Total No. of Questions – [8] Total No. of Printed Pages – [2]

G.R. No.	

Paper Code:- U218-155 (BE-FS)

MAY 2019/ENDSEM

S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)

COURSE NAME : THERMODYNAMICS

COURSE CODE : MEUA21175

(PATTERN 2017)

Time: [**2 Hours**] [Max. Marks: **50**]

(*) Instructions to candidates:

1) **Answer Q.1, Q.2, Q.3, Q.4, Q.5 OR Q.6, Q.7 OR Q.8**
2) **Figures to the right indicate full marks**
3) **Use of Steam Table, Mollier Diagram is allowed**
4) **Use of scientific calculator is allowed**
5) **Use suitable data where ever required**

Q.1 a) State and explain steady flow energy equation and write the equation when applied to following devices: i. Throttling device ii. Boiler iii. Condenser 6

OR

b) Air enters a compressor at 105 Pa and 25°C having volume of 1.8 m^3/kg and is compressed to 5×10^5 Pa isothermally. Determine: (i) Work done (ii) Change in internal energy; and (iii) Heat transferred. 6

Q.2 a) What are the Kelvin Plank statement and Clausius statement of second law of thermodynamics? Also establish their equivalence. 6

OR

b) A Carnot engine operates between two reservoirs whose difference in temperature is 200°C. If the work output of the engine is 0.5 times the heat rejected, make calculations for the temperature of source and sink and the thermal efficiency of the engine. 6

Q.3 a) Define: a. Entropy b. Available energy c. Unavailable energy 6

OR

b) Air at 20°C and 1.05 bar occupies $0.025m^3$. The air is heated at constant volume until the pressure is 4.5bar. Calculate: i. heat flow in kJ during process ii. Change in entropy in kJ/K. Take $C_v = 0.718$ kJ/kgK 6

Q.4 a) Define Critical Point and Triple point. State the values of pressure and temperature. 4

OR

b) Define dryness fraction of steam. Calculate the dryness fraction of steam which

has 1.25 kg of water in suspension with 40 kg of steam. 4

Q.5 a) The following readings were recorded during boiler trial:
Pressure of steam generated 12 bar, mass of steam generated 40000 kg, dryness fraction of steam generated 0.85, feed water temperature 30°C, coal used 4000kg, Calorific Value of coal 33400 KJ/Kg, Find: i. factor of equivalent evaporation ii. Equivalent evaporation from and at 100°C iii. efficiency of boiler 6

b) A boiler uses 14 kg air per kg of fuel. The temperature of hot gases inside the chimney is 597°C and that of outside air 17°C. If the draught produced is 26 mm of water, determine the minimum height of chimney required. 4

c) State the function and location of blow off cock and feed check valve. 4

OR

Q.6 a) A Lancashire boiler generates 2400 kg of dry steam per hour at a pressure of 11 bar. The grate area is $3m^2$ and 90 kg of coal is burnt per m^2 of grate area per hour. The calorific value of coal is 33180kJ/kg and the temperature of feed water is 17.5°C. Determine: 1. Actual evaporation per kg of coal 2. Equivalent evaporation from and at 100°C and 3. Efficiency of the boiler. 6

b) A chimney is 28 m high and the temperature of the hot gases in the chimney is 320°C. The temperature of outside air is 23°C and urnace is supplied with 15 kg of air per kg of coal burnt. Calculate draught in mm of water. 4

c) Show in tabular form boiler heat balance sheet and the formulas involved for estimating each component. 4

Q.7 a) A three stage reciprocating compressor compresses air from 1 bar and 17°C to 35 bar. The law of compression is $PV^{1.25} = C$ and is same for all stages of compression. Assuming perfect intercooling, neglecting clearance, find the minimum power required to compress 15 m^3/min of free air. Also find the intermediate pressures. 6

b) Draw isothermal, polytropic and isentropic compression processes on P-v and T-s diagram. 4

c) Enlist different applications of compressed air. 4

OR

Q.8 a) A single cylinder reciprocating compressor has a piston displacement of $0.1m^3$. The suction pressure and temperature are 1 bar and 298 K respectively. If the delivery pressure after compression is 7 bar, calculate: a. the work required to compress the air isentropically with $\Upsilon = 1.4$ and polytropically according to the law $Pv^{1.25}$ = constant. b. the isothermal efficiency for the isentropic compression process 6

b) Explain the following terms: a. Isothermal efficiency b. Volumetric efficiency 4

c) Sketch the theoretical indicator diagram for a single stage, single cylinder reciprocating air compressor with clearance volume showing various processes. 4

************Best of Luck************