Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEB02

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - II

B.Tech III Semester End Examinations, November/December – 2019

Regulations: IARE - R18

ENGINEERING THERMODYNAMICS

(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. a) Differentiate thermal equilibrium and thermodynamic equilibrium with and example. **[7M]**
   b) When a stationary mass of gas was compressed without friction at constant pressure, its initial state of 0.4m3 and 0.105MPa was found to change to final state of 0.20m3 and 0.105MPa. There was a transfer of 42.5kJ of heat from the gas during the process. Determine the change in internal energy of the gas? **[7M]**

2. a) Explain second law of thermodynamics and write about Joule's experiment with help of a neat sketch explains detail. **[7M]**
   b) Piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle the sum of all heat transfers is -170kJ. The system completes 100cycles/minute. Complete the following table showing the method for each item and compute net rate of work output in kW. **[7M]**

MODULE – II

3. a) Write the Kelvin-Planck and Clausius statements and explain with sketches. **[7M]**
   b) heat engine is operating between two reservoirs 1000K and 300K is used to drive a heat pump which extracts heat from the reservoir at 300K at a rate twice that at which the engine rejects the heat to it. If the efficiency of the engine is 40% of the maximum possible and COP of heat pump is 50% of the maximum possible, then determine the temperature of the reservoir to which the heat pump rejects heat. Also determine the rate of heat rejection from the heat pump, if the rate of heat supply to the heat engine is 50kW? **[7M]**

4. a) Explain the limitations of First law of thermodynamics in detail? Explain about thermal reservoir with a neat sketch? **[7M]**
   b) An air-water vapour mixture enters an adiabatic saturation chamber at 28°C and leaves at 18°C, which is the adiabatic saturation temperature. The pressure remains constant at 1.0 bar. Determine the relative humidity and humidity ratio of the inlet mixture. **[7M]**

MODULE – III

5. a) Draw the phase equilibrium diagram on p-v coordinates for a substance which shrinks in volume on melting and then for a substance which expands in volume on melting. Indicate there on the relevant constant property lines. **[7M]**

   b) A large insulated vessel is divided into two chambers, one containing 5 kg of dry saturated steam at 0.2 MPa and the other 10 kg of steam, 0.8 quality at 0.5 MPa. If the partition between the chambers is removed and the steam is mixed thoroughly and allowed to settle, find the final pressure, steam quality, and entropy change in the process. **[7M]**

6. a) Enumerate the Perfect Gas Laws and analyze from thermodynamics point of view? **[7M]**

   b) Moist air at 1 atm. pressure has a dry bulb temperature of 32o C and a wet bulb temperature of 26o C. Calculate a) the partial pressure of water vapour, b) humidity ratio, c) relative humidity, d) dew point temperature, e) density of dry air in the mixture, f) density of water vapour in the mixture and g) enthalpy of moist air using perfect gas law model and psychrometric equations. **[7M]**

MODULE – IV

7. a) Obtain an expression for the air standard efficiency on a volume basis of an engine working on the Otto cycle. And represent the processes on p-V and T-S diagrams. **[7M]**

   b) An air refrigeration open system operating between 1 M Pa and 100 k Pa is required to produce a cooling effect of 2000 kJ/min. Temperature of the air leaving the cold chamber is – 5°C and at leaving the cooler is 30°C. Neglect losses and clearance in the compressor and expander. Determine : (i) Mass of air circulated per min. (ii) Compressor work, expander work, and cycle work (iii) COP and power in kW required **[7M]**

8. a) What is an air standard cycle? What are the limitations of air standard cycle? State the assumptions to be taken for its analysis **[7M]**

   b) A Bell-Coleman refrigerator operates between pressure limits of 1bar and 8bar. Air is drawn from the cold chamber at 90C, compressed and then it is cooled to 290C before entering the expansion cylinder. Expansion and compression follow the law pV1.35=C. Calculate theoretical C.O.P of the system. Take ɣ of air is 1.4. **[7M]**

MODULE – V

9. a) Show that, for estimating radial heat conduction through a cylindrical wall, the log-mean area of the inner and outer surfaces to be considered. **[7M]**

   b) Water flows inside a tube 5 cm in diameter and 3 m long at a velocity 0.8 m/s. determine the heat transfer coefficient and the rate of heat 1ra11sfer if the mean water temperature is 50°C and the wall i.s isothermal at 70°C. For water at 60°C, take K = 0.66 W/mK, v= 0.478 x t0·6m2/s, and Pr= 2.98. **[7M]**

10 a) Obtain volumetric efficiency of single stage reciprocating compressor with clearance volume and without clearance volume. **[7M]**

   b) What is the optimum pressure ratio for perfect inter cooling in between two stages of compression? The inlet and outlet pressures may be taken as P1 and P2 **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

S. No	Description
I	Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.
II	Apply knowledge of pure substances, mixtures, usage of steam tables and Mollier chart, psychrometric charts
III	Understand the direction law and concept of increase in entropy of universe.
IV	Understand the working of ideal air standard, vapour cycles and evaluate their performance in open systems like steam power plants, internal combustion engines, gas turbines and refrigeration systems.
V	Understand the basic concepts of heat transfer and working and types of heat exchangers.

COURSE OUTCOMES (COs):

CO 1	Understand basics of thermodynamics along with basic laws of thermodynamics.
CO 2	Understand the limitations of first law of thermodynamics and different forms of second law of thermodynamics.
CO 3	Describe the properties of pure substances with help of phase diagrams and also understand the psychrometric properties.
CO 4	Understand different processes in different standard cycles and calculate efficiencies of each cycle.
CO 5	Understand working of heat exchangers, different types of heat exchangers and working of them.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

AAEB02.01	Understand the basic terms and terminologies of thermodynamics along with different view point of thermodynamic systems.
AAEB02.02	Get knowledge about concept of temperature and explain zeroth law of thermodynamics and also about quality of temperature.
AAEB02.03	Explain about first law of thermodynamics and its various corollaries along with Joules experiment.
AAEB02.04	Understand the limitations of first law of thermodynamics.
AAEB02.05	Explain about thermal reservoir, heat pump, heat engine and parameters of performance.
AAEB02.06	Explain second law of thermodynamics, Kelvin planck and Clausius statement of it.
AAEB02.07	Understand the Kelvin planck and Clausius equivalence, corollaries and understand about perpetual motion machine one.
AAEB02.08	Understand the term entropy, its principle and how it influences the availability and irreversibility of thermodynamic potentials.
AAEB02.09	Understand pure substances and phase diagrams and about terms triple point and critical point.
AAEB02.10	Understand how properties like wet bulb temperature, dry bulb temperature, dew bulb temperature help in building mollier chart and psychrometric chart.

AAEB02.11	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.
AAEB02.12	Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.
AAEB02.13	Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application.
AAEB02.14	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.
AAEB02.15	Understand about working of heat exchangers and different types of heat exchangers.
AAEB02.16	Understand the working of gas compressors and air compressors and different types of air compressors.

MAPPING OF SEMESTER END EXAMINATION TO COURSE OUTCOMES

SEE Question No.		Course Learning Outcomes		Blooms' Taxonomy Level
1	a	AAEB02.02	Get knowledge about concept of temperature and explain zeroth law of thermodynamics and also about quality of temperature.	Understand
	b	AAEB02.02	Get knowledge about concept of temperature and explain zeroth law of thermodynamics and also about quality of temperature.	Understand
2	a	AAEB02.01	Understand the basic terms and terminologies of thermodynamics along with different view point of thermodynamic systems.	Remember
	b	AAEB02.03	Explain about first law of thermodynamics and its various corollaries along with Joules experiment.	Understand
3	a	AAEB02.04	Understand the limitations of first law of thermodynamics	Understand
	b	AAEB02.05	Explain about thermal reservoir, heat pump, heat engine and parameters of performance.	Understand
4	a	AAEB02.07	Understand the Kelvin planck and Clausius equivalence, corollaries and understand about perpetual motion machine one.	Remember
	b	AAEB02.06	Explain second law of thermodynamics, Kelvin planck and Clausius statement of it.	Understand
5	a	AAEB02.11	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.	Understand
	b	AAEB02.11	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.	Understand
6	a	AAEB02.10	Understand how properties like wet bulb temperature, dry bulb temperature, dew bulb temperature help in building mollier chart and psychrometric chart.	Remember
	b	AAEB02.11	Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.	Understand
7	a	AAEB02.13	Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application.	Remember
	b	AAEB02.12	Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.	Understand
8	a	AAEB02.15	Understand about working of heat exchangers and different types of heat exchangers.	Understand
	b	AAEB02.14	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.	Understand
9	a	AAEB02.16	Understand the working of gas compressors and air compressors and different types of air compressors.	Understand
	b	AAEB02.15	Understand about working of heat exchangers and different types of heat exchangers.	Understand

SEE Question No.		Course Learning Outcomes		Blooms' Taxonomy Level
10	a	AAEB02.15	Understand about working of heat exchangers and different types of heat exchangers.	Remember
	b	AAEB02.16	Understand the working of gas compressors and air compressors and different types of air compressors.	Understand

Signature of Course Coordinator **HOD, AE**