3E1633

B.Tech. (Sem.III) (Main/Back) Examination, 2015
Mechanical Engineering
3ME3 Engineering Thermodynamics

e : 3 Hours

Total Marks : 80
Min. Passing Marks : 26

ructions to Candidates :
mpt any five questions selecting one question from each unit. All questions carry equal marks. Schematic grams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of ntities used/calculated must be stated clearly.

UNIT - I

(a) What is the zeroth law of thermodynamics. Consider a system whose temperature is 18°C. Express this temperature in R, K, and °F. (8)
(b) The main water line into a tall building has a pressure of 600 kPa at 5 m below ground level. A pump brings the pressure up so the water can be delivered at 200 kPa at the top floor 150 m above ground level. Assume a flow rate of 10 kg/s liquid water at 10°C and neglect any difference in kinetic energy and internal energy μ . Find the pump work. (8)

OR

(a) Explain intensive and extensive properties. Classify the following properties as intensive or extensive:
Mass, energy, temperature, volume, specific volume, density. (8)
(b) A nozzle receives 0.1kg/s of steam at 1 MPa and 400°C with negligible kinetic energy. The exit is at 500 kPa and 350°C, and the flow is adiabatic. Find the nozzle exit velocity and the exit area. (8)

UNIT – II

(a) Explain carnot cycle on T-S and P-V diagram. Give the reason, why carnot cycle is practically not possible? (8)
(b) The interior lighting of refrigerator is provided by incandescent lamps whose switches are actuated by the opening of the refrigerator door. Consider a refrigerator whose 40W light bulb remain on continuously as a result of the malfunction of the switch. If the refrigerator has a coefficient of performance of 1.3 and cost of the electricity is Rs. 8 per kWh, determine the increase in the energy consumption of the refrigerator and its cost per year if the switch is not fixed. (8)

OR

(a) An inventor claims to have developed a refrigerator that maintains the refrigerated space at –3°C while operating in a room where the temperature is 22°C and that has a coefficient of performance of 13.5. Is this claim reasonable? (8)
(b) A heat source of 800 k loses 2000 kJ of heat to sink at (i) 500 k and (ii) 750 k. Determine which heat transfer process is more irreversible. (8)

UNIT – III

(a) Derive Maxwell relation and explain their importance in thermodynamics. (12)
(b) Write Clapeyron equation, what is its importance in thermodynamics. (4)

OR

(a) What is Joule-Thomson coefficient, define it? What is it's significance? (8)
(b) What is compressibility factor? What is the role of generalized compressibility chart in thermodynamics. (8)

UNIT – IV

(a) Write the assumption utilized in the analysis of air standard gas power cycles. (4)
(b) An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 100kPa and 17°C, and 800kJ/kg of heat is transferred to air during the constant volume heat-addition process. Determine:
(i) The maximum temperature and pressure that occur during the cycle.
(ii) The net work output.
(iii) Thermal efficiency
(iv) The mean effective pressure for the cycle. (12)

OR

(a) Explain stirling cycle using T-S and P-V diagram. (6)
(b) A gas turbine power plant operating on an ideal Brayton cycle has a pressure ratio of 8. The gas temperature is 300K at the compressor inlet and 1300K at the turbine inlet. Utilizing the air standard assumptions, determine:
(i) The gas temperature at the exit of the compressor and turbine
(ii) Work ratio
(iii) The thermal efficiency (10)

UNIT – V

(a) In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10kPa. Determine the cycle efficiency. (10)
(b) Explain the effect of pressure and temperature of the efficiency of the Rankine cycle. (10)

OR

(a) Explain the Reheat cycle and its advantages. Draw T-S and schematic diagram for reheat cycle. (6)
(b) Consider a reheat cycle utilizing steam. Steam leaves the boiler and enters the turbine at 4 MPa, 400°C. After expansion in the turbine to 400kPa, the steam is reheated to 400°C and then expanded in the low pressure turbine to 10kPa. Determine the cycle efficiency. (10)

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