# B.M.S. College of Engineering, Bengaluru-560019

### Autonomous Institute Affiliated to VTU

### February / March 2023 Semester End Main Examinations

**Programme: B.E.**  **Semester: V**
**Branch: Mechanical Engineering**  **Duration: 3 hrs.**
**Course Code: 20ME5DCDM2/16ME5DCDM2**  **Max Marks: 100**
**Course: Design of Machine Elements - 2**  **Date: 21.02.2023**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.
3. Use of design data hand book is permitted.
4. Use of calculator is permitted.

## UNIT - I

1 a) Discuss on the assumptions made in the stress analysis of curved beams. Also, explain the factors which distinguish the stress distributions in straight and curved beams. **08**

b) The section of a crane hook is a trapezium whose inner and outer sides are 80mm and 40mm respectively and has a depth of 100mm. The centre of curvature of the section is at a distance of 120mm from the inner side of the section and load line is 110mm from the same point. Find the maximum load the hook can carry if the maximum stress is not to exceed 70MPa. **12**

### OR

2 a) A railway wagon weighing 40KN and moving with a speed of 10Km / hr has to be stopped by four buffer springs in which the maximum compression allowed is 200mm. Find the number of turns in each spring of mean diameter 150mm. The diameter of spring wire is 25mm. Take $G = 82.7 \times 10^3$ MPa. **10**

b) A locomotive spring has an overall length of 1100mm and sustains a load of 72750N at its centre. The spring has 3 full length and 15 graduated plates with a central band of 100mm wide. All the plates are to be stressed to 420 N/mm$^2$ when fully loaded. The ratio of total spring depth to width is to be 2. Determine **10**
(i) Width and thickness of plates
(ii) Initial space that should be provided between the full length and graduated plates before the band is applied
(iii) The load exerted on the band after the spring is assembled
Take $E = 2 \times 10^5$ MPa

## UNIT - II

3  a)  A single plate clutch is to be designed to transmit 9KW at 1200rpm. The intensity of pressure is not to exceed 0.08MPa and coefficient of friction is 0.2. Assuming uniform wear condition, determine  **10**

       (i)    Mean diameter and face width of the friction lining if the mean diameter is 9 times the face width

       (ii)   External and internal diameter of the clutch plate

  b)  A simple band brake of drum diameter 600mm has a band passing over it with an angle of contact of 225° while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400mm from the fulcrum. The brake lever is 1m long. The brake is to absorb a power of 15KW at 720rpm. Design the brake lever of rectangular cross section assuming depth to be thrice the width. Take allowable stress as 80MPa and coefficient of friction as 0.3  **10**

## UNIT - III

4    A cast steel pinion rotating at 900 rpm is to drive a cast iron gear at 144rpm. The static design stresses for pinion and gear materials are 103MPa and 55Mpa respectively. The teeth are to have 20° stub tooth involute profiles and maximum power to be transmitted is 25KW. Design the spur gears completely and check for dynamic and wear loads. Use 16 teeth on the pinion.  **20**

## OR

5    Design a pair of bevel gears to connect two shafts at 60°. The power transmitted is 25 KW at 900 rpm of pinion. The reduction ratio desired is 5 : 1. The teeth are 20° Full Depth Involute and pinion has 24 teeth. Check the design for dynamic and wear considerations choosing allowable static stresses of 220 MPa for pinion and 172.6 MPa for gear.  **20**

## UNIT - IV

6  a)  Discuss on bearing characteristic number with reference to thin film and thick film lubrication. Also, explain properties of lubricants.  **10**

  b)  A 75mm long full journal bearing of diameter 75mm supports a load of 10KN. The speed of the journal is 1200rpm. The absolute viscosity of the oil is 10 x $10^{-3}$PaS and diametral clearance ratio is 0.001. Determine the coefficient of friction by using Petroff's equation and McKee equation. Also, determine power loss in friction.  **10**

## UNIT - V

7  a)  Select a suitable roller chain drive to transmit 10 kW from a 1200 rpm motor to a compressor at 400 rpm. The central distance is adjustable to 800 mm. The service is 24 hours per day. Assume factor of safety as 14.  **10**

  b)  Select a V – belt drive to transmit 9KW from a shaft rotating at 1200rpm to a parallel shaft to run at 300rpm. The diameter of smaller pulley is 120mm. The centre distance between shafts is 1200mm.  **10**

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