

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2024****Subject Code:2171909****Date:30-11-2024****Subject Name: Machine Design****Time:10:30 AM TO 01:30 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 Design data book should be permitted during the examination.

MARKS

- Q.1**
- | | | |
|-----|---|-----------|
| (a) | What are the advantages of a gear drive over other mechanical power transmission systems? | 03 |
| (b) | Explain: (i) Pitch angle (ii) Helix angle (iii) Pressure angle (iv) Range ratio | 04 |
| (c) | Write a short note on gear tooth failures. | 07 |
- Q.2**
- | | | |
|-----|---|-----------|
| (a) | List the methods to eliminate interference in involute gears. | 03 |
| (b) | Derive an expression of power transmitting capacity of worm gears based on thermal considerations. | 04 |
| (c) | A pair of spur gears consists of a 24 teeth pinion, rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6 mm, while the face width is 60 mm. Both gears are made of steel with an ultimate tensile strength of 450 N/mm ² . They are heat treated to a surface hardness of 250 BHN. Assume that velocity factor accounts for the dynamic load. Calculate (i) beam strength; (ii) wear strength; and (iii) the rated power that the gears can transmit, if service factor and the factor of safety are 1.5 and 2, respectively. | 07 |
- OR**
- | | | |
|-----|---|-----------|
| (c) | The following data is given for a pair of parallel helical gears made of steel:
Power transmitted = 20 kW; speed of pinion = 720 rpm; number of teeth on pinion = 35; number of teeth on gear = 70; centre distance = 285 mm; normal module = 5 mm; face width = 50 mm; normal pressure angle = 20°; ultimate tensile strength = 600 N/mm ² surface hardness = 300 BHN; grade of machining = Gr. 6; service factor = 1.25. Calculate: (i) the helix angle; (ii) the beam strength; (iii) the wear strength; and (iv) the static load. | 07 |
|-----|---|-----------|
- Q.3**
- | | | |
|-----|---|-----------|
| (a) | Explain: Dynamic load carrying capacity and Equivalent bearing load. | 03 |
| (b) | State any two advantages and two disadvantages of deep groove ball bearing. | 04 |
| (c) | List the steps of the basic procedure for the selection of a bearing from the manufacturer's catalogue. | 07 |
- OR**
- Q.3**
- | | | |
|-----|---|-----------|
| (a) | Derive the Petroff's equation | 03 |
| (b) | Write about energy losses in hydrostatic bearing. | 04 |
| (c) | The following data is given for a 360° hydrodynamic bearing:
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. | 07 |

- Q.4** (a) Why is cylinder liner provided separately in I C engine cylinder? **03**
 (b) List the advantages and disadvantages of aluminium as a piston material. **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 N/mm^2 ; Mechanical efficiency = 80 %. Determine: (i) bore and length of the cylinder (ii) thickness of the cylinder head; and (iii) size of studs for the cylinder head.

OR

- Q.4** (a) Give function, types and materials used for crankshaft of an I C engine **03**
 (b) Why is I-section considered suitable for a connecting rod? **04**
 (c) Design a cast iron piston head, ribs and piston rings of a single acting four stroke engine for the following data: **07**
 Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2000 r.p.m.

- Q.5** (a) Explain the designation used for a steel wire rope. **03**
 (b) Write the steps for designing a crane hook. **04**
 (c) Classify material handling equipment. What are the basic objectives that a material handling equipment should fulfil? **07**

OR

- Q.5** (a) What are the advantages of geometric progression in a variable speed gear box? **03**
 (b) Draw structure diagrams for the following equations of a six speed gear box: **04**
 (i) $z = 2(1) 3(2)$ (ii) $z = 2(3) 3(1)$ (iii) $z = 3(1) 2(3)$ (iv) $3(2) 2(1)$
 (c) List the steps to draw a structure diagram. Explain the criteria to select an optimum structure diagram with an example. **07**
