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Question Paper Code : 57556

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

Fourth Semester

Mechanical Engineering

ME 6404 – THERMAL ENGINEERING

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

(Use of approved Thermodynamics Tables, Mollier diagram, Psychrometric chart and Refrigerant property tables permitted in the Examinations)

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. State the assumptions made in air standard cycle analysis.
2. Define mean effective pressure. Show that on a p-v diagram.
3. Show the valve overlapping period of a typical 4-stroke petrol engine on valve timing diagram.
4. Define the phenomenon 'knocking' in spark ignited engines.
5. Draw the shape of a supersonic nozzle.
6. Distinguish between impulse and reaction principles.
7. Define volumetric efficiency of an air compressor.
8. State the conditions which lower the volumetric efficiency of an air compressor.
9. Show the simple vapour compression cycle on pressure-enthalpy diagram.
10. List out the basic elements of an air conditioning system.

PART – B (5 × 16 = 80 Marks)

11. (a) The compression ratio for a single-cylinder engine operating on dual cycle is 9. The maximum pressure in the cylinder is limited to 60 bar. The pressure and temperature of the air at the beginning of the cycle are 1 bar and 30°C. Heat is added during constant pressure process upto 4 percent of the stroke. Assuming the cylinder diameter and stroke length as 250 mm and 300 mm respectively. Determine : (i) The air standard efficiency of the cycle, (ii) The power developed if the number of working cycles is 3 per second.

OR

(b) The swept volume of a diesel engine working on dual cycle is 0.0053 m^3 and clearance volume is 0.00035 m^3. The maximum pressure is 65 bar. Fuel injection ends at 5 percent of the stroke. The temperature and pressure at the start of the compression are 80°C and 0.9 bar. Determine the air standard efficiency of the cycle. Take γ for air as 1.4.

12. (a) Describe with suitable sketches the following system of a modern carburettor : (i) main metering system (ii) idling system (iii) economizer system (iv) acceleration pump system (v) choke.

OR

(b) (i) With a neat sketch, explain the principle of work of diesel fuel injector. **(6)**

(ii) A four-stroke, four-cylinder gasoline engine has a bore of 60 mm and a stroke of 100 mm. On test it develops a torque of 66.5 Nm when running at 3000 rpm. If the clearance volume in each cylinder is 60 cc, the relative efficiency with respect to brake thermal efficiency is 0.5 and the calorific value of the fuel is 42 MJ/kg, determine the fuel consumption in kg/h and the brake mean effective pressure. **(10)**

13. (a) (i) Define critical pressure ratio of a nozzle and discuss why attainment of sonic velocity determines the maximum discharge through steam nozzle. **(10)**

(ii) Explain the metastable expansion of steam in a nozzle with help of h-s diagram. **(6)**

OR

(b) A simple impulse turbine has one ring of moving blades running at 150 m/sec. The absolute velocity of steam at exit from the stage is 85 m/sec at an angle of 80° from the tangential direction. Blade velocity co-efficient is 0.82 and the rate of steam flowing through the stage is 2.5 kg/sec. If the blades are equiangular, determine : (i) Blade angles ; (ii) Nozzle angle ; (iii) Absolute velocity of steam issuing from the nozzle ; (iv) Axial thrust.

14. (a) A two-stage air compressor consists of three cylinders having the same bore and stroke. The delivery pressure is 7 bar and the free air delivery is 4.3 m^3/min. Air is drawn in at 1.013 bar, 15 °C and an intercooler cools the air to 38 °C. The index of compression is 1.3 for all the three cylinders. Neglecting clearance calculate : (i) The intermediate pressure (ii) The power required to drive the compressor (iii) The isothermal efficiency.

OR

(b) With a neat sketch, describe the construction and working of a single-stage acting reciprocating air compressor. Also derive the equation for work done with clearance and without clearance.

15. (a) Describe the following refrigeration systems with layout : (i) Ammonia water system (ii) Lithium-bromide water system

OR

(b) (i) Describe the working principle of a centralised air conditioning system and enumerate the need for it. **(12)**

(ii) List the loads that contribute to the overall cooling load. **(4)**