Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023**

**Subject Code:3171917 Date:14-12-2023**

**Subject Name: Design of Machine Elements**

**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 is allowed Bhandari/PSG.**

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| **Q.1** | **(a)** | What is the function of cylinder liners in IC Engines? List down the reasons for liner distortion. | **03** |
| | **(b)** | What is unilateral and bilateral tolerance? | **04** |
| | **(c)** | Explain in detail aesthetic and ergonomic consideration in design. | **07** |
| **Q.2** | **(a)** | Differentiate between Arithmetic, Geometric and Harmonic Progressions in case of design of gear box. | **03** |
| | **(b)** | Discuss different types of failure in gear design | **04** |
| | **(c)** | Design a pair of CI spur gear to transmit 12 kW having pinion speed of 200 rpm. The speed reduction required is 2:1. Assume face width as 3 times circular pitch. The minimum number of teeth on pinion is 24. Check your design in all failures considering the following data:<br>Pressure angel $14.5^0$ full depth involute,<br>Factor of safety 1.5<br>The modulus of elasticity for pair is $0.8 * 10^5$ N/mm2,<br>Error in manufacturing is not to exceed 0.05 mm,<br>Allowable bending stress for CI as 45 N/mm$^2$,<br>Surface endurance stress as 280 N/mm$^2$ | **07** |
| | | **OR** | |
| | **(c)** | Explain the design procedure of helical gear based on beam strength and wear strength theory. | **07** |
| **Q.3** | **(a)** | Explain hydrostatic and hydrodynamic lubrication in journal bearing with its application in engineering | **03** |
| | **(b)** | Derive and explain the importance of bearing characteristic number in design of journal bearing | **04** |
| | **(c)** | Calculate the maximum radial load that the journal can carry and operate at hydrodynamic condition for the following data of a full journal bearing. Journal diameter = 60 mm, bearing length = 60 mm, radial clearance = 0.06 mm, minimum film thickness = 0.006 mm, journal speed = 1440 rpm, viscosity of lubricant = 20 cP.<br>For the above calculated load, find the power lost in friction | **07** |
| | | **OR** | |
| **Q.3** | **(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)** | Drive the Lame's equation for thick cylinder. | **07** |
| **Q.4** | **(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** |

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| | **(c)** | Explain construction and working of valve gear mechanism with neat sketch. | **07** |

**OR**

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| **Q.4** | **(a)** | What are the functions of rib, cup, compression ring and oil scraper ring in piston? | **03** |
| | **(b)** | Explain different types of crankshafts used in IC Engine with their application. | **04** |
| | **(c)** | The following specification refers to EOT crane:<br>Application: class-II<br>Load to be lifted : 120 kN<br>Hoisting speed : 5m/min<br>Maximum lift : 15m<br>Design a Hook. | **07** |
| **Q.5** | **(a)** | Explain the Belleville spring? And its application. | **03** |
| | **(b)** | Explain following term regarding spring<br>1. Solid Length 2. Free Length 3. Spring index 4. Spring stifness | **04** |
| | **(c)** | A high pressure cylinder consists of steel tube with 20 mm and 35 mm as inner and outer diameter respectively. It is jacketed by outer steel tube with 50 mm outer diameter. The tubes are assembled by shrinking process in such a way that maximum principal stress included in any tube is restricted to 100 MPa. Calculated the shrinkage pressure and original dimensions of the tube. | **07** |

**OR**

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| **Q.5** | **(a)** | What do you mean by coupling? Give its applications. | **03** |
| | **(b)** | Explain Muff coupling in brief. | **04** |
| | **(c)** | Design muff coupling to connect two steel shaft transmitting 40 kw at 350rpm. The material for shafts and key is plain carbon steel for which allowable shear and crushing stress are 40 MPa and 80 Mpa respectively. The material for muff is cast iron for which allowable shear stress is 15 MPa. | **07** |

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