BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - V MECHANICAL : WINTER- 2022
SUBJECT : MACHINE DESIGN & ANALYSIS-II

Day : Wednesday | Time : 02:30 PM-06:30 PM

Date : 14-12-2022 | W-24509-2022 | Max. Marks : 60

N. B. :

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Draw neat and labelled diagrams **WHEREVER** necessary.
4) Use of non-programmable calculator is **ALLOWED.**
5) Assume suitable data, if necessary.
6) Use of design data book is allowed.

Q. 1 A pair of spur gears with 20^0 full-depth involute teeth consists of a 19 teeth pinion meshing with a 40 teeth gear. The pinion is mounted on a crankshaft of 7.5 kW single cylinder diesel engine running at 1500 rpm. The driven shaft is connected to a two-stage compressor. Assume the service factor as 1.5. The pinion as well as the gear is made of steel 40C8 (S_{ut} =600 N/mm^2). The module and face width of the gears are 4 and 40 mm respectively. **(10)**

i) Using the velocity factor to account for the dynamic load, determine the factor of safety.
ii) If the factor of safety is two for pitting failure, recommend surface hardness for the gears.
iii) If the gears are machined to meet the specifications of Grade 8, determine the factor of safety for bending using Buckingham's equation for dynamic load
iv) Is the gear design satisfactory? If not, what is the method to satisfy the design conditions? How will you modify the design?

OR

Q. 1 A steel pinion with 20^0 full depth involute teeth is transmitting 7.5kW power at 1000 rpm from an electric motor. The starting torque of the motor is twice the rated torque. The number of teeth on the pinion is 25, while the module is 4mm. The face width is 45mm. Assuming that velocity factor accounts for the dynamic load, calculate **(10)**
Calculate:

i) the effective load on the gear tooth
ii) The bending stresses in the gear tooth

Q. 2 A herringbone speed reducer consists of 26 teeth pinion driving a 104 teeth gear. The gears have normal module on 2 mm. The pressure angle is 20^0 and the helix angle is 25^0. The pinion receives 100 kW power through its shaft and rotates at 3600 rpm. The face width of each half is 35 mm. The gears are made of alloy steel 30Ni4Cr1 (S_{ut}=1500 N/mm^2) and heat treated to a surface hardness of 450 BHN. The service factor is 1.25. Determine the factor of safety against bending failure and against pitting failure. **(10)**

OR

Q. 2 A pair of parallel helical gears consists of an 18 teeth pinion meshing with a 45 teeth gear. 7.5 kW power at 2000 rpm is supplied to the pinion through its shaft. The normal module is 6 mm, while the normal pressure angle is 20^0. The helix angle is 23^0. Determine the tangential, radial and axial components of the resultant tooth force between the meshing teeth. **(10)**

P. T. O.

Q. 3 With neat sketch discuss force analysis of bevel gears. **(10)**

OR

Q. 3 A pair of worm and worm wheel is designated as 1/30/10/10. The input speed of the worm is 1200 rpm. The worm wheel is made of centrifugally cast, phosphor bronze and the worm is made of case-hardened carbon steel 14C6. Determine the power transmitting capacity based on the beam strength. **(10)**

Q. 4 A single-row deep groove ball bearing is used to support the lay shaft of a four speed automobile gear box. It is subjected to the following loads in respective speed ratios: **(10)**

Gear	Axial load (N)	Radial load (N)	(%) time engaged
First gear	3250	4000	1 %
Second gear	500	2750	3 %
Third gear	50	2750	21 %
Fourth gear	Nil	Nil	75 %

The lay shaft is fixed to the engine shaft and rotates at 1750 rpm. The static and dynamic load carrying capacities of the bearing are 11600 and 17600 N respectively. The bearing is expected to be in use for 4000 hours of operation. Find out the reliability with which the life could be expected.

OR

Q. 4 The radial load acting on a ball bearing is 2500 N for the first five revolutions and reduces to 1500N for the next ten revolutions. The load variation then repeats itself. The expected life of the bearing is 20 million revolutions. Determine the dynamic load carrying capacity of the bearing. **(10)**

Q. 5 The following data is given for a 360^0 hydrodynamic bearing: **(10)**
radial load = 6.5 kN, journal speed = 1200 rpm, journal diameter = 60 mm, bearing length = 60 mm, minimum oil film thickness = 0.009 mm, The class of fit is H7e7 (fine) normal running fit. Specify the viscosity of the lubricating oil that you will recommend for this application.

OR

Q. 5 The following data is given for a 360^0 hydrodynamic bearing: **(10)**
radial load = 2 kN, journal diameter = 50 mm, bearing length = 50 mm, viscosity of oil = 20 m Pa s. Specify radial clearance that need be provided so that when the journal is rotating at 2800 rpm, the minimum film thickness is 30 microns. Evaluate the corresponding coefficient of friction.

Q. 6 Explain procedure of selection of flat belt from manufacturer's catalogue. **(10)**

OR

Q. 6 a) Explain polygonal effect in chain with sketch. **(05)**

b) Explain any one belt tensioning method with suitable sketch. **(05)**

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