Register Number…….

**M.E. DEGREE EXAMINATIONS: DECEMBER 2009**

First Semester

**CAD/CAM**

CCM504: Advanced Mechanical Design

(Use of Approved data book is permitted)

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

**Answer ALL the Questions:-**

**PART A (10 x 2 = 20 Marks)**

1. What is optimum design?
2. Write the importance of S-N curve.
3. Define critical speed of a shaft.
4. Differentiate the hollow shaft and solid shaft.
5. What are the principles to be followed to obtain optimum design in multi speed gear box?
6. Why are the steps of speed arranged in the geometric progression in a machine tool gear box?
7. Define expanding ring clutch.
8. What are the different characteristics of clutch?
9. Why in automobiles, braking action when traveling in reverse is not as effective as when moving forward?
10. What are materials used for brake lining?

**PART B (5 x 16 = 80 Marks)**

11. a) Give the dimensions for the hole and shaft for the following:
    (i) A 12 mm electric motor sleeve bearing;
    (ii) A medium force fit on a 200 mm shaft; and
    (iii) A 50 mm sleeve bearing on the elevating mechanism of a road grader.

**(OR)**

b) Define the concept of Design for Manufacture and Assembly. Explain the guidelines to be followed for the same.

12. a) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.

**(OR)**

b) A hollow shaft of 0.5 m outside diameter and 0.3 m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings 6 metre apart and it transmits 5600 kW at 150 r.p.m. The maximum axial propeller thrust is 500 kN and the shaft weighs 70 kN. Determine:

(1) The maximum shear stress developed in the shaft and

(2) The angular twist between the bearings.

**(OR)**

13. a) A 35 kW motor running at 1200 r.p.m. drives a compressor at 780 r.p.m. through a 90° bevel gearing arrangement. The pinion has 30 teeth. The pressure angle of teeth is 14 ½ °. The wheels are capable of withstanding a dynamic stress, $\sigma_w = 140\left(\frac{280}{280+v}\right)$ MPa, where v is the pitch line speed in m / min.

The form factor for teeth may be taken as $0.124 - \frac{0.686}{T_E}$, where $T_E$ is the number of teeth equivalent of a spur gear. The face width may be taken as ¼ of the slant height of pitch cone. Determine for the pinion, the module pitch, face width, addendum, dedendum, outside diameter and slant height.

**(OR)**

b) A machine tool gear box is to have 12 speeds, with the output speed ranging form 63 rpm to 2800 rpm. Draw the speed diagrams for 2 x 2 x 3, 3 x 2 x 2. Among these schemes which is better and why?

14. a) A centrifugal clutch is to be designed to transmit 15 kW at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine: (1). mass of the shoes, and (2). size of the shoes.

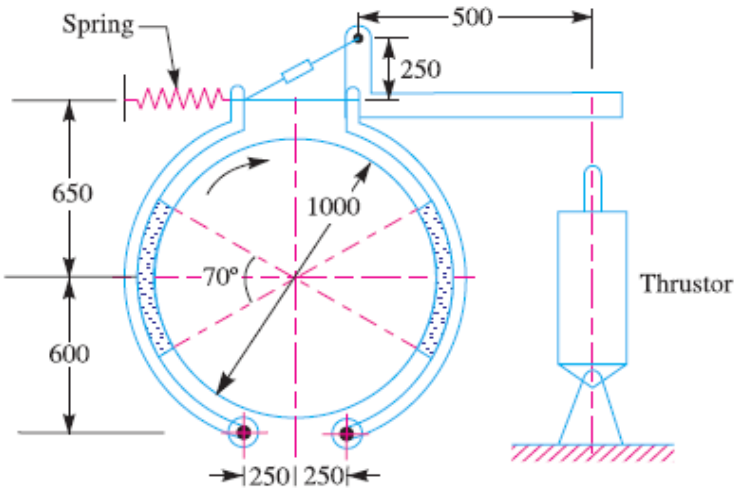
**(OR)**

b) Determine the principal dimensions of a cone clutch faced with leather to transmit 30 kW at 750 r.p.m. from an electric motor to an air compressor. Sketch a sectional front view of the clutch and provide the main dimensions on the sketch.

Assume : semi-angle of the cone = 12 ½ °; $\mu = 0.2$ ; mean diameter of cone is 6 to 10 d where d is the diameter of shaft; allowable normal pressure for leather and cast iron is 0.075 to 0.1 N/mm$^2$ ; load factor = 1.75 and mean diameter to face width ratio = 6.

15. a) A spring closed thrustor operated double shoe brake is to be designed for a maximum torque capacity of 3000 N-m. The brake drum diameter is not to exceed 1 metre and the shoes are to be lined with Ferrodo having a coefficient of friction 0.3. The other dimensions are as shown in Fig.

1. Find the spring force necessary to set the brake.
2. If the permissible stress of the spring material is 500 MPa, determine the dimensions of the coil assuming spring index to be 6. The maximum spring force is to be 1.3 times the spring force required during braking. There are eight active coils. Specify the length of the spring in the closed position of the brake. Modulus of rigidity is 80 kN / $mm^2$.
3. Find the width of the brake shoes if the bearing pressure on the lining material is not to exceed 0.5 $N/mm^2$.
4. Calculate the force required to be exerted by the thrustor to release the brake.



All dimensions in mm.

**(OR)**

b) Describe with the help of a neat sketch the principle of operation of an internal expanding shoe brake. Derive the expression for the braking torque.

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