



Assume any missing data.

#1

- (a) What does Computer Aided Design (CAD) means,
- (b) What are the CAD fields of applications?
- (c) What are the advantages of CAD?
- (d) Explain how can you use different computer software packages in Computer Aided Design of Machine Tools for design and modifications processes?
- (e) What is the case study you had tried by yourself? (Use clear free hand sketches)?

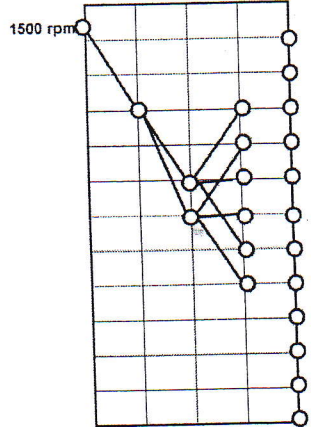
(25 Marks)

#2:

For the main gear box of a machine tool of 12 speeds, given: $\Phi=1.41$, $n_{motor} = 1500$ rpm, maximum speed of the gear box (n_{12}) = 31.5 rpm, the gear box is driven by 5 kw, 1500 rpm electric motor, the belt ratio between the electric motor and the gearbox is (1/2.1)?

(45 Marks)

- Give at least 6 options of (ray) kinematic diagrams
- Define the optimum ray (kinematic diagram) for 12 speed gear box.
- Calculate the number of teeth of all gears.
- Calculate the actual speeds.
- Calculate the theoretical speeds.
- Calculate the error in speeds.
- Complete the shown Sketch of the speed diagram.
- Calculate the gears module.
- Design the first shaft of the gear box.

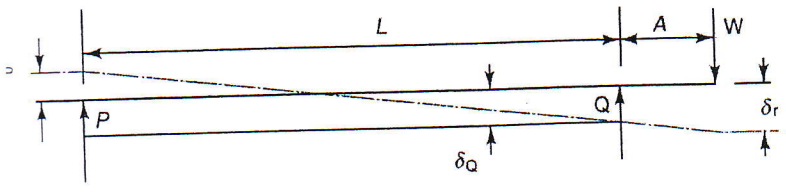


#3

For the gear box given in question Q# 2 If the spindle overhang (A) is 50 mm, the spindle is in a 31.5 - 1410 RPM range. Use a roller bearing near the overhung end, and a ball bearing at the farther end. ($\delta_q = 0.0002$ mm/kg, $\delta_p = 0.0005$ mm/kg), $E=2.1 \times 10^4$ kg/mm²

(15 Marks)

$$= \frac{\pi}{64} D^4 = 0.0491 D^4$$



$$\delta_o = \sqrt[3]{6EI_L \left(\delta_P + \delta_Q + \left(\frac{\delta_Q \cdot R}{A} \right) \right)}, \quad \delta = W \left(\frac{A^2}{3E} \left(\frac{L}{I_L} + \frac{A}{I_A} \right) + \delta_Q \left(1 + \frac{A}{L} \right)^2 + \delta_P \frac{A^2}{L^2} \right)$$

Find:

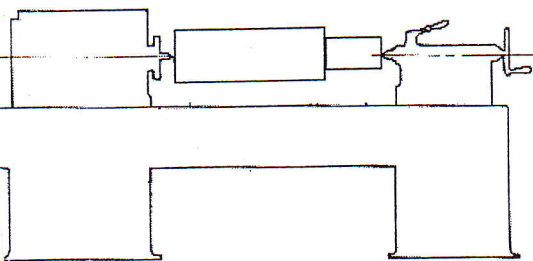
- 1) Calculate the spindle diameter?
- 2) Find Optimum span of bearings?
- 3) Estimate the spindle deflection and
- 4) determine the maximum deflection in the spindle?
- 5) What are the materials used in spindle manufacturing?
- 6) What are the factors controlling good spindle design?

Q#4

(15 Marks)

For the shown centre lathe:

- a) Sketch the forces develop and act on it?



- b) Find the forces on flat guideways on a lathe, if guideways are 25 mm thickness, and 50 mm wide. The center distance between the guideways is 350 mm. The machine has a 120 mm height above the guideway top faces. The machine is powered by a 5 kW motor. The machine mostly shapes steel workpieces at a speed of 25 meter/min. The tool frictional force (F_y) is 25% of the cutting force (F_z). Weight of saddle = 40 kg; Length of saddle = 220 mm?

- (b1) Select the slideway material?

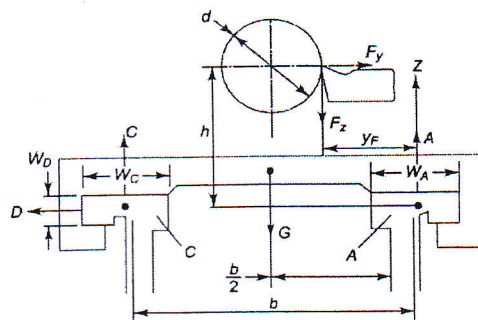
- (b2) Calculate the pressures on each contact surface?

$$\text{Pressure of face C } (P_C) = \frac{C}{W_C L} = \frac{\frac{F_z Y_f - F_y h}{b} + \frac{G}{2}}{W_C L}$$

$$\text{Pressure on face A } (P_A) = \frac{A}{W_A L} = \frac{F_z + \frac{G}{2} - \frac{F_z Y_f - F_y h}{b}}{W_A L}$$

$$\text{Pressure on edge D } (P_D) = \frac{D}{W_D L} = \frac{F_y}{W_D L}$$

W_A, W_C, W_D = Widths of faces A, C, D (mm)
 L = Length of saddle (mm)



(GOOD LUCK)