Hall Ticket | | | | | | | | | | | No.Question Paper Code: AMEB04

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

B.Tech III Semester End Examinations, May - 2019

Regulations: R18

THERMODYNAMICS

(Mechanical 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) State the Carnot's principle? What is the importance of the principle, explain? **[7M]**
   b) A fluid is confined in a cylinder by a spring loaded friction less piston, so the pressure in the fluid is a linear function of volume (p=a+bV).The internal energy of the fluid is given by the following equation U=34+3.15pV. Where U is in kJ, p in kPa and V is in m3. If the fluid changes from initial state of 170kPa, 0.03m^3 to a final state of 400kPa, 0.06m^3 with no work other than that done on the piston. Define the direction and magnitude of work and heat transfer. **[7M]**

2. a) Derive exit velocity for nozzle by considering steady flow energy equation? **M]**
   b) Air flows steadily at the rate of 0.5kg/sec through an air compressor, entering at 7m/sec velocity, 100kPa pressure and 0.95m^3/kg volume and leaving at 5m/sec, 700kpa and 0.19m^3/kg. The internal energy of air leaving is 90kJ/kg greater than that of air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW.Compute the rate of shaft work input to the air in KW. **[7M]**

MODULE – II

3. a) State the Carnot's principle? What is the importance of the principle, explain? **[7M]**
   Two bodies of equal capacities C and T1 and T2 from an adiabatically closed system. **[7M]**
   b) Determine the final temperature, if the system is brought to an equilibrium state. i) Freely, ii) reversibly, Proceed to calculate the maximum work which can be obtained from the system?

4. a) Write the Kelvin-Planck and Clausius statements and explain with sketches? **[7M]**
   b) Three Carnot engine are arranged in series. The first engine takes 4000kJ of heat from a source at 2000K and delivers 1800kJ of work. The second and third engines deliver 1200kJ and 500kJ of work respectively. Compare the exhaust temperature of second and third Carnot engines? **[7M]**

MODULE – III

5. a) State the expression for Vander Wall's equation and determine the constants? **[7M]**

   b) A steam power plant uses steam at boiler pressure of 150 bars and temperature of 550°C with reheat at 40 bars and 550°Cat condenser pressure of 0.1 bar. Find the quality of steam at turbine exhaust, cycle efficiency and the steam rate., enthalpy, entropy. **[7M]**

6. a) Why can not a throttling calorimeter measure the quality, if the steam is wet? Explain how is the quality been measured? **[7M]**

   b) Ata temperature of 423K,1 kg of nitrogen occupies volume of 200 liters. The gas undergoes constant expansion with fully resisted to a volume of 360 liters. Then the gas expanded isothermally to a volume of 500 liters. Sketch the process on p-V and T-S diagram. Find out overall change in entropy. **[7M]**

MODULE – IV

7. a) Explain the adiabatic saturation. And compare with degree of saturation. **[7M]**

   b) A mixture of hydrogen and oxygen is to be made, so that the ratio of H2 to O2 is 2:1 by volume. If the pressure and temperature are 1bar and 250C, respectively. Calculate mass of oxygen required and volume of the container? **[7M]**

8. a) Using definitions of mass and mole friction derive a relation between them. **[7M]**

   b) Air at 200C, 40% RH is mixed adiabatically with air at 400C, 40%RH in the ratio of 1kg of the former with 2kg of later (on dry basis).Find the final condition of air? **[7M]**

MODULE – V

9. a) Classify the assumptions to be made for the analysis of all air standard cycles? **[7M]**

   b) An engine working on Otto cycle has a volume of 0.45m^3 pressure 1bar and temperature 30^0C at the beginning of the compression stroke. At the end of the compression stroke the pressure is 11bar. 210kJ of heat is added at constant volume. Determine efficiency and mean effective pressure. **[7M**

10. a) Discuss limited pressure cycle, represent the processes of it on P-V diagram? **[7M]**

    b) 28tonnes of ice from and at 0^0C is produced per day in an Ammonia refrigerator. The temperature range in the compressor is from 25^0C to - 15^0C. The vapor is dry and saturated at the end of the compression and expansion valve is used. Assuming the C.O.P of 62% of the theoretical. Calculate power required to drive the compressor? **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:

I	Understand the laws of thermodynamics and determine thermodynamic properties, gas laws
II	Knowledge of properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts
III	Understand the direction law and concept of increase in entropy of universe.
IV	Understand the working of ideal air standard, vapor cycles and evaluate their performance in open systems like steam power plants.

COURSE OUTCOMES (COs):

CO 1	Describe the basic concepts and first law of thermodynamics.
CO 2	Describe the second law of thermodynamics and understand the concept of entropy and third law of thermodynamics.
CO 3	Understand the Pure Substances various thermodynamic processes.
CO 4	Understand the concept of mixtures of perfect gases and psychometric properties.
CO 5	Develop the concept power cycle with description and representation on P-V and T-S diagram.

COURSE LEARNING OUTCOMES (CLOs):

AMEB04.01	Understand the concepts of conservation of mass, conservation of energy.
AMEB04.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes.
AMEB04.03	Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.
AMEB04.04	Derive the first law of Thermodynamics from the concept of conservation of energy
AMEB04.05	Discuss the nature of steady and unsteady processes under the influence of time.
AMEB04.06	Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations based on Carnot Cycle.
AMEB04.07	Develop the second law of thermodynamics from the limitations of first law.
AMEB04.08	Knowledge of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems.
AMEB04.09	Discuss pressure-temperature, volume-temperature, pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.
AMEB04.10	Understand the inter relationship between thermodynamic functions and an ability to use suchrelationships to solve practical problems.
AMEB04.11	Understand the equation of state, specific and universal gas constants, throttling and free expansion processes.
AMEB04.12	Discuss deviations from perfect gas model, Vander Waals equation of state.
AMEB04.13	Understand mole fraction, mass friction, gravimetric and volumetric analysis, volume fraction
AMEB04.14	Discuss dalton‘s law of partial pressure, Avogadro‘s laws of additive volumes, and partial pressure, equivalent gas constant.
AMEB04.15	Understand enthalpy, specific heats and entropy of mixture of perfect gases.

AMEB04.16	Understand the process of psychrometry that are used in the analysis of engineering devices like air conditioning systems
AMEB04.17	Develop Otto, Diesel, Dual combustion cycles, description and representation on P-V and T-S diagram.
AMEB04.18	Discuss thermal efficiency; mean effective pressures on air standard basis.
AMEB04.19	Understand the comparison of various cycles
AMEB04.20	Understand introduction to Brayton cycle and Bell Coleman cycle.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Bloom's Taxonomy Level
1	a	AMEB04.01	Understand the concepts of conservation of mass, conservation of energy.	CO 1	Understand
	b	AMEB04.02	Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes.	CO 2	Understand
2	a	AMEB04.04	Derive the first law of Thermodynamics from the concept of conservation of energy.	CO 4	Understand
	b	AMEB04.04	Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.	CO 3	Understand
3	a	AMEB04.08	Knowledge of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statementof the equilibrium condition for closed and open systems.	CO 8	Remember
	b	AMEB04.06	Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations based on Carnot Cycle.	CO 6	Understand
4	a	AMEB04.09	Knowledge of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems.	CO 9	Remember
	b	AMEB04.07	Discuss pressure-temperature, volume-temperature, pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems	CO 7	Understand
5	a	AMEB04.07	Develop the second law of thermodynamics from the limitations of first law.	CO 7	Remember
	b	AMEB04.10	Understand the inter relationship between thermodynamic functions and an ability to use such relationships to solve practical problems..	CO 10	Remember
6	a	AMEB04.11	Understand the equation of state, specific and universal gas constants, throttling and free expansion processes..	CO 11	Understand
	b	AMEB04.12	Discuss deviations from perfect gas model, Vander Waals equation of state.	CO 12	Understand
7	a	AMEB04.13	Understand masonry, English and Flemish bonds. Finishing plastering painting and know about building services.	CO 13	Remember
	b	AMEB04.13	Understand the types of properties of wood, aluminum and manufacture of glass.	CO 13	Understand
8	a	AMEB04.16	Understand the process of psychometric that is used in the analysis of engineering devices like air conditioning systems.	CO 16	Understand
	b	AMEB04.16	Understand the process of psychometric that is used in the analysis of engineering devices like air conditioning systems.	CO 16	Remember

9	a	AMEB04.17	Develop Otto, Diesel, Dual combustion cycles, description and representation on P-V and T-S diagram.	CO 17	Understand
	b	AMEB04.20	Understand introduction to Brayton cycle and Bell Coleman cycle.	CO 20	Remember
10	a	AMEB04.20	Understand introduction to Braytoncycle and Bell Coleman cycle.	CO 20	Understand
	b	AMEB04.17	Develop Otto, Diesel, Dual combustion cycles, description and representation on P-V and T-S diagram.	CO 17	Understand

Signature of Course Coordinator **HOD, ME**