Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: MECHANICAL DESIGN - II [MME 303]

REVISED CREDIT SYSTEM

Time: 3 Hours   MAX. MARKS: 50
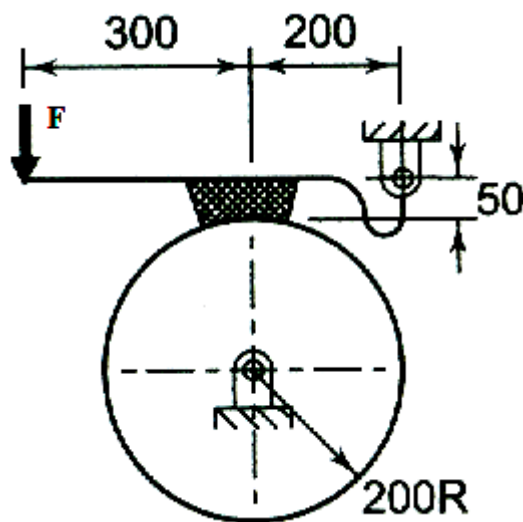
> **Instructions to Candidates:**
> ❖ Answer **ANY FIVE FULL** questions.
> ❖ Use of Design data hand book is permitted
> ❖ Missing data may be suitably assumed.

1A. Define the following: **03**
(i) solid length
(ii) surging in springs
(iii) spring rate

1B. The following data refer to a valve spring of a petrol engine. The spring load   **04**
when the valve is open is 45 N. The spring load when the valve is closed is
55 N. The lift of the valve is 6 mm. The spring must fit over the valve bush
which has an outside diameter of 20 mm and must go inside a space of 35
mm. The spring index is 12. The yield stress for spring material may be taken
as 330 MPa with a factor of safety of 2 and Modulus of rigidity is 80 GPa.
Determine the following:
(a) Wire diameter   (b) Number of active turns
(c) Spring rate   (d) free length.

1C. A semi elliptical spring is to sustain a load of 25 kN. The span of the spring is   **03**
1100 mm with a central band of 100 mm. The spring has 2 full length leaves
and 10 graduated leaves. All the leaves are to be stressed to 400 MPa when
fully loaded. The total depth to width ratio is approximately 2. Take modulus
of elasticity as 207 GPa. Determine:
    i)   width and thickness of leaves
    ii) the load exerted on the band after the spring is assembled
    iii) Spring deflection.

2A. A pair of helical gears is to transmit 34 kW at 2800 rpm of pinion. The teeth   **05**
are of 20° full depth involute profile with helix angle of 25°. Material for both

pinion and gear is C45 steel untreated. The normal module is 4 mm and face width is 40mm. The number of teeth on pinion and gear are 28 and 126 respectively. Both the gears are hardened to 300 BHN. The gears are subjected to medium shock with 8-10 hours of duty per day. Check the design for wear strength against dynamic loading.

2B. Derive an expression for beam strength of a spur gear tooth with the help of assumptions.   **05**

3A. A pair of bevel gears with generated teeth is used to transmit 6 kW at 1500 rpm of pinion. The pinion is of 80 mm diameter. The shaft angle is 60^0. The velocity ratio is 3:1.The teeth are of 20^0 full depth involute profile. The pinion is made of steel having a design stress of 120 MPa and gear is made of CI having design stress of 80 MPa. The gears are subjected to light shock with 8 hours per day of service. Take the face width as 1/3 of cone distance. Design the gear drive based on Lewis equation.   **05**

3B. Explain how the efficiency and self-locking in a worm gear drive is related to the number of starts.   **03**

3C. What are the four important parameters that are required to specify the worm gear drive   **02**

4A. A full journal bearing 75 mm long supports a load of 7.3 kN. The ratio of length to diameter of the journal is 1.5. The journal rotates at 750 rpm. The diametral clearance is 0.1 mm and the minimum film thickness is 0.02 mm. Determine   **05**
    i) the viscosity of the oil
    ii) coefficient of friction and
    iii) oil flow rate.

4B. Define the following with respect to bearings   **03**
    a) rating life
    b) static load carrying capacity
    c) median life

4C. State any two advantages of ball bearing over roller bearing.   **02**

5A. Select a V-belt drive to transmit 10 kW of power from an electric motor running at 720 rpm to a compressor running approximately at 200 rpm. The service is heavy duty varying from 10 - 14 hours per day. The center distance is around 600 mm. Take minimum pitch diameter as 200 mm.   **05**

5B. State the advantages and disadvantages of chain drives over belt drive   **02**

5C. With sketch discuss polygonal effect in chain drive.   **03**

6A. A temporary construction elevator is designed to carry workers and materials **05** to a height of 100 m. It is estimated that at least 10 workers along with a material load of 30 kN should be hoisted at a speed of 0.5 m/s which should be attained in the first 0.4 seconds. The recommended steel rope is 8 x19 with wire diameter of 1.25 mm. Take the pulley diameter as 45 times the rope diameter. Assume the average weight of the person as 75 kg. The factor of safety is 5.The tensile strength of the wire is 1300 MPa. Determine the number of ropes required.

6B. A block brake with a torque capacity of 250 Nm is shown in the Fig.Q6B. The **05** brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Determine
    (i) Normal force
    (ii) Required force F for clockwise rotation
    (iii) Required force F for anti-clockwise rotation
    (iv) Location of the fulcrum for self-locking of the brake
    (v) Heat generated

All dimensions in mm.

Fig. Q6B