Menoufia University
Faculty of Engineering, Shebin El Kom
Dept: Production Engineering & Mechanical Design
First Semester Exam, 2013-2014
Date of Exam: 13/1/2014

Subject: Machine Tool Design
(Production + Design Students)
Year: Diploma Level 500 1st
Time Allowed: 3 hours
Total Marks = 100

Answer the following questions:

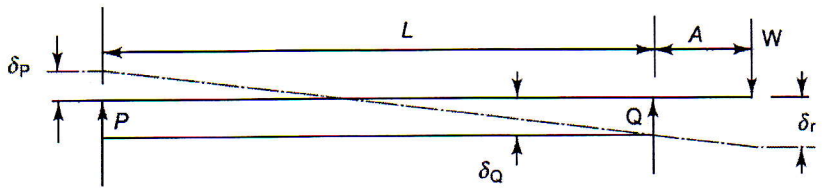
Q# 1: **(40 Marks)**

For the main gear box of a machine tool of 12 speeds, given: Φ=1.41, n_{motor} = 1500 rpm, maximum speed of the gear box (n_{12}) =31.5 rpm, the gear box is driven by 7.5 kw, 1500 rpm electric motor, the belt ratio between the electric motor and the gearbox makes the input shaft of the gearbox rotates at 1000 rpm?

1.	a. Calculate the number of teeth of all gears? b. Calculate the actual speeds? c. Calculate the theoretical speeds? d. Calculate the error in speeds?
2.	a. Sketch the speed diagram? b. Sketch the ray diagram? C. Sketch the kinematic diagram?
3.	a. Calculate the torques on all shafts? b. Calculate the gears module? c. Calculate the size of the gear box?

Q# 2: **(15 Marks)**

For the gear box given in question Q# 1 If the spindle overhang (A) is 30 mm spindle speeds 30–500 R.P.M. Use a roller bearing near the overhung end, and a ball bearing at the farther end. (δ_q = 0.0002 mm/kg, δ_p = 0.0005 mm/kg), E=2.1x10^4 kg/mm^2



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

$$L_0 = \sqrt[3]{6EI_L\left(\delta_P + \delta_Q + \left(\frac{\delta_Q . R}{A}\right)\right)}\ ,\qquad \delta = W\left(\frac{A^2}{3E}\left(\frac{L}{I_L} + \frac{A}{I_A}\right) + \delta_Q\left(1 + \frac{A}{L}\right)^2 + \delta_P \frac{A^2}{L^2}\right)$$

1.	(a) What are the functions and requisites of good spindle (b) What are the materials used in spindle manufacturing? (c) What are the factors controlling good spindle design?
2. Find:	(a) The spindle diameter. (b) Optimum span of bearings. (c) Spindle deflection and (d) Maximum deflection.

Q# 3: **(15 Marks)**

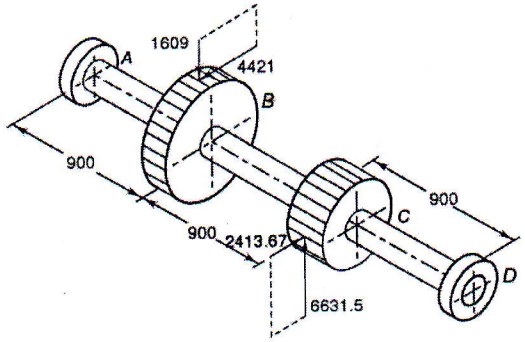
(a) What is the Computer Aided Design-CAD technique? What are the objectives of the Computer Aided Design-CAD technique? Where the Computer Aided Design-CAD technique has been applied?

(b) From your practice during this course, give an example of simple program to solve a problem in mechanical design?

Q# 4: **(15 Marks)**

(a). For the main parts of Horizontal Milling Machine (1. Base, 2. Column, 3. Knee, 4. Table, 5. Overarm / Head, 6. Spindle), sketch the forces to be used in their design?

(b). Design the shown intermediate shaft of a gear box supporting two spur gears B and C. The shaft is mounted on two bearings A & B. The pitch circle diameters of gears B & C are 900 and 600 mm respectively. The ultimate tensile and yield tensile stresses are 770 and 580 N/mm^2?



Q#5: **(15 Marks)**

Find the forces on flat guideways on a lathe, if guideways are 35 mm thickness, and 65 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 7.5 kW motor. The machine mostly shapes steel workpieces at a speed of 25 meter/min. The tool frictional force (*Fy*) is 25% of the cutting force (*Fz*). Weight of saddle = 40 kg; Length of saddle = 250 mm?

(1) What are the Functions and Requisites of good slideways?

(2) Select the slideway material?

(3) Calculate the pressures on each contact surface?

(4) Find the tool radial displacement?

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

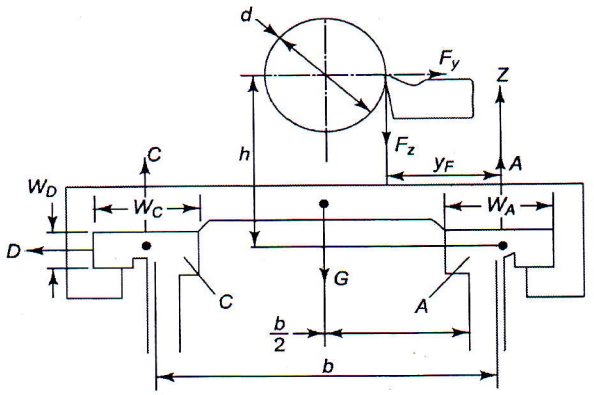
$$\text{Pressure on face } A (P_A) = \frac{A}{W_A L} = \frac{F_z + \dfrac{G}{2} - \dfrac{F_z Y_f - F_y h}{b}}{W_A L}$$

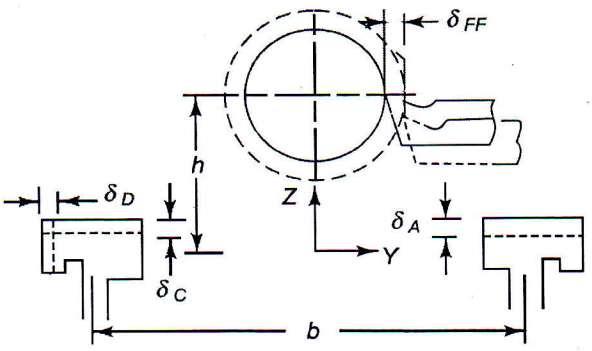
$$\text{Pressure on edge } D (P_D) = \frac{D}{W_D L} = \frac{F_y}{W_D L}$$

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

L = Length of saddle (mm)

$$\text{Tool displacement } (\delta_{FF}) = KP_D + K\frac{(P_A - P_c)h}{b}$$





(Assume any missing data)