### 2.3 ELECTRICAL NETWORKS

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##### RATIONALE

This course intends to teach the students facts, concepts and principles of circuits and circuit analysis so that he/she can use the knowledge in acquiring supervisory skill to assist in carrying out the analysis & investigation work.

##### COURSE OUTCOMES

At the end of this subject, the student will be able to:

CO1: Understand mesh, nodal methods, different network theorems and applying them to solve DC circuits.

CO2: Remember the concept of ac circuit, resonance, power factor and their significance. CO3: Apply the basic principles and solve the A.C. series and parallel circuit.

CO4: Recognize the concept of Poly-phase system and compute the electrical parameters.

##### DETAILED CONTENTS UNIT I

**DC Network Theorems**

* 1. Mesh analysis
  2. Nodal analysis using voltage and current sources
  3. Superposition theorem
  4. Thevenin theorem
  5. Norton theorem
  6. Maximum power transfer theorem
  7. Active and passive network, Linear and Non Linear network

##### UNIT II

**AC Fundamentals**

* 1. Generation of alternating Voltage and current. Difference between ac and dc, Equation of alternating quantity.
  2. AC Terminology: waveform, cycle, frequency, time period, amplitude, instantaneous value, alternation, and their important relations (time period and frequency, angular velocity and frequency etc.)
  3. Values of alternating voltage and current: Instantaneous value, peak value average value,

r.m.s. value, form factor and peak factor

* 1. Vector representation of alternating quantities
  2. Concept of phase, phase difference and phasors
  3. Representation of electrical quantities through phasors
  4. Addition of two alternating quantities: parallelogram method, component method

##### UNIT III

**Single Phase AC Series Circuits**

* 1. A.C circuit containing pure Resistance, Inductance, Capacitance with the concept of power consumed, phase Angle, inductive and capacitive reactance etc.
  2. AC series circuit: R-L, R-C, R-L-C along with the concept of phasor diagram, phase angle , Impedance, impedance triangle, power, power triangle etc.
  3. Concept of True power, apparent power and reactive power, Power factor and its significance, disadvantages of low power factor, cause of low power factor, improvement of power factor.
  4. Active and reactive components of current
  5. Resonance in RLC series circuit, Quality (Q) factor

##### UNIT IV

**Single Phase AC Parallel Circuits**

* 1. Concept of AC parallel circuit
  2. Methods of solving parallel AC circuit: vector method, admittance method, symbolic or J-method
  3. Parallel Resonance, Q-factor
  4. Comparison of series and parallel resonance.
  5. Introduction to transient and Harmonics in A.C. circuits

##### UNIT V

**Polyphase Circuit**

* 1. Principle of generation of 3 –ø alternating emf.
  2. Advantages of Polyphase circuit over single phase circuit, Phase Sequence.
  3. Types of three phase connections-Star connection and delta connection.
  4. Concept of balanced and unbalanced load.
  5. Relation between phase and line quantities of star and delta connection.

##### PRACTICAL EXERCISES

1. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
2. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
3. Verification of Superposition Theorem.
4. Verification of Thevenin’s theorem.
5. Verification of Norton’s Theorems.
6. Verification of Maximum Power transfer Theorem.
7. Observe the wave shape of an alternating supply on CRO and calculate average, RMS value, frequency and time period.
8. Measure input current, power, power factor of R-L series circuit and draw the power triangle.
9. Measure input current, power, power factor of R-C series circuit and draw the power triangle.
10. Measure input current, power, power factor of R-L-C series circuit and draw the power triangle.
11. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
12. To determine current, p.f., active, reactive and apparent power in R-C parallel A.C. circuit.
13. To determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
14. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
15. Verify the relationship between phase and line values of current and voltages and power in balanced and unbalanced star connected load.
16. Verify the relationship between phase and line values of current and voltages and power in balanced and unbalanced delta connected load.

##### RECOMMENDED BOOKS

1. Ashfaq Husain, “Networks & Systems”, Khanna Book Publishing, New Delhi, 2019.
2. D.Roy Chouhary, “Networks and System”, New Age International Publishers, 1988.
3. B.R Gupta, Singhal, Vandana, “Fundamentals of Electrical Network”, S.Chand and Co., New Delhi, ISBN: 978-81-219-2318-7, 2005.
4. S.B Lal Saxena, K Dasgupta, “Fundamentals of Electrical Engineering”, Cambridge University Press Pvt. Ltd., New Delhi, ISBN: 978-11-0746-435-3.
5. B. L Theraja, A. K Theraja, “A Text Book of Electrical Technology Vol-I”, S. Chand & Co. Ramnagar, New Delhi, ISBN: 9788121924405.
6. A Sudhakar, S. Palli Shyammohan, “Circuit and Network”, McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4.
7. David A Bell, “Electric Circuits”, Oxford University Press New Delhi, ISBN: 978-01- 954-2524-6.
8. R.L Boylested, “Introductory Circuit Analysis”, Wheeler, New Delhi, ISBN: 978-00-231- 3161-5.
9. V.N Mittle, Arvind Mittle, “Basic Electrical Engineering”, McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2.
10. S.N Sivanandam, “Electric Circuit Analysis”, Vikas Publishing House Pvt. Ltd, Noida, ISBN: 978-81259-1364-1.
11. S. Salivahanan, S Pravinkumar, “Circuit Theory”, Vikas Publishing House Pvt. Ltd, Noida; ISBN:978-93259-7418-0.

##### INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

1. Teachers may take help of various models and charts, you-tubes video’s, e-learning resources while studying the contents of the subject to the students so that the concepts should be clear. More emphasis should be laid on discussing and explaining practical applications.
2. Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles.
3. Preparing students to apply the technological method of problem solving to a real life problems. This quality is buildup in the students when students practice the numerical problems of the subject. Teachers should motivate students to solve the numerical problems of subject. Teachers must ask 30% of numerals problems in sessional test and final semester exam of this subject.
4. Teachers should expose to different learning tools used in respective labs, Operational safety and Procedure to be followed in the laboratory. Students may ask to make micro projects by using the idea as learning in the subject.
5. Activity- Theory - Demonstrate/practice approach may be followed throughout the coursesso that learning may be skill and employ-ability based.
6. Teachers take assignments, seminar, quiz, viva -voce etc. to enhance the learning ability of the students.
7. Students must have to perform at least 12 experiment in the laboratory.