

**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: **04**
  1. Length, diameter and clearance of the bearing. **04**
  2. Oil viscosity and coefficient of friction. **03**
  3. Power loss in overcoming friction at the bearing. **04**
  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.