Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2014

Subject code: 1720903 **Date: 04-12-2014**

Subject Name: Machine Tool Design

Time: 02:30 pm - 05:00 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)	Justify that stiffness of machine tool system is higher when most of the machine tool elements are joined in parallel compare to in series. Consider at least four machine tool elements (Springs) to justify the given sentence.	07
	(b)	Explain the selection of Motor for a machine tool with considering different loading conditions.	07
Q.2	(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)	Prove that unit strength under bending of material used for machine tool structure is given by $\sigma_b^{2/3} / \gamma$. Where $\mathring{u}_b$ is the bending strength and ɔ is the specific weight.	07
		OR	
	(b)	Derive the equation of (l^2/h) for simple machine tool bed with two side wall with considering as simply supported beam with concentrated load acting at centre.	07
Q.3	(a)	Derive the equation of the total compliance of the machine tool.	08
	(b)	Explain the selection or design procedure of sliding friction sleeve bearing used for the spindle.	06
		OR	
Q.3	(a)	While turning a 750mm long workpiece of 100mm diameter between centers, the radial cutting force was found to be 150kgf when tool was 200mm from the tailstock. Calculate the compliance of the workpiece, saddle and total machine tool if the stiffness of the Saddle, Head stock and Tail stock is 3000, 4000 & 2500 kgf/mm, respectively.	07
	(b)	Discuss the general requirements of machine tool design.	07
Q.4	(a)	Derive the equation for forces acting on the mating surfaces in a combination of V and Flat slide ways with considering orthogonal cutting condition.	07
	(b)	Derive the equation for deflection of spindle axis due to compliance of spindle supports.	07
		OR	
Q.4	(a)	Write the major requirements of the guide ways. Also sketch at least three slideway profiles with different combination and write their application.	06

(b) Fig 1 shows a schematic diagram of a hollow lathe spindle and the other data are as under: 08

Power - 4.5 kW & Speed -700 RPM.

Ratio of outer to inner diameter (hollow spindle) = 2

Peripheral and radial forces acting on spindle: P2 = 215 kgf and T2 = 78 kgf

Horizontal and vertical forces acting on spindle nose: P1 = 210 kgf and T1 = 60 kgf. Assume shear stress of spindle material is 50MPa.

Calculate the outer and inner diameter of lathe spindle.

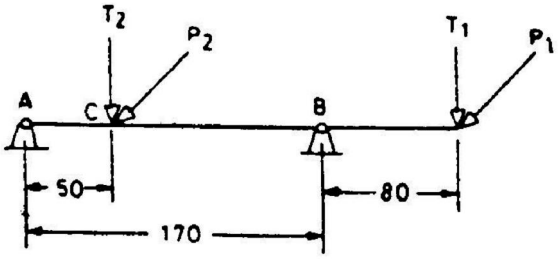

Fig 1 Schematic diagram of lathe spindle (All dimensions are in mm)

Q.5 (a) Explain the aesthetics considerations in machine tool design in detail with suitable example. 07

(b) What do you mean by pre-selective control system? Explain pre-selective control system with a typical example. 07

OR

Q.5 (a) Compare the Arithmatic progression and Geometric progression laws used to find the speed steps in Gear box design of machine tool. 04

(b) A nine speed gear box is connected to a motor running at 720RPM through belt drive. The gear box is to have minimum speed of 31.5RPM and maximum speed of 500RPM. Using the standard spindle speeds, 10

1) Draw the structure and speed diagram for the arrangement. (05 -Marks)
2) Select the suitable pulley diameters for connecting the motor to the gear box shaft. If the standard pulley diameters are based on R20 series with a diameter starting from 80mm. (03 -Marks)
3) Draw the gear box layout. (02 -Marks)

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