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V 4595

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Third Semester

(Regulation 2004)

Electrical and Electronics Engineering

ME 1211 — APPLIED THERMODYNAMICS

(Common to Electronics and Instrumentation Engineering and
Instrumentation and Control Engineering)

Time : Three hours

Maximum : 100 marks

(Use of approved thermodynamics charts and tables permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define point function and path function.
2. Define Helmholtz function.
3. Distinguish between two stroke and four stroke cycle engines.
4. What is the purpose of intercoder?
5. What is meant by 'Enthalpy'?
6. What do you mean by pressure compounding?
7. Define IMEP.
8. How is sub coding achieved?
9. State the Stefan-Boltzmann law.
10. What is a gray body?

PART B — (5 × 16 = 80 marks)

11. (a) Steam at a pressure of 4 bar and dryness 0.7 is allowed to expand at a constant volume, until the pressure rises to 5.5 bar. Find the final condition of steam and the heat absorbed by 1 kg of steam. (16)

Or

- (b) Explain the working principle of Carnot cycle with a neat sketch. (16)
12. (a) An engine working on a dual combustion cycle has a pressure of 1 bar and 50°C before compression. The air is then compressed isentropically to 1/15th of its original volume. The maximum pressure is twice the pressure at the end of isentropic compression. If the cut-off ratio is 2, determine the temperature at the end of each process and the ideal efficiency of the cycle. Take $r = 1.4$. (16)

Or

- (b) A hot air engine works on Brayton cycle with initial and final pressures of air as 3 bar and 1 bar respectively. If the temperature before isentropic compression and isentropic expansion are 298 K and 923 K, determine :
- (i) Heat supplied per kg of air (4)
 - (ii) Heat rejected per kg of air (4)
 - (iii) Work done per kg of air (4)
 - (iv) Efficiency of the engine. (4)

Take $C_p = 1 \text{ kJ/kg k}$ and $C_v = 0.715 \text{ kJ/kg k}$.

13. (a) A simple Rankine cycle steam power plant operates between the temperatures of 260°C and 95°C. The steam is supplied to the turbine at a dry saturated condition. In the turbine, it expands in an isentropic manner, determine the efficiency of the Rankine cycle followed by the turbine, and the efficiency of the Carnot cycle, operating between these two temperature limits. Draw the turbine cycle on a h-s and on a T-s diagram. (16)

Or

- (b) Explain the various methods of compounding of a steam turbine. (16)

14. (a) A single stage double acting air compressor delivers 3 m^3 of free air per minute at 1.013 bar and 20°C to 8 bar with the following data :

R.P.M. = 300 ; Mechanical efficiency = 0.9

Pressure loss in passing through in take valves = 0.04 bar

Temperature rise of air during suction stroke = 12°C

Clearance volume = 5% of stroke volume

Index of compression and expansion $n = 1.35$

Length of the stroke = 1.2 times the cylinder diameter.

Calculate :

- (i) Power input to the shaft (6)
- (ii) The volumetric efficiency (4)
- (iii) The cylinder diameter. (6)

Or

- (b) The atmospheric air at 760 mm of Hg, dry bulb temperature 15°C and wet bulb temperature 11°C enters a heating coil whose temperature is 41°C . Assuming by-pass factor of heating coil as 0.5, determine dry bulb temperature, wet bulb temperature and relative humidity of the air leaving the coil. Also determine the sensible heat added to the air per kg of dry air. (16)

15. (a) A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5m/s. If the oil has a specific gravity of 0.8 and kinematic viscosity of 1 stroke, calculate :

- (i) Boundary layer thickness at the middle of plate. (6)
- (ii) Shear stress at the middle of plate and (6)
- (iii) Friction drag on one side of the plate. (4)

Or

- (b) A surface having an area of 1.5 m^2 and maintained at 300°C exchanges heat by radiation with another surface at 40°C . The value of factor due to the geometric location and emissivity is 0.52. Determine :

- (i) Heat lost by radiation. (6)
- (ii) The value of thermal resistance and (6)
- (iii) The value of equivalent convection coefficient. (4)