B. TECH.

(SEM. VI) EXAMINATION, 2006-07

PRINCIPLES OF MACHINE TOOL DESIGN

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions.

1. Attempt any four of the following:

(a) What is the effect of tool wear on cutting forces and surface finish? Describe the mechanism of crater wear of the tools.

(b) Show that in orthogonal cutting with a zero rake tool, the ratio of shear stress ($\tau$) to the specific cutting energy ($P_s$) is given by

$$\frac{\tau_s}{P_s} = \frac{(1 - \mu r_c) r_c}{1 + r_c^2}$$

$\mu$ - Chip Thickness ratio
$\mu$ - Coefficient of friction between the tool and chip.

(c) Discuss the basic requirements of a good machine tool design.

(d) Explain what characteristics of grinding process makes it different from conventional turning/milling operations.

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(e) State the important parameters that would influence the torque and thrust in drilling. Describe the cutting action of a drill.

(f) Differentiate between up-milling and down-milling operations. What are the advantages and limitations of each?

2 Attempt any four parts of the following:

(a) Discuss how one would select a suitable drive system for a machine tool? What factors should be considered for this purpose?

(b) Describe the factors that should be considered while making a choice between group versus individual drive.

(c) Briefly describe any 4 mechanisms that can convert rotary motion into translation.

(d) Describe the general requirements of an ideal all-gear drive design. Describe any method used for speed changing in all-geared drive.

(e) Describe the advantages and disadvantages of using rigid and flexible couplings. Draw a sketch of Oldham coupling and explain its working.

(f) Discuss the significance of machine tool layout. Write the layout formula for a knee-type vertical milling machine (any information not supplied can be assumed suitably).

3 Attempt any two parts of the following:

(a) A lathe is to be designed for machining aluminium workpieces of up to 500 mm diameter and mild steel workpieces up to 300 mm diameter. Both HSS and carbide tools are used. Determine the smallest diameter
workpiece which may be machined on this lathe if permissible cutting speed for HSS-MS pair = 50 m/min and that of carbide – aluminium pair = 1500 m/min. Assume the $R_n$ value = 75 (speed range ratio).

(b) Discuss the advantages and disadvantages of hydraulic regulation of machine tool drives. Describe the working of a hydraulic drive unit for rotary motions.

(c) With the help of neat sketches describe the working, advantages and disadvantages of the following types of speed variators:

(i) Adjustable pulley belt variator.

(ii) Cone variator with spheres supported on shafts.

4 Attempt any two parts of the following:

(a) Write short notes on the following:

(i) Requirements of a machine tool structure
(ii) Selection of machine tool bed material
(iii) Theory of model mechanics as applied to machine tool design.

(b) Describe the constructional features and important characteristics of machine tool guides. With the help of neat sketches explain the characteristics of vee-type and dove-tail types of guideways.

(c) For a lathe guide-way show that the maximum workpiece diameter ($d_{\text{max}}$) that can be turned without overturning of the carriage is equal to

$$d_{\text{max}} = \left( B = \frac{2 F_r}{F_c} \right)$$

$B$ = Guideway width
$F_r$ = Radial component of the cutting force

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\[ F_c = \text{Tangential component of the cutting force} \]

State the assumptions made if any.

5 Attempt any four parts of the following:

(a) State the advantages and disadvantages of numerically controlled machine tools over conventional automated machines. How do you select the parts for NC machining?

(b) In the context of machine tool testing explain what is meant by?
   (i) Alignment test and
   (ii) Performance test.

With the help of a neat sketch explain how would you check the alignment between head stock and tail stock axes of a lathe?

(c) With the help of a neat sketch explain the working principle of Ward-Leonard drive used for machine tools. What are some of the important applications of this type of drive?

(d) What is meant by dynamic rigidity in case of machine tool structures? What are the common parameters that influence the vibration behaviour of a machine tool? — Discuss.

(e) With the help of a neat sketch describe the working of a Cam-controlled mechanism used in automatic lathes.

(f) What is meant by Dynamic rigidity in case of machine tool design? Explain what parameters influence the vibration behaviour of a machine tool? How to achieve a high value of dynamic rigidity?