Total No. of Questions – [**8**] Total No. of Printed Pages – [**3**]

G.R. No.	

U218-155 (ESE)

DECEMBER 2018/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)** Derive an expression for work done and heat supplied for polytropic process for non-flow systems. **6**

OR

b) A closed system of constant volume experiences a temperature rise of 25 °C when a certain process occurs. The heat transferred in the process is 30 kJ. The specific heat at constant volume for the pure substance comprising the system is 1.2 kJ/kg °C, and the system contains 2.5 kg of this substance. Determine :
(i) The change in internal energy
(ii) The work done. **6**

Q.2 **a)** What is COP? How will you calculate COP of refrigerator and heat pump? **6**

OR

b) What is the highest possible theoretical efficiency of a heat engine operating with a hot reservoir of furnace gases at 2100 °C when the cooling water available is at 15 °C ? **6**

Q.3 **a)** Prove that entropy is the property of the system. **6**

OR

b) Determine the entropy change of 4 kg of a perfect gas whose temperature varies from 127°C to 227 °C during a constant volume process. The specific heat varies linearly with absolute temperature and is represented by the relation :
$c_v = (0.48 + 0.0096\ T)$ kJ/kg K. **6**

Q.4 **a)** Explain working of separating and a throttling calorimeter **4**

OR

b) Write a short note on formation of steam

Q.5 **a)** A boiler house has natural draught chimney of 20 m height. Flue gases are at temperature of 380 °C and ambient temperature is 27 °C. Determine the draught in mm of water column for maximum discharge through chimney and also the air supplied per kg of fuel. **6**

b) Compare water tube boiler and fire tube boiler. **4**

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

OR

Q.6 **a)** The following particulars were recorded during a steam boiler trial

Pressure of steam	= 11 bar
Mass of feed water	= 4600 kg/h
Temperature of feed water	= 75 °C
Dryness fraction of steam	= 0.96
Coal used	= 490kg/h
Calorific value of coal	= 35700 kJ/kg
Moisture in coal	= 4% by mass
Mass of dry flue gases	= 18.57 kg/kg of coal
Temperature of flue gases	= 300 °C
Boiler house temperature	= 16 °C
Specific heat of flue gases	= 0.97 kJ/kg K

Draw the heat balance sheet of the boiler per kg of coal. **6**

b) Discuss briefly the term boiler efficiency and equivalent evaporation. **4**

c) Explain importance of boiler draught in steam power plant. **4**

Q.7 **a)** An air compressor takes in air at 1 bar and 20 ^{0}C and compresses it according to law $pV^{1.2}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar. R = 0.287 kJ/kg K. Determine

(i) Temperature at the end of compression

(ii) Work done and heat transferred during compression per kg of air. **6**

b) Explain the following terms with respect to reciprocating compressor:

(i) Isothermal efficiency

(ii) Isentropic efficiency **4**

c) Draw p – V & T – s diagrams for reciprocating compressor with and without clearance. **4**

OR

Q.8 **a)** Calculate the diameter and stroke for a double acting single stage reciprocating air compressor of 50 kW having suction pressure 100 kN/m^2 and temperature 150 ^{0}C. The law of compression is $pV^{1.2}$ = C and delivery pressure is 500 kN/m^2. Stroke / Diameter = 1.5 and mean piston speed in 150 m/min. Clearance is neglected. **6**

b) Mention the different applications of compressed air. **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************