Ref. No.: ME/T/214/2017(OLD)(S)

BACHELOR OF MECHANICAL ENGINEERING 2ND YEAR 1ST SEMESTER
SUPPLEMENTARY EXAMINATION 2017(OLD)

THERMODYNAMICS II

Time: Three hours | Full Marks: 100

Answer any ***FIVE*** questions
Use of steam and other thermodynamic tables is permitted
All parts of the same question must be answered together
Data, consistent with the problem may be assumed if necessary

Q:1 (a) Why is the back-work ratio much higher in the Brayton cycle than in the Rankine cycle? 5

(b) What is a tonne of refrigeration? 5

(c) Derive a relationship between relative humidity and specific humidity. 5

(d) Differentiate between open and closed feed water heaters. 5

Q:2 (a) Plot a gas turbine cycle with regeneration and inter-cooling on *P-v* and *T-s* planes. 5

(b) A gas turbine working on an air standard Brayton cycle operates between the temperature limits of 27^0C and 927^0C and pressure limits of 101 kPa and 505 kPa. Calculate (i) thermal efficiency of the cycle, (ii) compressor work in kJ/kg, (iii) work in kJ/kg and (iv) air flow rate for 2.0 kW of net output. 15

Q:3 (a) Define the following terms related to reciprocating engines: stroke, bore, top dead center, and clearance volume. 6

(b) An air-standard Diesel cycle has a compression ratio of 16 and a cutoff ratio of 2. At the beginning of the compression process, air is at 95 kPa and 27°C. Determine (i) the temperature after the heat-addition process, (ii) the thermal efficiency, and (iii) the mean effective pressure. 14

Q:4 (a) What is the difference between cogeneration and regeneration? 5

(b) Consider a 210 MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500°C and is cooled in the condenser at a pressure of 10 kPa. Show the cycle on a *T-s* diagram with respect to saturation lines, and determine (i) the quality of the steam at the turbine exit, (ii) the thermal efficiency of the cycle, and (iii) the mass flow rate of the steam. 15

Q:5 (a) What are the advantages and disadvantages of cascade refrigeration? 6

(b) A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.12 and 0.6 MPa. The mass flow rate of the refrigerant is 0.05 kg/s. Show the cycle on a *T-s* diagram with respect to saturation lines. Determine (i) the rate of heat removal from the refrigerated space and the power input to the compressor, (ii) the rate of heat rejection to the environment, and (iii) the coefficient of performance. 14

Q:6 (a) Why is cold air sometimes humidified after heating to a comfort temperature? 6

(b) Consider a room that contains air at 1 atm, 35°C, and 40 percent relative humidity. Using the psychrometric chart, determine (i) the specific humidity, (ii) the specific enthalpy, (iii) the wet-bulb temperature, (iv) the dew-point temperature, and (v) the specific volume of the air. 14

Q:7 Write short notes on (***any four***): (a) Combined power cycle (b) Gas refrigeration system (c) Heating and humidification (d) Adiabatic flame temperature (e) Refrigerant (f) Reheat Rankine cycle. 20