Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-II Examination July 2010

Subject code: 720903

Subject Name: Machine Tool Design

Date: 07 /07 /2010 **Time: 11.00am – 1.30pm**

Total Marks: 60

Instructions:

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

Q.1 **(a)** Explain the selection criterion of electrical drive for a machine tool and calculate the power spent on cutting operation in a cylindrical turning operation. **06**

(b) On the basis of power transmission capabilities, the axis of shaft transmitting motion, state the basic conditions under which spur, helical, bevel, spiral and worm gears are selected in the mechanical drives. **06**

Q.2 **(a)** A drum cam in the feed gear box permits the use of single lever control in changing the feed. With the help of sketch explain the mechanism of working of a drum cam in the feed gear box. **06**

(b) Compare and contrast: radial piston pump and variable delivery vane pump. **06**

OR

(b) State the function of pressure valve and throttle valve in the hydraulic system and compare ball type and spool type pressure valve. **06**

Q.3 **(a)** Derive the expression for y_x / y_{Amax} for the cutting tool located at a distance x from live centre A while turning the length of the job 'l'. In usual notations y_x and y_{Amax} are displacement at tool and live centre A of the lathe respectively. **06**

(b) Select the design parameter of a full hydrodynamic bearing of copper lead alloy for a journal of 60 mm diameter to support a load of 1500 N at 3000 rpm. Assume h_{cr} as 10 microns and $h_{min}/ h_{cr} \geq 1.1$. Assume copper lead material with l/d ratio as 1.0. For the journal diameter of 60 mm, relative diametrical clearance 0.001, and l/d ratio as 1 the critical value of Somerfield number is 1. The Somerfield number in usual notations is given as $S_o = \frac{p\psi^2}{\mu\omega_2}$. **06**

OR

Q.3 **(a)** Plot the variation of y_x / y_{max} as a function of x/l and draw suitable conclusions on maximum displacement of work piece on headstock and tailstock. In usual notations y_x and y_{max} are displacement at tool and live centre A of the lathe respectively. The cutting tool is located at a distance x from live centre A while turning the length of the job 'l'. **06**

(b) The spindle of high speed precision lathe has a diameter 80 mm and can run at a speed up to 2500 rpm. Check the suitability of aluminum alloy as a suitable sleeve bearing material for the above spindle if the maximum load on the bearing is 300 N and the length to diameter ratio of journal is 1. The aluminum alloy has permissible value of cutting speed, permissible bearing pressure intensity of 12 m/s and 2500 N/cm^2 respectively. **06**

Q.4 **(a)** The resultant stiffness of the entire assembly of machine tool elements for transmission is determined by an analogy of system of springs connected in series and parallel. Determine the relative stiffness in the case of springs connected in series and parallel. Show that for springs connected in parallel, the overall stiffness of the system can be improved by further increasing the stiffness of the machine element whose stiffness is the highest. **06**

(b) Plot the variation of volume (calculated on the basis of design that considers strength and deflection as independent criterion) and the ratio of l^2/h for two different materials namely cast iron and steel for a simply supported structure with a point load at the centre. **06**

OR

Q.4 **(a)** State the basic design procedure for machine tool structure and bring out the role of cutting force, friction force, forces of reactions, forces due to mass of structure and inertial forces due to vibration. **06**

(b) Plot the variation of dynamic amplification factor as a function of η (the ratio of excited frequency to natural frequency of excitation) for varying values of damping factor ρ. Draw suitable conclusions to avoid resonance and give the guide lines for designing the structure on static and dynamic conditions **06**

Q.5 **(a)** State the different shapes of slideways used in machine tools and discuss the applications of each of them with due justification. **06**

(b) Draw a schematic loading diagram for the combination of two flat slideways under oblique cutting conditions and derive the unknown forces acting on the mating surface. **06**

OR

Q.5 **(a)** Discuss the methods of adjusting clearances in slideways and bring out special features, limitations and applications of each of them, **06**

(b) Draw a schematic loading diagram for the combination of one flat and one V slideways under oblique cutting conditions and derive the unknown forces acting on the mating surface. **06**

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