and Total Energy Expenditure (TEE) 2.2 Principles of a Balanced Diet 2.3 Dietary Guidelines and Food Pyramid 2.4 Meal Planning for Different Age Groups 2.5 Special Dietary Considerations: Pregnancy, Lactation, and Vegetarianism		
03	**Nutrition and Lifestyle Diseases** 3.1 Role of Nutrition in Preventing Lifestyle Diseases 3.2 Obesity, Diabetes, and Cardiovascular Diseases 3.3 Hypertension and Osteoporosis 3.4 Nutritional Management and Intervention Strategies	**4**	**CO3**
04	**Food Safety and Quality** 4.1 Food Contamination and Food borne Diseases 4.2 Food Preservation Techniques 4.3 Food Adulteration and its Detection 4.4 Food Safety Standards and Regulations	**4**	**CO4**
05	**Sustainable Nutrition and Food Technology** 5.1 Sustainable Food Production and Consumption 5.2 Genetically Modified Foods and Their Impact 5.3 Functional Foods and Nutraceuticals 5.4 Role of Technology in Food Science	**5**	**CO5**
06	**Special Diets and Future Trends** 6.1 Diets for Specific Health Conditions 6.2 Personalized Nutrition and Nutrigenomics 6.3 Emerging Trends in Nutrition and Health 6.4 Future Challenges in Nutrition Science	**5**	**CO6**

Text Books:

6. **Srilakshmi, B.** – *Dietetics*, New Age International Publishers, 8th Edition, 2019.
7. **Srilakshmi, B.** – *Nutrition Science*, New Age International Publishers, 6th Edition, 2021.
8. **Swaminathan, M.** – *Essentials of Food and Nutrition*, Vol. I & II, The Bangalore Printing and Publishing Co. Ltd., 2nd Edition, 2012.
9. **Rao, U.** – *Advanced Human Nutrition*, CBS Publishers & Distributors, 1st Edition, 2014.

References:

5. **Wardlaw, G. M., Smith, A. M.** – *Contemporary Nutrition*, McGraw-Hill Education, 11th Edition, 2018.
6. **Gibney, M.J., Lanham-New, S.A., Cassidy, A., Vorster, H.H.** – *Introduction to Human Nutrition*, Wiley-Blackwell, 2nd Edition, 2013.
7. **Whitney, E., Rolfes, S.R.** – *Understanding Nutrition*, Cengage Learning, 15th Edition, 2018.
8. **Bamji, M. S., Krishnaswamy, K., Brahmam, G.N.V.** – *Textbook of Human Nutrition*, Oxford & IBH Publishing, 4th Edition, 2019.

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

10. Assignment: 5 Marks
11. Quiz/Open book test/Presentation: 10 Marks
12. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
EEMC401	Digital Business Management	--	50	--	--	--	50	

Prerequisite: Entrepreneurship and finance management	
Course Objectives: The course aims to	
1	Familiarize with digital business concept along with drivers
2	Acquaint with E-commerce
3	Understand and various approaches and techniques for E-business and management
4	Give insights into E-business and its strategies
Course Outcomes: Learners will be able to	
1	Understand the fundamental concepts and drivers of digital business management.
2	Analyze impact of e-commerce on business model
3	Develop insights into building digital business application & infrastructure.
4	Acquire knowledge management skills for E-business operations.
5	Understand different E-business strategies
6	Prepare business plan and analyze case study.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Introduction to Digital Business:** 1.1 Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **1.2 Drivers of digital business-** Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business.	**08**	**CO1**
02	**Overview of E-Commerce:** 2.1 E-Commerce- Meaning, Retailing in e-commerce-products and	**05**	**CO2**

	services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public 2.2 B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals. 2.3 Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing.		
	Self Learning Topic: **OLA , UBER Application**		
03	**Digital Business Support services:**	**05**	**CO3**
	3.1 ERP as e –business backbone, knowledge Tope Apps, Information and referral system **3.2 Application Development:** Building Digital business Applications and Infrastructure.		
	Self Learning Topic: **ERP for some application**		
04	**Managing E-Business:**	**03**	**CO4**
	4.1 Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security 4.2 Threats to e-business -Security Overview, Electronic Commerce Threats.		
05	**E-Business Strategy:**	**04**	**CO5**
	5.1 E-business Strategic formulation- Analysis of Company‘s Internal and external environment, Selection of strategy, 5.2 E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)		
06	**Materializing e-business:**	**03**	**CO6**
	From Idea to Realization-Business plan preparation		
	Self Learning Topic: Case Study		

Text Books:

1. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
2. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
3. Electronic Commerce- A Managerial and Social Networks Perspective ,Eighth Edition, Efraim Turban ,David King ,Jae KyuLee,Ting-Peng Liang ,Deborrah C. Turban, Springer
4. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
7. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

References:

1. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002

2. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
3. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
4. https://onlinecourses.nptel.ac.in/noc19_mg54/preview
5. https://nptel.ac.in/courses/110105083
6. https://onlinecourses.swayam2.ac.in/imb25_mg31/preview

Internal Assessment (50 Marks)

A. **Continuous Internal Evaluation (50 Marks)**
   1. Assignment: 15 Marks
   2. Quiz/Open book test: 10 Marks
   3. Case study/Presentation: 20
   4. Regularity and attendance: 5 Marks

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration(Hrs)		Total Marks	2*+ 2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					2
VEC401	Business Communication Skills	-	25	-	-	-	25	

Prerequisite: Learners should have completed FE Semester I Professional Communication and Ethics course.	
Course Objectives: The course aims to enable learners to	
1	Draft effective Business and Technical Reports and Proposals
2	Learn impactful oral and visual aids to make effective presentations
3	Strategize and document business meetings
4	Lead people and successful projects using interpersonal skills
5	Apply Skills necessary for employment purposes and emerge successful
Course Outcomes: Learners will be able to	
1	Prepare well drafted documents like Business and Technical Reports and Proposals
2	Develop impactful presentations using oral and visual aids
3	Plan and prepare strategies for business meetings and document it
4	Manage and lead people and successful projects using interpersonal skills
5	Acquire skills for employment purposes to successfully navigate industry and career challenges

Module	Detailed Contents	Hrs.	CO Mapping
01	**Business and Technical Writing Skills** 1.1 Project based learning :Project Report Preparation 1.2 Purpose and classification of reports 1.3 Types of Reports 1.4 Parts and Formats 1.5 Preparation of a Report (Group work): Front Matter, 1.6 Main matter, Back matter/Appended Pages etc. 1.7 Business Proposal **Self Learning Topic:** **Business Vocabulary and Writing strategies, APA, MLA, IEEE style, Plagiarism checker tools**	8	CO1

02	**Business Presentation Skills** 2.1 Four *P*'s of Presentation (*Plan, Prepare, Practice, Perform*) 2.2 Making Effective Slides 2.3 Types of Presentation Aids 2.4 Closing a Presentation and Handling Questions 2.5 Group Presentation based on project Report **Self Learning Topic:** **Design softwares and Apps (e.g. Canva) Social Media Presentation**	4	CO2
03	**Business Meetings and Documentation** 3.1 Effective Meeting Strategies and Skills Documentation of a Meeting Notice Agenda, and Minutes of a Meeting **Self Learning Topic:** 3.1 Meeting Roles and Responsibilities (Chairperson, Secretary, Analyst etc.)	4	CO3
04	**Interpersonal Skills** 4.1 Emotional Intelligence Time Management 4.2 Assertiveness and Self confidence Team building Leadership Conflict Resolution and Negotiation **Self Learning Topics: Oral speaking skills, Listening skills, Dressing etiquette**	6	CO4
05	**Employment Skills** 5.1 Structured and Unstructured Group Discussions 5.2 Types of Group Discussions (Factual, Abstract, Strategic, Case Study, Picture based) 5.3 Resume Writing: How to build your Resume 5.4 Interview skills: 5.5 Formats (Structured, Behavioural, Situational, Stress, Case interviews etc.) 5.6 Types of Questions (Open ended, Closed, Hypothetical, Leading, Loaded etc.) 5.7 Strategies for successful interviews, Interview File,Mock Interviews **Self Learning Topic:** **Statement of Purpose (SOP), Vocabulary building, Sentence construction and Grammar rectifications.**	6	CO5

Text Books:

1. Meenakshi Raman, Sangeeta Sharma, Technical Communication, Principles and Practice (2004), Oxford Press.
2. Bovee C.L. & Thill J.V. , Business Communication Today (2021), NJ: Pearson

3. Butterfield J., Verbal Communication: Soft Skills for a Digital Workplace (2017), Boston MA Cengage Learning.

References:

1. BCOLA-138 Business Communication - Course https://onlinecourses.swayam2.ac.in/nou25_cm09/preview
2. Business Communication Essentials - Course https://onlinecourses.swayam2.ac.in/imb25_mg05/preview
3. Softskills for Business - Course https://onlinecourses.swayam2.ac.in/imb25_mg87/preview

Suggested List of Assignments

Sr. No.	List of Experiments	CO Mapping
01	Synopsis of Report	CO 1
02	Print out of PPT slides	CO 2
03	Notice, Agenda and Minutes of Meeting	CO 3
04	Activity sheets of Interpersonal skills	CO 4
05	Employment skills record (Resume and Group Discussion)	CO 5

Continuous Internal Evaluation (25 Marks)

1. **Assignment/ Role play/ Activity: 10 Marks**
2. **Project Book Report: 05 Marks**
3. **Project Presentation: 05 Marks**
4. **Regularity and attendance: 5 Marks**

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hours
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
EEPCL402	Analog and Digital integrated circuit Lab	-	25	25	-	-	50	

Course Objectives: The course aims to	
1	Understand the basic concept of various electronic devices, circuits and their application.
2	Develop ability among students to design and implement electronic circuits.
3	Introduce the basic building blocks, theory and applications of linear integrated circuits.
4	Develop ability among students for problem formulation, system design and solving skills
Course Outcomes: Learners will be able to	
1	Plot frequency response of BJT and JFET amplifier.
2	Analyze effect of feedback on the performance of amplifier.
3	Analyze the performance of different type of oscillators, Timer and regulator IC
4	Demonstrate various linear and non-linear application of Operational amplifiers.
5	Build, design and analyze combinational circuits.
6	Build, design and analyze sequential circuits.

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	BJT biasing network stability analysis	CO1
2	Frequency response of BJT CE amplifier	CO1
3	Study of MOSFET characteristics and calculation of parameters	CO2
4	Study of a RC phase shift oscillator	CO3
5	Study of a Wien Bridge oscillator	CO3
6	Linear applications of op-amp	CO4
	Nonlinear applications of op-amp	CO4

7	Implementing a Binary to Gray, gray to binary or Binary to XS3 code converter using gate ICs.	CO5
8	Constructing flip-flops like SR, D, JK and T using all NAND gates	CO5
9	Design of a ripple counter	CO6
10	Design two-bit comparator using gate ICs	CO5
11	Full Adder using Gates and using Decoder or a Multiplexer.	CO5
12	Using a shift register as a sequence generator.	CO6
13	ADC & DAC	CO6
14	Gain calculation of Two stage CE amplifier	CO1
15	SOP and POS implementation using universal gates	CO5
16	555 timer	CO3
17	Regulator IC	CO3

Continuous Internal Evaluation (25 Marks): Minimum 10 experiments are compulsory for the term work.

1. Lab Performance: 10 Marks
2. Mid Semester Oral & Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Oral & Practical Exam (25 Marks)

An Oral & Practical exam will be held based on entire syllabus of ADIC theory.

Department of Electrical Engineering

Second Year Engineering Curriculum: Semester IV

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
EECEP401	**Mini Project I**	-	25	25 Oral	-	-	50	

Course Objectives: The course aims	
1	To understand the process of identifying needs and transforming them into well-defined problems.
2	To gain experience in collaborative problem-solving within a group setting.
3	To develop the ability to apply fundamental engineering principles to propose effective solutions.
4	To inculcate the process of self-learning and research.
Course Outcomes: Learners will be able to	
1	Identify and define engineering or research problems addressing societal and technological needs.
2	Apply theoretical knowledge and practical skills to design, implement, and analyze solutions through experimentation or simulation.
3	Collaborate effectively in teams, demonstrating leadership, interpersonal, and communication skills.
4	Evaluate results and proposed solutions considering societal, ethical, and environmental implications for sustainable development.
5	Adhere to standard engineering norms and professional practices while managing project activities.
6	Engage in self-directed and lifelong learning, applying project management principles to continuous improvement and innovation.

General Guidelines for Mini Project

Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.

- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress,

guide/supervisor can verify and record notes/comments.
Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on
self-learning.
Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
Students shall convert the best solution into working model using various components of their domain
areas and demonstrate.
The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project I adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project I with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Mini Project I –General Guidelines for Execution.

Design and Fabrication

a. Initial fabrication of the project by students can be done using standard devices/material/software tools to verify the circuit functionalities Initial project fabrication and testing is expected to be done by soldering/assembling on general purpose PCB/ Bakelite boards or suitable platforms required for the electrical/electronic/digital components. Avoid the use of breadboards.
b. If essential, use of a simulation/ emulation software tools to test and verify the performance of the
circuit should be encouraged.
c. Students should prepare the proper drawings (electrical/ mechanical), schematics/ layouts of the project.
d. For final implementation of the circuit, preparation of PCB (if any required) using suitable CAD tools
and fabricating the same in the lab is expected.

Devices/ Components/ Systems to be Used:

Students are encouraged to use passive components like resistors, capacitors, inductors etc. If any specialize inductor is not readily available, the fabrication of the same in the lab should be encouraged.
Other components like: Transistors, diodes, voltage regulators, logic gates, Op-amps, general purpose
microcontroller, DC motors/ AC motors, sensors, actuators, relays etc. (Students may add more components as per the requirement of project).

Testing and analysis of the Project

Students should test the circuit using suitable laboratory equipments like power supply, multi-meter, CRO, DSO etc. In case of any debugging requirement, students should record the problems faced during the testing and solutions sought after for the fault in the circuit.
All the testing results must be well documented in the final project report verifying the functionalities

of the propose project.

Use of Reference Material/Literature :

Students are advised to refer Application Notes, research publications & data sheets of various electrical/electronic/digital devices from Texas Instruments, Microchips, International Rectifiers, ST Microelectronics, Philips, NXP and many other manufacturers.

Self-learning and Skill Set Development

Students should be encouraged to develop/ improve their understanding and skill sets by attending various
online/offline expert lectures / video lectures/ courses/ webinars/ workshops etc. to facilitate the smooth
execution of mini project

1. Understanding passive components viz. resistors, capacitors and inductors from practical point of view:
types/ varieties, device packages, applications and cost.
2. Understanding semiconductor components viz. diodes, BJT and JFET/MOSFETs from practical point
of view: types/ varieties, device packages, applications and cost.
3. Design principles of simple electrical / electronic circuits with some examples.
4. Selection of switches and circuit protection components.
5. Selection and sizing of wires and conductors.
6. Soldering Practice.
7. Heat-sinking and Enclosure design concepts
8. Overall workmanship while working on the project fabrication.
9. Use of different software tools for design and development of circuits
10. Use of standard as well as advanced laboratory equipment's needed for testing of such projects

Suggested Application Domains for Mini Projects:

List of key application domains from where students are encouraged to derive Mini Projects topics:

1. Home/Office automation
2. Renewable Energy
3. Energy Conservation
4. Energy Storage
5. Battery Charging and Protection
6. Fire Safety
7. Electrical System Protection
8. Lighting Control
9. Wireless Power Transfer
10. Electrical Components Testing
11. Electrical Parameters Measurement
12. Non-conventional Electricity Generation
13. Laboratory Equipment's
14. E-Mobility
15. Video Surveillance Systems

16. Robotics for Hazardous applications
17. Waste Management System 2.
18. Smart City Solutions
19. Smart Classrooms and learning Solutions
20. Smart Agriculture solutions etc.
21. Health/ Biomedical

Students can identify the mini project topics either from above suggested domains or any other relevant
engineering domains.

Reference Books:

1. P. Horowitz and W. Hill, “The Art of Electronics”, 3 rd Edition, Cambridge University Press, 2015

2. R. S. Khandpur, “Printed Circuit Board”, McGraw-Hill Education; 1st edition, 2005.

3. Simon Monk, “Hacking Electronic: Learning Arduino and Raspberry Pi”, McGraw-Hill

Education TAB; 2 edition (September 28, 2017).

Suggested Software Tools:

1. LTspice:https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#

2. Eagle : https://www.autodesk.in/products/eagle/overview

3. OrCAD: https://www.orcad.com/

4. Multisim : https://www.multisim.com/

5. Webbench:http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html

6. Tinkercad : https://www.tinkercad.com/

7. Raspbian OS: https://www.raspberrypi.org/downloads

8. Arduino IDE: https://www.arduino.cc/en/main/software

Online Repository:

1. https://www.electronicsforu.com

2. https://circuitdigest.com

3. https://www.electronicshub.org

4. Github

Continuous Internal Evaluation (25 Marks)

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Distribution of marks for **Continuous Internal Evaluation (25 Marks)** shall be as below;

- Marks awarded by guide/supervisor based on log book and performance: 10
- Marks awarded by review committee: 10
- Quality of Project report: 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

Half-year Mini Project:

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment; First shall be for finalization of problem and proposed solution. Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

Quality of survey/ need identification

Clarity of Problem definition based on need.

Inattentiveness in solutions

Feasibility of proposed problem solutions and selection of best solution

Cost effectiveness

Societal impact

Inattentiveness

Cost effectiveness and Societal impact

Full functioning of working model as per stated requirements

Effective use of skill sets

Effective use of standard engineering norms

Contribution of an individual's as member or leader

Clarity in written and oral communication

In case of half year project all criteria in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Oral Examination:

Report should be prepared as per the guidelines issued by the University of Mumbai and the guide.

Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.

Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Oral & Practical Exam (25 Marks)

Mini Project can be assessed based on following points through **Oral examination**

1. Quality of problem and Clarity
2. Inattentiveness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets and development
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication
9. Learning outcomes

A set of rubrics should be designed for evaluation.

Multidisciplinary Minor (MDM) (14 Credits)

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
CEMDM401	Data Structure and Algorithm	20	20	60	1	2	100	

Prerequisite: Concepts in C Programming and Python	
Course Objectives: The course aims to	
1	Introduce the fundamental knowledge & need of Data Structures and abstract the concept of Algorithm for problem solving.
2	Implement fundamental knowledge and applications of Stack, Queue, Linked List, Trees, Graphs etc.
3	Understand the working of different Sorting, Searching & Hashing techniques.
4	Understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
Course Outcomes: Learners will be able to	
1	Classify and apply linear and non-linear data structure concepts and compare functions using asymptotic analysis to describe the relative merits.
2	Apply various operations on Stack and Queue.
3	Develop the ability to demonstrate the operations of Linked list.
4	Demonstrate and apply Trees & Graph data structures.
5	Analyse various Sorting and Searching Algorithms and their performance characteristics.
6	Describe the hash function and concepts of collision and its resolution methods

Module	Detailed Contents	Hrs.	CO Mapping
	Prerequisite: Control Structures, Arrays, Recursion, Pointers, Structures, Memory Allocation Techniques, Self-referential structures.		
01	**Introduction** Introduction to Data Structures, Concept of ADT, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures. Algorithm: Performance characteristics of algorithm, Importance of Algorithm Analysis, Complexity of an Algorithm, Introduction to Asymptotic Analysis and Notations.	8	CO1
02	**Stack & Queue**	8	CO2

	Introduction to Stack, ADT of Stack, Operations on Stack, Array Implementation of Stack. Applications of Stack- Infix Expression to Postfix Expression Conversion, Infix Expression to Prefix Expression Conversion, Postfix Expression Evaluation. Introduction to Queue, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queues, Applications of various types of Queues. **Self-Learning Topic:** Well form-ness of Parenthesis using Stack		
03	**Linked List** Introduction, Representation of Linked List, Types of Linked List - Singly Linked List, Doubly Linked List. Operations on Singly Linked List and Doubly Linked List. Linked representation of Stacks, and Linked representation of Queues. Application of Linked List-Polynomial Representation and Addition. **Self-Learning Topic:** Linked List v/s Array.	**8**	**CO3**
04	**Trees & Graph** Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, AVL tree. Applications of Binary Tree- Expression Tree, Huffman Encoding. Graph: Introduction, Graph Terminology, Memory Representation of Graph, Operations Performed on Graph. Graph Traversal, Breadth First Search, Depth First Search, Applications of the Graph, Shortest Path, Minimum Spanning Tree.	**9**	**CO4**
05	**Searching & Sorting** Searching: Sequential Search, Index Sequential Search, Binary Search Sorting: Bubble Sort, Quick Sort, Merge Sort, Selection Sort, Insertion Sort	**5**	**CO5**
06	**Hashing** Hashing-Concept, Hash Functions, Common hashing functions Collision resolution Techniques.	**4**	**CO6**

Text Books:

1. Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and its Applications”, McGraw-Hill Higher Education.
2. “Fundamentals of Computer Algorithms” Ellis Horowitz, Sartaj Sahani and Sanguthevar Rajasekaran, Second Edition, Universities Press (India) Pvt. Ltd.
3. “Learning with Python”, Allen Downey, Jeffrey Elkner, Chris Meyers, Dreamtech Press.

References:

1. Jean Paul Tremblay, Paul G. Sorenson; An introduction to data structures with applications; Tata McGraw-Hill; 1984
2. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw-Hill Edition.
3. Narasimha Karumanchi, Data Structures and Algorithms, 5th Edition, CareerMonk, 2016.

4. https://nptel.ac.in/courses/106/102/106102064/

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
CEMDML401	Data Structure and Algorithm Lab	-	25	-	-	-	25	

Prerequisite:	
Course Objectives: The course aims to	
1	Introduce the essential concepts and requirements of data structures.
2	Apply fundamental knowledge and applications of Stack, Queue, Linked List, Trees, Graphs etc.
3	Understand the working of different Sorting, Searching & Hashing techniques.
4	Understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.
Course Outcomes: Learners will be able to	
1	Classify and apply linear and nonlinear data structure concepts, as well as perform operations including insertion, deletion, and traversal.
2	Apply various operations on Stack and Queue.
3	Develop the ability to demonstrate the operation of Linked list.
4	Demonstrate and apply Trees & Graph data structures.
5	Analyse various Sorting and Searching Algorithms and their performance characteristics.
6	Describe the hash function and concepts of collision and its resolution methods

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	Implementation of Insertion and deletion in a specific position in an Array using Function.	CO1
02	Array Implementation of Stack.	CO2
03	Array Implementation of Linear Queue.	CO2
04	Array Implementation of Circular Queue.	CO2
05	Implement Singly Linked List.	CO3
06	Implementation of Queue using Linked List.	CO3
07	Implementation of Stack using Linked list.	CO3
08	Implementation of Binary Search Tree and its traversal methods.	CO4
09	Program to count Number of leaf nodes, find the biggest and smallest and height of the tree.	CO4

10	Implementation of binary search and selection search algorithm.	CO5
11	Implementation of selection sort and insertion sort algorithm.	CO5
12	Study of hash function for immutable and mutable objects.	CO6
13	Program to illustrate how to hash a file	CO6

Continuous Internal Evaluation (25 Marks)

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
ETMDMC401	Microprocessor and Microcontroller	20	20	60	1	2	100	

Prerequisite: Basic Electronics, Number Systems, Computer Organization and Architecture	
Course Objectives: The course aims to	
1	Understand the architecture, operation, and memory organization of Intel 8086 microprocessor and 8051 microcontroller.
2	Prepare students for advanced processor architectures.
3	Explore instruction sets, addressing modes, and assembly language programming for Intel 8086 microprocessor and 8051 microcontroller to develop basic programs.
4	Analyze peripheral interfacing techniques with microcontrollers.
5	Apply microcontroller concepts in industrial process control.
Course Outcomes: Learners will be able to	
1	Describe the architecture, operation, and interrupt handling of the Intel 8086 microprocessor
2	Utilize Intel 8086 instruction sets, addressing modes, and assembly language programming to develop basic programs.
3	Demonstrate the architecture and architectural features of Intel 80386DX and Pentium processor
4	Illustrate the architecture and memory organization of the Intel 8051 microcontroller.
5	Apply instruction sets, addressing modes, and assembly language programming of the Intel 8051 microcontroller to develop basic programs.
6	Implement peripheral interfacing techniques and process control using the Intel 8051 microcontroller

Module	Detailed Contents	Hrs.	CO Mapping
01	**Intel 8086 Microprocessor Architecture** Intel 8086 Microprocessor features, Pipelined architecture and operation Intel 8086 Programmer's model, Memory banking Segmentation - Logical address, Offset and Physical address Multiplexed buses in 8086 processor and the demultiplexing	07	**CO1**

	Intel 8284 Clock generator- Power-on-reset and CK generation Minimum and Maximum mode configurations, Minimum mode timing diagram Interrupt mechanism and Interrupt processing in Intel 8086 processor		
	Self-learning topic: Intel 8288 Bus Controller		
02	**Intel 8086 Instruction Set and Programming**	07	**CO2**
	Major Instruction groups in Intel 8086 Microprocessor Data Transfer instructions, String instructions with repeat prefixes Arithmetic instructions, Rotate and Shift instructions Classification and concepts of branch instructions Addressing modes of Intel 8086 Microprocessor Simple programs based on the assembly language of Intel 8086 Microprocessor		
	Self-learning topic: Assembler directives		
03	**Introduction to Intel 80386DX and Pentium Processor**	07	**CO3**
	Intel 80386DX Microprocessor- 32 bit Microprocessor architecture block diagram Registers of 80386DX processor- Data, Pointer, Index, Eflag and Control registers Operating modes- Real, Protected and V-86 modes Protected mode address translation mechanism Pentium processor – Features, Block diagram of pentium and it's Superscalar operation Integer and Floating point pipeline stages of Pentium L1 Data and Code Cache designs of Pentium Processor		
	Self-learning topic: Branch prediction, Pentium versions, Pentium-4's Net-Burst Architecture		
04	**Intel 8051 Microcontroller Architecture**	06	**CO4**
	Block diagram of Intel 8051 Microcontroller Details of the general registers and SFR's Internal RAM and ROM organization I/O port functionality, Counters and timers, Serial ports Interrupt mechanism of 8051 controller and Interrupt priorities Interfacing external memory to 8051 microcontroller		
05	**Intel 8051 Instruction Set and Programming**	07	

	Major Instruction groups in Intel 8051 Microcontroller Data Transfer instructions, Logical and bit level instructions Arithmetic instructions Branching instructions – JUMP and CALL instructions Addressing modes of Intel 8051 Microcontroller Simple programs based on the assembly language of Intel 8051 Microcontroller		**CO5**
06	**Interfacing I/O devices to Intel 8051 Microcontroller** Concept of matrix keyboard interfacing Interfacing of 7-segment display, LCD display interfacing Stepper motor interfacing, Printer interfacing Interfacing High power devices through an Optoisolator, relays Concept of A/D and D/A converter interfacing Case study of Industrial Process Control system like liquid level control, temperature level control etc.	08	**CO6**

Text Books:

1. John Uffenbeck: The 80X86 Family Design Programming and Interfacing, 2nd Edition, Pearson Education
2. Barry B. Brey: Intel Microprocessors, 2nd Edition, Prentice Hall Publication
3. Mazidi, Mazidi & McKinlay: The 8051 Microcontroller and Embedded Systems, 2nd Edition, Pearson Education
4. Raj Kamal: Microcontrollers Architecture, Programming, Interfacing and System Design, Pearson Education

References:

1. Douglas Hall: Microprocessors and Interfacing, McGraw Hill Publication
2. Kenneth Ayala: The 8051 Microcontroller, 3rd Edition, Thomson Learning
3. https://archive.nptel.ac.in/courses/108/103/108103157/
4. https://archive.nptel.ac.in/courses/108/105/108105102/

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
ETMDML401	Microprocessor and Microcontroller Lab	-	25	-	-	-	25	

Prerequisite: Basic Electronics Concepts	
Course Objectives: The course aims to	
1	Implement assembly language programs for Intel 8086 and 8051 microcontroller to perform various operations.
2	Interface general purpose peripheral devices with the Intel 8051 microcontroller for real-time applications.
Lab Outcomes: Learners will be able to	
1	Develop simple programs based on the assembly language of Intel 8086 Microprocessor using various instructions and addressing modes.
2	Write appropriate instructions for simple programs based on 8051 microcontroller
3	Interfacing of peripherals for 8051 microcontroller

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	Simple assembly language program for addition, subtraction and multiplication for 8086 processor.	CO1
02	Simple assembly language program for packed BCD arithmetic operations for 8086 processor.	CO1
03	Simple assembly language program for unpacked BCD arithmetic operations for 8086 processor.	CO1
04	Memory block transfer program for 8086 processor.	CO1
05	Finding largest/smallest number from given array.	CO1
06	Sorting the given array in ascending order.	CO1
07	Any program based on mixed language for 8086 processor.	CO1
08	Simple program for addition and subtraction for 8051 microcontroller.	CO2
09	Simple program for multiplication and division for 8051 microcontroller.	CO2
10	Software delay generator using 8051 microcontroller.	CO2

11	Interface single LED to 8051 microcontroller and write a program to blink that LED with some delay.	CO3
12	Interface 7-segment display to 8051and write a program to display a character on it.	CO3
13	Interface LCD panel to 8051 microcontroller and write a program to display a sample message.	CO3
14	Interface D/A converter to 8051 microcontroller and generate waveforms using this interface.	CO3
15	Stepper motor interfacing to 8051 microcontroller.	CO3

Continuous Internal Evaluation (25 Marks)

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
ARMDM401	**Artificial Intelligence**	20	20	60	1	2	100	

Prerequisite: Discrete Mathematics, Data Structures	
Course Objectives: The course aims to	
1	To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2	To make students understand and explore the mechanism of mind that enables intelligent thought and action.
3	To make students understand advanced representation formalism and search techniques.
4	To make students understand how to deal with uncertain and incomplete information.
Course Outcomes: Learners will be able to	
1	Ability to develop a basic understanding of AI building blocks presented in intelligent agents.
2	Ability to choose an appropriate problem solving method and knowledge representation technique.
3	Ability to analyze the strength and weaknesses of AI approaches to knowledge– intensive problem solving.
4	Ability to design models for reasoning with uncertainty as well as the use of unreliable information.
5	Ability to design and develop AI applications in real world scenarios.
6	Ability to understand Emerging AI Technologies and Future Trends in Mechanical Engineering.

Module	Detailed Contents	Hrs.	CO Mapping
01	**Fundamentals of AI and Machine Learning** Introduction to AI, Machine Learning (ML), and Deep Learning Role of AI in Mechanical Engineering Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning Data Collection and Preprocessing for Mechanical Applications Case Study: AI-Driven Material Selection for Engineering	06	CO1
02	**AI in Mechanical Design and Product Development** Generative Design and AI-Assisted Computer-Aided Design (CAD) AI in Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD)	07	CO2

	Optimization Techniques for Mechanical Systems Using AI AI-Driven Topology Optimization for Lightweight Structures Case Study: AI in Aerospace Component Design.		
03	**AI in Manufacturing and Smart Factories** AI in Industry 4.0 and Digital Twins Computer Vision for Quality Control and Defect Detection AI for Process Automation and Control in Manufacturing AI-Based Supply Chain and Inventory Management Case Study: AI-Powered Predictive Quality Control in Automotive Manufacturing	**08**	**CO3**
04	**AI in Robotics and Autonomous Systems** AI in Industrial Robotics and Automation Path Planning and Motion Control Using AI AI in Collaborative Robotics (Cobots) AI for Autonomous Vehicles and Drones in Mechanical Applications Case Study: AI-Driven Robotic Assembly System	**08**	**CO4**
05	**AI for Predictive Maintenance and Condition Monitoring** AI-Based Fault Detection and Diagnosis Machine Learning for Vibration Analysis and Wear Prediction IoT and AI Integration for Real-Time Condition Monitoring AI in Energy Efficiency and Performance Optimization Case Study: Predictive Maintenance in Heavy Machinery	**07**	**CO5**
06	**Emerging AI Technologies and Future Trends in Mechanical Engineering** AI for Sustainable and Green Engineering AI in Additive Manufacturing (3D Printing) AI in Human-Machine Interaction and Augmented Reality Ethical Considerations and Challenges in AI Adoption Capstone Project: AI-Driven Solution for a Mechanical Engineering Problem	**07**	**CO6**

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition" Pearson Education, 2020.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
3. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education.,2005
4. Ramin S. Esfandiari"Artificial Intelligence Techniques in Mechanical Engineering: A Practical Approach"McGraw-Hill Education.

References:

1.Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2.Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3.Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.

4.Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017 .

Useful Links
1.https://nptel.ac.in/courses/106/105/106105078/
2.https://thestempedia.com/blog/simple-ai-and-machine-learning-projects-for-students-and-beginners/
3.https://nptel.ac.in/courses/106/105/106105079/

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
ARMDML401	Artificial Intelligence Lab	-	25	-	-	-	25	

Course Objectives: The course aims to	
1	To provide hands-on experience in using AI and machine learning techniques for solving mechanical engineering problems like design, manufacturing, and maintenance.
Course Outcomes: Learners will be able to	
1	Familiar with basic tools for AI and prepare data for analysis.
2	Apply machine learning to predict mechanical properties.
3	Group similar data points (e.g., materials or components) without labeled data.
4	Use reinforcement learning to optimize a mechanical system & designing optimized mechanical structure.
5	Use machine learning to enhance FEA simulations & AI based quality control
6	Predict and diagnose mechanical failures before they happen. & path planning for robotics

Sr. No.	List of Experiments	CO Mapping
01	Introduction to Python for AI and Data Preprocessing	CO1
02	Using Supervised Learning for Mechanical Data	CO2
03	Clustering Mechanical Data (Unsupervised Learning)	CO3
04	Reinforcement Learning for System Optimization	CO4
05	Generative Design for Structural Optimization	CO4
06	AI in Finite Element Analysis (FEA)	CO5
07	AI-Based Quality Control	CO5
08	Predictive Maintenance Using AI	CO6
09	Path Planning for Robotics	CO6

Continuous Internal Evaluation (25 Marks)

1. Lab Performance and assignments: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
ITMDM401	Internet of Things and Applications	20	20	60	1	2	100	

Prerequisite: Basic electrical principles, including AC circuits, magnetism, and electro mechanical energy conversion.	
Course Objectives: The course aims to	
1	Understand the fundamentals of IoT architecture and protocols.
2	Explore sensors, actuators, and embedded systems in electrical engineering.
3	Apply IoT technologies to solve electrical engineering problems.
4	Analyze case studies in smart grids, energy management, automation, and power systems.
Course Outcomes: Learners will be able to	
1	Understand the concept of IoT.
2	Illustrate IOT architecture and applications in various fields.
3	Demonstrate use Devices, Gateways and Data Management in IoT.
4	Understand various wired and wireless protocols.
5	Understand emerging technological options, platforms and case studies of IoT implementation in home & city automation.
6	Understand Data Analytics and Security in IoT.

Module	Detailed Contents	Hours	CO Mapping
01	**Introduction to IoT** Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Sources of IoT; Sensing, Actuation, Basics of Networking; Software Architectures and Software Inter-operability, Applications in Electrical Engineering. **Self-Learning Topic:** Privacy and Security	**06**	**CO1**
02	**IoT Architecture** Introduction, Functional View, Information View, Deployment and Operational View, Real-World Design Constraints- Introduction, Technical Design constraints, Data representation and visualization, **Self-Learning Topic:** Interaction and remote control.	**06**	**CO2**
03	**Sensors and Embedded Systems**	**06**	**CO3**

	Types of Sensors Used in Electrical Applications (Voltage, Current, Power, Temperature), Interfacing Sensors with Microcontrollers (e.g., Arduino, Raspberry Pi, ESP32), Signal Conditioning and Data Acquisition, Postioning and localization, Medium access control, Introduction to Embedded Programming (C/C++, Python)		
	Self-Learning Topic: operating systems, time synchronization		
04	**Networking and Communication Protocols for IoT:**	**10**	**CO4**
	Cloud based IoT platforms, Zigbee and Zwave, advantage of low power mesh networking. Long distance Zigbee; Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Wireless protocols such as Piconet and packet structure for BLE and Zigbee. Web Communication Protocols for connected devices, Web connectivity using Gateway, SOAP, REST, HTTP, RESTful and WebSockets (Publish – Subscribe), MQTT, AMQP, CoAP Protocols.		
	Self-Learning Topic: ThingsBoard, Blynk, Firebase, AWS IoT		
05	**IoT Applications**	**10**	**CO5**
	IoT in Power and Energy Systems Smart Grids and IoT Integration, Energy Monitoring and Management Systems, Real-time Load Monitoring, Predictive Maintenance of Electrical Equipment using IoT, Fault Detection in Power Lines, Smart Street Lighting Systems, IoT-enabled Electric Vehicle Charging Stations. **Industrial and Home Automation** IoT-based Control of Electrical Loads, Home Automation: Lighting, HVAC, Smart Meters, Industrial Automation: PLCs, SCADA Systems with IoT Integration, Safety and Fault Detection Systems. Case Study: Agriculture, Healthcare, Activity monitoring.		
	Self-Learning Topic: IoT for Renewable Energy Monitoring (Solar, Wind)		
06	**Data Analytics and Security in IoT**	**04**	**CO6**
	Basics of Data Logging and Visualization, Introduction to Edge and Cloud Computing, Cybersecurity in IoT Systems, IoT Standards and Compliance		
	Self-Learning Topic: IEEE standards used in protection and data management.		

Text /Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020.
3. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press. 2020.
4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, John Wiley, 2014
5. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting

Everything", 1 st Edition, Apress Publications, 2013.
6. CunoPfister, "Getting Started with the Internet of Things", OReilly Media, 2011
   A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
7. Samuel Greenguard, "Internet of Things", MIT Press, 2015.
8. Mandler, B., Barja, J., Mitre Campista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing
9. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.
10. Internet of things (IoT): Technologies, Applications, Challenges, and Solutions Edited by B.K. Tripathy J. Anuradha, CRC Press, 2018
11. Simone Cirani, Gianluigi Ferrari, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards"

Web Reference /Video Courses

1. NPTEL Course: Introduction to Internet of Things By Prof. Sudip Misra, IIT Kharagpur

References:

1. Introduction to the Internet of Things (IoT), Publisher: Cisco Networking Academy
2. Internet of Things (IoT) – Lecture Notes & Tutorials, Author: Dr. Rajkumar Buyya (University of Melbourne)
3. A Reference Architecture for the Internet of Things, Publisher: IEEE / ITU-T
4. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, Author: Pethuru Raj
5. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases, Authors: David Hanes, Gonzalo Salgueiro, Patrick Grossetete

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

2. Assignment: 5 Marks
3. Quiz/Open book test/Presentation: 10 Marks
4. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
ITMDML401	Internet of Things and Applications Lab	-	25	-	-	-	25	

Prerequisite: Students know the construction, working principle and operation of DC machines, transformers and Induction motors	
Course Objectives: The course aims to	
1	To Understand the definition and significance of the Internet of Things.
2	To Discuss the architecture, operation, and business benefits of an IoT solution**.**
3	To Explore the relationship between IoT, cloud computing, and Data Analytics.
4	To Explore the interconnection and integration of the physical world and be able to design & develop IOT applications.
Course Outcomes: Learners will be able to	
1	Adapt different techniques for data acquisition using various IoT sensors for different applications.
2	Demonstrate the working of actuators based on the collected data**.**
3	Use different IoT simulators and correlate working of IoT protocols.
4	Adapt different techniques for Integrating IoT services to other third-party Clouds**.**
5	Execute data analysis and encryption methodologies for deployment of IoT applications**.**
6	Implement IoT protocols for communication to realize the revolution of internet in mobile devices, cloud and sensor networks.

Suggested List of Experiments

Sr. No.	List of Experiments	CO Mapping
01	To measure voltage, current, and power consumption of an appliance using ESP32 and display the data on an OLED screen or send it to a cloud platform.	CO1
02	To control a light or appliance remotely using a mobile app (Blynk) using ESP32.	CO1
03	To measure room temperature and send the data to an online IoT platform using ESP32	CO1
04	To monitor transformer temperature and raise alerts on overheating.	CO2
05	To display power usage data from a sensor on a custom web dashboard using RasberyPi	CO2
06	To automate a streetlight system based on surrounding light intensity	CO2

	using ESP32	
07	To monitor the ON/OFF status of an appliance and view it remotely using ESP32.	CO2
08	To detect motion and capture an image using Raspberry Pi camera using Raspberry Pi	CO2
09	Simulate an energy meter that calculates power usage using Arduino and sensors.	CO3
10	Simulate a weather station that logs temperature and humidity online using **Tinkercad + ThingSpeak**	CO3
11	Simulate an automatic light that turns on when it gets dark using **Tinkercad or Proteus**	CO3
12	Simulate a simple smart grid system that balances load using IoT control logic using MATLAB Simulink	CO3
13	Simulate control of home devices via mobile interface using **Tinkercad + Blynk API Simulation**	CO3
14	To study and demonstrate working of 6LoWPAN in Contiki OS (simulator)	CO4
15	Write a program on Raspberry Pi to push and retrieve the data from cloud like thingspeak/thingsboard/AWS/ Azure etc	CO4
16	Write a program to collect data from sensor encrypt data send it to receiver (server) and decrypt is at receiving end Ardino/Raspberry Pi/ Contiki OS (simulator)	CO5
17	To study and implement IoT Data processing using Pandas.	CO5
18	Write a program for Arduino / Raspberry Pi Publishing MQTT Messages to ESP8266	CO6
19	To study and implement interfacing of actuators based on the data collected using IoT sensors. (like led switch ON/OFF, stepper motor)	CO6
20	Write a program to Control Your ESP8266 From Anywhere in the World	CO6

Online References:

1. https://spoken-tutorial.org/watch/Arduino/Introduction+to+Arduino/English/
2. https://pythonprogramming.net/introduction-raspberry-pi-tutorials/
3. https://iotbytes.wordpress.com/basic-iot-actuators/
4. http://www.contiki-os.org/
5. https://www.bevywise.com/iot-simulator/
6. https://mqtt.org/

Continuous Internal Evaluation (25 Marks)

1. Lab Performance: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
MEMDM401	Basics of Mechanical Engineering	20	20	60	1	2	100	

Prerequisite: Engineering Mechanics, chemistry	
Course Objectives: The course aims to	
1	Explain: Fundamental concepts, laws of classical thermodynamics, principle of working and operation of thermodynamic cycles, scope and applications in research
2	To understand the nature of stresses developed in simple geometries
3	To understand the material used and their application in manufacturing
Course Outcomes: Learners will be able to	
1	Understand the fundamental concepts of Mechanical engineering
2	Understand & apply the basic laws of thermodynamics to analyze energy conversion systems
3	Understand the Basics of kinematics and various mechanism.
4	Understand the working principles and applications of common mechanical mechanisms such as linkages, gears.
5	Classify engineering materials and explain their mechanical properties, structure, and industrial applications.
6	Understand the working principles of Power Plants & types of Renewable energy sources

Module	Detailed Contents	Hrs.	CO Mapping
01	**Fundamentals of Mechanical Engineering** Introduction to Mechanical Engineering and its applications Basic concepts: systems, units, energy, force, work, power Engineering materials: types, properties, and applications Stress-strain basics and Hooke's Law Simple numerical problems on stress and strain	06	CO1
02	**Basics of Thermodynamics** Introduction to Thermodynamics and basic definitions, Zeroth, First, and Second Laws of Thermodynamics, Properties of pure substances (pressure, volume, temperature), Heat and work interactions, Ideal and real gases. Introduction to heat engines, refrigerators, and heat pumps Introduction to I.C. Engines: SI and CI engines	09	CO2

	Engine components and working principles,2-Stroke vs 4-Stroke engines.		
03	**Theory of Machines** Basics of kinematics and dynamics of machines, Types of links, kinematic pairs and chains, Four-bar mechanism, slider-crank mechanism, Gear trains: simple and compound, Cam and follower basics, Flywheel and governor (conceptual overview)	**07**	**CO3**
04	**Mechanical Systems and Machines** Basic machine elements: gears, belts, pulleys, bearings Introduction to mechanisms and kinematics of machines Simple lifting machines (screw jack, pulley block) Power transmission: shaft, couplings, and keys Basics of vibrations and balancing (introductory)	**08**	**CO4**
05	**Materials Science & Manufacturing Processes** Classification of materials: metals, ceramics, polymers, composites, Mechanical properties: hardness, toughness, ductility, strength, Heat treatment process. Overview of manufacturing: importance and types Basic casting process: pattern, moulding, and casting Introduction to welding, brazing, and soldering Basics of machining: turning, milling, drilling Introduction to 3D printing and modern manufacturing trends	**07**	**CO5**
06	**Power Plants & Renewable energy sources** Overview of power plants: thermal, hydro, nuclear (layout & working briefly) Renewable energy sources: solar, wind, biomass (brief)	**05**	**CO6**

References & Text Books:

1. R.K. Rajput – *Basic Mechanical Engineering*
2. V. B. Bhandari – *A Textbook of Machine Design*
3. R.S. Khurmi – *Theory of Machines*
4. Kalpakjian & Schmid – *Manufacturing Engineering and Technology*
5. William D. Callister – *Materials Science and Engineering*

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)

End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
MEMDML401	Mechanical Engineering Lab	-	25	-	-	-	25	

Prerequisite: Engineering Mechanics	
Course Objectives: The course aims to	
1	Practically verify the concepts learnt in theory course
2	Fundamental laws of thermodynamics through experimental analysis.
3	To acquaint with the material testing by performing experiment related to Hardness, Fatigue, Tension, Deflection, Torsion, Impact and Flexural Test
Course Outcomes: Learners will be able to	
1	Verify Law of Thermodynamics & various boilers accessories and mountings
2	Understand and demonstrate the working of 2-stroke & 4-stroke Engine.
3	Verify the Bernoulli's Principle & Calibration of Venturimeter, Orifice meter
4	Perform Tension test to analyze the stress - strain behavior of materials
5	Perform heat treatment process of metal sample
6	Perform flexural test with central and multi point loading conditions

Sr. No.	List of Experiments	CO Mapping
01	Verification of the Zeroth Law of Thermodynamics.	CO1
02	Experiment on boilers and their accessories and mountings.	CO1
03	Demonstration of 2-stroke & 4-stroke Engine.	CO2
04	Calibration of Venturimeter,Orifice meter	CO3
05	Verification of Bernoulli's equation	CO3
06	Tension test on mild steel bar	CO4
07	Brinell hardness Test	CO4
08	Experiments based on heat treatment method	CO5
09	Flexural test on beam (Multi-point load)	CO6

Continuous Internal Evaluation (25 Marks)

1. Lab Performance and assignments: 10 Marks
2. In-Semester Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks

Course Code	Course Name	Examination Scheme						Lecture
		Marks Distribution			Exam Duration (Hrs)		Total Marks	3 Hrs
		Internal Assessment		End Semester Exam (ESE)	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					3
EEMDM401	Elements of Electrical Systems	20	20	60	1	2	100	

Course Objectives:

1. To list & describe the different methods of Power generation
2. To elaborate the various types of transmission lines
3. To understand the basics of illumination and various types of electrical loads
4. To understand and calculate the power consumption in electrical system
5. To explain the various types of electrical energy storage system
6. To discuss the various types of electrical meters

Course Outcomes:

1. Understand the different methods of Power generation
2. Evaluate the sending end and receiving end voltage of transmission line
3. Study the basics of illumination and various types of electrical loads
4. Understand the ratings and calculate the electrical energy consumption
5. Study the various types of electrical storage
6. Illustrate the working of different types of meters in electrical system

DETAILED SYLLABUS:

Module	Detailed Contents	Hrs.	CO Mapping
01	**Generation of Electrical Power** Basics of different Power generating systems: thermal (fossil fuels, nuclear), renewable (solar, wind, hydro, geothermal), nuclear and emerging technologies (tidal, wave, biomass). Basic Layout of hydroelectric power station, thermal power plant, solar generation, nuclear power plant with their advantages and disadvantages. Cost of generation, peak load and base load plant.	10	CO1
02	**Transmission** Study of different types of transmission lines (Short, medium and long), Different types of conductors used (Single and three phase transmission line). Application of KVL, KCL to find sending end and receiving end voltage and Calculations of Power transmitted.	7	CO2
03	**Utilization of Electrical Energy**	10	

	Basic structure of Electrical power Generation, Transmission and distribution systems: grid structure. Illumination: Introduction, Terms used in illumination, Laws of illumination, Numericals on illumination. Types of Electrical loads: Residential: Basics of refrigeration and air-conditioning Industrial: Machines (Motors and generators: AC vs. DC) Self-learning topics: Electric Heating and welding. Basics of DC motors, single and three phase induction motor.		**CO3**
04	**Ratings & Calculation of Energy Consumption** Power rating of household appliances such as tube light, fan, air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, understand the calculation of electricity bill for LT & HT consumers.	**5**	**CO4**
05	**Energy Storage** Battery Technologies: Chemistry basics: lead-acid, lithium-ion, sodium-ion, solid-state batteries. Charging and discharging characteristics. Battery management systems (BMS). Battery storage: types (lead-acid, lithium-ion, flow batteries), applications.	**5**	**CO5**
06	**Measurement in Electrical Energy Systems** Importance of measurement in electrical energy systems. Basic principles of Digital and analog electrical measurement. Moving coil and Moving iron Ammeters & Voltmeters, Power measurement by wattmeter in single phase circuit	**5**	**CO6**

Text Books:

1. Mahesh Verma, Power Plant Engineering, Metrolitan Book Co Pvt Ltd
2. RK Rajput, A Text Book of Power System engineering, Laxmi Publication
3. D. P. Kothari, I. J. Nagrath, Power System Engineering, 3 Edition, Mc GrawHill
4. B.R. Gupta, Power System Analysis And Design, S.Chand
5. Mehta V.K., Principles of Power System, S Chand
6. AK Sawhney, Electrical & Electronic Measurements and Instrumentation, Dhanpat Rai & Sons
7. Dincer I., and Rosen M. A. (2011); Thermal Energy Storage: Systems and Applications,Wiley

References:

1. W. D. Stevenson, Elements of Power System, 4 Edition TMH
2. Trevor M. Letcher, Storing Energy with Special Reference to Renewable Energy Source, Elsevier, 2016.
3. RS Sirohi & Radhakrisnan, Electrical Measurement & Instrumentation, New Age International

Online References:

Sr. No.	Website Name
1	https://www.energy.gov/eere/renewable-energy

Internal Assessment (40 Marks)

A. Mid Semester Exam (20 Marks)

Mid semester examination will be based on 40 % to 50% of the syllabus.

B. Continuous Internal Evaluation (20 Marks)

1. Assignment: 5 Marks
2. Quiz/Open book test/Presentation: 10 Marks
3. Regularity and attendance: 5 Marks

End Semester Examination (60 Marks)
End semester will be based on the syllabus coverage up to Mid Semester Examination (MSE) carrying 20% to 30% weightage and the syllabus covered from MSE to ESE carrying 70% to 80% weightage.

Course Code	Course Name	Examination Scheme						Practical
		Marks Distribution			Exam Duration (Hrs)		Total Marks	2 Hrs
		Internal Assessment		Oral & Practical	MSE	ESE		Total Credits
		Mid Sem Exam (MSE)	Continuous Internal Evaluation (CIE)					1
EEMDML401	Elements of Electrical Systems Lab	-	25	-	-	-	25	

Course Objectives:

1. Evaluate the performance of transmission lines.
2. Understand the performance parameters of a generator.
3. Evaluate the characteristics of batteries.
4. Study the operation and performance of an electric motor.
5. Analyze the performance of renewable energy sources.
6. Familiarize with electrical measurement techniques.

Course Outcomes:

1. To study various aspects of performance of different renewable energy sources.
2. To study different types of lamps used in Electrical system..
3. To evaluate the efficiency and performance of DC machines (motor and generator) under varying speed and load conditions.
4. To demonstrate the effective use of various meters to perform voltage, current and power measurements of single and three phase circuits.
5. To study the nature of V-I characteristics for single phase and three phase loads.
6. To analyze the behavior of a transmission line under varying load conditions

Online Resources:

Sr. No.	Website Name
1.	https://www.vlab.co.in/broad-area-electrical-engineering
2.	https://www.vlab.co.in/broad-area-electronics-and-communications

Suggested List of Experiments:

Sr. No.	List of Experiments
01	Measure and plot the no load magnetization (open circuit) characteristic (V-I curve) of a DC generator.
02	Calculate efficiency and voltage regulation of DC generator using external characteristics.
03	Case study to get the current-voltage (I-V) characteristics of a solar PV panel under different light intensities (simulated using lamps).

04	Calculate the MPPT of a solar PV panel under different light intensities (simulation using lamps).
05	Measure speed-torque characteristics of a DC motor under different load conditions.
06	Calculate efficiency and analyze the starting and running performance of a DC motor under different load conditions.
07	Measure charge-discharge characteristics of different types of batteries (e.g., lead-acid, lithium-ion).
08	To analyze efficiency, capacity, and voltage profiles of different types of batteries (e.g., lead-acid, lithium-ion) (simulation based or hands on).
09	Perform voltage, current and power measurements in single phase circuit using analog meters and verify Ohm's law.
10	Perform voltage, current and power measurements in single phase circuit using digital meters and verify Ohm's law.
11	Perform voltage, current and power measurements in three phase circuit using analog meters and verify Ohm's law.
12	Perform voltage, current and power measurements in three phase circuit using digital meters and verify Ohm's law.
13	To perform load test using 1- phase and 3 phase sources and loads using MATLAB Simulink
14	To deduce the transmission line performance i.e. sending end voltage and receiving end voltage for long, medium and short transmission lines using MATLAB Simulink.
15	Generation of sinusoidal voltage waveform using MATLAB Simulink.
16	Simulation of transmission line model using MATLAB Simulink
17	To perform speed control of DC motor using MATLAB Simulink
18	To perform practical using breadboard to extract the charging and discharging characteristics of capacitor.
19	Case Study to compare efficiency and reliability of different renewable energy sources
20	Case Study to analyze the effectiveness of energy storage in balancing supply and demand in distribution networks.
21.	Study of different types of lamps and to measure the intensities of different lamps using lux meter.
22.	To measure voltage, current and power of different types of lamps.

Continuous Internal Evaluation (25 Marks)

1. Lab Performance: 10 Marks
2. Mid Semester Oral & Practical Exam during lab session: 10 Marks
3. Regularity and Attendance: 5 Marks