Department of Electrical Engineering

SEMESTER-III

SCHEME -2022

Shri Vile Parle Kelavani Mandal's

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC

TEACHING AND EXAMINATION SCHEME

FULL TIME

PROGRAMME: ELECTRICAL ENGINEERING | **With effect from Batch admitted in June, 2022(Progressively)**

SEMESTER-III | **Duration : 16 Weeks**

Sr. No	Course Name (Code)	Scheme of Instruction & Periods per week					Theory Paper Duration and Marks (ESE)		Examination Scheme and Maximum Marks							Gr,	Scheme L/P/Cr
		L	P	D	T	Cr (L+P+D+T)	Hrs	Mks	SSL	TA	TH	TW	PR	OR	TOTAL		
1	Applied Mathematics (AMT220013)	3	-	-	1	4	3	70	20	10	70	25	-	-	125	C	3/1/4
2	Basic Electronics (BEX220306)	4	2	-	-	6	3	70	20	10	70	25	25	-	150	B	4/2/6
3	Electrical Transmission & Distribution (ETD220307)	4	-	2	-	6	3	70	20	10	70	25	-	25	150	C	4/2/6
4	Electrical Circuits & Networks (ECN220308)	3	2	-	1	6	3	70	20	10	70	25	25	-	150	C	3/3/6
5	Transformers & Induction Motors (TIM220309)	4	2	-	-	6	3	70	20	10	70	25	50	-	175	C	4/2/6
6	Electrical & Electronic Measurements (EEM220310)	3	2	-	-	5	-	-	-	-	-	50	50	-	100	C	3/2/5
		21	**8**	**2**	**2**	**33**	**No of Papers = 05**		**100**	**50**	**350**	**175**	**150**	**25**	**850**		**21/12/33**
Total Periods : 33									**Total Marks : 850**								

Theory , Practical, Drawing and Tutorial periods of 1 Hour each = 1 Credit, # Award winning subject, @ Online Examination
L-Lecture period, P-Practical period, D- Drawing Practice, T- Tutorial, Cr-Credit, ESE: End Semester Examination, SSL –Sessional,
TA- Teachers Assessment, TH- Theory, TW- Term Work, PR- Practical, OR-Oral, Gr-Group,, B-Basic, C-Core, A-Applications, M-Management,
PR/OR- Assessed by Internal and External Examiners jointly, TW- Assessed by Internal Examiner Only

Head of Department | **Controller of Examination** | **Secretary CDC** | **Principal**

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC * MUMBAI 400 056.

1. COURSE DETAILS

Programme: CE/ME/EE/PL/CH/EXTC	**Semester: III**
Course: Applied Mathematics	**Group:C**
Course Code: AMT220013	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credit (L+P+D +T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	-	-	1	4	3	70	20	10	70	25	-	-	125

3. COURSE OBJECTIVE

This Course is being introduced to provide mathematical background needed for any Diploma engineer. It intends to enable the students to apply basic facts, concepts and principles of Differential Equation, Application of derivatives, Probability Distribution and Definite integral with application as a tool to analyze engineering problems.

4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Solve application-based Engineering problems using the Advanced Knowledge of mathematics**

5. COURSE OUTCOMES (COs): At the end of the semester student will be able to**: -**

CO No.	COURSE OUTCOME
CO1	Understand the concepts of differential calculus and definite integral and apply to solve engineering related problems.
CO2	Understand the Concept of differential equation and apply it to solve engineering problems
CO3	Solve the Problem based on Numerical Method.
CO4	Understand Laplace transform, study properties of it and apply it to solve numerical

6. CO-PO, CO- PSO MAPPING TABLE- CIVIL ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Applied Mathematics (AMT220013)	CO1	3	3	3	2	1	2	2	-	1
	CO2	3	3	3	2	2	2	2	1	1
	CO3	3	3	3	2	1	1	2	-	-
	CO4	3	3	3	2	1	2	2	-	1
	CO Avg.	3	3	3	2	1.25	1.75	2	1	1

CO-PO, CO- PSO MAPPING TABLE- MECHANICAL ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Applied Mathematics (AMT220013)	CO1	3	3	3	2	1	2	2	-	2
	CO2	3	3	3	2	2	2	2	1	2
	CO3	3	3	3	2	1	1	2	-	-
	CO4	3	3	3	2	1	2	2	1	2
	CO Avg.	3	3	3	2	1.25	1.75	2	1	2

CO-PO, CO- PSO MAPPING TABLE- ELECTRICAL ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Applied Mathematics (AMT220013)	CO1	3	3	3	2	1	2	2	2	2
	CO2	3	3	3	2	2	2	2	2	2
	CO3	3	3	3	2	1	1	2	2	2
	CO4	3	3	3	2	1	2	2	1	1
	CO Avg.	3	3	3	2	1.25	1.75	2	1.75	1.75

CO-PO, CO- PSO MAPPING TABLE- PLASTICS ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
Applied Mathematics (AMT220013)	CO1	3	3	3	2	1	2	2	-	2	-
	CO2	3	3	3	2	2	2	2	-	2	-
	CO3	3	3	3	2	1	1	2	-	-	-
	CO4	3	3	3	2	1	2	2	-	2	-
	CO Avg.	3	3	3	2	1.25	1.75	2	-	2	-

CO-PO, CO- PSO MAPPING TABLE- CHEMICAL ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Applied Mathematics (AMT220013)	CO1	3	3	3	2	1	2	2	-	2
	CO2	3	3	3	2	2	2	2	-	2
	CO3	3	3	3	2	1	1	2	-	-
	CO4	3	3	3	2	1	2	2	-	2
	CO Avg.	3	3	3	2	1.25	1.75	2	-	2

CO-PO, CO- PSO MAPPING TABLE- ELECTRONIC AND TELECOMMUNICATIONS ENGINEERING

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Applied Mathematics AMT220013)	CO1	3	3	3	2	1	2	2	2	1
	CO2	3	3	3	2	2	2	2	2	1
	CO3	3	3	3	2	1	1	2	2	1
	CO4	3	3	3	2	1	2	2	2	1
	CO Avg.	3	3	3	2	1.25	1.75	2	2	1

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic	CO
I	**Application of Derivatives** 1.1 Tangent and normal line 1.2 Maxima and minima 1.3 Radius of curvature	CO1
II	**Differential Equation** 2.1 Introduction and definition 2.2 Concept of order, degree of Differential equation 2.3 Formation of Differential Equation 2.4 Differential Equation of first order and first degree • Method of variable separable • Equation reducible to method of variable separable • Homogeneous Differential equation • Linear Differential equation	CO2
III	**Numerical Method** 3.1 Solution of equation of one variable using • Bisection method • Regular falsi method • Newton Raphson method 3.2 Solving simultaneous equation with 2 and 3 variables using • Gauss elimination method, Iterative methods –Gauss Seidal and Jacobi's methods	CO3
IV	**Integration** Method of integration 4.1 By Substitution – Various Types of Integration 4.2 By Parts 4.3 Mixed Problems	CO1
V	**Definite Integral & its Applications** 5.1 Definition of Definite Integral 5.2 Properties of Definite Integral 5.3 Area under the curve & Area between curve Volume of Solid	CO1
VI	**Laplace Transform** 6.1 Introduction 6.2 Definition and Basic Formula 6.3 Properties of Laplace transform' • Linearity property • First shifting • Change of Scale • Multiplication by t^n • Division by t 6.4 Inverse of Laplace Transform 6.5 Properties of Inverse of Laplace Transform 6.6 Methods of Inverse of Laplace Transform By Partial Fraction	CO4

8. LIST OF PRACTICALS/ASSIGNMENTS/ TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of –10 Tutorials.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	CO
1	Tutorials on Application of derivatives	3	CO 1
2	Tutorials on Differential equation.	4	CO 2
3	Tutorials on application of Differential equation	3	CO 2
4	Tutorials on Numerical Method.	3	CO 3
5	Tutorials on Integration-1	3	CO 1
6	Tutorials on Integration-2	3	CO 1
7	Tutorials on definite integration	4	CO 4
8	Tutorials on application of definite integration	3	CO 4
9	Tutorials on Laplace Transform	3	CO 1
10	Tutorials on Inverse Laplace Transform	3	CO 2
	TOTAL	**32**	

9. TEACHERS ASSESSMENT (TA): Assessment to be based on one of the following tools and rubrics for evaluation of TA to be well defined by course teacher.

1. Assignment based on application of Mathematics in real life or in engineering field.
2. Mathematical programming using Sci-Lab.
3. Quiz test

10. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Assignments
3. Home Work Assignment

11. SUGGESTED LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Calculus for Polytechnics	Shri. S.P.Deshpande	Pune Vidyarthi Graha Prakashan Pune-30
2	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna Publishers 2/B, Delhi-6
3	Applied Mathematics	G.V.Kumbhojkar	P.Jamnadas LLP

12. WEB REFERENCES

1. www.mic-mathematics.com
2. www.math.com
3. www.lenerstv.com
4. www.onlinetutorials.com
5. www.archieves.math.utk.edu

13.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Application of Derivatives	04	-	-	7	07
II	Differential Equation	14	4	10	5	19
III	Numerical Method	06	2	5	2	09
IV	Integration	07	6	2	2	10
V	Definite Integral & its Applications	05	2	-	6	08
VI	Laplace Transform	12	3	10	4	17
	TOTAL	**48**	**17**	**27**	**26**	**70**

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14.COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Dr. Kavita Dange
2	Internal	Mr. Akhileshwar Singh
3	External	Prof. Taqdis Pwale
		Organization: Mithibai Degree College, Vile Parle.

1. COURSE DETAILS

Programme: Diploma in Electrical Engineering	**Semester: III**
Course: Basic Electronics	**Group: B**
Course Code: BEX220306	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
4	2	--	--	6	03	70	20	10	70	25	25	--	150

3. COURSE OBJECTIVE:

In present era the field of electronics plays an important role in almost every sphere of our life. It has penetrated in every field of engineering.

It is therefore necessary for an engineer to study the electronic components, their characteristics and applications.

4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified components through various teaching learning experiences

- **Maintain electronic circuits comprising of discrete electronic components**
- **Interpret datasheet of electronic components.**

5. COURSE OUTCOMES (COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Draw and identify symbol, construction and characteristics of semiconductor devices.
CO2	Interpret the significance of transistors in Electrical engineering applications
CO3	Identify and compare methods of transistor biasing
CO4	Use Field Effect Transistors in Electrical engineering applications
CO5	Select and use appropriate amplifier for required application.
CO6	Use regulated power supply in electronic applications

6. CO-PO, CO-PSO MAPPING TABLE:

Course and Code	Course Outcomes	Program Outcomes							Program Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Basic Electronics (BEX220306)	CO1	3	-	2	-	-	-	1	1	2
	CO2	3	-	1	-	2	-	-	1	2
	CO3	3	2		2			1	1	2
	CO4	3	-	1	-	2	-	-	1	2
	CO5	2	3	-	2	-	-	1	1	2
	CO6	3	2	-	2	-	-	1	1	2
	CO Avg.	2.83	2.33	1.33	2.00	2.00	-	1.00	1.00	2.00

7. COURSE CONTENTS

Unit No.	TOPIC/Sub-Topics	CO
I	**1.0 Semiconductor Physics** 1.1 Introduction-Conductor, Semi-Conductor and insulator 1.2 Intrinsic and Extrinsic Semiconductor, doping, charge carriers 1.3 Semiconductor diode (P-N Junction)-working under unbiased, forward bias and reverse biased condition & V-I Characteristics 1.4 Half Wave Rectifier (HWR) and Full Wave rectifier (FWR), their working with waveforms and their expression of average and rms voltage and current, ripple factor, efficiency (No derivation expected). 1.5 Filter: Types-C,L, CLC (π). Their advantages and disadvantages. 1.6 Zener diode: Construction, symbol, working, characteristics and its application 1.7 Photo diode-Construction, working principle, characteristics and application 1.8 LED-Construction, working principle, characteristics and application	CO1
II	**2.0 Bipolar Junction Transistor** 2.1 Construction, symbol and working principle of NPN and PNP transistor 2.2 Characteristics of CB, CE and CC Configuration 2.3 Transistor Parameter-Input resistance, Output resistance α & β and relation between them. (basic Numerical) 2.4 Concept of transistor as a Switch 2.5 Transistor as an Amplifier 2.6 Transistor as an Inverter **Transisor Biasing** 3.1 Need of biasing circuits	CO 2
III	**3.0 Transistor Biasing** 3.1 Need of biasing circuits 3.2 Different types of biasing: 3.2.1 Fixed bias 3.2.2 Fixed bias with emitter resistor, 3.2.3 Collector to base bias, 3.2.4 Voltage divider biasing	CO3

IV	**4.0 Field Effect Transistor** 4.1 Construction and working of P and N channel type (JFET) 4.2 Types of JFET and MOSFET, symbol and characteristics 4.3 Application of FET 4.4 Comparison of BJT, FET & MOSFET.	CO 4
V	**5.0 Small Signal Amplifier** 5.1 Concept of Amplifier 5.2 Voltage gain (No derivation) 5.3 Single stage CE amplifier 5.4 Frequency response of Single Stage CE amplifier 5.5 Multistage Amplifier (Cascaded Amplifier)- 5.5.1 Need, gain of Amplifier 5.5.2 Types of Amplifier Coupling-Direct, RC and transformer coupling 5.6 RC Phase Shift Oscillator Need and Importance	CO 5
VI	**6.0 Regulated Power Supply** 6.1 Need of Regulator 6.2 Concept of Load and line regulation. 6.3 Zenner Diode as a voltage regulator 6.4 Regulator IC 78XX,79XX (Numerical can be asked)	CO6

8. LIST OF PRACTICALS/ASSIGNMENTS/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 experiments/Assignments

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	CO
1	Measurement of amplitude and frequency using CRO	2	CO1
2	Plot P-N junction diode characteristics	2	CO 1
3	Plot zener diode characteristics	2	CO 1
4	Verify zener diode as a voltage regulator	2	CO6
5	Test performance of half wave rectifier	2	CO 1
6	Test performance of full wave rectifier	2	CO 1
7	Use and understand the need of LC and π filter in electronics	2	CO 1
8	Identify the Terminals of NPN and PNP transistors	2	CO1
9	Plot Characteristics of BJT in CE configuration	2	CO 2
10	Plot CE Amplifier characteristics	2	CO 2
11	Plot FET Characteristics	2	CO 4
12	Find Frequency response of CE Amplifier	2	CO 2
13	Understand Two Stage RC Coupled Amplifier	2	CO 5
14	Study RC Phase Shift Oscillator	2	CO 5
15	Test and Troubleshoot the performance of 78XX regulator IC's	2	CO 6
16	Simulation	2	
	Total	**32**	

9. TEACHERS ASSESSMENT (TA) : Assessment to be based on one of the following tools and rubrics for evaluation of TA to be well defined by course teacher

1. Micro Projects
2. Seminar/Presentation
3. Model/Chart making
4. Surveys
5. Case Study
6. Quiz
7. Assignment

10. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum no of practical/assignments.
3. Guest/Expert lectures & Demonstrations/Simulations
4. Slides & Quiz
5. Any other method adopted
6. Self-learning Online resources

11. SUGGESTED LEARNING RESOURSES

Sr. No.	Title Of Book	Author	Publication
1.	Electronics Devices and Circuits	Robert Boyalestead	PHI New Delhi
2.	Basic Electronics and Linear Circuits	N.N.Bhargava,D.C.Kulshreshtha and S.C.Gupta-TTTI Chandigarh	Tata McGraw Hill
3.	Basic Electronics	Grob Bernard	Tata McGraw Hill
4.	Principles of Electronics	V.K.Mehta	S.Chand

12. WEB REFERENCES

1. http://electronicsforu.com/
2. http://www.electronicshub.org/
3. http://electronicdesign.com/
4. https://www.allaboutcircuits.com/
5. https://onlinecourses.nptel.ac.in/noc23_ee62/preview

13. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Semiconductor Physics	14	2	4	8	14
2	Bipolar Junction Transistor	10	4	4	4	12
3	Transistor Biasing	08	-	4	6	10
4	Field Effect Transistor	14	4	4	6	14
5	Small Signal Amplifier	10	4	6	-	10
6	Regulated Power Supply	08	4	-	6	10
TOTAL		**64**	**18**	**22**	**30**	**70**

R Remembering, U Understanding, A Applying, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs.The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	NAME	
1	Internal	Mr.S.S.Rokade
2	Internal	Mr.P.S.Dhuri
3	External	Mr. Umang Patel
		Organisation : K.J.Somaiya College Of Engg,Mumbai

1. COURSE DETAILS

Programme: Electrical Engineering	**Semester: III**
Course: Electrical Transmission & Distribution	**Group: C**
Course Code:ETD220307	**Duration:16 Weeks**

2.TEACHING AND EXAMINATION SCHEME:

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
04	-	02	-	06	03	70	20	10	70	25	-	25	150

3. COURSE OBJECTIVE

Electrical diploma pass out should know system for electrical transmission & distribution. They also will be able to identify various components & their functions. They will be able to measure system performance. They will use this knowledge in studying switchgear and protection. On completing the study of generation, transmission, & distribution & switch gear & protection, students will be able to work as technician/supervisor in power industry, manufacturing industries and public utilities.

4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

- **Identify various components and types of Transmission and distribution systems.**
- **Maintain different types of Substation, Transmission lines and Underground cables.**

5. COURSE OUTCOMES (COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Explain various components and types of transmission systems.
CO2	Identify various components and types of distribution systems. .
CO3	Understand performance of transmission line w.r.to load change.
CO4	Explain underground cables their faults and tests
CO5	Understand different types of Substation, equipment of substation, layout of Substation.

6. CO-PO, CO- PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical Transmission & Distribution (ETD220307)	CO1	3	-	-	-	-	1	2	2	1
	CO2	3	-	-	-	-	2	1	2	2
	CO3	3	-	2	-	-	1	1	2	2
	CO4	1	2	-	3	-	-	-	2	2
	CO5	1	-	-	-	2	3	1	2	1
	CO Avg.	2.20	2.00	2.00	3.00	2.00	2.00	1.33	1.80	1.60

7. COURSE CONTENTS

UNIT NO.	Topic/Sub-Topic	CO
I	**Introduction to Transmission systems** 1.1 Introduction to transmission. 1.2 Necessity of transmission of electricity 1.3 Classification & comparison of different Transmission system. 1.4 Introduction to line components. 1.5 Types of conductors-copper, Aluminium & state Their trade names. solid, stranded & bundled conductors 1.6 Line supports- requirements, types, and field, Applications. 1.7 Line insulators-requirements, types, and field, Applications. 1.8 Failure of insulator and reasons for Failure. 1.9 Distribution of potential over a string of Suspension insulators. 1.10 Concept of string efficiency, methods of Improving string efficiency. 1.11 Corona-corona formation, advantages & disadvantages, factors affecting corona, Important terms related to corona. 1.12. Introduction of Sag in Overhead Transmission line 1.13 calculation of Sag when Supports are at equal Level, Supports are at unequal Level, Effect of wind and ice loading (numerical based on 1.9 , 1.13)	CO1
II	**Performance of Transmission line.** 2.1Transmission Line Parameters 2.1.1 R,L & C of 1-ph & 3-ph transmission line & their Effects on line. 2.1.2 Skin effect, Proximity effect & Ferranti effect. 2.2 Classification of transmission lines. 2.3 Losses, efficiency & regulation of line. 2.4 Performance of single phase short transmission Line (numericals based on it) 2.5 Effect of load power factor on performance of transmission lines. 2.6 Performance of Medium transmission Lines-	CO3

	1.End condenser method 2.Nominal T method 3.Nominal π method	
III	**Extra High Voltage Transmission.** 4.1 Introduction and Requirement. 4.2 EHVAC Transmission. 4.3 Reasons for adoption & limitations. 4.4 HVDC Transmission-Advantages, Limitations. 4.5 Comparison of EHVAC Transmission line with HVDC Transmission	CO1
IV	**Components of Distribution System** 4.1 Introduction of distribution system. 4.2 Classification of distribution system. 4.3 Requirement of distribution system. 4.4 Design consideration of distribution system 4.5 D.C. Distributors and its types 4.6 D.C. Distribution calculations for Voltage drop. 4.7 A.C.Distribution 4.7.1 Introduction of A.C. distribution system. 4.7.2 A.C. Distribution Calculations 4.7.3 Methods of Solving AC Distribution Problems (Numerical based 4.6,4.7.3)	CO2
V	**Underground cables.** 5.1 Requirements of Underground Cable 5.2Construction of Underground Cable 5.3 Insulating materials used for Cables (Properties and different materials used such as Rubber, Vulcanised India Rubber, Impregnated paper, Varnish Cambric, PVC). 5.4 Classification of cables 5.4.1 Construction of –Belted cables, Screened Cables, Pressure Cables, Gas Pressure Cables 5.5 Comparison of Underground cable with overhead lines. 5.6 Cable laying(Direct laying, Draw in System) 5.7 Cable faults. 1. Types of fault 2. Varley loop Test 3.Murray loop Test	CO4
VI	**Substations.** 6.1 Introduction and Factors considered while designing substation. 6.2 Classification of Substation (according to Service Requirement and Constructional features) 6.3 Comparison of Indoor and Outdoor substation 6.4. Construction and Operation of (Transformer Substation, Pole-Mounted Substation, Underground Sub-Station) 6.5 Equipment and circuit elements of substations. In coming & outgoing lines, Transformers, CT & PT, Bus bar Relays, Circuit Breaker, fuses, Isolators, lightning arresters, Insulators. (only symbols and function) 6.6 Key diagram of 11KV/400 V Substation.	CO5

8. LIST OF DRAWING SHEETS

Term Work consists of minimum no of Six Drawing Sheets and Assignments from the following.

Sr. No.	Title of Drawing Sheet	Approx.Hrs required	COs
1.	Types of Transmission systems	6	CO1
2.	Components of Transmission System	6	CO1
3.	Performance of Transmission line.	6	CO3
4.	Components of Distribution System	6	CO2
5.	Types of Underground cables.	4	CO4
6.	Components and different types of Substations	4	CO5
	Home Assignments		
1.	Assignment on Introduction to Transmission System	-	CO1
2.	Assignment on Performance of Transmission line.	-	CO3
3.	Assignment on Components of Distribution System	-	CO2
4.	Assignment on Underground cables.	-	CO4
	Total	32 Hrs	

9.TEACHERS ASSESSMENT (TA): Assessment to be based on one of the following tools and rubrics for evaluation of TA to be well defined by course teacher.

1. Micro-Project
2. Seminar/Presentation
3. Model/Chart making
4. Surveys
5. Case Study
6. Quiz

10. IMPLEMENTATION STRATEGY(PLANNING)

In depth study and understanding of the subject will be implemented by adopting following strategy.

1. Teaching Plan/Tutorials
2. Minimum no of drawings.
3. Industry visit
4. Guest/Expert lectures
5. Demonstrations/Simulations
6. Slides
7. Self Learning Online Resources

11. SUGGESTED LEARNING RESOURCES:

Sr.No.	Title of the Book	Author	Publication
1	Power system	V.K Mehta	S.Chand publication
2	A Course in Electrical Power	S.L Uppal	Khanna publication
3	A Course in Electrical Power	Soni, Gupta & Bhatnagar	Dhanpatrai & sons
4	A Course in Electrical Power	J.B.Gupta	Khanna Publication

12 WEB REFFERENCES:

1.www.tatapowerindia.com
2.www.mahagenco.com
3. https://electricalnotes.wpcomstaging.com/articals/
4. www.electrical-technologies.com/
5. www.electrical4u.com.

13.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1.	Introduction to Transmission system	16	4	8	4	16
2.	Performance of Transmission line.	14	8	6	2	16
3.	Extra High Voltage Transmission.	04	-	4	-	04
4.	Components of Distribution System	14	4	6	4	14
5.	Underground cables	08	2	4	4	10
6.	Substations.	08	5	5	-	10
TOTAL		64	23	33	14	70

R- Remembering, U- Understanding, A- Applying, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs.The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14.COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Mrs Ajayshree N. Kinhekar
2	Internal	Mr.N.D.Adate
3	External	Mrs.Jyoti Waghmare
		Organisation: G.P. Bandra,Mumbai

1. COURSE DETAILS

Programme: Electrical Engineering	**Semester: III**
Course: Electrical Circuits & Networks	**Group: C**
Course Code: ECN220308	**Duration: 16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	--	01	06	03	70	20	10	70	25	25	--	150

3. COURSE OBJECTIVE

This Course deals with the Different circuit elements, Transformation techniques, Network Theorems, Analysis of two port network and practical's thereof. In order to understand electrical machines, power system, controls and measurements, knowledge of electrical circuit and network is very important. Study of electrical network lays the foundation to understand Courses of application level.

4. SKILL COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences.

- **Diagnose the electrical and electronic circuits problems**

5. COURSE OUTCOMES (COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME
CO1	Identify circuit elements and use circuit transformation techniques
CO2	Use principles of circuit analysis to troubleshoot electric circuits
CO3	Apply network theorems to troubleshoot electric circuits.
CO4	Interpret Graph theory used to solve electrical networks
CO5	Explain and evaluate transient behavior of RC and RL circuit
CO6	Analyze two port network for and T and π networks

6. CO - PO, CO - PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical circuits & Networks (ECN220308)	CO1	3	2	1	2	-	-	-	2	3
	CO2	1	3	2	1	-	-	-	2	3
	CO3	3	2	1	1	-	-	-	2	3
	CO4	1	3	2	1	-	-	-	2	3
	CO5	3	2	2	1	-	-	-	2	3
	CO6	3	2	2	1	-	-	-	2	3
	CO Avg	**2.33**	**2.33**	**1.67**	**1.17**	**-**	**-**	**-**	**2.00**	**3.00**

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic	CO
I	**Circuit Elements and Transformation Techniques** 1.1 Classification of circuit elements, unilateral, bilateral, linear, non-linear, lumped, distributed passive & active circuit elements. 1.2 Types of sources 1.2.1 Ideal voltage source and Practical voltage source 1.2.2 Ideal current source and Practical current source 1.3 Source transformation Technique. 1.4 Star delta transformation for resistance. Numericals on the above topics	CO1
II	**Circuit Analysis Methods** 2.1 Kirchhoff's voltage Law 2.2 Kirchhoff' current Law 2.3 Mesh Current Analysis using KVL 2.4 Node Voltage Analysis using KCL Numericals on the above topics	CO2

III	**Network Theorems.** 3.1 Superposition Theorem 3.2 Thevenin's Theorem 3.3 Norton's Theorem 3.4 Maximum Power Transfer Theorem 3.5 Reciprocity theorem Numericals on the above topics	CO3
IV	**Graph Theory** 4.1 Graph of a network 4.2 Types of Graphs 4.2.1 Connected Graph 4.2.2 Unconnected Graph 4.2.3 Directed Graph 4.2.4 Undirected Graph 4.3 Subgraph and its Types 4.3.1 Tree 4.3.2 Co-Tree 4.4 Matrices associated with Network Graphs 4.4.1 Incidence Matrix 4.4.2 Fundamental Loop Matrix 4.4.3 Fundamental Cut-Set Matrix 4.5 Duality Simple Numericals on above topics.	CO4
V	**D.C Transient Response.** 5.1 R-L transients. Expression for the rise and decay of current in simple R-L series circuit. 5.2 Initial conditions, time constant in R-L transient 5.3 Expression for energy stored in inductance. 5.4 R-C-transients. Expression for the rise and decay of current, charge and voltage in simple R-C series circuit. 5.5 Initial conditions, time constant in R-C transient 5.6 Expression for energy stored by a capacitor. Numericals on the above topics	CO5

VI	**Two Port Network Analysis.** 6.1 Impedance, admittance, hybrid and ABCD parameters. 6.2 Condition of Reciprocity for all above parameters 6.3 Condition of Symmetry for all above parameters 6.4 Calculation of these parameters for T and Pi Network Numericals on T network	CO6

8. LIST OF PRACTICALS/ASSIGNMENTS/TUTORIALS/DRAWINGS

Term work consist of Journal containing minimum number of 8 Experiments/assignments/drawings

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	CO
1	To Verify Star Delta Transformation technique	4	CO1
2	Assignment on Circuit Analysis Methods	-	CO2
3	To Verify Superposition theorem with DC Source	4	CO3
4	To Verify Thevenin's theorem in DC Circuits	4	CO3
5	To Verify Norton's theorem in DC Circuits	4	CO3
6	To Verify Maximum power transfer theorem in DC Circuits	4	CO3
7	To Verify Reciprocity theorem in DC Circuits	2	CO3
8	Assignment on Matrices associated with network graphs	-	CO4
9	To determine the time constant of RC circuit during discharging of capacitor	4	CO5
10	To calculate and verify Z parameter of two port network	2	CO6
11	To calculate and verify Y parameter of two port network	2	CO6
12	To calculate and verify H parameter of two port network	2	CO6
13	Assignment on Z, Y, h and ABCD parameters	-	CO6
TOTAL		32 Hrs	

9. TEACHERS ASSESSMENT (TA): Assessment to be based on one of the following tools and rubrics for evaluation of TA to be well defined by course teacher

1. Micro project
2. Seminar/Presentation
3. Model/Chart making
4. Surveys
5. Case Study
6. Quiz

10. IMPLEMENTATION STRATEGY(PLANNING)

1. Teaching Plan.
2. Minimum number of Practicals/Assignments.
3. Guest/Expert lectures.
4. Slides
5. Demonstrations.
6. Self-Learning Online Resources

11. SUGGESTED LEARNING RESOURSES

Sr. No.	Title of Book	Author	Publication
1	Electrical Technology.Volume-1	B.L.Thereja	S.Chand & Co.
2	Network Analysis and Synthesis	C.L.Wadhwa	New Age international
3	Network Analysis	Van Valkenburg	PHI Learning
4	Circuit Analysis	B Subramanyam	I K International Publishing House Pvt. Ltd ISBN-13 : 978-8189866440

12. WEB REFERENCES

1. www.nptel.ac.in/courses/108105053/7
2. www.electricaltechnology.org
3. www.electrical4u.com
4. https://www.maplesoft.com/content/EngineeringFundamentals
5. https://circuitglobe.com/

13. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Circuit Elements and Transformation Techniques	12	4	4	4	12
II	Circuit Analysis Methods	08	2	4	4	10
III	Network Theorems	12	4	4	6	14
IV	Graph Theory	10	2	4	4	10
V	D.C Transient Response	12	4	6	4	14
VI	Two Port Network Analysis.	10	2	4	4	10
TOTAL		64	18	26	26	70

R- Remembering, U - Understanding, A- Applying (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs.The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14. COURSE EXPERT COMMITTEE MEMBERS

SR.NO.		NAME
1	Internal	Mr.Dinesh G Rajmandai
2	Internal	Miss Urvi Sawant
3	External	Mrs. Ashivini Patil
		Organization: Government Polytechnic, Mumbai

1. COURSE DETAILS

Programme: Electrical Engineering	**Semester: III**
Course: Transformers & Induction Motors	**Group: C**
Course Code: TIM220309	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
04	02	-	-	06	03	70	20	10	70	25	50	-	175

3. COURSE OBJECTIVE

This subject deals with transformer and induction motor, their concept, principle and operation. Transformer is a very vital link in power system and induction motor is cheapest motor available in general purpose motors. The knowledge and skill obtained by the student will be useful to him as a supervisor or technician in performing the technical function.

4. SKILL COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through the teaching learning experiences:

- **Perform various tests on induction motors and transformers**
- **Select the proper type of transformer and starting, speed control methods for induction motor for various industrial applications.**

5. COURSE OUTCOMES (COs): At the end of the semester student will be able to:

CO No.	COURSE OUTCOME
CO1	Determine equivalent circuit parameters, efficiency and regulation of transformer by performing appropriate tests on the single phase transformer.
CO2	Justify the need of auto transformer.
CO3	Choose the type of connection and vector group of three phase transformer for specific application.
CO4	Calculate slip, speed, torque and parameters of equivalent circuit of 3 phase induction motor by performing appropriate tests on the same and through circle diagram.
CO5	Select the type of starters, speed control method for given application.
CO6	Identify the methods of starting single phase induction motors.

6. CO-PO, CO- PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Transformers & Induction Motors (TIM220309)	CO1	3	1	1	2	1	-	1	3	3
	CO2	3	1	-	1	-	-	-	3	3
	CO3	3	1	1	-	-	-	-	3	3
	CO4	3	2	1	2	-	-	-	3	3
	CO5	3	1	1	2	1	-	-	3	3
	CO6	3	-	1	-	-	-	-	3	3
	CO Avg.	3	1.2	1	1.75	1	-	1	3	3

7. COURSE CONTENTS

UNIT NO.	TOPIC/Sub-topic	CO
I	**Single Phase Transformers** 1.1. Working principle, need and role of transformer 1.2. Basic construction, types, comparison and classifications of transformer 1.3. E.M.F. Equation 1.4. Transformation ratio and rating 1.5. Ideal transformer, assumptions on no load and on load at different power factor, vector diagram 1.6. Practical transformer on no load and on load at different power factor, vector diagram 1.7. Equivalent circuit of a Transformer 1.8. Transformer losses 1.9. Open circuit test and short circuit test, Determination of the equivalent parameters from a OC/SC test 1.10. Equivalent circuits referred to any side (HV & LV side) 1.11. Voltage regulation of a transformer its computation 1.12. Efficiency of a transformer & condition for maximum efficiency 1.13. Distribution and power Transformer 1.14. All day efficiency 1.15. Per unit impedance, per unit reactance, per unit resistance 1.16. (Numerical based on above)	CO1
II	**Autotransformer** 2.1. Concept of Autotransformer 2.2. comparison with 2 winding transformer & potential divider 2.3. Copper saving 2.4. Advantages and disadvantages of auto-transformer, Uses	CO2
III	**Three Phase Transformers** 3.1. Construction of three phase transformer 3.2. Bank of Three single phase Transformers 3.3. Single unit of three phase Transformer 3.4. Three phase transformer connections and vector group 3.5. Cooling methods three phase transformer connections 3.6. Indian standards list for transformers	CO3

IV	**Three Phase Induction Motor** 4.1. Rotating magnetic field 4.2. Induction motor as generalized transformer 4.3. Construction, types and principle of three phase induction motor 4.4. Concept of slip & equation for rotor current, rotor e.m.f, Effect of slip 4.5. Torque equation, Condition for maximum torque 4.6. Torque-speed, Torque-slip curve, Full load torque and starting torque and maximum torque 4.7. Effect of change in rotor circuit resistance and supply voltage on torque-slip 4.8. Power stages of three phase Induction Motor 4.9. Equivalent circuit of an induction motor 4.10. No-load and block rotor test 4.11. Construction of circle diagram 4.12. Computation of performance characteristics for circle diagram. 4.13. Numerical based on above	CO4
V	**Starting and Speed Control of Induction Motors** 5.1. Necessity of starter for an induction motor 5.2. Starter for induction motor- Types, selection, comparison 5.3. Stator resistance type, rotor resistance type 5.4. auto transformer type, starts delta type starters 5.5. Power wiring diagram and control circuit diagrams of 5.5.1 Direct online starters. Starter using contactors - 5.5.2 Reverse - forward starter 5.6. Automatic and semi-automatic star - delta starters, interlocks. 5.7. Speed Control Methods: 5.7.1 Rotor rheostat control, 5.7.2 pole changing method, 5.7.3 Frequency changers and stator voltage.	CO5
VI	**Single Phase Induction Motor** 6.1. Double Field revolving theory and cross field theory 6.2. Construction, working principle and applications of 6.2.1 Resistance start induction run 6.2.2 Capacitor start induction run motor 6.2.3 Capacitor start and capacitor run motor	CO6

8. LIST OF PRACTICALS/ASSIGNMENTS/ TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 Experiments/ assignments/ drawing.

Sr. No.	Title of Experiment/Assignment/ Exercise/Tutorial/Drawings	Approx. Hrs. required	CO
1	To verify turns ratio of single phase transformer	2	CO1
2	To perform Open and Short circuit test on single phase transformer	4	CO1
3	To perform Load test on single phase transformer	4	CO1
4	To verify turns ratio of auto transformer	2	CO2
5	To study Three phase transformers: Basic configuration	2	CO3
6	To start 3 phase induction motor using DOL starter	2	CO5
7	To start 3 phase induction motor using Auto-transformer	2	CO5
8	To start 3 phase induction motor using Star-delta starter	2	CO5
9	To perform No load and blocked rotor test on 3 phase induction motor	4	CO4
10	To determine equivalent circuit parameters using Circle diagram of 3 phase induction motor	2	CO4
11	To perform Load test on 3 phase induction motor	4	CO4
12	To study single phase induction motor	2	CO6
	TOTAL	32	

9. TEACHER'S ASSESSMENT (TA): Assessment to be based on one of the following tools and rubrics for evaluation of TA to be well defined by course teacher.

1. Micro-Project
2. Seminar/ Presentation
3. Model/Chart making
4. Surveys
5. Case Study
6. Quiz

10. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum no of practical/assignments.
3. Industry visit
4. Guest/Expert lectures
5. Demonstrations
6. Slides
7. Self-Learning Online Resources

11. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Electrical Technology Vol – II	Theraja B. L. Theraja A. K.	S. Chand Co. New Delhi ISBN 10:8121924375
2	Electrical Machinery	Dr. P. S. Bimbra	Khanna Publishers
3	Theory and Performance of Electrical Machines	J. B. Gupta	Dhanpatrai & sons
4	Electrical Machines	Ashfaque Hussain	Khanna Publications

12. WEB REFERENCES:

1. www.nptel.iitm.ac.in
2. www.howstubworks.com
3. www.electrical4u.
4. www.electricalnotesandarticles.co.in
5. www.electricalportal.com.

13. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Single Phase Transformers	18	4	6	8	18
II	Autotransformer	04	2	4	-	06
III	Three Phase Transformers	07	4	4	-	08
IV	Three Phase Induction Motor	18	4	6	8	18
V	Starting and Speed Control of Induction Motors	10	4	4	4	12
VI	Single Phase Induction Motor	07	-	4	4	08
	TOTAL	64	18	28	24	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

14. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME
1	Internal	Ms. Urvi Sawant
2	Internal	Mr. N D Adate
3	External	Mrs. Vaishali Bhosale
		Organization: Government Polytechnic Mumbai

1.COURSE DETAILS:

Programme : Electrical Engineering	**Semester : III**
Course: Electrical & Electronic Measurements	**Group: C**
Course Code :EEM220310	**Duration : 16 Weeks**

2. TEACHING AND EXAMINATION SCHEME:

Scheme of Instructions and Periods per week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-	-	05	-	-	-	-	-	50	50	-	100

3. COURSE OBJECTIVE

The said course is classified as a core domain as an electrical engineering working with the industry will be in position to function as a Supervisor need to be familiarized with various techniques of measurements and also should be in a position to measure various electrical and parameters like voltage, current, resistance, inductance etc. using analog and digital instruments

4. SKILL COMPETANCY:

The aim of this course is to help the students to attain the following industry identified competency through various teaching-learning experiences:

- **Use relevant measuring instruments in different electrical and electronic applications**

5. COURSE OUTCOMES (CO's) at the end of course students will be able to: -

CO. No	COURSE OUTCOME
CO1	Choose appropriate instruments for measurement of voltage, current,
CO2	Select appropriate instrument transformer for measurement
CO3	Use appropriate instrument for measurement of resistance
CO4	Select suitable bridge for measurement of inductance, capacitance and frequency
CO5	Calibrate and choose instrument used for measurement of power and energy
CO6	Measure electrical parameters using digital instruments

6. CO-PO, CO-PSO MAPPING TABLE

Course and Code	Course Outcomes	Programme Outcomes							Programme Specific Outcomes	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
Electrical & Electronic Measurements (EEM220310)	CO1	2	-	-	3	1	-	-	2	2
	CO2	2	-	-	3	1	-	-	2	3
	CO3	3	-	-	2	1	-	-	3	2
	CO4	3	-	-	2	1	-	-	2	2
	CO5	3	2	2	2	2		-	2	3
	CO6	2	2	-	3	2	-	-	2	2
	CO Avg.	**2.50**	**2.00**	**2.00**	**2.50**	**1.33**	**-**	**-**	**2.17**	**2.33**

7. COURSE CONTENTS

Unit No.	Topic/Sub-Topics	CO
I	**Basics of Measurements and Measuring Instruments** 1.1 Importance of Measurement 1.2 System of units, standards and dimensions 1.3 Types of standards, Primary & Secondary standards for voltage, current and resistance. 1.4 Classification of Analog instruments 1.5 General Features of Indicating, recording & integrating instruments. 1.6 Torque acting on the moving system of indicating instruments. 1.7 Method of damping & damping curve 1.8 Principle of operation, Equation for deflecting torque, Usual scale distribution & its modifications, Sources of errors, remedies for errors & common usage of the following type of instruments 1.8.1 Permanent magnet moving coil instruments 1.8.2 Moving iron instruments 1.8.3 Electrodynamics or dynamometer type instruments 1.8.4 Induction instruments 1.8.5 Rectifier instruments. 1.9 Series register, shunts, universal shunts, multiplying power of a multiplier. Simple Numerical	CO1
II	**Instrument Transformer.** 2.1 Construction of Current transformers and potential transformers 2.2 Types of CT with specifications 2.3 Advantages of instrument Transformers over Shunts and Multipliers 2.4 Phasor diagram, phase angle, phase angle error, ratio error 2.5 Methods to minimize it. Simple Numerical	CO2
III	**Resistance Measurements.** 3.1 Classification of resistance as low, medium & high resistance 3.1.1 Voltmeter & ammeter method, 3.1.2 Substitution method, Potentiometer method	

	3.2 Bridge method –Wheatstone's bridge 3.2.1 Limitations of Wheatstone's bridge, 3.2.2 Kelvin double bridge for low resistance. 3.3 Measurements of high resistance. (Insulation Resistance) 3.3.1 Surface leakage & Guard Circuit 3.4 Measurements of high resistance by loss of charge method. 3.5 Ohm –meters, series type shunt type and Megger 3.6 Mega ohm bridge Simple Numerical	CO3
IV	**A.C Bridges.** 4.1 General theory of A.C Bridges 4.2 Different sources and detectors used for bridge circuits. 4.3 Different bridge networks, their balance equations & phasor diagrams under balanced conditions of 4.3.1 Maxwell's L- and L-C Bridge 4.3.2 Anderson bridge 4.3.3 Wein bridge, 4.3.4 Schering bridge – low voltage & high voltage bridge, Quality Factor , Dissipation factor and Loss angle	CO4
V	**Measurement of Power and Energy** 5.1 Power measurement using 5.1.1 Electrodynamics type 5.1.2 Induction type wattmeter 5.2 Measurement of three phase power 5.2.1 One wattmeter method 5.2.2 Two-wattmeter method for balance and unbalanced loads and star and delta connection. 5.3 Variation of the ratio of the wattmeter reading against the power factor of the load. 5.4 Measurement of reactive power for balanced load. 5.5 Poly-phase wattmeter. 5.6 Measurement of energy using analog Energy meter 5.6.1. Principle of operation, 5.6.2 Equation for torque, 5.7 Different adjustment in ac energy meter. 5.8 Construction and working principle of Electronic energy meter 5.9 Introduction to poly-phase energy meter. 5.10 Calibration of single phase energy-meter with various types of loads by direct loading. Simple Numerical	CO5
VI	**Electronic Instruments.** 6.1 Digital multimeter 6.2 Digital L-C-R Meter. 6.3 Digital Tachometer, Digital frequency meter 6.4 Digital Storage oscilloscope. 6.5 Measurement of Time, Frequency & phase angle measurements	CO6

8. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISE/TUTORIALS/DRAWINGS

The term work consists of journals consisting of minimum 10 experiments/assignments with approx. number of hours required with corresponding CO's

Sr. No	Title of Experiments/Assignments/Exercise/Tutorials/Drawings	Approx Hrs. Required	CO's
1	Identify the constructional details of analog ammeter /voltmeter/Wattmeter	02	CO1
2	Measurement of Resistance using Wheatstone bridge method	02	CO 3
3	Calibration of dc analog energy-meter.	02	CO 5
4	Calibration of ac single-phase electronic energy meter by direct loading.	02	CO 5
5	Measurement of three phase power by one wattmeter method	02	CO 5
6	Measurement of three-phase power by two-wattmeter method.	02	CO 5
7	Appreciate the variation of the ratio of two-wattmeter reading against power factor	04	CO 5
8	Measurement of reactive power	02	CO 5
9	Measurement of Insulation resistance using Loss of Charge method	02	CO 3
10	Study of Electronic energy meter	02	CO 6
11	Study of LCR Meter	02	CO 6
12	Study of CT construction working and applications	04	CO2
13	Study of PT construction working and applications	04	CO2
14	Assignment on AC Bridges	-	
TOTAL		**32**	

9. IMPLEMENTATION STRATEGY: (PLANNING)

1. Teaching plan
2. Minimum no of Practical's/Assignments
3. Industrial Visit
4. Guest/Expert Lectures
5. Demonstrations
6. Slides
7. Continuous assessment for lab works
8. Self-learning Online Resources

10. SUGGESTED LEARNING RESOURCES:

Sr.No.	Title of Book	Author	Publication
1	Electrical measurements and Instrumentation	A.K.Shawney	Dhanpatrai& sons, New Delhi ISBN:9780000279744
2.	Electrical Measurements & Measuring Instruments	N.V Suryanarayana	S Chand & Co, New Delhi ISBN: 8121928116
3	Electrical Measurements	C.T.Baldwin	Lyall book Dept. Delhi
4.	Electrical Measurements & Measuring instruments	E.W Golding	A.H.Wheeler& Co.
5.	Modern Electronic Instrumentation and Measurement Techniques.	Helfrick and Cooper	Prentice-Hall of India, Reprint 1988
6	Electrical and Electronics Measurements & Instrumentation	R K Rajput	S Chand & Co, New Delhi ISBN: 9789385676017

11. WEB REFERENCES:

1. www.automaticelectrical.com
2. www.nptel.com
3. www.test-meter.co.uk/

12. COURSE EXPERT COMMITTEE MEMBERS:

Sr.No		**Name**
1.	Internal	Shri N D Adate
2.	Internal	Ms. Urvi Sawant
3.	External	Dr..M. S. Narkhede
		Organization : G P Mumbai,