GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Electrical Engineering / Renewable Energy

Course / Subject Code: DI02000171

Course / Subject Name: AC Fundamental

W. E. F. Academic Year:	2024-25
Semester:	2nd
Category of the Course:	PCC

Prerequisite:	**Acquaintance with basic concepts and law of electrical circuits and magnetic circuits**
Rationale:	Most of electrical power generation, transmission, distribution, and utilization are in the form of alternating current. Therefore, it is essential for students of diploma electrical engineering to know fundamental concepts of AC and principles of series, parallel and three phase AC circuits to solve electrical circuits. This course is not only a prerequisite to learn the advanced electrical courses but also diploma students undertaking this course are expected to apply the principle of ac circuits to troubleshoot electrical circuits in industries/power system. This is one of the most important core engineering courses for electrical technocrats and hence students should try to develop mastery over fundamental concepts and principles of AC circuits for effective working as an electrical engineer.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Interpret various terminologies, waveform, and vector representation of alternating quantities.	A
02	Apply principles of AC series circuit to solve electrical circuits	A
03	Apply principles of AC parallel circuit to solve electrical circuits	A
04	Apply principles of three phase system to solve electrical circuits	A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Fundamentals of Alternating Voltage and Current** Contents: (1) Comparison between AC and DC System (2) Principle of generation of alternating voltage (3) Sinusoidal Function Terminology: (a) Define terms - wave form, cycle, time period, frequency, amplitude and angular frequency (b) State relations among these terminologies (c) Different forms of sinusoidal quantities (4) Various values of sinusoidal alternating quantities: (a) Define terms - instantaneous value, maximum value, average value, RMS value, peak factor, and form factor (2) State relations among these values (5) Phase difference between alternating quantities: lagging and leading quantities (6) Vector representation of alternating quantity (7) Addition of alternating quantities using vector: Graphical and Analytical method (8) Transfer of vector from rectangular form to polar form and vice-versa (9) Mathematical operation of vectors (10)Numerical based on fundamentals of alternating quantities	12	29 %
2.	**Single Phase AC Series Circuits** Contents: (1) Behavior of AC through pure resistive, inductive and capacitive circuit: (a) State equations of voltage, current, power and power	12	29 %

	factor (b) Define term - inductive and capacitive reactance (c) draw wave form and vector diagram of voltage, current and power. (2) Behavior of AC through RL, RC, and RLC series circuit: (a) Derive equation of current, power and power factor (b) Draw wave form and vector diagram of voltage and current (c) Draw impedance triangle (3) Concepts of power factor: lagging, leading and unity power factor (4) Active power, reactive power, apparent power and power triangle (5) Resonant condition and resonance frequency in RLC series circuit (6) Numerical based on AC series circuits and series resonance		
3.	**Single Phase AC Parallel Circuits** Contents: (1) Phasor (Vector) method for solving AC parallel circuits. (2) Terms related to AC parallel circuits:(a) Define term- admittance, conductance and susceptance (b) Draw admittance triangle (3) Admittance method for solving AC parallel circuits. (4) Complex algebra method for solving AC parallel circuits. (5) Resonance condition and resonant frequency in parallel AC circuits (6) Comparison between series and parallel resonance (7) Numerical based on AC parallel circuits and parallel resonance	09	19 %
4.	**Three Phase System and Circuits** Contents: (1) Comparison between single and three phase systems (2) Principle of generation of three phase alternating voltage (3) Three phase system terminology: (a) Define term - phase sequence, balanced & un- balanced supply, balanced & un-balanced load (b) state importance of these terminologies (4) Values of voltage and current in three phase system: Define terms- line voltage, phase voltage, line current and phase current (5) Three phase star connection (6) Three phase delta connection (7) Numerical based on three phase circuits	12	23 %
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25 %	**35 %**	**40%**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with Place, Year and ISBN
1	A text book of Electrical Technology Volume-I (Basic Electrical Engineering)	B. L. Theraja & A.K. Theraja	S. Chand and Co., New Delhi, 23 edition or Latest edition (ISBN: 9788121924405)
2	Elements of Electrical Engineering	U.A. Patel	Atul Prakashan, Ahmedabad 2010 edition or latest edition
3	Principles of Electrical Engineering	B. R. Gupta	S. K. Kataria & Sons, New Delhi, Latest edition (ISBN-9788121901031)
4	Fundamentals of Electrical Engineering	Tarlok Singh	S. K. Kataria & Sons, New Delhi, Latest edition (ISBN: 9789350140680)
5	Basic Electrical Engineering	K. Uma Rao and A. Jayalakshmi	Pearson Education, New Delhi Latest Edition (ISBN: 9789385909283)
6	Basic Electrical and Electronics Engineering	Ravish. R. Singh	Tata McGraw Hill Education Pvt. Ltd., New Delhi 2018 edition or Latest edition (ISBN-978007026092)
7	Fundamentals of Electrical Engineering and Electronics	S.K. Sahdev	Dhanpatrai & Co., New Delhi Latest edition (ISBN: 978877002027)

8	Principles of Electrical Engineering and Electronics	V.K. Mehta Rohit Mehta	S. Chand and Co., New Delhi (ISBN: 9789352837199)

(b) Open-source software and website:

1. https://nptel.ac.in/courses/108/105/108105112/
2. https://nptel.ac.in/courses/108/105/108105053/
3. https://lectures.gtu.ac.in/(related to course content)
4. https://circuitglobe.com/
5. https://www.electronics-tutorials.ws/accircuits
6. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/
7. https://www.electricaltechnology.org/
8. www.vlab.co.in
9. www.khanacademy.org
10. https://ndl.iitkgp.ac.

Suggested Course Practical List:

Sr. No.	Practical Outcome/Title of experiment	CO 1	CO2	CO3	CO4
1	Demonstrate waveforms of alternating quantities using CRO and function generator	√			
2	Use CRO to measure peak value, RMS value, time period and frequency of alternating quantity	√			
3	Measure voltage, current, and power through pure resistor.		√		
4	Measure inductance and internal resistance of choke coil.		√		
5	Measure voltage, current, power and power factor in RL series circuit.		√		
6	Measure voltage, current, power and power factor in RC series circuit.		√		
7	Measure voltage, current, power and power factor in RLC series circuit.		√		
8	Measure resonance frequency and resonant impedance in RLC series circuit.		√		

9	Measure voltage, current, power and power factor in RL parallel circuit.			√	
10	Measure voltage, current, power and power factor in RC parallel circuit.			√	
11	Measure voltage, current, power and power factor in RLC parallel circuit.			√	
12	Verify line & phase voltage and line & phase current relation for three phase star connection.				√
13	Verify line & phase voltage and line & phase current relation for three phase delta connection.				√
14	Measure voltage, current, power and power factor in three phase circuits				√
15	Test relation between power consumption in three phase star and delta connected load.				√

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications
01	Single phase variac: 10A, Output 0-270V AC for Input of 230V 50Hz AC
02	Single phase choke coil :230V, 50Hz, 2KVAR
03	Single phase capacitor bank: 230V, 50Hz, 2KVAR
04	Three phase variac: 20A, Output 0-415V for Input of 415V 50Hz AC
05	Single phase resistive load bank or lamp loads: 230V, 2KW
06	Three phase lamp loads suitable for making three phase star and delta connection
07	Three phase Induction Motor - D. C. Generator set
08	CRO or DSO
09	Function Generator
09	Ammeter:0-1A/0-5A/0-10A
11	Voltmeter:0-50V/0-150V/0-300V/0-500V

Suggested Project List:

1. Build model to demonstrate generation of alternating EMF

2. Build single phase lamp load
3. Build three phase lamp load
4. Build inductive load bank
5. Build capacitive load bank
6. Build lamp loads suitable for making three phase star and delta connection
7. Prepare chart of generation of alternating voltage.
8. Prepare chart for phase difference between alternating quantities
9. Prepare chart of waveforms and vector diagram of voltage, current and power in purely resistive, inductive and capacitive circuits.
10. Prepare chart of graphical representation of series and parallel resonance
11. Prepare chart of waveforms and vector diagram of three phase voltage.
12. Prepare chart for three phase star and delta connection with current and voltage relations.
13. Build model to demonstrate various concepts and principles of AC circuits

Suggested Activities for Students:

Beyond classroom and laboratory learning, the following co-curricular activities are recommended to enhance the achievement levels of various outcomes in this course. Students are encouraged to undertake these activities either individually or in groups and prepare comprehensive reports of approximately five pages for each activity. Additionally, students should gather and document physical evidences for their portfolios, which could be beneficial during placement interviews:

a) Project Model / Seminar Presentations: Demonstrate project models or deliver seminars on various topics covered in the course content.

b) Numerical Problem Solving: Work on numerical problems provided in tutorial problems.

Assignments /Tutorial problems should be distributed unit-wise, and students should seek progressive assessment from the concerned course facilitators throughout the term. At the end of the term, the entire body of work should be submitted to the respective course facilitators for evaluation.

These activities will not only reinforce the theoretical understanding but also provide practical exposure and critical thinking opportunities essential for professional growth.

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