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Question Paper Code: 41474

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fourth Semester

Mechanical Engineering

14UME404 - THERMAL ENGINEERING

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

(Steam table with Mollier charts are permitted)

PART A - (10 x 1 = 10 Marks)

- The thermodynamic cycle working with air as working cycle is known as
 - induction stroke
 - compression stroke
 - power stroke
 - exhaust stroke
- For the same compression ratio
 - thermal efficiency of Otto cycle is greater than that of diesel cycle
 - thermal efficiency of Otto cycle is less than that of diesel cycle
 - thermal efficiency of Otto cycle is same as that of diesel cycle
 - thermal efficiency of Otto cycle cannot be predicted
- The number of revolutions required to complete one cycle in four stroke cycle engine is
 - 2
 - 3
 - 4
 - 5
- Carburettor is used for
 - S.I. engines
 - Gas engines
 - C.I. engines
 - None of these
- The isentropic expansion of steam through nozzle for the steam initially dry saturated at inlet is approximated by the equation
 - $pv = C$
 - $pv^{1.4} = C$
 - $pv^{1.3} = C$
 - $pv^{1.135} = C$

6. In case of impulse steam turbine
- (a) there is enthalpy drop in fixed and moving blades
 - (b) there is enthalpy drop only in moving blades
 - (c) there is enthalpy drop in nozzles
 - (d) none of these
7. For complete intercooling, the temperature at the inlet and exit of the compressor are
- (a) $T_i < T_e$
 - (b) $T_i > T_e$
 - (c) $T_i = T_e$
 - (d) $T_i \neq T_e$
8. In reciprocating air compressor, the method of controlling the quantity of air delivered is done by the
- (a) Throttle control
 - (b) Clearance control
 - (c) Blow off control
 - (d) All the above
9. The C.O.P of an air refrigeration system is _____ a vapour compression system.
- (a) More than
 - (b) Less than
 - (c) Equal to
 - (d) No such comparison
10. A sling psychrometer measures temperature of
- (a) Dry bulb
 - (b) wet bulb
 - (c) dew point
 - (d) both dry bulb and wet bulb

PART - B (5 x 2 = 10 Marks)

11. Define air standard efficiency and mean effective pressure.
12. List the methods used to find the friction power.
13. Name the various types of nozzles.
14. Enumerate the advantages of staging of reciprocating air compressor.
15. Define C.O.P of a refrigerator.

PART - C (5 x 16 = 80 Marks)

16. (a) Illustrate the P-V diagram and T-S diagram of Diesel cycle and deduce the expression for air standard efficiency. (16)

Or

- (b) A four stroke SI engine has the compression ratio of 6 and swept volume of 0.15 m^3 . Pressure and temperature at the beginning of compression are 98 kPa and 60°C . Determine the pressure, volume and temperatures at all salient points if heat

supplied is 150 kJ/kg. Also find out entropy change, work done, efficiency and mean effective pressure of cycle assuming $C_p = 1 \text{ kJ/kg}\cdot\text{K}$, $C_v = 0.71 \text{ kJ/kg}\cdot\text{K}$. Also plot the cycle on T-S diagram. (16)

17. (a) (i) Explain the working of 4 stroke cycle diesel engine with neat sketch. (8)
(ii) Differentiate between SI and CI engines. (8)

Or

(b) A 4 cylinder two stroke petrol engine develops 30 kW at 2500 r.p.m. The mean effective pressure on each piston is 8 bar and mechanical efficiency is 80%. Calculate the diameter and stroke of each cylinder of stroke to bore ratio 1.5. Also calculate the fuel consumption of the engine, if the brake thermal efficiency is 28%. The calorific value of the fuel is 43900 kJ/kg. (16)

18. (a) (i) Derive an expression for the maximum mass flow through the nozzle. (8)
(ii) Dry saturated steam at 6.5 bar with negligible velocity expands isentropically in a convergent divergent nozzle to 1.4 bar and dryness fraction 0.956. Determine the final velocity of steam from the nozzle if 13% heat is loss in friction. Find the % reduction in the final velocity. (8)

Or

- (b) (i) Differentiate between impulse turbine and reaction turbine. (8)
(ii) Describe briefly the various methods of steam turbine governing. (8)

19. (a) A single stage double acting air compressor is required to deliver 14 m³ of air per minute measured at 1.013 bar and 15°C. The delivery pressure is 7 bar and the speed 300 r.p.m. Take the clearance volume as 5% of the swept volume with the compression and expansion index of $n = 1.3$. Estimate

- (i) swept volume of the cylinder
(ii) delivery pressure
(iii) indicated power (16)

Or

(b) Describe the construction and working of multi stage compressor and discuss the perfect and imperfect inter cooling. (16)

20. (a) Describe the construction and working of Ammonia-water vapour absorption refrigeration system. (16)

Or

(b) It is required to design an air-conditioning system for an industrial process for the following hot and wet summer conditions:

Outdoor conditions : 32°C DBT and 65% R.H.

Required air inlet conditions : 25°C DBT and 60% R.H.

Amount of free air circulated : 250 m³/min.

Coil dew temperature : 13°C

The required condition is achieved by first cooling and dehumidifying and then by heating.

Calculate the following:

(i) The cooling capacity of the cooling coil and its by-pass factor.

(ii) Heating capacity of the heating coil in kW and surface temperature of the heating coil if the by-pass factor is 0.3.

(iii) The mass of water vapour removed per hour (16)