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DECEMBER 2021 - ENDSEM EXAM
S. Y. B. TECH. (MECHANICAL) (SEMESTER - I)
COURSE NAME: THERMODYNAMICS
COURSE CODE: MEUA21204
(PATTERN 2020)

Time: [1 Hour]

[Max. Marks: 30]

(*) Instructions to candidates:

- 1) Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6.
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator is allowed.
- 4) Use suitable data where ever required.
- 5) Use of steam table and Mollier Diagram is allowed.

Q.1 a) Draw the p-v diagram of water-vapour region and point out its peculiarities. [4 marks]

b) The following observations were made during experiment on combined separating and throttling calorimeter for determining the dryness fraction of a sample of steam: Mass of water trapped in the separator = 0.5 kg, Mass of steam condensed after throttling = 3 kg, Steam pressure before and after throttling = 8 bar and 1.2 bar, Temperature of steam after throttling = 120 °C. Make calculations of dryness fraction of steam in the main. Take $C_p = 2.1 \text{ kJ/kgK}$ for superheated steam.

[6 marks]

OR

Q.2 a) Determine the state of steam at:

i) $p = 20 \text{ bar}$ and $h = 2700 \text{ kJ/kg}$

ii) $p = 15 \text{ bar}$ and $t = 220 \text{ deg C}$

[4 marks]

b) Steam at 1000kPa and 300 °C enters an engine and expands to 20 kPa. If the exhaust steam has a dryness fraction of 0.9, Make calculations for the drop in enthalpy and change in entropy.

[6 marks]

Q.3 a) What is the basic difference between Otto cycle and Diesel cycle? [4 marks]

b) The following data pertains to compression ignition engine working on air standard Diesel cycle:

Cylinder bore (dia) = 15 cm; Stroke length = 25 cm; Clearance volume = 400 cm³ [6 marks]

Calculate the air standard efficiency of the engine if fuel injection takes place at constant pressure for 5% of the stroke.

OR

Q.4 a) Where do the following cycles have applications?

- i) Vapor compression cycle ii) Dual cycle iii) Rankine Cycle
- iv) Brayton Cycle

[4 marks]

b) An ideal engine operating on Otto cycle sucks air at 1.01325 bar and 288 K. The compression ratio is limited to 5 and addition of heat at constant volume amounts to 2600 kJ per kg of air induction. Determine the peak pressure of the cycle and mean effective pressure. Take $\gamma = 1.4$ and $C_v = 0.718$ kJ/kgK.

[6 marks]

Q.5 a) Mention was made of following in the boiler installation report:

- i) Fusible plug ii) Superheater iii) Water level indicator iv) Dead weight safety valve v) Blow off cock vi) Steam stop valve vii) Economizer viii) Air preheater

List these separately under headings of mountings and accessories.

[4 marks]

b) Draw the heat balance sheet on the basis of 1 kg of fuel and on the percentage basis from the data given below which pertains to the trial made on a boiler generating 500 kg/hr of steam at 10.5 bar pressure and 0.97 dryness fraction. Fuel used and its calorific value: 75 kg/hr and 31500 kJ/kg, Moisture present in the fuel: 6% by mass, Mass of dry flue gases: 10 kg/kg of fuel, Temperature of flue gases: 315 °C, Sp. Heat of flue gases: 1.1 kJ/kgK, Temperature of boiler room: 38 °C, Feed water temperature: 50 °C, Heat carried away by moisture: 178.1 kJ/kg.

[6 marks]

OR

Q.6 a) By a line diagram, indicate the position of boiler accessories in typical boiler plant.

[4 marks]

b) In a boiler test 1250 kg of coal is consumed in 24 hrs, mass of water evaporated is 13000 kg and boiler pressure of 7 bar. Feed water temperature is 40 °C and heating value of coal is 30000 kJ/kg. Find equivalent evaporation per kg of coal, factor of evaporation and boiler efficiency (Take enthalpy of 1 kg of steam at boiler exit as 2570 kJ/kg).

[6 marks]
