

JAN 2012

Student Exam No.: _____

Ganpat University

M. Tech. Semester – I Mechanical Engineering (CAD / CAM)

Regular Examination

3ME112 Advanced 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

- 1 (a) Derive the condition of natural entry of strip into rolls. 11
- (b) Derive an expression for the pressure distribution in rolling of strip in plain strain condition. Interpret the expression derived.
- (c) A billet 75 mm x 75 mm is to be reducing to a round 20 mm diameter in seven passes. Assuming mean deformation ratio constant in all passes. Calculate the area of cross section of the billet after each of seven passes.

OR

- 1 (a) With the first principle, derive the expression for pressure distribution for forging of a rectangular block in open die condition. State the assumption made by you 11
- (b) A piece of lead 25mm x 25mm x 150 mm having a yield stress of 7Nmm^2 is to be pressed between flat dies a size of approximately 6.25 mm x 100 mm x 150 mm. $\mu = 0.25$. Determine pressure distribution and the total forging load.

- 2 (a) What is difference between Conventional and True stress strain and derive expression for relationship between them. 12
- (b) A resultant stress of 150 N/mm^2 is acting in a direction making angle $30^\circ, 45^\circ, 60^\circ$ with x, y, z axes.

Determine :

- i). Normal & shear stresses on an oblique plane whose normal makes an angle $40^\circ, 60^\circ, 70^\circ$ respectively with the same co-ordinate axes.
- ii). Determine $\sigma_{xx}, \sigma_{yy}, \sigma_{zz}$ & principal stresses if $\tau_{xy} = 10\text{ N/mm}^2, \tau_{yz} = 15\text{ N/mm}^2, \tau_{zx} = 8\text{ N/mm}^2$.

OR

- 2 (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. 12
- (b) What is stress tensor? With usual notation and from first principle, derive the cubic equation for determining the principle stresses acting in three dimensional metal forming processes.

- 3 Write short notes on the following 12
 - (a) Super plasticity of metal.
 - (b) Role of friction in metal forming processes.
 - (c) Yield criteria in metal forming process.

SECTION - II

- 4 (a) Considering energy transitions explain LASER generation process and explain the working principle of Laser Machining with its important characteristics. 12
- (b) With suitable assumption derive the condition for material removal rate for brittle material machined by Ultrasonic Machining. Material removal rate can be expressed 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

- 4 (a) Schematically explain the working principle of Electrical Chemical Machining process with its characteristic and effects on output parameters during process. 12
- (b) Calculate the drilling time required to drill 10 mm hole in 7 mm thick ceramic plate with fracture strength of 1150 N/mm² and under a static load of 150 N in an Ultrasonic Machining, working at 22 KHz and vibrating with 35 microns amplitude. The slurry of 80 microns SiC with water in 1:10 ratio by weight is used. Assume one out of ten vibrations is effectively used for the purpose.

- 5 (a) 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. 11
- (b) Explain automatic electrode re feed concept with servo-controlled system in Electro Discharge Machining

OR

- 5 (a) Draw schematic diagram and list out the effect of process parameter with areas of application of Electrochemical Grinding process. 11
- (b) In a standard abrasive water jet machining system, when the water pressure is 4000 bar, being issued from an orifice of diameter 0.3 mm. Determine water jet velocity and mass flow rate of water assuming no losses and all related coefficients to be 1. If the mass flow rate of abrasive is 1 kg/min, determine the abrasive water jet velocity assuming no loss during mixing process. Also determine depth of penetration, if a steel plate is AWJ machined at a traverse speed of 300 mm/min with an insert diameter of 1 mm. The specific energy of steel is 13.6 J/mm³.

- 6 Answer the following: (Any Three) 12
- (a) Significance of different transducers used in Ultrasonic Machining process
- (b) Brief out commonly used industrial Lasers with layouts.
- (c) Elaborate the effects of process parameters with respect to output parameters in Electro Discharge Machining process.
- (d) Justify the development requirements of unconventional machining process

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