Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

# UNIVERSITI KUALA LUMPUR
## Malaysia France Institute

## FINAL EXAMINATION
## JANUARY 2014 SESSION

| | | |
|---|---|---|
| SUBJECT CODE | : | FMB31203 |
| SUBJECT TITLE | : | MACHINE TOOL DESIGN |
| LEVEL | : | BACHELOR |
| TIME / DURATION | : | 2.5 HOURS 9.00 am - 11.30 am |
| DATE | : | 30 MAY 2014 |

### INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This paper consists of FIVE (5) questions. Answer any FOUR (4) questions only.
6. Answer all questions in English.

THERE ARE 4 PAGES OF QUESTIONS AND 2 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

**INSTRUCTION: Answer any FOUR (4) questions.**
**Please use the answer booklet provided.**

**Question 1**

(a) In manufacturing of machine tools, one of the main components is spindle. Describe the main function of spindles for machine tools.

(5 marks)

(b) Explain the requirement needed for a machine tool spindle.

(5 marks)

(c) Figure 1 shows the types of spindle ends. Describe briefly the application for type A and B.

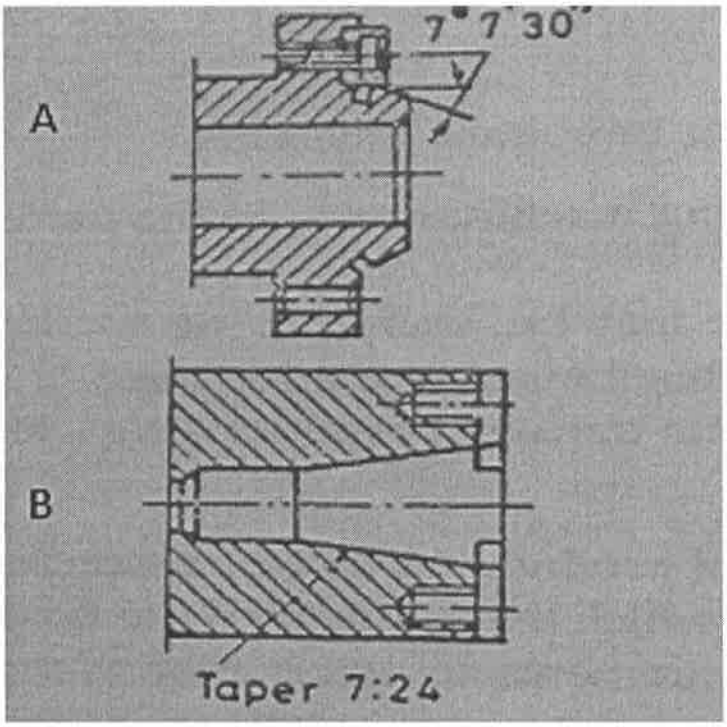


Figure 1

(10 marks)

(d) Examine the common requirements of spindle support.

(5 marks)

## Question 2

(a) A machine spindle is to be used for roughing and finishing copper alloy workpiece of 100 mm in diameter. Find the range ratio and RPM for roughing and finishing. (Roughing speed = 80 m/ min, finishing speed = 180 m/ min)

(6 marks)

(b) Find 6 speeds for a lathe, to be used for rough turning and finishing mild steel workpieces, ranging from 22 to 65, in diameter. Use standard speeds and standard step ratios (Ø). Roughing speed = 30 m/min; Finishing speed = 80 m/min.

(8 marks)

(c) A chain drive consists of a 21 teeth driving sprocket, running at 500rpm and another 35 teeth driven sprocket. The sprockets are connected by a simple roller chain no.06B, which transmits 1kW power. Calculate:

i) the pitch circle diameters of the driving and driven sprocket wheels

(8 marks)

ii) the chain velocity

(3 marks)

## Question 3

(a) Based on the Figure 2 below, determine the pressure, tool displacement and tool rigidity as follows:

i) The pressure on the face C

(6 marks)

ii) Tool displacement

(6 marks)

iii) Tool rigidity

(5 marks)

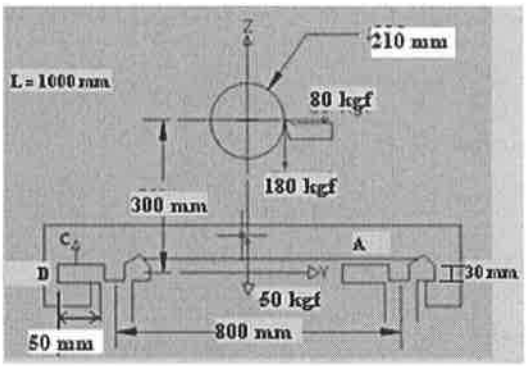


Figure 1

(b) While turning a 1000 mm long workpiece of 100 mm diameter between centers, the radial cutting force was found to be 200 kgf when the tool was located at the center of the workpiece and 300 mm from the headstock. Calculate the machine tool and system compliances if the stiffness of the headstock, saddle and tailstock are 2000, 1000 and 750 kgf/mm respectively.

(8 marks)

**Question 4**

(a) There are two different types of chatter vibrations that can occur. With aid of diagram, give your explanation on self-induced chatter and pressure-induced chatter in machine tool.

(10 marks)

(b) Describe physical causes of chatter vibrations.

(5 marks)

(c) A system may vibrate under initial displacement and/or initial velocity, which is called free vibration. As the Machine Tool Engineer you are required to write a report on mechanical Vibration. Include in your report the elements of Single Degree of Freedom System.

(5 marks)

(d) Explain how to isolate vibration?

(5 marks)

**Question 5**

(a) Describe the meaning of CNC and give the advantages of CNC compare to NC.

(5 marks)

(b) Examine the special requirements for utilizing CNC.

(5 marks)

(c) Explain the concept of adaptive control systems

(5 marks)

(d) Sketch a diagram showing the establishing location via Cartesian coordinates for point XYZ in space.

(10 marks)

**END OF QUESTION**

## Simplex Roller Chains

| Part No. | Pitch | | Inner Width | Roller Dia. | Pin Dia. | Plate Depth | Transverse Pitch | Conn Pin Length | Breaking Load | Approx. Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| | p mm | p in | $b_1$ min mm | $d_1$ max. mm | $d_2$ max. mm | g max. mm | e mm | $a_1$ max. mm | kN | kg/m |
| E03B-1 RIV | 5.00 | - | 2.5 | 3.2 | 1.49 | 4.1 | — | 7.4 | 2.4 | 0.08 |
| E04B-1 RIV | 6.00 | - | 2.8 | 4.0 | 1.85 | 5.0 | — | 7.8 | 3.2 | 0.12 |
| E05B-1 RIV | 8.00 | - | 3.0 | 5.0 | 2.31 | 7.1 | — | 8.9 | 5.9 | 0.18 |
| E06B-1 RIV | 9.525 | - | 5.72 | 6.35 | 3.28 | 8.2 | — | 14.1 | 10.4 | 0.41 |
| E081B-1 RIV | 12.7 | 1/2 | 3.3 | 7.75 | 3.66 | 9.9 | — | 10.2 | 9.97 | 0.28 |
| E083B-1 RIV | 12.7 | 1/2 | 4.88 | 7.75 | 4.09 | 10.3 | — | 12.9 | 12.7 | 0.42 |
| E085B-1 RIV | 12.7 | 1/2 | 6.38 | 7.77 | 3.58 | 9.9 | — | 14.0 | 12.26 | 0.4 |
| E08B-1 RIV | 12.7 | 1/2 | 7.75 | 8.51 | 4.45 | 11.8 | — | 18.2 | 19.4 | 0.7 |
| E10B-1 RIV | 15.875 | 5/8 | 9.65 | 10.16 | 5.08 | 14.7 | — | 20.9 | 27.5 | 0.9 |
| E12B-1 RIV | 19.05 | 3/4 | 11.68 | 12.07 | 5.72 | 16.0 | — | 24.2 | 32.2 | 1.3 |
| E12BH-1 RIV | 19.05 | 3/4 | 11.68 | 12.07 | 5.94 | 16.0 | — | 26.8 | 40.0 | 2.0 |
| E16B-1 RIV | 25.4 | 1 | 17.02 | 15.88 | 8.28 | 21.0 | — | 37.4 | 72.8 | 2.7 |
| E20B-1 RIV | 31.75 | 1-1/4 | 19.56 | 19.05 | 10.19 | 26.4 | — | 45.0 | 106.7 | 3.6 |
| E24B-1 RIV | 38.1 | 1-1/2 | 25.4 | 25.4 | 14.63 | 33.4 | — | 57.8 | 178.0 | 6.7 |
| E28B-1 RIV | 44.45 | 1-3/4 | 30.99 | 27.94 | 15.90 | 37.0 | — | 29.5 | 222.0 | 8.3 |
| E32B-1 RIV | 50.8 | 2 | 30.99 | 29.21 | 17.81 | 42.2 | — | 71.0 | 277.5 | 10.5 |
| E40B-1 RIV | 63.5 | 2-1/2 | 38.1 | 39.37 | 22.89 | 52.9 | — | 89.2 | 394.0 | 16.0 |
| E48B-1 RIV | 76.2 | 3 | 45.72 | 48.26 | 29.24 | 63.8 | — | 107.0 | 621.6 | 25.0 |
| E56B-1 RIV | 88.9 | 3-1/2 | 53.34 | 53.98 | 34.32 | 77.8 | — | 123.0 | 940.0 | 35.0 |

$$d = \frac{p}{\sin\left(\frac{180}{teeth}\right)}$$

$$P_A = \frac{F_z + \frac{G}{2} - \left(\frac{F_z y_f - F_y h}{b}\right)}{W_A L}$$

$$v = \frac{\pi D n}{60x10^3}$$

$$P_D = \frac{F_y}{W_D L}$$

$$v = \frac{Zpn}{60x10^3}$$

$$\phi^n = \frac{N_{max}}{N_{min}}$$

$$pressure\ on\ face, P = \frac{\frac{F_C y_f - F_y h}{b} + \frac{G}{2}}{W_C L}$$

$$deflection, \delta_f = kP_D + k\left(\frac{P_A - P_C}{b}\right)h$$

$$where, k = 0.1$$

Table 2.3: Standard spindle speeds for various step ratios ($\phi$)

| $\phi \rightarrow$ | 1.26 | 1.414 | 1.585 | 1.78 |
|---|---|---|---|---|
| | 10 | | 10 | 10 |
| | | 11.2 | | |
| | 12.5 | | | |
| | 16 | 16 | 16 | |
| | 20 | | | 18 |
| | | 22.4 | | |
| | 25 | | 25 | |
| | 31.5 | 31.5 | | 31.5 |
| | 40 | | 40 | |
| | | 45 | | |
| | 50 | | | |
| | | | | 56 |
| | 63 | 63 | 63 | |
| | 80 | | | |
| | | 90 | | |
| | 100 | | 100 | 100 |
| | 125 | 125 | | |
| | 160 | | 160 | |
| | | 180 | | 180 |
| | 200 | | | |
| | 250 | 250 | 250 | |
| | 315 | | | 315 |
| | | 355 | | |
| | 400 | | 400 | |
| | 500 | 500 | | |
| | | | | 560 |
| | 630 | | 630 | |
| | | 710 | | |
| | 800 | | | |
| | 1,000 | 1,000 | 1,000 | 1,000 |

**Note:** The actual spindle speed [R.P.M.] can be 6% higher or 2% lower, as per IS 2218 [1962], i.e. variation in nominal speed of 1,00 R.P.M. should be within +6 [106] and –2 [98].