Semester	**:**	**I**			
Course No.	**:**	**REE-111**	**Credit Hrs.**	**:**	**3(2+1)**
Course Title	**:**	**Basic Electrical Gadgets and Instruments**			

SYLLABUS

Objectives:

(i) To enable the students to take up repair and maintenance of different common electrical gadgets.

(ii) To acquire the basic knowledge of instruments used for scientific measurements.

THEORY

Introduction to different electrical appliances used in agricultural buildings, structures and farm operations; Difference between AC and DC supply system; Introduction to AC fundamentals; AC through series RL, RC, and RLC circuits, parallel AC circuit, series and parallel resonance; Q-factor and bandwidth. Three-phase AC circuit: Concept of balanced three-phase AC circuits, line and phase quantity in star and delta network, power in three-phase circuit, various methods of three phase power measurement like (one wattmeter and two-wattmeter method). Diode and its applications: Rectifier, Clipper, Clamper, voltage multiplier and capacitive filter zener diode as voltage regulator. Transistor and its applications: Bipolar junction transistor, operating point. Various biasing methods, fixed, self-biasing and potential divider biasing method; OP-AMP, Ideal OP-AMP characteristics, Linear and non-linear applications of OP-AMP (adder, subtractor, integrator, active rectifier, comparator). Introduction to digital electronics and logic gates: Basic theorem of Boolean algebra, Combinational logic circuits (basic gates, SOP rule and K-map), binary adder. Principles of general instruments, measurement of displacement, temperature, velocity, force and pressure using different instruments like, strain gauges, load cell, thermistors, thermocouples, pyrometer, linear variable differential transformer (LVDT), capacitive transducers, RTD, instruments for measurement of speed, wind velocity, solar radiation, anemometer, multimeter etc.

PRACTICAL

BASIC ELECTRICAL AND ELECTRONICS GADGETS

To prepare an electrical switch board to control two light points, one plug point, one fan point and fuse (House wiring); To prepare an electrical switch board to control two light points using two two-way switch (staircase wiring); To connect and test a fluorescent lamp; To find faults and repair home appliances such as heater, electric iron, fans and mixer-grinder, etc.; To find faults and repair UPS; To measure the power requirement and power factor in a AC single phase series RLC circuit; To measure energy of a single phase AC circuit with the help of ammeter, voltmeter and power factor meter and energy meter; To measure the power consumption in a three-phase circuit using two-wattmeter method.

INSTRUMENTATION

To prepare a DC power supply unit using diode and filter circuit; To study the Zener diode as voltage regulator circuit; To study transistor characteristics in CE configurations; To verify different logic gates; To measure unknown resistance using Wheatstone bridge; To measure the displacement and to determine the characteristics of LVDT; To measure the displacement using LVDT and potentiometer; To measure the pressure using strain gauge and Bourden tube; To measure the temperature using RTD, thermistors and thermocouple and study their characteristics; To measure the speed, wind velocity, solar radiation etc., using different measuring tools like tachometer, anemometer, pyranometer, multimeter, etc.; To acquaint with different other types of instruments used in agriculture and food processing application

TEACHING SCHEDULE

THEORY [REE-111]

Lecture No.	Topic	Sub-topics/Key Points	Weightage (%)
1	Introduction to different Electrical Appliances used in Agricultural Buildings Structures and Farm Operations. Difference between AC and DC Supply systems.	Brief Introduction of electrical appliances used in: Electrified Dairy Farm, Electrified Fruit and Vegetable Farm, Electrified Livestock Farm, Electrified Poultry Farm, Electrified General Farm, Electrified Farm Shop, Definitions and Concepts of Time period, Frequency, Magnitude, Waveform to differentiate A.C. and D.C.	5
2-4	Introduction to AC Fundamentals	Generation of Alternating Voltages and Current Equation of Alternating Voltages and Current Cycle, Time Period, Frequency, Amplitude Different Forms of E.M.F equation Phase and Phase Difference, Root Mean-Square (R.M.S) Value and its Analytical Derivation Average Value and its Analytical Derivation Form, Crest or Peak or Amplitude Factor A.C Through Pure Ohmic Resistance, Pure Inductance and Pure Capacitance Alone.	10
5-6	AC through series RL, RC and RLC Circuits	A.C. Through Resistance and Inductance. Definition and Concept of Power Factor, Active Power, Reactive Power and Apparent Power. A.C. through Resistance and Capacitance A.C. through Resistance Inductance and Capacitance. Examples on A.C. through Resistance and Inductance.	
7	Parallel AC Circuit	Solving Parallel Circuit by Vector or Phasor Method	5
	Series and Parallel Resonance	Resonance in R-L-C series Circuit and in Parallel Circuit.	
	Q-factor and Bandwidth	Brief concept Q factor and Bandwidth	

Continued…

8-10	Three-phase AC Circuit	Concept of balanced three-phase AC circuits Generation of Poly phase Voltage. Phase sequence. Interconnection of Three Phases,	10
	Line and Phase Quantity in Star and Delta Network	Star or Wye Connection, Voltages and Currents in Star or Wye Connection, Delta or Mesh Connections; Voltages and Currents in delta or Mesh Connection	
11	Power in Three-phase Circuit	Power Measurement in 3-Phase Circuits, Three wattmeter Method, Two wattmeter Method (Balanced or Unbalanced Load), One Wattmeter Method.	5
12-16	Diode and its Applications	Principal, Types and Uses of Rectifier and Capacitive filter.	5
		Principal, Types and Uses of Clipper, Clamper, Voltage multiplier and Zener diode as Voltage regulator	5
17-19	Transistor and its Applications	Working principle of : Bi-polar junction Transistor with CE, CB, CC Operating point; Various biasing methods (viz., fixed, self and potential divider biasing methods).	10
20-22	Operational Amplifier (OP-AMP) and its Application	Basic concept of OP-AMP and its Ideal Characteristics; Linear and Non-linear applications of OP-AMP (adder, subtractor, integrator, active rectifier, comparator)	10
23-25	Introduction to Digital Electronics	Concept and Working of Logic gates. Basic theorem of Boolean Algebra. Combinational Logic circuits (Basic gates, Introduction to K-Map binary adder and SOP rule)	10
26-32	Measuring Instrumentation (Transducer and Sensors)	Principles of General instrumentation system with Block diagram; Electrical measurement of: Displacement [like, Linear variable differential transformer (LVDT), Capacitive transducers, Strain gauge]	10
		Temperature (Thermistors, Thermocouples, RTD, Pyrometer); Force (Strain gauge, Pressuductor load cell)	5
		Pressure (Strain gauges, Load cell, Capacitive, Potentiometric); Speed (Resonance tachometer, Eddy current Tachometer)	5
		Wind velocity (Anemometer); Solar radiation (Pyranometer).	5
		Total	**100**

TEACHING SCHEDULE

PRACTICAL [REE-111]

Exercise No.	Exercise Title
1	To prepare an electrical switch board to control two light points, one plug point, one fan point and fuse (House wiring).
2	To prepare an electrical switch board to control two light points using two two-way switch (Staircase wiring).
3	To connect and test a fluorescent lamp.
4	To find faults and repair home appliances such as heater, electric iron, fans and mixer-grinder and UPS etc.
5	To measure the power requirement and power factor in an AC single phase series RLC circuit.
6	To measure energy of a single-phase AC circuit with the help of ammeter, voltmeter and power factor meter and energy meter.
7	To measure the power consumption in a three-phase circuit using two-wattmeter method.
8	To prepare a DC power supply unit using diode and filter circuit.
9	To study the Zener diode as voltage regulator.
10	To study transistor characteristics in CE configurations.
11	To verify different logic gates.
12	To measure unknown resistance using Wheatstone bridge.
13	To measure the displacement and to determine the characteristics of LVDT and Potentiometer.
14	To measure the pressure using strain gauge and Bourden tube.
15	To measure the temperature using RTD, thermistors and thermocouple and study their characteristics.
16	To measure the speed, wind velocity, solar radiation etc., using different measuring tools like tachometer, anemometer, pyranometer, multimeter etc.

Suggested Readings [REE-111]:

1. Boylestad R L and Nashelsky L N. 2011. Electronic Device and Circuit Theory. Pearson.
2. Ghosh S. 2007. Fundamentals of Electrical & Electronics Engineering, 2nd Ed PHI Learning, New Delhi.
3. Metha V K and Metha R. 2012. Basic Electrical Engineering, Fifth edition. S Chand & Co., New Delhi.
4. Metha V K and Metha R. 2012. Principle of Electronics, Fifth edition. S Chand & Co., New Delhi.
5. Rajput R K. 2007. Basic Electrical and Electronics Engineering. Laxmi Publications, New Delhi.
6. Theraja B L and Theraja A K. 2005. A Text Book of Electrical Technology Vol. I. and II, S Chand & Co., New Delhi.
7. Robert H. Brown, Farm Electrification. Allied Pacific Private Limited Bombay, Indian Edition.
8. Singh S K, Industrial Instrumentation and control, third edition, published by Tata McGraw-Hill Companies.