

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

Subject code: 182004

Subject Name: Design of Mechanisms II
Total Marks: 70

Instructions:

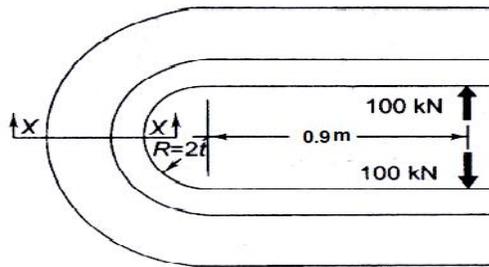
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q : 1 A Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below: **07**

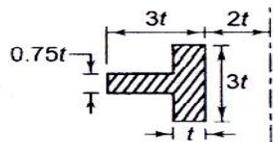
Shear stress on shaft = 100 MPa
Crushing stress on shaft = 250 MPa
Shear stress on keys = 100 MPa
Crushing stress on keys = 250 MPa
Shear stress on cast iron = 15 MPa
Shear stress on bolts = 100 MPa

B The frame of a 100 kN punch press is shown in the following figure. **07**
Determine the maximum stress in the frame. Take $t = 0.1$ m.

$$R_n = \frac{A}{(b_i - t) \ln\left(\frac{R_i + t_i}{R_i}\right) + t \ln\left(\frac{R_o}{R_i}\right)}$$



(a)



(b) Section at XX

Q : 2 A 1. Why the section of the arms in pulley is usually elliptical? In which plane the major axis of arm section is placed and why? **04**

2. Explain the importance of ergonomics and reliability while designing the machine components. **03**

B Select the suitable size of 6 X 7 steel wire rope to lift a cage of vertical mine hoist 500 m deep. The cage has a mass of 400 kg and it has to lift 1200 kg mass of iron ore at a speed of 120 m/min. the full speed is to be attained in 2 meters. Assume the factor of safety as 7. Take sheave diameter = 60 d mm, $E = 8 \times 10^4$ MPa, mass of rope = $0.35 d^2$ kg/100 meter, diameter of wire 0.1d mm, Area of wires in rope = $0.38d^2$ mm², ultimate strength = $560d^2$ N, where, d is the diameter of rope in mm. **07**

OR

Q : 2 B 1. What is meant by endurance strength of a material? Explain the influence of various factors on endurance limit of a ductile material. **04**
 2. What is meant by 'stress concentration'? Illustrate how the stress concentration in component can be reduced. **03**

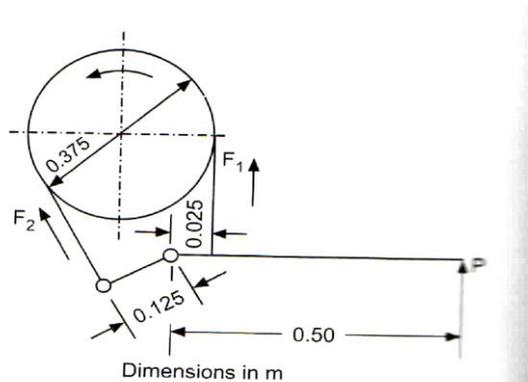
Q : 3 A Explain the design procedure for Journal bearing. **07**

B An overhung pulley transmits 35 kW at 240 rpm. The belt drive is vertical and the angle of wrap may be taken as 180°. The distance of the pulley centre line from the nearest bearing is 350 mm. The co-efficient of friction = 0.25. Design shaft, pulley and key. The following stresses may be taken for design purpose: For shaft and key tension and compressive stress = 80 MPa, shear stress = 50 MPa, tensile stress of belt is 2.5 MPa, Pulley rim tensile stress = 4.5 MPa, pulley arm tensile stress = 15 MPa. **07**

OR

Q:3 A differential band brake is shown in following figure. The angle of contact is 280 deg. The brake is to sustain a torque of 400 Nm. The band has compressed woven lining and presses against cast iron drum is 0.375 m diameter. Assuming coefficient of friction as 0.3: **14**

- Determine the necessary operating force, P
- Find the width and thickness of the steel band, assuming safe stress in tension as 55 N/mm²
- Find the section of the brake lever.
- Design the pins and show the attachments of the band with the pins.



Q:4

A pair of a carefully cut spur gear with 20° full depth involute teeth consists of 19 pinion meshing with 40 teeth gear. The pinion shaft is directly coupled to a single cylinder diesel engine developed power 8 kW at 1500 rpm. The gear shaft is transmitting a power to a two stage reciprocating air compressor. There service factor and factor of safety are 1.5 and 3 respectively. The pinion as well as gear are made of plain carbon steel 45C8 ($S_{ut} = 600 \text{ N/mm}^2$). The module and face width are 3 mm and 50 mm respectively. The gears are heat treated to a surface hardness of 450 BHN. Calculate the factor of safety of the above gear drive.

14

OR

Q:4

A pair of spur gear with 20° full depth involute consist of 18 teeth pinion meshing with 40 teeth gear. The module is 5 mm and face width is 50 mm. The pinion is made up of alloy steel , While the gear is made up of plain carbon steel , For which the permissible bending stress are 250 MPa and 200 MPa respectively. The gears are heat treated to a surface hardness of 400 BHN. The service factor is 1.75. If pinion rotates at 1440 rpm, determine rated power transmitting capacity of gear pair.

14

$$Y_p = 0.154 - \frac{0.912}{Z_p}$$

$$F_s = f_b \times b \times Y_p \times \pi \times m$$

$$C = 11860 \times e$$

$$e = 0.025$$

$$F_d = F_t + \frac{21v(cb + F_t)}{21v + (cb + F_t)^{1/2}}$$

$$Q = \frac{2Z_g}{Z_g + Z_p}$$

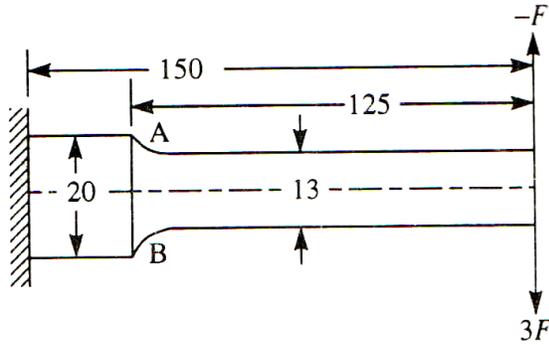
$$k = \frac{f_{es}^2 \sin \phi}{1.4} \left[\frac{1}{E_p} + \frac{1}{E_g} \right]$$

$$F_w = D_p \times Q \times k \times b$$

Q:5 A

A cantilever beam made of cold drawn carbon steel of circular cross section as shown in figure is subjected to a load which varies from $-F$ to $3F$. Determine the maximum load that this member can withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42 and the notch sensitivity is 0.9. Assume the following values: Ultimate stress = 550 MPa, Yield stress = 470 MPa, Endurance limit = 275 MPa, Size factor = 0.85, Surface finish factor = 0.89.

07



- B**
1. Explain the hydrodynamic and hydrostatic lubrication **04**
 2. A block and tackle consists of three sheave block and one four sheave block. Assume the frictional loss at each sheave to be 3 percent of the rope tension on the right of the sheave. Determine the load that can be lifted when applied rope pull is 700 N. **03**

OR

- Q : 5** Write various steps for selection of rolling element bearings required for input shaft of gear box which receives power through V belt. **14**
