Course title: Energy Science Lab			
Course code: DSE 109	**No. of credits:** 3	**L-T-P:** 15-00-60	**Learning hours:** 75
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering			
Course coordinator: Prof. Naqui Anwer		**Course instructor:** Prof. Naqui Anwer/ Dr Ramkishore Singh	
Contact details: naqui.anwer@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 1	

Course Description:
Laboratory experiments help in better understanding of the subjects discussed in the classes. The experiments based on basic principles related to energy stimulate students for further investigation and their application.

Course objectives:

- To provide hands-on experience on experimental setups related to basic electrical circuits
- To provide practical learning about the basic operation of electrical circuits and equipment
- To provide hands-on experience on experimental setups related to basic thermal science
- To provide practical learning about the basic operation of equipment used in determination of heat transfer coefficients, thermal mass transer and related experiments

Course content

Module	Topic	L	T	P
1.	**Familiarization with common equipment** Selection of wire and its gauge and electrical parameter measuring devices (Ammeter, Voltmeter, wattmeter, Rheostat, loading devices) while drawing single-phase and three-phase circuits (star/delta)	1		4
2.	**Identification of various components** Identification of various active (diode, transistor) and passive (R,L,C) electronic components To note how the LEDs, resistors, and connecting wires use the columns for electrical connectivity within the breadboard.	1		4
3.	**Resistance Measurement** Measure the value of a given resistor and to confirm with colour code	1		4
4.	**Verification of Laws** • Verification of Ohm's Law • Verification of KCL • Verification of KVL	1		4
5.	**Combinations of components in circuits** Series and parallel circuits for single phase load and measurement of current drawn	1		4
6.	**Power Measurement** Use of voltmeter, ammeter, and wattmeter to determine active, reactive and apparent power consumed in given RLC series circuit.	1		4

7.	**Power Measurement for domestic load** Construction of single phase circuit /electrical network to run domestic load and measurement of power drawn	1		4
8.	**Multiway Switch/ Sensor based switching** Construction of multiway switching circuit to lightup staircase	1		4
9.	**Thermal Conductance** To find the overall thermal conductance and plot the temperature distribution in case of a composite wall.	1		4
10.	**Thermal Convection** To find out the temperature distribution along the length of a Pin Fin under free convection.	1		4
11.	**Stefan Boltzmann constant** To find out the Stefan Boltzmann constant.	1		4
12.	**Temperature Measurement** To perform error analysis test on different temperature measuring sensors and their calibration w.r.t standard reference.	1		4
13.	**Water Boiling Test** To perform water boiling test (WBT) method- Cold Start, Hot Start and Simmer Start.	1		4
14.	**Calorific Value** To determine calorific value of a given sample of biomass solid fuel.	1		4
15.	**Determination of Moisture & Volatile Matter** To determine the moisture, volatile matter, ash and fixed carbon contents in a given coal lignite and biomass solid fuel.	1		4
	Total	15	0	60

Evaluation criteria

Test 1: Performance during experiments - 30%
Test 2: Viva-voce (at the end of the semester) - 30%
Test 3: Practical Exam (at the end of the semester) - 20%
Test 4: Practical Records (spread over the entire semester) - 20%

Learning outcomes

After completing this course, students would be able to:

- Identify various electrical components and appreciate various equipment used in 1-φ and 3-φ circuits
- understand series and parallel circuits
- measure power in domestic load
- use voltmeter, ammeter and wattmeter in different circuits
- verify Ohm's law, KVL, KCL
- understand practical concept of transfer of heat through conduction and connection
- Measure temperature of materials and understand the change in characteristics
- Determine calorific value of different types of fuel materials
- Determine moisture content, volatile matter, ash content and carbon content in different types of fuel materials

Pedagogical approach

Students complete a procedure given in the laboratory manual to determine the behaviour of the equipment/prototypes/experimental setups and produce the expected characteristics
Materials: • Kulshreshtha, D.C. Basic Electrical Engineering. Tata McGraw Hill, New Delhi.2012 • Herman, Stephen L.. The Complete Laboratory Manual for Electricity. United States: Thomson/Delmar Learning, 2004. • YA Cengel and AJ Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", Tata McGraw Hill, 4th edition, 2011 • Robert Alan Granger, "Experiments in Heat Transfer and Thermodynamics", Cambridge University Press, 1994
Additional information (if any): N.A.
Student responsibilities Attendance, discipline, feedback as per TERI SAS rules

Course reviewers:

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