19AE211 ENGINEERING THERMODYNAMICS AND HEAT TRANSFER

Source :
comsol.comheat-transfer-module

Hours Per Week :

L	T	P	C
3	0	2	4

Total Hours :

L	T	P
45	-	30

CS	WA/RA	SSH	SA	S	BS
5	5	30	20	5	5

COURSE DESCRIPTION AND OBJECTIVES:

This course provides fundamental concepts in thermodynamics, first and second laws of thermodynamics, entropy and energy, Ideal and real gases and non-reactive ideal gas mixtures and general thermodynamic properties. The objective of this course is to impart analytical and practical problem solving skills in thermodynamics.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to achive the follwoing out comes

COs	Course Outcomes	POs
1	Understand the first and second laws of thermodynamics and their applications.	10
2	Apply the knowledge to distinguish the various thermodynamic properties,	10,12
3	Analyze the concepts of open and closed system, boundary conditions, work and heat interactions.	4,9,10,
4	Develop an understanding of various work interactions, cycles and subsequently apply first and second law of thermodynamics.	9,10,
5	Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility.	9,10

SKILLS:

- ✓ *Identify the type of systems, open or closed systems*
- ✓ *Identify reversible and irreversible processes*
- ✓ *Identify properties of ideal and real gases*
- ✓ *Estimate critical wall thickness of insulation*

UNIT – I **L-10**

BASIC CONCEPT AND LAWS OF THERMODYNAMICS Basic concepts, Concept of continuum, Macroscopic approach, Thermodynamic systems, Closed, Open and isolated. Property, State, Path and process, Quasi-static process, Work, Modes of work, Zeroth law of thermodynamics, Concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics SFEE (Steady flow energy equation – continuity equation). Application to closed and open systems, Second law of thermodynamics, Reversibility and irreversibility. Carnot cycle reversed Carnot cycle, Efficiency, COP. Thermodynamic temperature Scale, Clausius inequality, Concept of entropy and availability.

UNIT – II **L-8**

IDEAL REAL GASES AND THERMODYNAMIC RELATIONS: Gas mixtures, Properties of ideal and real gases, Equation of state, Avagadro's law, Vander Waal's equation of states, Compressibility, and compressibility chart. Dalton's law of partial pressure, Exact differentials, T-D, Relations, Maxwell relations, Clausius Clapeyron equations, Joule Thomson Coefficient.

UNIT – III **L-9**

PROPERTIES OF STEAM: – DRYNESS FRACTION – CONDITIONS OF STEAM –wet, dry, saturated and super heated steam. problems Lenoir, Striling, Ericsson, Brayton Superheated steam. Simple problems using steam tables and moillier chart.Power cycles- Lenoir, Striling, errricsson and Bryton cycles.

UNIT – IV **L-9**

AIR COMPRESSORS: Types of air compressors, Single acting and double acting air compressors,Effect of clearance volume, Volumetric efficiency, Isothermal efficiency,Multistage compression- effect of intercooling, Condition for minimum work. Refrigeration system-VCR, VAS-winter, summer, year round air conditioning system

UNIT – V **L-9**

HEAT TRASNFER: Modes of heat transfer One-dimensional Heat Conduction: Plane wall, Composite walls, Cylinder, Sphere, Heat transfer through extended surfaces (simple fins).Convection film heat transfer coefficient: Free convection and forced convection (parallel and counter flow, LMTD and AMTD), Radiation: Black–Gray bodies,Wein's law.

TEXT BOOKS:

1. Nag.P.K. "Engineering Thermodynamics", Tata McGraw-Hill, 2009.
2. R.K.Rajput "Applied Thermodynamics", Laxmi Publishing Co., 2009.

REFERENCES BOOKS:

1. Holman.J.P., "Thermodynamics", 3rd edition. McGraw-Hill, 2007.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" Tata McGraw Hill, 2004
3. Arora C.P, "Thermodynamics", Tata McGraw Hill, 2003.
4. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics", Prentice-Hall, 2005.

LABORATORY EXPERI MENTS

LIST OF EXPERIMENTS **TOTAL HOURS : 30**

THERMODYNAMICS

1. Conduct a Grease penetration Test to determine the penetration of the grade grease
2. Viscosity measurement using Redwood viscometer and Saybolt Viscometer
3. Aniline point measurement
4. Carbon residue, cloud and pour point measurement
5. Flash and fire point measurement
6. Water tube and fire tube boilers demonstration
7. Boiler mountings and accessories study and demonstration
8. Dryness fraction measurement of steam using steam calorimeter
9. Steam condenser efficiency measurement
10. Steam turbine blade efficiency measurement

HEAT TRANSFER

1. Overall heat transfer co-efficient measurement using Composite Slab Apparatus
2. Heat Transfer measurement through lagged pipe
3. Heat Transfer measurement through a Concentric Sphere
4. Conduct an experiment to find the Thermal Conductivity of given metal rod
5. Conduct an experiment to determine the heat transfer through pin-fin
6. Conduct an Experiment on the study of Transient Heat Conduction
7. Conduct an experiment to study the heat transfer in forced convection apparatus
8. Study of Heat transfer in natural convection
9. Conduct an experiment to study the working principle of concentric tube heat exchanger operating under Parallel and counter flow
10. Emissivity apparatus: Study of radiation heat transfer by black body and test plate
11. Conduct an experiment on Stefan Boltzman Apparatus to verify the Stefan Boltzman law
12. Study of heat transfer in drop and film wise condensation
13. Critical Heat flux apparatus to visualize the pool boiling over the heater wire
14. Study of heat pipe and its demonstration
15. Conduct an experiment on Shell and tube heat exchanger to find out the heat transfer coefficient