

(3 Hours)

[Total Marks : 80]

- NB:** (1) Question No. 1 is **compulsory**.  
 (2) Attempt any **THREE** questions from the **remaining**.  
 (3) Use of PSG Design Data Book is **permitted**.  
 (4) Make appropriate assumptions, wherever necessary.  
 (5) Illustrate your answers with **neat** sketches.



1. Design a two stage, 9 speed Gear Box for a machine tool from the following **20**  
 particulars:  
 Minimum output speed = 150 rpm  
 Maximum output speed = 1000 rpm  
 Input motor power = 10HP  
 Motor speed = 1400 rpm.  
 Design the shaft sizes, arrangement of gears and their sizes. Also draw the structural diagram, optimum ray diagram and deviation diagram. Prepare a neat sketch depicting the layout of the gear box with relevant details.
2. (a) Explain with sketches various methods of elimination of backlash in power screws. **05**  
**15**  
 (b) Design a lead screw and nut for a lathe to sustain an axial load of 8 kN. The lead screw is to be 3 m long and is to rotate at 100 rpm. The coefficient of friction at the collar and threads could be taken as 0.12 and 0.14 respectively.
3. (a) Discuss the various wear compensation techniques used in slideways. **05**  
**15**  
 (b) Design and sketch a multi-plate clutch used in a metal cutting machine tool with a power transmitting capacity of 8kW at 1000 rpm. The clutch is to be operated 80 to 100 times in an 8 hour shift. The design should include the discs and the operating lever. Assume appropriate data from hand book, clearly specifying the same.
4. (a) Explain in brief the slideway profiles stating its advantages and disadvantages **05**  
 (b) A full journal bearing is to be designed to support a load of 5 kN. The shaft is to operate at a speed of 1000 rpm. The spindle transmits 8 HP. It is desired to operate the bearing at a surface temperature not exceeding 60°C in a room temperature of 32 °C. **04**  
 Determine: **04**  
 1. Length, diameter and clearance of the bearing. **03**  
 2. Oil viscosity and coefficient of friction. **04**  
 3. Power loss in overcoming friction at the bearing.  
 4. Quantity of oil required to be circulated to maintain the bearing surface temperature.

(TURN OVER)

5. (a) Discuss the different bearing materials and their characteristics. **05**  
 (b) A deep groove ball bearing with dynamic capacity of 35kN is loaded as **15**  
 shown:

Axial Load (N)	Radial Load (N)	rpm	%cycle time
2000	4000	1000	25
1000	2800	1200	35
1800	4200	1400	40

Determine: Cubic mean load, 90% life of bearing in hours, Average life of bearing in hours.

6. Write explanatory notes on any **four** of the following:- **20**  
 (a) Enumerate the various characteristics of a machine tool.  
 (b) Types of belts and materials of construction.  
 (c) PIV drives.  
 (d) Norton gear box.  
 (e) Different safety devices incorporated in machine tools.

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