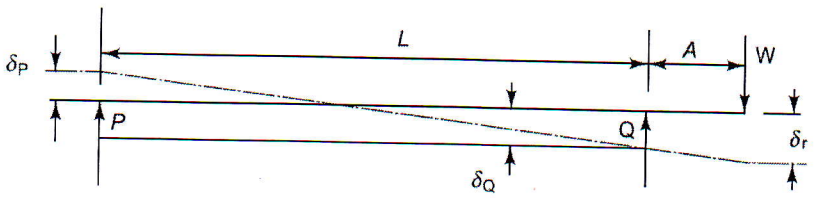
Menoufia University
Faculty of Engineering,
Shebin El Kom
Final First Term Exam
Academic Year 2013/2014
Date: 21/9/2014
Allowed Tables and Charts: None
Answer all the following questions:

Dept: Production Engineering & Mechanical Design
Year: Diploma Level 500 1st
Subject: Machine Tool Design
Time Allowed: 3 hours
Total Marks = 100

Q#1 (20 Marks)

For the gear box given in question Q# 3 If the spindle overhang (A) is 40 mm spindle speeds 30–500 R.P.M. Use a roller bearing near the overhung end, and a ball bearing at the farther end. ($\delta_q = 0.00025$ mm/kg, $\delta_p = 0.0004$ mm/kg), E=2.1x10^4 kg/mm^2



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

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

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

Q=2: (20 Marks)

(2.a) As a machine tool designer, explain how can you use computer aided design andrapid prototyping techniques to have a good machine tool structures? Use clear sketch?
(2.b) As a machine tool designer, explain how can you use frequency response function (FRF) to have a good design for the machine tool structures? Use clear sketch?

Q=3: (45 Marks)

Design a 9-speed, two-stage gear box for spindle speeds 30–500 R.P.M. Use a 4 HP, 1500 R.P.M. motor. Use belt transmission for reducing motor speed to a level, suitable for the gear box input shaft, $\Phi = 1.41$.

3.1.	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. e. Sketch the speed diagram.
3.2.	a. Calculate the torques on all shafts. b. Calculate the gears module. c. Calculate the size of the gear box.
3.3.	Design the second shaft of the gear box.

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

Find the forces on flat guideways on a lathe, if guideways are 30 mm thickness, and 60 mm wide. The center distance between the guideways is 450 mm. The machine has a 120 mm height above the guideway top faces. The machine is powered by a 4.5 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 = 50 kg; Length of saddle = 250 mm?

(4.1) Select the slideway material?
(4.2) Calculate the pressures on each contact surface?
(4.3) Find the tool radial displacement?

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

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

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

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

L = Length of saddle (mm)

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