Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Subject code: 1720903 **Date: 31-12-2013**

Subject Name: Machine Tool Design

Time: 10.30 am – 01.00 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)** Design a column (square) for a drilling machine, if column height is 1.12 meters. Maximum torque acting is 6.6 kgm and feed force is 400 kg. Distance of drill center from column face(throat0 is 250 mm. E=2.1 X 10^4 kg/mm^2 **07**

Size factor(S)	0.4	0.75	1.0	1.5	1.8
Wall thickness Ext(mm)	6	8	10	12	14
Internal	5	7	8	10	12

(b) What do you mean by model techniques in design of machine tool structure? Why it is finding wider application & under what condition the model techniques can be used. **07**

Also derive the relationship for natural frequency of bending vibration for structure and model.

Q.2 **(a)** Find the spindle size and optimum span of bearing and deflection, if the spindle overhang (A) is 80 mm. The cutting force at the overhung end is 110 kg. Powered by a 5 kw motor, the spindle runs in a 54-470 rpm range. Use a roller bearing near the overhung end and a ball bearing at the farthest end. E= 2.1 x 10^4 kg/mm^2, for C45 material fluctuating load fb = 6 kg/mm^2, for 45 dia X 100 X 36 roller bearing dr= 14 and δq=0.000137 and for 40 dia x 68 x 15 brg Co=980 , δp=0.00045/kg and IL=IA=201340.7 mm^4 **07**

(b) For identical beam length, prove that the volume of steel beam is 13.07 times less, height 2.80 times greater and thickness will be 36.5 times less than that of CI beam. Use the following relationship. **07**

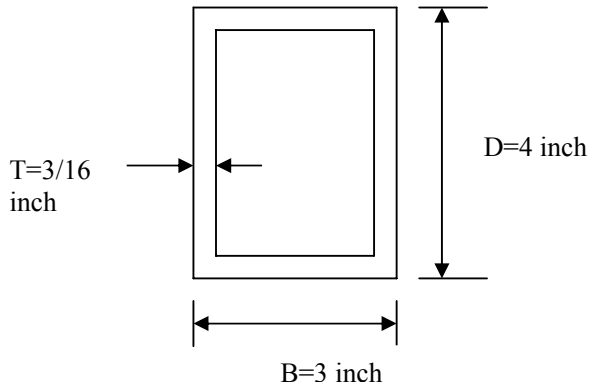
$(3/2)(P/\sigma)(l^2/h) = (P/4E\delta)(l^2/h)^2$

For Mild steel E=2.1 x 10^4 kg/mm^2, σ=1400 kg/mm^2 and δ=0.002 mm and for CI E=1.2 x 10^4 kg/mm^2, σ=300 kg/mm^2 and δ=0.002 mm.

OR

(b) State the basic design procedure of machine tool structure & bring out the role of cutting force, friction force, forces of reaction, forces due to mass of the structure and inertial force due to vibration. **07**

Q.3 **(a)** A small machine is supported at the end of a cantilever beam 6 ft long. During its operation, it exerts a force (f) on this support and must be held within allowable deflection. **07**



Find moment of inertia of section in figure given above. A new model of this machine must extend out a distance of 18.5 ft and must be operated under the same condition and allowables. It is decided that the new beam will have a width(B) equal to half its depth(D) and a wall thickness equal to 5 % of its depth. Find the dimension D,B and T for the new model.

(b) Find the forces on flat guideways on a lathe, if guideways are 25 mm thich and 50 mm wide. The center distance between the guideways is 400 mm. The machine has a 110 mm height above the guidewy 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(Fy) is 30 % of the cutting force(Fz). Weight of saddle is 40 kg and length of saddle is 250 mm ,α=60, β=30 **07**

OR

Q.3 **(a)** Derive an equation for forces acting on the mating surfaces in a combination of two flat guideways in oblique cutting. Also draw a schematic load diagram for the same. **07**

(b) Derive an equation and plot the pressure distribution diagram along the slideway length for the following cases: **07**

1. $X_{A/L} < 1/6$
2. $X_{A/L} > 1/6$

Q.4 **(a)** Explain the ergonomics consideration in the design for following control members of machine tool. **07**

1. Toggles
2. Knob
3. Crank
4. Rotary lever and star wheel.

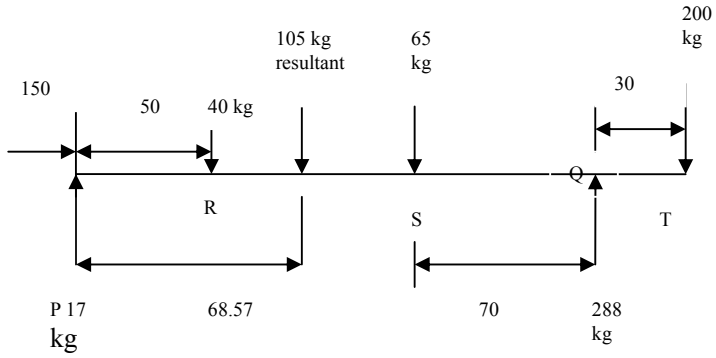
(b) State the function of pressure valve, throttle valve & direction control valve and explain with the help of neat sketch ball type pressure valve. **07**

OR

Q.4 **(a)** Explain Pre-Selective control system with the help of one typical example. **07**

Q.4 **(b)** Show that $\sigma_b^{2/3}/\gamma$ is an index of the ability of a material to resist bending. **07**

Q.5 **(a)** Find the diameter in the overhanging part and between bearings, for the spindle shown in figure below. **07**



The reactive bending moment for bearing at Q can be taken as 15% of the moment due to the overhanging load. The gears 1 and 2, mounted between bearings are of 2 module. The runout of the spindle should be limited to 0.03. The spindle is running in the range of 350-2500 rpm and transmitting 1 kw. The load is fluctuating considerably.E=2.1 $x10^4$kg/mm^2. permissible stress for C45 is 4.5 kg/mm^2.

(b) Critically compare the sliding friction sleeve bearing and rolling friction ball/roller/needle used to support the spindle of machine tool. **07**

OR

Q.5 **(a)** Show that $\tau_u^{2/3}/\gamma$ is an index of the ability of a material to resist torsion. **07**

(b)
1. Find the critical speed for a 70 diameter spindle, if it carries a 100 kg load at the center of an 870 mm span. The spindle can be considered as simple supported. **07**
2. Design a sleeve bearing for a 40 mm diameter shaft, subjected to 1500 kg radial load and rpm is 500. assume l=d and Ψ is less than 0.0005, For bearing material (Tin-Bronze0 E = 10,000 kg/mm^2.

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