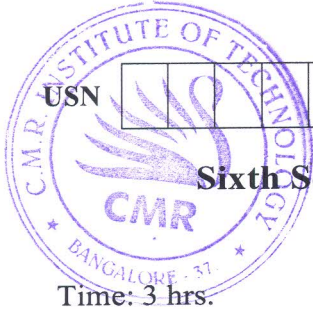USN

17ME64

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
Design of Machine Elements – II

Time: 3 hrs.   Max. Marks: 100

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of Design Data hand book is permitted.*

Module-1

1   a. Differentiate between straight beam and curved beam. **(04 Marks)**
    b. Derive the pure bending stress equation for a curved beam, subjected to bending moment 'M'. **(08 Marks)**
    c. A section of a crane hook is a trapezium whose inner and outer sides are 20 mm and 10 mm respectively and depth 25 mm, the centre of curvature of the section is at a distance of 25 mm from the inside of the section and the load line is 20 mm from the same point. Find the greatest load the hook will carry if the maximum stress is no to exceed 70 MPa. **(08 Marks)**

OR

2   a. A cast iron cylinder of internal diameter 500 mm and 75 mm thickness is filled with a fluid at a pressure of 6 N/mm^2. Determine the circumferential and radial stresses at inner and outer surfaces and sketch the stress distribution across the thickness. **(10 Marks)**
    b. A cast-steel cylinder of 350 mm inside diameter is to contain a liquid at a pressure of 13.5 MPa. It is closed at both ends by flat cover plates which are made of alloy steel and are attached by bolts. Determine:
    (i) Wall thickness of cylinder, if the maximum hoop stress in the material is limited to 55 MPa.
    (ii) Minimum thickness necessary of the cover plates, if the working stress is not to exceed 65 MPa. **(10 Marks)**

Module-2

3   a. Sketch and explain Hoisting tackle (Block and Tackle mechanism) of rope drive. **(05 Marks)**
    b. List the advantages and disadvantages of chain drives. **(05 Marks)**
    c. It is desired to transmit 110 KW at 1440 rpm to a machine running at 400 rpm by a V-belt. Diameter of driving wheel is 300 mm and centre distance between centres of pulley is 2.5m. The machine is to be run for two shifts per day of 8 hours. Design the V-belt. **(10 Marks)**

OR

4   a. At the bottom of a mine shaft a group of 10 identical closed coiled helical springs are set in parallel to absorb the shock caused by the falling of the cage in case of failure. The loaded cage weighs 75 kN while the counter weight, weighs 15 kN. If the loaded cage falls through a height of 5 m from rest, find the maximum stress induced in each spring, if it is made of 50 mm diameter steel rod. The spring index is 6 and number of active turns in each spring is 20. Modulus of rigidity G = 8 × 10^4 N/mm^2. **(10 Marks)**

b. A locomotive semielliptical laminated spring has an overall length of 1 m and sustains a load of 70 kN at its centre, the spring has 3 full length leaves and 15 graduated leaves and a central band of 100 mm width, all leaves are to be stressed to 400 N/mm^2, when fully loaded, the ratio of total spring depth to that of width is 2. Take E = 2 × 10^5 MPa. Determine:
   (i) The thickness and width of leaves.
   (ii) The initial gap that should be provided between the full length and graduated leaves before the band load is applied.
   (iii) The load exerted on the band after the spring is assembled. **(10 Marks)**

Module-3

5 a. Derive the bending stress equation (Lewis equation) of a spur gear, subjected to tangential load. **(06 Marks)**

   b. A spur gear drive is used for transmitting 12 KW at 1000 rpm of pinion speed. The pinion has 30 teeth and pressure angle of 14.5 degree. The gear has 75 teeth along with module of 6 mm and face width 60 mm. Take permissible static bending stress of 100 MPa for pinion and gear materials and surface endurance limit for the material is 600 MPa and E = 100 GPa, service factor = 1.5. You are required to check the design for bending and wear strength. **(14 Marks)**

OR

6 A pair of bevel gears connect two shafts at right angles and transmits 9 KW power. Design the bevel gears and check for dynamic and wear load, using following specifications.

Particulars	Pinion	Gear
Number of teeth	21	60
Material	Semi steel	Grey cast iron
Brinell Hardness number	200	160
Allowable static stress	85 MPa	55 MPa
Speed	1200 rpm	420 rpm
Tooth profile	14.5° composite	14.5° composite

(20 Marks)

Module-4

7 An elevator cage is lifted at the rate of 90 m/min, the elevator drum is 600 mm diameter and the load lifted is 18 kN. A worm gear is keyed to the drum shaft. The speed of driving motor is 1000 rpm. Take centre distance between worm and worm gear as 100 mm and number of threads on worm as 1. Determine:
   (i) The worm and worm gear proportions.
   (ii) The efficiency of the drive.
   (iii) The required power of motor. **(20 Marks)**

OR

8 a. A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure is limited to 0.1 N/mm^2. Design the clutch for transmitting 25 KW at 1575 rpm. Use uniform wear condition and coefficient of friction as 0.3. **(10 Marks)**

b. A differential band brake shown in Fig.Q8(b) has a drum diameter of 600 mm, angle of contact is 240°. The brake band is 5 mm thick and 100 mm wide. The coefficient of friction between band and drum is 0.3. If the band is subjected to a stress of 50 MPa, find:
  (i) The least force required at the end of a 600 mm lever, and
  (ii) The torque applied to the brake drum shaft.

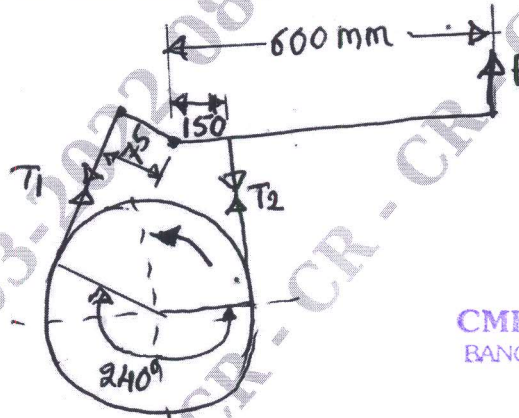Fig.Q8(b)   (10 Marks)

Module-5

9 a. Sketch and explain hydrodynamic journal bearing.   (05 Marks)
   b. Derive Petroff's equation for coefficient of friction in journal bearing. (05 Marks)
   c. Determine the dimensions of square journal bearing ($l = d$) to support a load of 1000 N at 450 rpm using hardened steel journal and bronze backed babbit bearing. The oil used has absolute viscosity of 7.83 centipoise at 82°C. Take diametral clearance ration of 0.003. Also find the heat generated.   (10 Marks)

OR

10 a. Determine the type and size of a bearing for 75 mm shaft, the speed of shaft is 350 rpm and radial load is 10 kN with very light shock and axial load 2 kN, the instrument is in service for a year with 2 hours working per day.   (10 Marks)
   b. Select 62 series deep groove ball bearing which has to work under following cycle at constant shaft speed of 1440 rpm.
     (i) Radial load of 2.5 kN for 10 seconds
     (ii) Radial load of 1.2 kN for 20 seconds
     (iii) Radial load of 450 N for 30 seconds.
   And above cycle repeats itself. The bearing has to work for five years at 80 hours per week.
                                                                              (10 Marks)

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