GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

AC CIRCUITS
(Code: 3330901)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

Most of electrical power generation, transmission, distribution and utilization are in the form of alternating current. Therefore it is essential for every electrical engineer to know the behaviour of resistance, capacitance, inductance and related concepts in AC systems.

This course is not only a prerequisite to learn the advanced electrical courses and develop the skills but also enable the students 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 engineers and hence students should try to develop mastery over concepts of AC circuits for effective working as an electrical engineer.

2. COMPETENCY (Programme Outcome according to NBA Terminology):

The course content should be taught and with the aim to develop different types of skills so that students are able to acquire following competency:

- **Apply the principles of AC circuits to maintain electrical systems**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**ESE**	**PA**	**ESE**	**PA**	**150**
03	02	02	7	70	30	20	30	

Legends: L - Lecture; **T -** Tutorial/Teacher Guided Student Activity; **P -** Practical; **C -** Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I AC Fundamentals	1a. Explain generation of alternating EMF. 1b. Define various electrical parameters 1c. Derive equation for RMS and average value of sinusoidal wave.	1.1 Principle of generating an alternating voltage 1.2 Cycle, Time period, Frequency, Amplitude, Phase and Phase difference, Average value, R.M.S. value, Form factor, Peak Factor and Power Factor
	1d. Explain the vector representation and mathematical operations of alternating vector quantities 1e. Solve numerical based on AC fundamentals	1.3 Vector representation of alternating quantities, addition, subtraction, multiplication and division
Unit – II AC Series circuits	2a. Explain the behaviour of AC voltage, current and power through pure resistance, pure inductance and pure capacitance with sketches	2.1 Waveforms, phasor diagram and expression of voltage, current and power in pure: Resistance, Inductance, Capacitance
	2b. Explain behaviour of AC voltage, current and power through RL, RC and RLC series circuit with sketches	2.2 AC through RL, RC, LC, RLC series circuit
	2c. Explain resonance in RLC series circuit with sketches 2d. Solve numerical based on AC series circuits and series resonance.	2.3 Resonant frequency and Resonance condition in RLC series circuit
Unit – III AC Parallel Circuits	3a. Explain behaviour of AC voltage, current and power through RL, RC and RLC parallel circuit.	3.1 Solution of AC RL, RC, LC and RLC parallel circuits using phasor method. 3.2 Solution of AC RL, RC, LC and RLC parallel circuits using admittance method.
	3b. Explain resonance in RLC parallel circuit.	3.3 Resonant frequency and resonance condition in parallel AC circuits
	3c. Solve numerical based on AC parallel circuit and parallel resonance	3.4 Numerical based on AC parallel circuits and parallel resonance.
Unit – IV Poly phase circuits	4a. Explain generation of three phase alternating voltage. 4b. Differentiate between single and three phase circuits. 4c. Distinguish between line and phase voltage, line and phase currents in 3-phase AC circuits 4d. Describe the star and delta connection with phasor diagrams	4.1 Principle of generation of three phase alternating voltage. 4.2 Line and phase voltage, line and phase current 4.3 Single and three phase circuits 4.4 Three-phase star connection 4.5 Three phase delta connection

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – V Power in AC Circuits	5a. Explain the concept of active power, reactive power and power factor with power triangle 5b. Explain the concept of lag and lead	5.1 Active, reactive and apparent power with examples. 5.2 Lagging, leading power and unity power factor
	5c. Illustrate the effects of power factor	5.3 Effects of poor power factor.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	AC Fundamentals	10	06	06	04	16
II	AC Series circuits	10	06	06	06	18
III	AC Parallel circuits	08	04	05	05	14
IV	Poly phase circuits	08	05	05	04	14
V	Power in AC Circuits	06	04	02	02	08
Total		**42**	**25**	**24**	**21**	**70**

Legends: R = Remember; U = Explain; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
1.	I	Use CRO to measure peak value, RMS value, Period and frequency of alternating quantity.	2
2.	II	Measure of inductance and resistance of choke coil and also the active power through resistor	2
3.	II	Measure voltage, current, power and power factor in a series RL circuit with relevant phasor diagram.	2
4.	II	Measure voltage, current, power and power factor in a series RC circuit with relevant phasor diagram.	2
5.	II	Measure voltage, current, power and power factor in a series RLC circuit with relevant phasor diagram.	2
6.	II	Measure voltage, current, power and power factor in a RL parallel circuit with relevant phasor diagram.	2

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Apprx. Hrs. Required
7.	III	Measure voltage, current, power and power factor in a RC parallel circuit with relevant phasor diagram.	2
8.	III	Measure voltage, current, power and power factor in a RLC parallel circuit with relevant phasor diagram.	2
9.	III	Measure voltage, current, power and power factor for combined series-parallel circuits	2
10.	III	Identify of electrical components (R, L, C) using high frequency generator.	4
11.	III	Measure resonance frequency and resonant impedance in RLC series circuit.	2
12.	IV	Test voltage and current relation for 3 phase star and delta connections.	2
13.	V	Measure active and reactive power of three phase circuits.	2
		Total	**30**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Preparing journals based on experiments performed in laboratory
ii. Assignments for solving numerical

8. SPECIAL INSTRUCTION STRATEGY (If ANY)

i. Students should be shown animations/video films to explain the principle of ac wave form and ac circuits
ii. Tutorial hours should be used to develop the ability in students to solve the numerical problems related to ac wave form and circuits. It is must because only by solving the numerical they would develop the understanding of the ac wave form and circuits. Students must be classified in three groups i.e. academically weak students, average students and good students and they should be given problem according to their abilities in each unit. This would provide them a challenge which they can face without indulging in unfair means.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Electrical Technology Vol-1	Theraja, B. L.	S. Chand, New Delhi, 2011 or latest
2	Principles of Electrical Engineering	Gupta, B. R.	S. K. Kataria & Sons, New Delhi, 2011 or latest
3	Basic Electrical Engineering	Rao, Uma. K.	Pearson Education, New Delhi, 2011 or latest
4	Basic Electrical Engineering	Murthy, R. S.	Pearson Education, New Delhi, 2011 or latest
5	Fundamentals of Electrical Engineering	Singh, Tarlok	S. K. Kataria & Sons, New Delhi, 2011
6	Basic Electrical and Electronics Engineering	Singh, Ravish. R.	Tata Mc Graw Hill Education Pvt.Ltd., New Delhi, 2011.

B) List of Major Equipment/Materials with Broad Specifications

i. Ammeter: 0A-1A/0A-5A/0A-10A
ii. Voltmeter: 0V-50V/0V-150V/0V-300V/0V-500V
iii. Wattmeter: 0-1000W(5A/10A,300V/600V)
iv. Multimeter: $5^{1/2}$ digits resolutions with all basics measurement facility like DC Voltage: 200 mV ~ 1000 V, DC Current: 200 μA ~ 10 A, AC Voltage: True-RMS, 200 mV ~ 750 V, AC Current: True-RMS, 20 mA ~ 10 A, 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ, Capacitance Measurement: 2 nF ~ 10000μF, Frequency Measurement: 20 Hz ~ 1 MHz etc., 0.015% DC Voltage Accuracy.
v. CRO: 30 MHz Bandwidth, 2 channel, 20 ns sampling time
vi. Function generator: 10 HZ to 10MHZ , 10 Vpp , rise & fall time =20ns, manual / external triggering
vii. RF ammeter:
viii. Choke coil: 0- 80 mH, variable choke coil
ix. Single phase variac : 0-300V/ 1KVA

C) List of Software/Learning Websites

i. Electronic Work bench or Circuit maker
ii. www. kpsec.freeuk.com
iii. www.howstuffworks.com/

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. R.L. Patel**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Jamnagar
- **Prof. M. J. Aghara**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Rajkot
- **Prof. A.A. Amin**, Sr. Lecturer, Electrical engineering Department, Govt. Polytechnic, Vadnagar
- **Prof.(Mrs) V.R. Kotdawala**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Himmatnagar.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Joshua Earnest**, Professor, Department of Electrical Engineering
- **Dr. (Mrs.) C.S. Rajeshwari**, Professor & Head Department of Electrical Engineering