Student Exam No. __________

Ganpat University

B.Tech SEM VIII Mechatronics Engineering
CBCS Regular Examination April – June 2017
2MC804 Design of Mechanical Systems

Duration: 3hr **Marks: 70**

Instructions:

1. Assume suitable data if necessary.
2. Write your answer to the point and precisely.
3. Draw neat and clean sketch.

SECTION - 1

Q.1 Attempt following questions.

(a) Write down the procedure to select ball bearing from Manufactures' catalogue. [06]

(b) A ball bearing operates on a work cycle consisting of three parts: a radial load of 3000 N at 720 r.p.m. for 30% of the cycle, a radial load of 7000 N at 1440 r.p.m. for 40 % of the cycle and radial load of 5000 N at 900 r.p.m. for the remaining part of the cycle. The basic dynamic capacity of the bearing is 30700 N. Calculate: [06]
(i) The rating life of the bearing in hours; (ii) the average speed of rotation; and
(iii) the life of the bearing with 95 % reliability.

OR

Q.1 Attempt following questions.

(a) What is equivalent dynamic load carrying capacity of bearing? How bearing is selected based on dynamic load carrying capacity? [06]

(b) Deep groove ball bearing of 6207 series carries a combined load of 1820 N radially and 1365 N axially at 1200 r.p.m. The outer ring rotates, and the bearing is subjected to moderate shock. Find the average expected life of this bearing in hours. Assume value of shock factor = 1.9. C0 = 15.3 KN and C = 25.5 KN [06]

Q.2 Attempt following questions.

(a) Derive the Stribeck's equation for basic static capacity of bearing. State the assumptions made. [04]

(b) Following data is given for a hydrostatic thrust bearing: [07]

Shaft speed	720 r.p.m.
Supply pressure	5 Mpa
Shaft diameter	400 mm
Recess diameter	250 mm
Film thickness	0.15 mm
Viscosity of lubricant	30cp
Specific heat of lubricant	1.76 KJ/Kg °C
Specific gravity of lubricant	0.86

Calculate: (i) Load carrying capacity of the bearing (ii) flow required in l/min (iii) frictional power loss (iv) pumping power loss and (v) temperature rise.

OR

Q.2 Attempt following questions.

(a) Explain the power loss in Hydrostatic step bearing. [04]

(b) The following data is given for a 360 °C hydrodynamic bearing: **[07]**

- Radial load 10 KN
- Journal speed 1450 r.p.m.
- (l/d) ratio 1
- Bearing length 50 mm
- Radial clearance 20 microns
- Eccentricity 15 microns
- Specific gravity of lubricant 0.86
- Specific heat of lubricant 2.09 KJ/Kg °C

Calculate: (i) the minimum oil film thickness (ii) the coefficient of friction (iii) the power lost in friction (iv) the viscosity of lubricant (v) the total flow of the lubricant (vi) the side leakage (vii) the average temperature, if make-up oil is supplied at 30 °C.

Q.3 Attempt following questions **[12]**

(a) Write a short note: Mounting of bearings

(b) Explain hydrodynamic lubrications with their different types in detail.

SECTION – II

Q.4 Attempt following question

A pair of spur gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20^0. The face width is 40 mm and the module is 4 mm. The pinion as well as gear the gear are made of steel 40C8 (S_{ut} = 600 N/mm^2) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears. **[12]**

OR

Q.4 Attempt following question

The Layout of double reduction helical gear box is shown in figure – 1. Pinion A is the driving gear and 10 kW power at 720 rpm in counter clockwise is supplied to it through its shaft No. 1. The number of teeth on different helical gear are Z_A = 20, Z_B = 50, Z_C = 20, Z_D = 60. The normal pressure angle for all gears is 20^0. For the pair of helical gears A and B, the helix angle is 30^0 and normal module is 3 mm. For the pair of C and D, the helix angle is 25^0 and normal module is 5 mm. Pinion A has right handed helical teeth, while pinion C has left handed helix. The bearing B1 and B2 are mounted on shaft No. 2 in such a way that bearing B1 can only take both radial and thrust load while Bearing B2 can take only radial load. Determine the magnitude and direction of bearing reactions on shaft No. 2. **[12]**

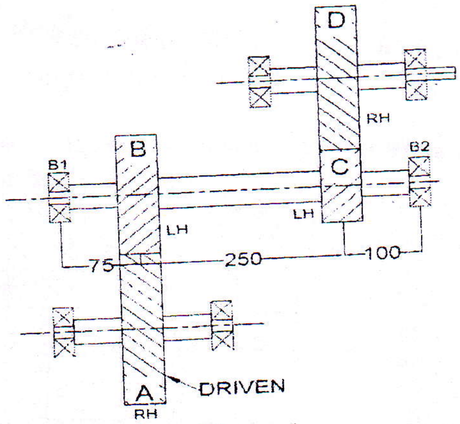

Figure 1

Q.5 A 35 kW motor running at 1200 r.p.m. drives a compressor at 780 r.p.m through a 90^0 bevel gearing arrangement. The pinion has 30 teeth. The pressure angle of teeth is 14.5^0. The wheels are capable of withstanding a dynamic stress, $\sigma_w = 140\left(\frac{280}{280+v}\right) MPa$, Where v is the pitch line speed in m/min. The form factor for teeth may be taken as $0.124 - \frac{0.686}{T_E}$, Where T_E is the number of teeth equivalent of a spur gear. The face width may be taken as ¼ of the slant height of pitch cone. Determine for the pinion, the module pitch, face width, addendum, dedendum, outside diameter and slant height. **[11]**

OR

Q.5 (a) A planetary gear train is shown in figure.2 . The sun gear A rotates in a counter clockwise direction and transmit 3.5 KW power at 1440 rpm to the gear train. The number of teeth on sun gear A, planet gear B and the fixed ring C are 30, 60 and 150 respectively. The module is 5 mm and the pressure angle 20^0 . Draw a free body diagram of forces acting on each gear and calculate the torque that the arm D can deliver to its output shaft. **[08]**

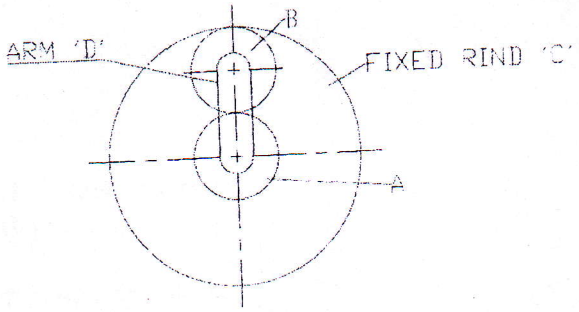

Figure 2

(b) Explain any two kind of Gear Tooth failure. **[03**

Q.6 Attempt **any three** questions. **[12**

(a) Evaluate Parallel and Crossed helical gear

(b) Explain the Johnson's method for optimum design of component.

(c) Write a short note on Design of speed box of machine tool.

(d) Write down the selection criteria for the Rolling and Sliding contact bearing.

Table 1: Radial and thrust factors for single –row deep groove ball bearing

F_a/C_0	$(F_a/VF_r) \le e$		$(F_a/VF_r) > e$		e
	X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22
0.04	1	0	0.56	1.8	0.24
0.07	1	0	0.56	1.6	0.27
0.13	1	0	0.56	1.4	0.31
0.25	1	0	0.56	1.2	0.37
0.5	1	0	0.56	1.0	0.44

Table 2: Value of Lewis Form Factor

Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y
16	0.295	20	0.320	24	0.337	28	0.352	33	0.367	40	0.389
17	0.302	21	0.326	25	0.340	29	0.355	35	0.373	45	0.399
18	0.308	22	0.330	26	0.344	30	0.358	37	0.380	50	0.408
19	0.314	23	0.333	27	0.438	32	0.364	39	0.386	300	0.471

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