

Student Exam No.: _____

Ganpat University

M. Tech. Semester – I Mechanical Engineering (Advanced Manufacturing Techniques)

Regular Examination

3ME103 Analysis of Metal Forming and Machining Processes

Time: 3 Hours

Total Marks: 70

Instructions:

- (1) Answers of two sections must be written in the separate answer book.
- (2) Draw neat sketches wherever necessary.
- (3) Assume suitable additional data wherever necessary.

SECTION I

Q -1

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- (a) Sketch out the Waveforms of Relaxation power generator with its proper notations and justify its charging and discharging conditions with its circuit diagram used for Electrical Discharge Machining process.
- (b) With suitable assumption derive the condition for material removal rate for brittle material machined by Ultrasonic Machining. Material removal rate can be express as: $MRR = 4.17 D^{1/2} Y_0^{1/2} (\sigma/H) f$ (mm / second). Where D = Diameter of grit, σ = Stress, H= Hardness, f= Frequency, Y_0 = Amplitude of vibration.

OR

Q -1

12

- (a) Prove that in constant voltage Electro Chemical Machining the highest accuracy may be achieved at highest productivity and the machining gap adjusts itself for any feed rate.
- (b) Find out the time require drilling $\varnothing 5$ mm in 6 mm thick silicon carbide plate with fracture strength of 1100 N/mm^2 and under a static load of 60 N in an Ultrasonic Machine, working at 18 KHz and vibrating with 18 microns amplitude. The slurry of 80 microns abrasive with water in 1:10 ratio by weight is used. Assume one out of ten vibrations is effectively used for the purpose.

Q -2

11

- (a) Define Electrical Discharge Machining? Briefly explain the process principle of single discharge condition using neat sketch and effect of process parameters on surface finish for Electrical Discharge Machining.
- (b) Draw schematic diagram of Abrasive Jet Machining and derive the equation for Material Removal Rate for ductile and brittle materials in an Abrasive Jet Machining.

OR

Q -2

11

- (a) With the help of neat sketch explain all phases of material removal mechanism and list out advantages and disadvantages of Electrochemical Grinding process.
- (b) Schematically explain Laser Beam Machining process and characterize the process with their merits and area of applications.

Q -3 Write short notes on the following (Any three)

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- (a) With suitable example list out the necessities that contribute the development of non-traditional machining processes.
- (b) Schematically explain significant features of rotary ultrasonic machining process.
- (c) Explain the working of intensifier in Water Jet Machining Process.
- (d) Schematically explain the working of Electron Beam Machining Process

SECTION II

- Q - 4** 11
- (a) Differentiate between Conventional & True stress – strain and explain why True stress – strain are used for analysis of metal forming processes.
- (b) The total stress $216 \times 10^6 \text{ N/m}^2$ is acting at a point whose direction makes angle 45° , 75° and 55° with co-ordinate axes X, Y & Z. Find the normal and shear stresses on an oblique plane whose normal makes an angle 67° , 30° & 71° respectively with the same co-ordinate axes. If $\tau_{xy} = 23 \times 10^6 \text{ N/m}^2$ $\tau_{yz} = -3.1 \times 10^6 \text{ N/m}^2$ $\tau_{xz} = 57 \times 10^6 \text{ N/m}^2$ Determine σ_{xx} , σ_{yy} , σ_{zz} . Determine also the principle stresses for the system.
- OR**
- Q - 4** 11
- (a) Derive the expression for energy required to deform unit volume of metal.
- (b) During a tensile test of a round metal specimen with an initial diameter of 12.8 mm and maximum load of 53.4 kN is reached. At this load the cross section area is reduced to 60% initial area. Calculate the mean true flow stress of the metal during this deformation.
- Q - 5** 12
- (a) With usual notation, derive from first principle an expression for pressure distribution in lagging zone in hot rolling of strip. State the assumptions made by you. Interpret the formula derived by you.
- (b) Calculate maximum possible reduction & corresponding rolling load, if radius of roll = 250 mm, bite angle = 30° , width of strip = 200 mm, average rolling pressure = 150 N/mm^2 .
- OR**
- Q - 5** 12
- (a) In case of open die forging, derive the expression for average pressure distribution in forging. Make appropriate assumptions.
- (b) Calculate maximum pressure, Average pressure and forging load if a cube of 50 mm is to be pressed into a rectangular size of $20 \times 125 \times 50 \text{ mm}$ between two flat platens. The yield stress of the material is 75 N/mm^2 . Assume coulomb's friction law with $\mu = 0.35$.
- Q - 6** 12
- Answer the following**
- (a) What is the effect of temperature in metal forming processes? Explain in how mechanical properties vary with temperature in 0.13 % carbon steel material.
- (b) What is yielding of metals? Discuss the different criteria of yielding of metals.
- (c) Discuss the influence of process variables on pressure distribution in hot rolling

===== End of Paper =====