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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## VI SEMESTER B.TECH (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATION, APRIL / MAY-2017

## SUBJECT: AUTOMOTIVE COMPONENT DESIGN [MTE 4002] REVISED CREDIT SYSTEM (27/04/17)

Time: 3 Hours

MAX. MARKS: 50

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- Answer all the questions
- Data not provided may be assumed suitably
- Using data sheet is permitted
- 1a) A cast iron four stroke engine with the following data: Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure =  $5 \text{ N/mm}^2$ ; Indicated mean effective pressure =  $0.75 \text{ N/mm}^2$ ; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel =  $42 \times 10^3 \text{ kJ/kg}$ ; Speed = 2000 r.p.m. Permissible bending stress = 38MPa, Heat absorbed by the piston = 0.05, Difference in temperature = 220 °C, Heat conductive = 46.6 W/m/°C, Number of rings = 4, Pressure of gas cylinder wall =  $0.035 \text{ N/mm}^2$ , Allowable bending stress for piston ring= 90MPa, Bearing pressure =  $0.45 \text{ N/mm}^2$ , Bearing pressure at small end of the connecting rod =  $25 \text{ N/mm}^2$ , Bending stress of piston pin = 140 MPa.

Calculate

- 1) Heat flowing through piston head.
- 2) Length of the piston.
- 3) Inside diameter of the piston pin.
- 1b) A single cylinder four stroke engine runs at 1000 r.p.m and has a bore of 115 mm and has a stroke of 140 mm. The brake load is 6 kg at 600 mm radius and the mechanical efficiency is 80 percent. Calculate brake power and mean effective pressure.
- **1c)** Explain the combustion process in CI engine with the help of pressure-crank diagram.
- 2a) Sketch various types of combustion chambers for automotive diesel engines.
- **2b**) Draw and label the design terminologies for a piston.
- **2c)** List and explain factors influencing detonation.
- **3a)** Compare between detonation and diesel knock.
- **3b**) Write a short note on material and manufacturing techniques used in crankshaft.

**3c)** A four stroke diesel engine has the following specifications :

Brake power = 5 kW; Speed = 1200 r.p.m.; Indicated mean effective pressure =  $0.35 \text{ N} / \text{mm}^2$ ; Mechanical efficiency = 80 %. Allowable circumferential stress = 42 Mpa. Constant C=0.1 Determine,

- 1. Bore and length of the cylinder
- 2. Thickness of the cylinder head
- 3. Size of studs for the cylinder head.
- 4a) Derive an expression for velocity and acceleration of engine with respect to connecting rod and 3 crank.
- **4b**) Determine maximum load on the rocker arm for exhaust and inlet valve for a four stroke I.C. engine from the following data:

Diameter of the valve head = 80 mm; Lift of the valve = 25 mm; Mass of associated parts with the valve = 0.4 kg: Angle of action of camshaft =  $110^{\circ}$ ; Revolution perminute of the crankshaft = 1500. From the probable indicator diagram, it has been observed that the greatest back pressure when the exhaust valve opens is 0.4 N/mm<sup>2</sup> and the greatest suction pressure is 0.02 N/mm<sup>2</sup> below atmosphere. The maximum load on rocker arm for exhaust valve is 2460 N, Bearing pressure = 5 N/mm<sup>2</sup>, length of the fulcrum pin and roller pin is 1.25times the diameter of the fulcrum pin & diameter od roller pin, compressive stress for tappet screw is 50 MPa, phosphorus bronze bush of thickness 3 mm, bending stress for rocker arm cross-section is 70 MPa, external diameter of the fulcrum is twice the diameter of fulcrum pin, the diameter of circular end of arm and the depth is taken as twice the diameter of stud. The rocker arm is to be of I-section and the effective length of each arm may be taken as 180 mm; the angle between the two arms being 135°.

**4c)** The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multicylinder engine, taken in order from one end are as follows:

 $-35, +410, -285, +325, -335, +260, -365, +285, -260 \text{ mm}^2.$ 

The diagram has been drawn to a scale of 1 mm = 70 N-m and 1 mm =  $4.5^{\circ}$ . The engine speed is 900 r.p.m. and the fluctuation in speed is not to exceed 2% of the mean speed. Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken as 7200 kg/m<sup>3</sup>. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc

- 5a) Derive an expression for effective mean radius of cone clutch with case (i) uniform pressure intensity and (ii) uniform rate of wear.
- **5b**) Design a sliding gear box for a four wheeler vehicle which is having four forward and one reverse speeds. The different speed ratios is as follows:

Gear ratio on top gear = 1:1

Gear ratio on third gear = 1.38:1

Gear ratio on second gear = 2.24:1

Gear ratio on first gear = 3.8:1

Gear ratio on reverse gear = 3.8:1

Assumed counter shaft or layout shaft speed is half that of the engine speed and the smallest gear is not to have less than 15 teeth.

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