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Question Paper Code: 31474

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

Fourth Semester

Mechanical Engineering

01UME404 - THERMAL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. What is meant by mean effective pressure?
2. Define the term Adiabatic heating.
3. Why compression ratio of petrol engines is low while diesel engines have high compression ratio?
4. State any three functions of lubrication?
5. Explain the phenomenon of super saturated expansion in steam nozzle.
6. What are the different methods of compounding?
7. Define clearance ratio?
8. What is meant by inter cooler?
9. Define tonne of refrigeration.
10. How does humidity affect human comfort?

PART - B (5 x 16 = 80 Marks)

11. (a) An engine working on Otto cycle has a volume of 0.45 m^3, pressure of 1 *bar* and temperature of 30^o *C* at the beginning of compression stroke. At the end of compression stroke the pressure is 11 *bar*. The heat of 210 *kJ* of heat is added at constant volume. Determine (i) pressure, temperature and volume at salient points (ii) percentage clearance, (iii) efficiency, (iv) net work per cycle, (v) MEP, (vi) ideal power developed by the engine if the number of working cycles per min is 210. (16)

Or

(b) A gas engine operating on the ideal Otto cycle has a compression ratio of 6:1. The pressure and temperature at the commencement of compression are 1 *bar* and 300 *K*. The heat added during the constant volume combustion process is 1170 *kJ/kg*. Determine the pressure and temperatures at the salient points, work output per *kg* of air and air standard efficiency. Assume C_v = 0.717 *kJ/kg-K* and ratio of specific heats to be 1.4 for air. (16)

12. (a) Draw the energy balance sheet for a 4-stroke, 4-cylinder diesel engine by considering the following data.

Test duration = 30 *min*; Brake torque = 160 *Nm*; RPM = *1500*; Fuel consumption = 4.125 *lit;* C_v = 43000 *kJ/kg*; Density of fuel = 0.*85gm/cc*; Cooling water consumed = 5.3 *lit* in 10 *sec*;
Rise in temperature of coolingwater = 9^oC; *A/F* = 25 : 1;
Cp(gas) = 1.115 *kJ/kg-K*; Temperature of exhaust gas =300^oC; Room temperature = 25^oC. (16)

Or

(b) An engine having a single jet carburettor consumes 6.5 *kg* of fuel per hour. The fuel density is 700 kg/m^3. The level of fuel in the float chamber is 3 *mm* below the top of the jet when the engine is not running. Ambient conditions are 1.01325 *bar* and 17^oC. The jet diameter is 1.25 *mm* and its discharge coefficient is 0.6. The coefficient of air is 0.85. The Air fuel ratio is 15. Determine the critical air velocity and the throat diameter (effective). Express the pressure depression in mm of water and neglect the compressibility of air. (16)

13. (a) Steam is supplied to a group of 4 nozzles at 18 bar and 250^{o}C. It is expanded down to 4 *bar* and friction loss may be neglected. If the expansion is metastable, calculate for a flow of 2.5 *kg/s*, the exit dimensions of nozzles if they are rectangular in shape and have length to breath ratio of 3 : 1. What is the degree of undercooling and degree of supersaturation. (16)

Or

(b) Define compounding in Turbine. Explain Pressure and Velocity compounding with neat sketch. (16)

14. (a) Explain the construction and working of a sliding vane compressor and axial flow compressor. (16)

Or

(b) A single stage reciprocating air compressor receives air at 25 m^3/min at 1*bar* and discharges it at 15 *bar*. Assume the value of '*n*' for compression as 1.35, and volumetric efficiency as 0.75. Determine (i) the theoretical power required, (ii) the piston displacement per min and (iii) maximum air temperature. (16)

15. (a) Atmospheric air at 1.0132 *bar* has a Dry Bulb Temperature of 32^{o}C and Wet Bulb Temperature of 26^{o}C. Compute (i) the partial pressure of water vapour, (ii) the specific humidity, (iii) the Dew Point Temperature, (iv) the Relative Humidity, (v) the degree of saturation, (vi) the density of air in the mixture, (vii) the density of vapour in the mixture and (viii) the enthalpy of the mixture. (16)

Or

(b) Explain the working principle of water-Lithium bromide refrigeration system with neat sketch. (16)

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