

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2024****Subject Code:2171909****Date:22-05-2024****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. Simple and non-programmable scientific calculators are allowed.
5. Use of design data book is permitted.

		MARKS
Q.1	(a) Discuss different types of failure in gear design.	03
	(b) Explain the rang ratio in gear box design.	04
	(c) Design a pair of spur gear with 20° FD involute teeth to transmit 10 kW at 1440 rpm of the pinion. The speed ratio is 4: 1. The pinion is made of plain carbon steel Fe 410 (Sut = 410 MPa) and the gear is made of grey cast iron FG 200(Sut = 200 MPa). The factor of safety desired is 3 and the load is steady with medium shocks running for 8 to 10 hours per day. The gears are commercial gears.	07
Q.2	(a) Classify different types of bearings.	03
	(b) Explain the design parameters to be considered in the performance of a hydrodynamic bearing.	04
	(c) A foot step bearing supports a shaft of 100 mm diameter which is counter bored at the end with a hole diameter of 50 mm. The bearing pressure is limited to 1 N/mm ² . The speed of shaft is 100 rpm. Assume $\mu = 0.015$. Find (i) the load to be supported (ii) the power lost in friction (iii) the heat generated in bearing.	07
	OR	
	(c) A ball bearing, subjected to a radial load of 5 KN, is expected to have a life of 8000 hrs at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of bearing, so that it can be selected from manufacturer's catalogue based on a reliability of 90%.	07
Q.3	(a) Differentiate between hydrodynamic and hydrostatic bearings.	03
	(b) Explain the different types of stresses acting on crank shaft of an IC engine. Any four with neat sketches.	04
	(c) A three stage gear box with twelve speeds is to be designed based on R10 series with a minimum spindle speed of 125 rpm. The electric motor is connected to the gear box through a belt drive and runs at 1440 rpm and transmits power of 5 kW. Using standard spindle speeds, a) Draw the structure and speed diagram for the arrangement. b) Determine the ratio of the belt pulley diameters. c) Draw the gear box layout.	07
	OR	
Q.3	(a) What is the flexibility of wire rope? How does the flexibility of the wire rope influence in wire rope design?	03
	(b) Define the following terms: (i) Rating life of rolling contact bearings (ii) Median life	04

- (iii) Equivalent dynamic load
(iv) Reliability of bearing
- (c) It is required to select a 6×19 wire rope with 1570 as tensile designation for a hoist on the basis of long life. The weight of the hoist along with the material is 5 kN. It is to be raised from a depth of 100 m. The maximum speed of 5 m/s is attained in 5 s. Determine the size of the wire rope and the sheave diameter for long life on the basis of the fatigue as failure criterion. What is the factor of safety of this wire rope under static conditions? **07**
- Q.4** (a) Discuss the different types of piston rings and function of each one of it. **03**
(b) What is material handling? What are the essentials of good material handling system? **04**
(c) The cylinder of a four-stroke diesel engine has the following specifications: **07**
Brake power = 5 kW
Speed = 600 rpm
Indicated mean effective pressure = 0.5 MPa
Make suitable assumptions and calculate:
(i) bore and length of the cylinder liner
(ii) thickness of the cylinder liner
(iii) thickness of the cylinder head
(iv) size, number and pitch of studs
- OR**
- Q.4** (a) What is formative number of teeth in bevel gear? Derive the expression for formative number of teeth in bevel gears. **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) Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data: Cylinder bore = 100 mm, Length of connecting rod = 350 mm, Maximum gas pressure = 4 MPa, Factor of safety = 6 **07**
- Q.5** (a) Draw rope sheave and drum with usual notations. **03**
(b) List the major advantages of using geometric progression of for speed regulation in a gear box. **04**
(c) The following data is given for a hydrostatic thrust bearing: **07**
thrust load = 500 kN
shaft speed = 720 rpm
shaft diameter = 500 mm
recess diameter = 300 mm
film thickness = 0.15 mm
viscosity of lubricant = 160 SUS
specific gravity = 0.86
Calculate
(i) supply pressure;
(ii) flow requirement in litres/min;
(iii) power loss in pumping; and
(iv) frictional power loss.
- OR**
- Q.5** (a) What is the criterion for design of push rod? **03**
(b) When do you use Johnson's equation for buckling columns? **04**
(c) A pair of worm and worm wheel is designated as 3/60/10/6 The worm is transmitting 5 kW power at 1440 rpm to the worm wheel. The coefficient of friction is 0.1 and the normal pressure angle is 20° . Determine then components of the gear tooth force acting on the worm and the worm wheel. **07**
