Course title: Energy lab – I (Power system lab and heat transfer lab)

Course code: ENR 101	**No. of credits:** 2	**L-T-P:** 0-0-60	**Learning hours:** 60

Pre-requisite course code and title (if any): N.A.

Department: Sustainable Engineering

Course coordinator: Prof. Naqui Anwer	**Course instructor(s):** Prof. Naqui Anwer / Dr. Ramkishore Singh

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Course type: Programme Core	**Course offered in:** Semester 1

Course description

To work in power industry, it is very important to develop an expertise to handle various power system equipmentslike synchronous machine, DC machine, Induction machine, transformers and transmission lines. This laboratory is designed to give students a hands-on experience on different equipment of electrical power system.

Heat Transfer is one of the important subjects which is commonly applied in renewable energy, industrial, commercial and domestic systems. The experiments are designed to provide exposure of practical aspects of the
various theoretical concepts developed under the various courses. The laboratory consists of experiments on various conductive, convective, radiative, boiling and condensing mechanisms of heat transfer.

Course objectives

- To provide hand-on experience on experimental set ups/prototypes related to power system and heat transfer.
- To provide practical learning about construction and operation of power system equipment and heat transfer equipments.

Course contents

Module	**Topic**	**L**	**T**	**P**
	Transmission & Distribution			
1	ABCD parameters of short, medium and long transmission lines	0	0	3
	To determine the performance of transmission line under different loading condition.	0	0	2
	Induction Machine			
2	To vary the speed of an induction motor by varying voltage and to change the direction of rotation.	0	0	2
	To perform the no load test and block rotor test on an induction motor.	0	0	3
	To perform the load test on an induction motor.	0	0	2
	Transformer			
3	To operate two transformers in parallel and study the load sharing between them.	0	0	3
	To perform the OC and SC test and Polarity test.	0	0	2
	Sumpner's back to back test on a transformer and determine the circuit model parameters.	0	0	2
	To calculate regulation at full and unity power factor of a single phase transformer.	0	0	2
	DC Machines			

4	To study speed control of DC motor above the normal range by field control and to plot speed vs field current characteristics. To obtain load characteristics of DC shunt motor.	0 0	0 0	3 3
5	**Power System Analysis** To understand reactive power and power factor in single-phase and three-phase circuits. To find the OCC and SCC of an alternator. To simulate the different types of faults in a power system.	0 0 0	0 0 0	3 3 3
6	**Conduction**	0	0	3
	Measurement of thermal conductivity of an insulating slab.			
7	**Natural Convection** Measurement of heat transfer coefficient in natural convection on vertical cylinder.	0	0	3
8	**Radiation** Measurement of emissivity of a grey surface Impact of temperature on attaining steady state condition	0	0	6
9	**Heat Exchanger** Estimation of overall heat transfer coefficient for tube in tube type heatexchanger in counter flow mode. Estimation of overall heat transfer coefficient for shell and tube heat exchangerwith water on both sides. Estimation of overall heat transfer coefficient for shell and tube heat exchangerwith thermic fluid on one and water on the other side.	0 0 0	0 0 0	3 3 3
10	**Forced Convection** Measurement of convective heat transfer coefficient in a pipe by forced convection.	0	0	3
	Total	**0**	**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

- Students shall be able to understand the characteristics and behaviour of various power system equipments andheat transfer systems through experimental verification.
- Students are expected to learn the integrated operation and mathematical modelling of the power systemequipments.

Pedagogical approach

Students complete a procedure given in the laboratory manual to determine the behaviour of the equipments/prototypes/experimental set ups and produce the expected characteristics.

Materials **Recommended** **readings** D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis", Tata McGraw-Hill, 3rd edition, 2014 D.P. Kothari and I.J. Nagrath, "Electrical Machines", Tata McGraw-Hill, 4th edition, 2010Prabha Kundur, "Power System Stability and Control", McGraw-Hill Inc., 1994 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):NA
Student responsibilities Attendance, feedback, discipline: as per university rules.

Course Reviewers

1. Dr. M. Rizwan, Assistant Professor (Electrical Engineering), Delhi Technological University, New Delhi
2. Prof. S. Maji, Department of Mechanical Engineering, SOET, IGNOU, New Delhi