

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2020

Subject Code: 2171909
Date: 28/01/2021
Subject Name: Machine Design
Time: 10:30 AM TO 12:30 PM
Total Marks: 47
Instructions:

1. Attempt any **THREE** questions from Q.1 to Q.6 .
2. Q.7 is compulsory.
3. Make suitable assumptions wherever necessary.
4. Figures to the right indicate full marks.

- Q.1**
- (a) What is Lewis form factor? How does it vary with number of teeth on gear? **03**
 - (b) Derive the expression for beam strength of a gear tooth. **04**
 - (c) A pair of helical gears with pinions 26 teeth and gear 100 teeth supplies power 5KW at 2000 rpm of pinion. Normal pressure angle is 20° and helix angle of teeth is 15° . Both the gears are made of hardened steel with $S_{ut} = 660 \text{ N/mm}^2$. Gears are finished to accuracy of grade 8. Assume service factor = 1.5, factor of safety = 1.8 and pitch line velocity of gears as 10 m/s, determine normal module of gear teeth as per beam strength. Specify the hardness of the surface of gears if $S_w = S_b \cdot b = 12m_n$. Where b is face width. **07**
- Q.2**
- (a) Why heat dissipation is an important consideration in worm gear drive? **03**
 - (b) Derive and express the force analysis in worm gear drive with sketch. **04**
 - (c) A pair of bevel gears is required to transmit 10 KW power at 500 rpm from motor shaft to a machine shaft. The speed reduction is 3:1 and the shafts are inclined at 60° . the pinion is to have 24 teeth with pressure angle 20° and is to be made of cast steel having strength 75 N/mm^2 . The gear is to be made of cast iron with static stress of 55 N/mm^2 . Design the gear pair. **07**
- Q.3**
- (a) Plot the typical relationship between coefficient of friction and bearing characteristic number for a journal bearing. Elaborate the different regions of the plot. **03**
 - (b) Explain the design parameters to be considered in the performance of a hydrodynamic bearing. **04**
 - (c) A 360° hydrodynamic bearing has 50 mm diameter and 50 mm length. The journal is carrying a load of 15 KN and rotates at 1450 rpm. The eccentricity ratio is 0.8. The radial clearance is 20 μm . Calculate **07**
 - a) Probable coefficient of friction.
 - b) Viscosity of oil.
 - c) Minimum film thickness.
 - d) Quantity of oil in circulation.
 - e) Oil leakages through sides.

If the oil is supplied at 28°C , find the oil temperature. The specific gravity of oil is 0.86 and the specific heat can be taken as $2.09 \text{ KJ/Kg } ^\circ\text{C}$.
- Q.4**
- (a) What are the typical causes of failure in rolling contact bearings? **03**
 - (b) Derive the expression for the equivalent load for a rolling contact bearing operating under cyclic loads in usual notations. **04**
 - (c) A ball bearing is subjected to purely radial force. The magnitude of radial force acting on the bearing varies in a sinusoidal manner from 0 to 1500 N in first half revolution and 1500 N to 0 in second half revolution. The cycle then repeats. The direction force remains fixed. The speed of rotation is 720 rpm. Determine the dynamic load carrying capacity of the bearing for a life of 8000 hours. **07**

- Q.5** (a) What is the flexibility of wire rope? How does the flexibility of the wire rope influence in wire rope design? **03**
- (b) Explain different types of stresses in wire rope design. **04**
- (c) At the construction site, 1 tonne of steel is to be lifted up to a height of 20 m with the help of 2 wire ropes of 6 x 19 size, nominal diameter 12 mm and tensile strength designation 1770. Determine the factor of safety if the sheave diameter is 56d and if the wire rope is suddenly stopped in 1 second when travelling at a speed of 1.2 m/s. What is the factor of safety if bending load is neglected? Assume mass per m is 0.498 kg, breaking load = 78 KN for given tensile strength designation and metal cross section area is $0.39d^2$. **07**
- Q.6** (a) What is bulk load? Explain the typical character classifications of bulk materials. **03**
- (b) Explain different types of conveyors used in material handling systems. **04**
- (c) Design the crane hook of a hoisting block for a maximum load lifting capacity of 10 ton. The material for hook is forged for which permissible tensile stress may be taken as 120 N/mm^2 . The modified triangular section is used for hook. **07**
- Q.7** (a) Explain different types of crankshafts used in IC Engine with their application. **05**
- OR**
- Q.7** (a) What are the functions of rib, cup, compression ring and oil scraper ring in piston? **05**

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