



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4 Examination in Engineering: December 2016

Module Number: ME4303

Module Name: Manufacturing Engineering
[Three Hours]

[Answer all questions, each question carries twelve (12) marks]

State the assumptions where necessary and do the calculations stating the units. All the notations have usual meanings.

Q1. a) Clearly state the definition of Manufacturing and describe two Manufacturing Processes.

[1.5 Marks]

b) State each three Independent and Dependent variables of machining.

[1.5 Marks]

c) Derive the equation for the chip thickness ratio (r_c) using the geometric parameters of the orthogonal model with aid of neat sketches.

Hence;

Prove that the shear plane angle ϕ as:

$$\phi = \tan^{-1} \left[\frac{r_c \cos \alpha}{1 - r_c \sin \alpha} \right]$$

[2.0 Marks]

d) Show the relationship of Cutting velocity (V_c), Chip velocity (V_f) and Shear velocity (V_s) with aid of neat sketches as:

$$\frac{V_c}{\cos(\phi - \alpha)} = \frac{V_f}{\sin \phi} = \frac{V_s}{\cos \alpha}$$

[2.0 Marks]

e) In mild steel shaft of 50 mm outside diameter is turned on a lathe with cutting speed of 20ms^{-1} with a tool having a rake angle of 35° (tool is given a feed of 0.1 mm/rev and depth of cut is 1.5 mm) and it is found by dynamometer that the cutting force 250N and feed force 100N. Length of the continuous chip in one revolution is 80 mm. Calculate,

- The shear plane angle.
- Velocity of the chip along the tool surface.
- Material removal rate.

[5.0 Marks]

- Q2. a) State three modes of tool failure in machining and describe one principal location on a cutting tool where tool wear occurs. [2.0 Marks]
- b) Based on the Taylor's Tool Life Equation, describe two parameters that affect the life of a tool. [2.0 Marks]

- c) Turning tests have resulted in 1 minute tool life for a cutting speed of $4ms^{-1}$ and 20 minutes tool life for a cutting speed of $2ms^{-1}$. [2.0 Marks]

Find :

- (i) Constant values of the Taylor's Tool Life Equation.
 (ii) How long the tool would last for a cutting speed of $1ms^{-1}$. [2.5 Marks]

- d) Compare Laser Beam Machining (LBM) and Electron Beam Machining (EBM). [2.5 Marks]

- e) State each three specific applications of Water Jet Machining (WJM) and Ultrasonic Machining (UM). [3.0 Marks]

- Q3. a) State three importance of Metal Working Fluids and it's application strategies. [3.0 Marks]

- b) I. Derive the following equation for the cutting velocity (V_{cm}) that gives the minimum cost per piece by considering a milling operation.

(Hint: Use the cost per piece equation)

$$V_{cm} = \frac{CR_m^n}{\left[\frac{1}{n} - 1\right]^n [t_c R_m + t_g R_g + D_g]^n}$$

Hence;

- II. Find the equation for tool life (T_{cm}) that gives the minimum cost per piece. [4.0 Marks]

- c) A shaft is to be milled in a vertical milling machine by using a cutter having 37 teeth. For this 38 mm diameter mild steel rod will be used as the work piece. The following information is known.

- Machine operator's rate 65 Rs/hour
- Machine department overhead rate 70 Rs/hour
- Grinding department overhead rate 120 Rs/hour
- Cost of cutter 5000 Rs/=
- 20 permissible grindings
- Tool grinding time 10 min
- Tool changing time 3 min
- Ideal time 3 min
- $VT^{0.2} = 350$

Determine the cutting velocity and the tool life that will yield a minimum cost per piece.

[5.0 Marks]

- Q4. a) What are the requirements of a good moulding sand? [2.0 Marks]
- b) Explain briefly the followings. [3.0 Marks]
- (i) Parting sand
 - (ii) Facing sand
 - (iii) Backing sand
- c) What are the objects of 'Sintering' in powder metallurgy? [2.0 Marks]
- d) Explain briefly the compacting and shaping processes used in powder metallurgy. [3.0 Marks]
- e) Write a brief description on 'Self-lubricating bearings'. [2.0 Marks]
- Q5. a) Differentiate between pressure (solid state) welding and fusion (liquid state) welding. [2.0 Marks]
- b) Explain briefly the 'principle of resistance welding'. [2.0 Marks]
- c) What do you mean by 'high voltage arc' and 'low voltage arc' and which one is used in welding? [2.0 Marks]
- d) Describe the process of Gas Metal Arc Welding (GMAW) with neat sketches. [2.0 Marks]
- e) What are the advantages and disadvantages of cold working? [2.0 Marks]
- f) Discuss the principle and mechanism of 'metal rolling'. [2.0 Marks]