

- 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. A machine tool gear box consists of 3 stages & gives 12 output speeds. The minimum & maximum output speeds are 250 rpm & 1350 rpm respectively. The input motor rating is 14HP at 1440 rpm. Determine: Optimum Ray Diagram, Sizes of gears & shafts, Gear box layout. 20
2. (a) Draw and explain slide-way profiles & their combinations. 05
(b) A machine tool lead screw 2.5m long carries a load of 25 kN and rotates at 50 rpm. Design and sketch the lead screw based on strength, rigidity and buckling. Also calculate power required and its efficiency. 15
3. (a) Discuss the various safety devices incorporated in machine tools. 05
(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. 15
4. (a) Explain in brief Acceptance tests carried out on a lathe. 05
(b) A full journal bearing is to be designed to support a load of 20 kN. The shaft is to operate at a speed of 800 rpm. The spindle transmits 7 HP. It is desired to operate the bearing at a surface temperature not exceeding 70°C in a room temperature of 35 °C. Determine: 1. Length, diameter and clearance of the bearing. 04
2. Oil viscosity and coefficient of friction. 04
3. Power loss in overcoming friction at the bearing. 03
4. Quantity of oil required to be circulated to maintain the bearing surface temperature. 04
5. (a) Discuss the step to step procedure for designing a V-belt drive. 05
(b) A deep groove ball bearing with dynamic capacity of 35kN is loaded as shown: 15
- | Axial Load (N) | Radial Load (N) | rpm | %cycle time |
|----------------|-----------------|------|-------------|
| 4500 | 2500 | 1000 | 15 |
| 3000 | 3500 | 1200 | 35 |
| 2500 | 4200 | 1800 | 50 |
- 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) Wear compensation techniques in slideways.
(b) Types of belts and materials of construction.
(c) PIV drives.
(d) Bed and column sections used in machine tools.
(e) Machine tool structure requirements and design guidelines.
