

**B.Tech. MECHANICAL ENGINEERING  
(COMPUTER INTEGRATED  
MANUFACTURING)**

**Term-End Examination**

**December, 2015**

**BME-024 : MECHANICAL ENGINEERING DESIGN**

*Time : 3 hours*

*Maximum Marks : 70*

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**Note :** *Question no. 1 is compulsory. Attempt any four questions from the rest. Attempt five questions in all. Assume missing data, if any. All questions carry equal marks.*

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1. (a) Answer the following questions in brief :  $5 \times 2 = 10$
- (i) Define the factor of safety. Enlist eight factors responsible for selection of F.O.S.
  - (ii) Why are hollow shafts preferred over solid shafts for high torque transmission ?
  - (iii) Define the pressure angle for involute profile of a spur gear. Why is higher pressure angle ( $25^\circ$ ) preferred for a compact gear box ?
  - (iv) "Use of a tension spring is avoided, if it is possible to use a compression spring." Why ?
  - (v) Select suitable materials, with proper justification, for a piston and a flywheel for a high speed I.C. Engine.

- (b) A pressure vessel 1000 mm in diameter and 12 mm thick is subjected to a test pressure of 2 MPa. Determine the maximum shear stress developed in the vessel. 4
2. (a) Why is longitudinal joint a riveted butt joint and circumferential joint a riveted lap joint? Justify with proper reasoning. 4
- (b) A boiler drum 4.15 m in diameter is to withstand a steam pressure of 1.2 MPa. The tensile strength and shear strength of the steel was found to be 400 MPa and 340 MPa respectively. If the factor of safety is 5, design a longitudinal butt joint, triple riveted (chain riveted) with five rivets per pitch length and double cover plates. Assume the efficiency of the joint to be 85%. 10
3. A rigid flange coupling is used to connect two 48 mm diameter shafts. The flanges are joined by 6 bolts on a pitch circle diameter of 140 mm. If the shaft is to transmit a torque of 1000 Nm at 330 rpm, design the bolts, flanges and keys. The keys, bolts and shafts are made of the same material with permissible compressive and shear stresses of 90 MPa and 55 MPa respectively. But the permissible shearing stress in C.I. flange is 10 MPa. Also sketch the coupling in front view with upper half in section showing the maximum details. 14

4. A double threaded power screw with square threads is used to raise a load of 350 kN. The nominal diameter is 100 mm and the pitch is 12 mm. The coefficient of friction between the screw and the nut is 0.15. Neglecting the collar friction, determine :
- (a) Torque required to raise the load 3
  - (b) Torque required to lower the load 3
  - (c) Efficiency of the screw 3
  - (d) If the form of thread is trapezoidal, find the efficiency of the screw. 5
5. (a) Design a closed coiled helical compression spring for a service load ranging from 2000 N to 2500 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 6 and permissible shear stress of 45 MPa. The modulus of rigidity is 84 GPa for spring material. 10
- (b) Write four major applications of a spring along with examples. 4
6. (a) Derive Stribeck's equation for static load carrying capacity of a single row deep groove ball bearing. 7

- (b) A spur pinion is driven by an electric motor of power 18 kW at 770 rpm. Pitch diameter of the pinion is 108 mm and speed reduction is 4 : 1. The module is 8 mm and pressure angle is  $20^\circ$  full depth involute profile. Pinion is mounted on the centre of the shaft between the bearings 250 mm apart. If the gear is overhung by 50 mm, determine the bearing reactions for the pinion and gear.

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7. A multiple disk clutch is to be used in a bike (motor cycle). There are 8 driven disks having an outside diameter of 80 mm and inside diameter of 60 mm. The clutch is of wet type and coefficient of friction can be assumed as 0.02. The permissible lining pressure is limited to 0.75 MPa. Determine :

(a) The axial pressure required for engagement.

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(b) The power that can be transmitted at 6000 rpm.

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