

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII(NEW) EXAMINATION – SUMMER 2019****Subject Code:2171909****Date:18/05/2019****Subject Name:Machine Design****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. Use of design data book is permitted.

		MARKS
<b>Q.1</b>	(a) List the major advantages of using geometric progression of for speed regulation in a gear box.	<b>03</b>
	(b) Classify different types of bearings.	<b>04</b>
	(c) Explain different types of gear tooth failures, causes and their possible remedies.	<b>07</b>
<b>Q.2</b>	(a) List the merits and demerits of worm gear drives.	<b>03</b>
	(b) Derive the equation for formative number of teeth for helical gears.	<b>04</b>
	(c) Design a pair of straight teeth spur gears to transmit 20 kW when the pinion rotates at 300 r.p.m. The velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 14 times the module. Assume steady load condition and 8-10 hours of service per day.	<b>07</b>
	Take, the tooth form factor, $y = 0.154 - (0.912 / \text{No. of teeth})$ ; and the velocity factor, $C_v = 3 / (3 + v)$ .	
	<b>OR</b>	
	(c) Considering static strength determine a suitable module and face width for a pair of helical gears that transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. The gears are made of cast steel having allowable static strength of 100 MPa. Assume endurance strength of gear material = 618 MPa.	<b>07</b>
	Also, check the gears for wear.	
<b>Q.3</b>	(a) Explain the significance of L/D ratio and minimum oil-film thickness in hydrodynamic bearings.	<b>03</b>
	(b) Differentiate between Hydrodynamic and Hydrostatic bearings.	<b>04</b>
	(c) Find the range ratio, geometric progression ratio and spindle speeds for the following data: $N_{\min} = 100$ r.p.m., $N_{\max} = 1800$ r.p.m. and number of speed steps = 8.	<b>07</b>
	Also, draw all possible structure diagrams.	

- Q.3** (a) How the bevel gears are classified ? Explain with neat sketches. **03**
- (b) Explain interference and undercutting in involute gear tooth profile. **04**
- (c) A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of  $1.4 \text{ N/mm}^2$ . The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of  $75^\circ\text{C}$  may be taken as  $0.011 \text{ kg/m-s}$ . The room temperature is  $35^\circ\text{C}$ . Find : 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is  $10^\circ\text{C}$ . Take specific heat of the oil as  $1850 \text{ J / kg / }^\circ\text{C}$ . **07**

- Q.4** (a) Discuss advantages of rolling contact bearings over sliding contact bearings. **03**
- (b) Derive the equation for equivalent dynamic load for bearing under cyclic loads. **04**
- (c) A four stroke diesel engine has the following specifications : **07**
- Brake power = 5 kW; Speed = 1200 r.p.m.; Indicated mean effective pressure =  $0.35 \text{ N/mm}^2$ ; Mechanical efficiency = 80 %.
- Determine: 1. Bore and length of the cylinder; 2. Thickness of the cylinder head; and 3. Size of studs for the cylinder head.
- Take, Allowable circumferential stress for cylinder material = 42 MPa, and Allowable tensile strength of material for stud = 65 MPa.

**OR**

- Q.4** (a) With neat sketch explain the 'inertia bending forces' acting on connecting rod of an Internal Combustion (IC) engine. **03**
- (b) Describe the design procedure of a crank shaft of an Internal Combustion (IC) engine. **04**
- (c) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years (300 days/year) at 10 hours per day. Assume uniform and steady load. **07**

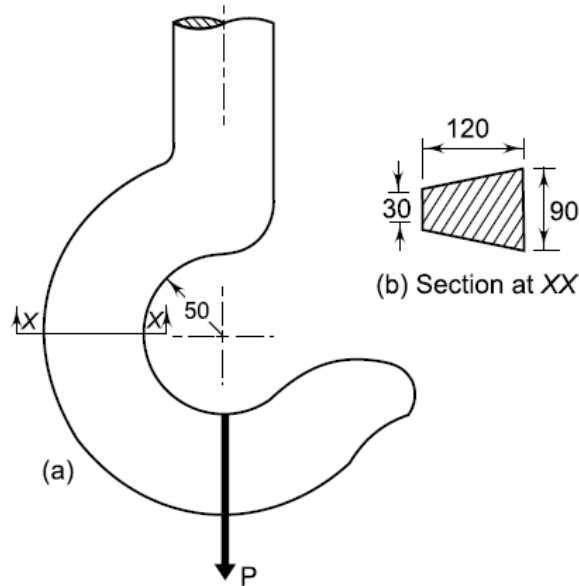
- Q.5** (a) List the basic objectives of material handling systems. **03**
- (b) Explain with neat sketches : Construction and designation of steel wire ropes. **04**
- (c) A crane hook having an approximate trapezoidal section is shown in Figure 1. The hook is made of plain carbon steel 45C8 (yield strength = 380 MPa) and the f.o.s. is 3.5. Determine the load carrying capacity of the hook. **07**

**OR**

- Q.5** (a) Explain different types of loads handled by material handling equipments. **03**
- (b) A crane is lifting a load of 25 kN through a wire rope and a hook. The weight of hook, etc. is 15 kN. The rope drum diameter may be taken as 3 times the diameter of the rope. The load is to be lifted with an

acceleration of  $1 \text{ m/s}^2$ . Calculate the diameter of the wire rope. Take f.o.s. of 6 and Young's modulus for the wire rope  $80 \text{ kN/mm}^2$ . The ultimate stress may be taken as  $1800 \text{ Mpa}$ . The cross-sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter.

- (c) Explain the need of material handling equipments. Also, Classify material handling equipments. **07**



**Figure 1**

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