Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2171909 Date:18/11/2017

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. **Use of design data book is permitted.**

			MARKS
Q.1	**(a)**	Why dissimilar materials are used for worm and worm wheel?. And explain the designation 4/29/10.6/2.5/50 used for the pair of worm and worm gear.	**03**
	(b)	Explain the followings: i) Interference and undercutting of gears ii) Static and Dynamic load carrying capacity of rolling contact bearings	**04**
	(c)	What are the major advantages of using geometric progression of for speed regulation in a gear box?. And explain the design procedure of 8-speed gear box for machine tool application with the assumption of suitable and necessary data.	**07**
Q.2	**(a)**	How are the gears classified?. Explain the role of pressure angle in the gears.	**03**
	(b)	Explain different types of gear tooth failures	**04**
	(c)	Design a spur gear drive to transmit 30 HP at 900 r.p.m. Speed reduction ratio is 2.5 . Material for pinion and wheel are C.I steel and Cast Iron respectively. Take pressure angle of 20^0 . Design bending stress for pinion material is 85 N/mm^2 and surface endurance limit for pinion material is 620 N/mm^2. Take the following data for the given gears: Quality of the gears to be - Grade 12 Service factor, [illegible]	**07**
		OR	
	(c)	Design the bevel gear pair for the following specification using Carl Barth velocity factor and wear consideration: Power transmitted : 40 kW Input speed : 360 rpm Reduction ratio : 3	**07**

Shaft angle : 90^0
Application : Agitator

Q.3 **(a)** Give the classification of hydrodynamic bearings based on lubrication. **03**

(b) Explain the significance of L/D ratio and minimum oil-film thickness in hydrodynamic bearings. **04**

(c) The following data is given for a 360^0 hydrodynamic bearings: **07**

Radial load : 3.1 kN
Journal diameter : 50 mm
Bearing length : 50 mm
Journal speed : 1440 rpm
Radial clearance : 50 microns
Viscosity of lubricant : 25 cP
Density of lubricant : 860 kg / m^3
Sp. Heat of lubricant : 1.76 kJ / kg ^{0}C

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing. Calculate:

i) Sommerfeld Number
ii) Minimum oil-film thickness
iii) The coefficient of friction
iv) The power lost in friction
v) The total flow rate of lubricant in liter /minute
vi) Side leakage

OR

Q.3 **(a)** What are the difference between Hydrodynamic and Hydrostatic bearings. **03**

(b) Derive the " Petroff's equation with assumptions made there in. **04**

(c) A Petroff's sleeve bearing consists of a sleeve having a bore diameter of 100.1 mm and a length of 100 mm. A shaft having 100 mm diameter supports a load of 4000 N. A shaft runs at 2880 r.p.m in the sleeve. If the frictional torque on the shaft is 10 N-m, find **07**

i) The absolute viscosity of lubrication
ii) The bearing pressure
iii) The coefficient of friction and
iv) The power lost in bearing.

Q.4 **(a)** Define static and dynamic load carrying capacities of the rolling contact bearings. **03**

(b) Derive the equation for equivalent dynamic load for bearing under cyclic loads. **04**

(c) A single-row deep groove ball bearing operated with the following work cycle. If the expected life of the bearing is 13000 hours with reliability of 90%. Calculate the dynamic load rating of the bearing and determine reliability of a system consisting of four such bearings. The work cycle is as follows: **07**

Gear	Axial load (KN)	Radial load (KN)	Radial Factor	Thrust factor	Race rotation	C_s	N rpm	% time engaged
I	1.5	5	0.56	1.1	Inner	1.25	960	30 %
II	0.73	3.7	0.56	1.3	Outer	1.4	1440	40 %
III	-	-	-	-	Outer	-	720	30 %

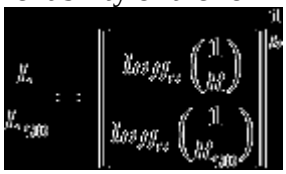
OR

Q.4 **(a)** Classify the rolling contact bearings. And explain how they are designated according to ISI code of practice. **03**

(b) Define the following terms: **04**

(i) Rating life of rolling contact bearings
(ii) Median life
(iii) Equivalent dynamic load
(iv) Reliability of bearing

(c) Establish the following relationship between the life and reliability of the rolling contact bearing; **07**



Q.5 **(a)** Why the cylinder liners are being used in I.C.Engine?. What are the desirable properties of the materials for the cylinder liners. **03**

(b) What are the functions of I.C.Engine piston ?. List the elements involved in the I.C.Engine piston. **04**

(c) The following data is given for the piston of a four-stroke diesel engine: **07**

Cylinder bore : 250 mm
Material of piston rings : Gray C.I.
Allowable tensile stress : 100 N / mm^2
Allowable radial pressure on cylinder wall : 0.03 MPa
Thickness of piston head : 42 mm
No. of piston rings : 4

Calculate:

i) Radial width of the piston rings
ii) Axial thickness of the piston rings
iii) Gap between the free ends of the piston rings before and after the assembly
iv) Width of the top land

v) Width of the ring grooves
vi)Thickness of the piston barrel

OR

Q.5 **(a)** What are the basic objectives of material handling systems?. **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) Design the following components of EOT cranes for the following requirements: **07**

Application	: class – II
Load to be lifted	: 8 tones
Hoisting speed	: 4 m / min
Maximum lift of the load	: 12 m

(i) Select through design procedure a suitable wire rope
(ii) Sheave in a snatch block assembly of crane.
