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BIME-010

B.Tech. MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2013

00745

BIME-010 : THERMAL ENGINEERING

Time : 3 Hours *Maximum Marks : 70*

Note: *Attempt **any five** questions. All questions carry **equal** marks. Use of scientific calculator is **permitted**.*

1. (a) (i) What are the main applications of compressors ? 4+10

(ii) Define the adiabatic efficiency and the isothermal efficiency of compressor.

(b) 0.2 m^3 of air at 20° C and 100 kPa is compressed according to the relation $pv^{1.3}$ = Constant by the piston in an engine cylinder that has a compression ratio of 6. Heat is then added while the pressure remains the same, until the piston returns to its original position.

Calculate :

(i) mass of air

(ii) pressure at the end of compression,

(iii) final temperature,

(iv) network transfer in the combined process.

2. (a) Explain the advantages of multistage compression over single stage compression. **4+10**

(b) A single stage single - acting air compressor deals with 90 $\frac{m^3}{hr}$ .of air at 101.325 kPa and 15°C. The pressure and temperature during the suction stroke remain constant at 98 kPa and 40°C respectively,m = 1.22. The air is delivered at 735 kPa, $R_a = 0.287$ kJ/kgK.

Find :

(i) the power needed to drive the compressor if the mechanical efficiency is 0.85,

(ii) the swept volume if the speed is 120 rpm.

Take the volumetric efficiency as 0.78.

3. (a) Compare the relative advantages and disadvantages of Four-stroke and Two-stroke cycle engines. **4+10**

(b) A six-cylinder, four-stroke 'Petrol engine' having a bore of 90 mm and stroke of 100 mm has a compression ratio of 7. The relative efficiency with reference to indicated thermal efficiency is 55% when the indicated specific fuel consumption is 0.3 kg/kWh. Estimate the calorific value of the fuel and fuel consumption (in kg/hr), given that the imep is 8.5 bar and speed is 2500 rpm.

4. (a) Describe the phenomenon of detonation or knocking in S.I. engines. How can it be controlled ? **4+10**

(b) The power output of an I.C. engine is measured by a rope brake dynamometer. The diameter of the brake pulley is 700 mm and the rope diameter is 25 mm. The load on the light size of the rope is 50 kg mass and spring balance reads 50N. The engine running at 900 rpm consumes fuel of calorific value of 44000 kJ/kg, at a rate of 4 kg/hr.
Take $g = 9.81\ m/s^2$.
Calculate :
(i) Brake specific fuel consumption.
(ii) Brake thermal efficiency.

5. (a) What is mean by ignition delay is SI engines ? **4+10**

(b) Following observations were recorded during a test on a single-cylinder oil engine :
Bore = 300mm ;
Stroke = 450 mm ;
Speed = 300 rpm ;
i.m.e.p = 6 bar ;
net brake load = 1.5 kN ;
brake drum diameter = 1.8 metre ;
brake rope diameter = 2 cm,
Calculate :
(i) Indicated power ;
(ii) Brake power ;
(iii) Mechanical efficiency

(a) What is the reason that two-stroke engine is not used in car even though it develops theoretically twice power than that of four-stroke engine ? **4+10**

(b) A four-cylinder four-stroke, Spark-ignition engine develops a maximum brake torque of 160 Nm at 3000 rpm. Calculate the engine displacement, bore and stroke. The brake mean effective pressure at the maximum engine torque point is 960kPa. Assume bore is equal to stroke.

(a) What are the two basic types of nozzles used in diesel injection system ? Briefly explain them. **4+10**

(b) Enumerate the basic ignition systems and describe ***any two*** of them.

(a) What do you understand by "scavensing" in two stroke engine ? **4+10**

(b) Air consumption for a four stroke petrol engine is measured by means of a circular orifice of diameter 3.2 cm. The coefficient of discharge for the orifice is 0.62 and the pressure across the orifice is 150 mm of water. The barometer needs 760 mm of Hg. Temperature of air in the room is 20°C. The piston displacement volume is 0.00178 m^3. The compression ratio is 6.5. The fuel

consumption is 0.135 kg/min of calorific value 43900 kJ/kg. The brake power developed at 2500 rpm is 28kW.

Determine :

(i) The volumetric efficiency on the basis of air alone

(ii) The air-fuel ratio

(iii) The brake mean effective pressure

(iv) The relative efficiency on the brake thermal efficiency basis.
