Exam Date & Time: 02-May-2024 (02:30 PM - 05:30 PM)





MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, APRIL-MAY 2024 MECHANICAL DESIGN - II [MME 3252]

Marks: 50

Α

Duration: 180 mins.

Answer all the questions.

Instructions to Candidates:

Answer ALL questions

Missing data may be suitably assumed

Use of Design Data Hand Book is permitted Suggested corrections of data hand book is included in reference material.

The two helical compression springs nested one inside the other support a load of 600N. Both the springs are made up of the same material with G=82.7 GPa. The dimensions of helical compression springs are as follows:

A)

1)

Particulars	Outer spring	Inner spring
Spring index	8	7
Wire diameter (mm)	5	4
Number of active coils	10	6
Free length (mm)	90	75

Determine i) Deflection of each spring ii) Load shared by each spring iii) Shear stress induced in each spring wire

B) A heavy-duty truck spring has an overall length of 1.4 m and sustains a load of 80 kN at its center. The spring has 3 full-length leaves and 10 graduated leaves with a central band 150 mm wide. All the leaves are to be stressed to 300 MPa when fully loaded. The total spring depth-to-width ratio is to be approximately 2. Determine

i) width and thickness of leaves

ii) initial nip

iii) the load exerted on the band after the spring is assembled.

- C) Define the following: -
 - (a) Spring rate
 - (b) Surging
 - (c) Nip
- Design a pair of spur gears to transmit 20 kW of power while operating for 8 to 10 hours per day (8) sustaining medium shock, from a shaft (pinion mounted) rotating at 1085 rpm to a parallel shaft (gear mounted) which is to rotate at 310 rpm. The number of teeth on the pinion is 26 and gears have 20° full depth involute tooth profile. To improve wear resistance the materials given are surface hardened to higher BHN. The material of the pinion is C40 steel untreated (BHN₁=400) and for gear is cast steel untreated (BHN₂=300). Assume the face width to be 10 times the module. Check the design for the dynamic load and the wear load.

Note: Select only the preferred choice module from the recommended series of modules.

(4)

(3)

(3)

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- B) List the differences between helical gears and spur gears (ANY FOUR)
- 3) A pair of right-angle bevel gears is to transmit 5kW at 1500 rpm of the pinion at the speed ratio of 3:1. The diameter of the pinion is 75mm. The tooth form is 14.5° involute. The pinion is made of steel $(\sigma_d=160MPa)$ and gear of cast iron $(\sigma_d=80MPa)$. Design the gear based on strength. Take the service (4)
 - A) factor as unity. Assume velocity factor for generated teeth.
 - B) A worm gear drive transmits 12 kW at 500 rpm of the worm. The speed ratio is 12:1. The gear material is phosphor bronze and the worm is hardened steel. The load is steady and intermittent. Design the gear based on strength and calculate the dynamic load and wear load. Use $C_v = 3.05/(3.05+v)$. Assume the face width to be 7.5 times the module. (6)
- A fixed profile full journal bearing 45mm diameter and 63mm long is required to be designed for a reciprocating pump. The main bearing has a radial load bearing capacity of 1.6 MPa per unit projected area and the speed of the journal is 1200RPM. The operating temperature of the bearing is limited to 80°C, and room temperature is 30°C. The ratio of journal diameter to diametral clearance is 1000. Determine
 - i. Viscosity of oil to be used as lubricant and suggest a suitable grade lubricating oil.

(5)

(4)

(2)

ii. Friction Coefficient based on McKee's Equation.

iii. Minimum film thickness

- B) A single-row deep groove ball bearing is subjected to a radial load of 12kN for 50% of the time, 6kN for 30% of the time and 3kN for the remainder of the load cycle. The speed is 1880rpm and the expected life is 10 years. The number of working days per year is 250 and the working hours per day is (5)
 7. Find the minimum value of the basic load rating that the bearing must have.
- A differential band brake is shown in Fig. The width and thickness of the steel band are 100 mm and 3 mm respectively and the maximum tensile stress in the band is 50 N/mm². The coefficient of friction between the friction lining and the brake drum is 0.25. Calculate:
 - i) The tensions in the band.
 - ii) Determine the actuating force for both clockwise and counterclockwise rotation.
 - iii) The torque capacity of the brake.
 - iv) Check for self-locking.





All dimensions are in mm

B) Discuss the phenomenon known as a polygonal effect in chain drives used for power transmission.
 What is it, and how does it affect the smoothness of motion? Include a clear sketch to help illustrate the concept. (3)

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C) How many 20 mm diameter, 8 x 19 construction steel wire ropes are needed to lift a 20 kN load using a hoisting drum with a 1 m diameter, considering a safety factor of 5? The coal mine's depth is 0.8 km, and the acceleration is 3 m/s². Assume no weight for the tackle. The wire has a tensile strength of 1300 MPa.

Nominal breaking strength (F_u)	External load (F) +	Load due to self-weight (F _w) +	Load due to acceleration (Fa) +	Bending load	
Factor of safety				(Fb)	
					(3)

Where, Load due to acceleration (Fa) = $(F + F_w) * \frac{Acceleration (a)}{Gravity (g)}$

-----End-----