

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2022****Subject Code:3171917****Date:03/06/2022****Subject Name:Design of Machine elements****Time:02:30 PM TO 05:30 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.
5. Use of PSG design data book is permitted.

		MARKS
Q.1	(a) It is required to standardize eleven shafts from 100 to 1000 mm diameter. Specify their diameters.	03
	(b) Differentiate between <ol style="list-style-type: none"> i. Rigid and flexible coupling ii. Protected and unprotected flange coupling. 	04
	(c) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.	07
Q.2	(a) What is nipping in a leaf spring? Discuss its role.	03
	(b) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 N. The wire diameter of spring is 2 mm with a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: Design shear stress = 680 MPa Modulus of rigidity = 80 kN/mm ² Determine : 1. the initial torsional shear stress in the wire; 2. spring rate; and 3. the force to cause the body of the spring to its yield strength.	04
	(c) A pair of straight teeth spur gears, having 20° involute full depth teeth is to transmit 12 kW at 300 r.p.m. of the pinion. The speed ratio is 3 : 1. The allowable static stresses for gear of cast iron and pinion of steel are 60 MPa and 105 MPa respectively. Assume the following: Number of teeth of pinion = 16; Face width = 14 times module; Velocity factor (C_v) = $4.5/(4.5 + v)$, v being the pitch line velocity in m / s; and tooth form factor (y) = $0.154 - (0.912/\text{No. of teeth})$. Determine the module, face width and pitch diameter of gears. Check the gears for wear; given σ_{es} = 600 MPa; Young's Modulus for pinion = 200 kN/mm ² and Young's Modulus for gear = 100 kN/mm ² .	07

OR

- (c) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 40 teeth gear. The helix angle is 25° and the normal pressure angle is 20° . The normal module is 3 mm. Calculate
(i) the transverse module;
(ii) the transverse pressure angle;
(iii) the axial pitch;
(iv) the pitch circle diameters of the pinion and the gear;
(v) the centre distance; and
(vi) the addendum and dedendum circle diameters of the pinion. **07**

- Q.3** (a) What are the difference between Hydrodynamic and Hydrostatic bearings. **03**
(b) Explain the thermal consideration in Journal Bearing design. **04**
(c) The following data is given for a 360° hydrodynamic bearing: **07**
radial load = 3.2 kN
journal speed = 1490 rpm
journal diameter = 50 mm
bearing length = 50 mm
radial clearance = 0.05 mm
viscosity of lubricant = 25 cP
Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate
(i) coefficient of friction;
(ii) power lost in friction;
(iii) minimum oil film thickness;
(iv) flow requirement in litres/min; and
(v) temperature rise.

OR

- Q.3** (a) Enlist causes of failure in rolling contact bearings? **03**
(b) Selection procedure of rolling contact bearing from manufacturer's catalogue. **04**
(c) The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720 r.p.m. The bearings are to have 99% reliability corresponding to a life of 24000 hours. The bearing is subjected to an equivalent radial load of 1 kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. **07**
Find the basic dynamic load rating of the bearing from manufacturer's catalogue, specified at 90% reliability.

- Q.4** (a) What are the different types of wears in gear design? suggest its remedies also. **03**
(b) Explain the aspect of heat generation in design of worm gears. **04**
(c) Explain the step by step procedure for constructing structure diagram for speed box. **07**

OR

- Q.4** (a) Explain various types of ends used for pressure vessels giving practical applications of each. **03**
(b) Explain Clavarino's and Birnie's equation for pressure vessels in detail. **04**
(c) A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as **07**

0.10. Calculate : 1. tangential force acting on the worm ; 2. axial thrust and separating force on worm; and 3. efficiency of the worm drive.

- Q.5** (a) What do you understand by 6 x 37 ropes? Explain with neat sketch the different rope section. **03**
- (b) What are the different types of ropes used in EOT cranes? How they are designated and selected in the hoisting mechanism. **04**
- (c) Discuss the stresses in wire ropes with formulas and explain the step by step procedure for wire rope design. **07**

OR

- Q.5** (a) Describe the basic objectives of material handling system. State the basic principles in selection of material handling equipment. **03**
- (b) Explain the different cross section being used for hook design. **04**
- (c) Discuss with neat sketches the valve gear mechanism for horizontal and vertical engines. Explain Poppet valve. **07**
