

(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 2 stage, 9 speed Gear Box for a machine tool from the following particulars: **20**
Minimum output speed = 150 rpm
Maximum output speed = 1000 rpm
Input motor power = 10 kW
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) Compare and contrast the various thread profiles used in power screws. **05**
(b) Design a lead screw and nut for a lathe to sustain an axial load of 15 kN. The leadscrew is to be 2.5 m long and is to rotate at 80 rpm. Calculate frictional power loss. Assume suitable data. **15**
3. (a) Discuss the various aspects of selecting materials in designing a friction clutch. **05**
(b) Design and sketch a multi-plate clutch used in a metal cutting machine tool with a power transmitting capacity of 12 kW at 800 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. **15**
4. (a) Describe the bed and column sections used in machine tools. **08**
(b) A full journal bearing is to be designed to support a load of 12 kN. The shaft is to operate at a speed of 900 rpm. The spindle transmits 7 HP. It is desired to operate the bearing at a surface temperature not exceeding 75°C in a room temperature of 35 °C.
Determine:
1. Length, diameter and clearance of the bearing. **03**
2. Oil viscosity and coefficient of friction. **03**
3. Power loss in overcoming friction at the bearing. **03**
4. Quantity of oil required to be circulated to maintain the bearing surface temperature. **03**

5. (a) Discuss the clearance adjustment techniques used in slideways. 08
(b) A deep groove ball bearing has dynamic capacity of 35 kN. It is subjected to the following duty, during one cycle of operation. 12
1. Radial load of 3000N at 400 rpm for 20% of time
 2. Radial load of 6000N at 600 rpm for 20% of time
 3. Radial load of 7000N at 600 rpm for rest of the time
 4. Constant axial load of 3000N.
- Determine: Cubic mean load, Rated life of bearing in hours, Average life of bearing in hours.
6. Write explanatory notes on any **four** of the following:- 20
- (a) Acceptance test of machine tools.
 - (b) Types of belts and materials of construction.
 - (c) Norton gear box.
 - (d) Slideway profiles used in machine tools.
 - (e) Role of a machine tool designer.
