Indian Institute of Engineering Science and Technology, Shibpur
B. E. (ME,Met.E.) Part IV 8th Semester Final Examination, 2014
Subject: Metal Forming : ME-805/2 (Elective-III)

Time: 2 Hours Full Marks: 35

Write all answers in a SINGLE answer-script.
Answer any FIVE questions

1 (a) What are the slip-lines in slip-line theory? What is hodograph?
(b) For a 50% inverted extrusion process, find the actual values of absolute and relative velocities at different points on slip-line using an actual hodograph with proper scale. Take the inlet velocity U = 20 mm/s

[3+4]

2 (a) Prove that maximum reduction of area (r) in frictionless drawing operation of a circular rod is approximately equal to 63%.
[Use the formula : $\sigma_{xa} = \sigma_o ln\left(\frac{1}{1-r}\right)$]
(b) An annealed steel wire is drawn by wire-drawing from 3 mm diameter to 2 mm diameter drawing dies having $\alpha = 12^0$ at a speed of 1.5 m/s. Calculate the drawing force and power required for the process. Use the formula :

$$\sigma_{xa} = \sigma_o \left(\frac{1+B}{B}\right)\left[1 - \left(\frac{D_a}{D_b}\right)^{2B}\right]$$ (symbols have their usual meaning)

For the work material assume $K = 500$ MPa and $n = 0.26$ also take $\mu = 0.1$

[2+5]

3 (a) Explain the lubrication system used in dry drawing and wet drawing system.

(b) A 10 kW electric motor is geared to a draw-bench which operates at a speed of 0.2 m/s What would be the maximum size of round bar that could be drawn under ideal condition (frictionless), so that the diameter of the rod can be reduced by 2 mm? For the process take the flow stress= 400 MPa and use the formulae:

$$\sigma_{xa} = \sigma_o \ln\left(\frac{A_0}{A_1}\right);$$ (symbols have their usual meaning)

[3+4]

4. (a) Explain the use of front and back tension in rolling operation. Where is it applied?
(b) What roll load will be necessary to roll 200x6 (mm) annealed copper strip for 20% reduction of thickness using 360 mm diameter rolls. What roll load would be necessary for a further 20% reduction? Take K=315 MPa and n=0.54 for copper. Use the formulae: $P = 1.2 \times w \times \sigma_0 \times \sqrt{R\Delta h}$

[3+4]

5. (a) Explain the method of rolling mill control with the characteristic curves.
(b) Suggest suitable size of rollers (ie. roller diameter) for rolling a steel sheet from 0.8 mm thickness to 0.4 mm thickness. Width (w) = 750mm. For this steel take K=760 MPa and n =0.19. Roll force should not exceed 4000 kN and design the roller on this basis.

[4+3]

6. (a) Derive the expression for the distance for sticking friction from the center of a rectangular block which is undergoing upset forging. Use the formulae:

$$\frac{p}{2k} = e^{\frac{2\mu}{h}(a-x)};$$ (symbols have their usual meaning)

(b) A cylindrical specimen made of annealed steel has a diameter 200 mm and 125 mm height. It is upset at room temperature by open-die forging with flat dies to a height of 60 mm. Assuming take μ = 0.2 calculate the upsetting force. Take K=600 MPa and n =0.19 for the work material. Use the formulae:

$$p_{av} = \sigma_0\left(1 + \frac{2\mu r}{3h}\right)$$

[4+3]

7. (a) Explain with diagram how hollow sections can be produced in both direct and indirect extrusion.
(b) Prove that the required pressure for direct extrusion is :

$$p = \sigma_0(\epsilon_x + \frac{2L}{D_0})$$ (symbols have their usual meaning)

[2+5]