

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (09) APPLIED THERMAL AND HYDRAULIC ENGINEERING SUBJECT CODE: 2140907 B.E. 4th SEMESTER

Type of Course: Engineering Science

Prerequisite: Nil

Rationale: The course is designed to give fundamental knowledge of thermal and hydraulic prime movers, heat transfer, properties of fluid and pumps.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE(V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	0	3	70	20	10	0	0	0	100

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Module 1. Engineering application of thermodynamics -Steam power cycle-Rankine cycle, thermal efficiency, methods of improvement of thermal efficiency -regenerative and reheat. Mollier diagram. Gas turbine cycle- thermal efficiency, Brayton cycle, methods of improvement of thermal efficiency -regenerative, intercooler and reheat. Refrigeration-vapour compression refrigeration system, air cycle refrigeration system -bell column cycle, simple air craft refrigeration system-psychometric chart. (Simple numerical problems).	10	25
2	Module 2. Modes of Heat Transfer, Fourier Law of Conduction and Thermal Conductivity, Conduction of Heat Through A Slab, Conduction of Heat transfer through Hollow Cylinder, Convection and Heat Transfer Coefficient, Natural and Forced Convection, Combined Conduction and Convection Heat Transfer, concept of thermal resistance. Critical thickness of insulation. Fins and their application. Heat Through composite wall and cylinder. Introduction to Radiation Heat Transfer, Concept of Black Body, Monochromatic and Total Emissive Power, Concept of Gray Body and Emissivity, Kirchoff's Law, Heat Exchangers, LMTD, Overall Heat Transfer Coefficient, parallel and counter flow heat exchangers. (Simple numerical problems).	10	25
3	Module 3. Fluid Mechanics - Fluid properties density, viscosity, surface tension and capillarity Newton's Law of viscosity, Absolute and gauge pressure. Manometers, Bourdon tube pressure gauge. Pressure exerted by a liquid column. Simple numerical	10	25

	problems. Fluid dynamics Continuity equation, one dimensional flow along a streamline - Euler's momentum equation, Bernoulli's equation. Flow measuring instruments-Venturimeter, orifice meter, nozzle meter, notches and weirs, Pitot tubes (simple numerical problems).		
4	Module4. Main Parts of a Centrifugal Pump, Work Done by the Centrifugal Pump (or by Impeller) on Water, Definitions of Heads and Efficiencies of a Centrifugal Pump, velocity diagram, Multistage Centrifugal Pumps, Specific Speed of a Centrifugal Pump, Priming of a Centrifugal Pump, Characteristic Curves of Centrifugal Pumps, Cavitation, Maximum Suction Lift (or Suction Height), Net Positive Suction Head (NPSH): Positive displacement pumps- Reciprocating pumps: main parts, discharge work done and power required to drive a slip in a reciprocating pump simple (simple problems only), Turbines: Definitions of Heads and Efficiencies of a Turbine, Classification of Hydraulic Turbines, Pelton Wheel: main parts, Velocity Triangles and Work Done for Pelton Wheel, Radial Flow Reaction Turbines-Francis turbine: main parts, Velocity Triangles and Work Done by water on runner, Degree of Reactions, draft tube, specific speed, Characteristic Curves (simple problems only).	12	25

Suggested Specification table with Marks (Theory):

Remembrance R Level	Understanding U Level	Application A Level	Analyze N Level	Evaluate E Level
11	17	16	15	14

Legends: R: Remembrance; U: Understanding; A: Application and above Levels (Revised Bloom's 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

Reference Books:

1. D. S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K.Kartha and sons.
2. R. K. Bansal, Fluid Mechanics and Hydraulic machine, Laxmi Publications.
3. P. K. Nag, Power Plant Engineering, Tata McGraw Hill
4. Holman. J.P, Heat Transfer, McGraw Hill Publishing Co. Ltd.
5. D. S. Kumar, Heat and Mass Transfer, S K Kataria & Sons

Course Outcomes:

After learning the course the students should be able to:

Comprehend the concepts of Heat transfer, Fluid mechanics, engineering thermodynamics and Hydraulic machines (Hydraulic pump & Hydraulic Turbine) Correlate the fundamentals of Heat transfer, Fluid mechanics, Thermodynamics and Hydraulic engineering with various mechanical system.

Understand various thermodynamic cycle, working of various mechanical equipments and use of various charts used in Thermal science.

List of Open Source Software/learning website: <http://nptel.iitm.ac.in/courses.php>

Active Learning Assignments (ALA): Preparation of power-point slides: which may include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus can be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of faculty and the department.