Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –IIst SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1720903 **Date: 10/07/2012**

Subject Name: Machine Tool Design

Time: 10:30 am – 13:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** "The life and smooth functioning of slideway depends significantly upon the clearance between the sliding surfaces." Justify the statement. Explain the different ways to adjust the clearance in the slideway. **07**

(b) Show that the design criteria for the machine tool structure is given by the expression $l^2/h = 6E\delta/\sigma$. **07**

Q.2 **(a)** Explain in detail the general requirements of machine tool structure. **07**

(b) Define unit strength under torsion and derive the following expression for a bar subjected to the torsion. **07**

$$W_1/W_2 = \frac{\tau^{2/3}_{u2}/\gamma_2}{\tau^{2/3}_{u1}/\gamma_1}$$

OR

(b) Show that the volume of steel beam required to withstand the same load is 13.07 times less than that of CI beam, if the failure of beam is determined by normal stress under tensile loading. Use the following data for Mild Steel: **07**

$E = 2.0 \times 10^4$ kgf/mm^2, $\sigma = 1400$ kgf/mm^2 and $\delta = 0.002$ mm. While for Cast Iron (CI) : $E = 1.2 \times 10^4$ kgf/mm^2, $\sigma = 300$ kgf/mm^2 and $\delta = 0.002$ mm.. Also explain the important design requirements of the machine tool structure.

Q.3 **(a)** Explain the procedure for the selection of electric motor that work under the variable loading condition. **07**

(b) Find the forces on flat guideways on a lathe, if guideways are 25 mm thick and 50 mm wide. The center distance between the guideways is 400 mm. The machine has a 110 mm height above the guideway top faces. The machine is powered by a 5.5 kw motor. The machine mostly shapes steel workpieces at a speed of 24 m/min. The tool frictional force (F_y) is 30 % of the cutting force (F_Z) , $\alpha = 60$ & $\beta = 30$.Assume the maximum possible diameter as twice the center height (110 mm). **07**

OR

Q.3 **(a)** Explain the procedure to obtain the optimum spacing between spindle supports. Also explain the functions performed by the spindle in machine tool. **07**

(b) Compare sliding friction sleeve bearing and roller friction ball/roller/needle bearing used for the spindle. **07**

Q.4 **(a)** Derive and plot the pressure distribution diagram along slideway length for the following condition: **07**

1) $X_A/L > 1/6$
2) $X_A/L = 0$

Where $X_A = L/6\ (P_{max} - P_{min}/P_{max} + P_{min})$

X_A = distance between point of action of normal force on slideway and

center of carriage.
L = length of carriage.

(b) Explain the preselective control system with the help of neat schematic diagram and a suitable example. **07**

OR

Q.4 (a) Discuss the ergonomic considerations applied to the design of push button and the lever. **07**

Q.4 (b) Derive and plot the pressure distribution diagram along slideway length for the following condition: **07**

1) $X_A/L < 1/6$
2) $X_A/L = 1/6$

Where $X_A = L/6\ (P_{max} - P_{min}/P_{max} + P_{min})$
X_A = distance between point of action of normal force on slideway and center of carriage.
L = length of carriage.

Q.5 (a) For the wear resistance slideway design, derive the expression for the forces acting on the mating surface in a combination of two flat slideways **07**

(b) The spindle of a high precision machine is subjected to 50 kgf load at mid span, between the antifriction bearings. It is subjected to 250 kgf overhung load at 50 mm from the nearest bearing. Find the spindle diameters in the overhung portion (D_A) and between the bearings (D_L), to optimize the span (L). The spindle is transmitting 6 KW at 110 rpm. It is subjected to a fluctuating load. The deflection between the bearings should be limited to 0.03.Permissible bending stress f_b = 6 kgf/mm^2 and for precision machine λ =0.1 **07**

OR

Q.5 (a) Explain how the model technique is useful in design of machine tool structure. Derive the relationship between actual parameter & that of model for bending stiffness of structure. **07**

(b) Find the spindle size and optimum span of bearing and deflection, if the spindle overhung is 80 mm. The cutting force at the overhung end is 110 kg. Powered by a 5 kw motor, the spindle runs in a 58 to 470 rpm range. Use roller bearing near the overhung end and a ball bearing at the farther end.use the following data: **07**

$E = 2.1 \times 10^4$ kgf/mm^2, f_b = 6 kgf/mm^2 . d_r = 14 mm, δ_q = 0.000137, C_0 = 980, δp =0.00045/kg, I_l & I_A = 201340.7 mm^4.

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