MASTER OF PRODUCTION ENGG. EXAMINATION, 2018
2nd Semester

ADVANCED MATERIAL FORMING, TOOLS AND DIE DESIGN

Time: Three hours   Full Marks 100

Answer any five questions
All parts of a question (a, b etc.) should be
answered at one place.

1. (a) Derive the relationship between tensile and shear yield stress.
   (b) Explain redundant work in material forming operation.
   (c) Write down the different methods of estimation of working load in plastic deformation.
   (d) Draw the Mohr circle and find out the principal stresses and slip lines at the
       (i) at the interface with Coulomb friction
       (ii) at the perfectly rough interface

                                                             6+4+4+6

2. (a) What is a and β line? Show that
       $p + 2k\varphi = C_1$ along an a line
       $p + 2k\varphi = C_2$ along a β line
   (b) Draw the slip line field and hodograph for 50% inverted extrusion in plane strain with unlubricated 180° die and determine the extrusion pressure.

                                                             10+10

3. (a) State upper bound theorem and explain its physical significance.
   (b) Estimate the upper bound bending moment required to cause plastic bending of a single notched bar.

                                                             5+15

4. (a) Draw an upper bound field for a frictionless plane strain indentation by a flat punch. Draw the hodograph and find the indentation pressure in terms of 2K.
   (b) A series of 8 straight-sided parallel grooves 6 mm wide with 6mm separation is to be formed along a thick aluminium blank 100 mm wide and 300 mm long. If a suitable forging tool is used in a hydraulic press, what initial force would be necessary? How much would this increase by the time the punch had penetrated to a depth of 6 mm? Assume that

the blank has previously been forged, so that the yield stress is sensibly constant at 150 N/mm².

12+8

5.(a) Determine the Lee and Shaffer's lower bound cutting force in orthogonal metal cutting operation. Compare this solution graphically with the Ernst and Merchant upper bound solution.

(b) A mild steel plate is compressed rapidly between smooth parallel platens. Calculate the temperature jump across the lines of thermal discontinuity assuming plane strain compression. The following data are given.

initial temperature of the mild steel = 680°C
density = 7.8 gm/cm³
specific heat = 620 J/kg/°C
yield stress = 350 MPa
width to thickness ratio = 1

10+10

6(a) Show how stripping of the job from the punch can be achieved in deep drawing operation by machining a slight recess into the underside of the draw die using a neat sketch.

(b) Show the die and punch shapes for bending operations requiring more than one stage for
(i) forming 'U' shape
(ii) forming a bead

(c) Show how tubes and other hollow sections can be produced from sheet metals using a series of contoured rolls, where bending operation is performed continuously.

5+8+7

7(a) Explain why die and punch corners are provided with radius in deep drawing operation, where they are not provided in blanking/piercing operation. Also explain why angular clearance is provided on die in a simple blanking/piercing die and punch assembly. Show neat sketches of the die and punch shapes for both the operations.

(b) Discuss about the basic design features of drop forging dies using neat sketch of a typical drop forging die set.

10+10

8   Show how the design of the die and punch assembly for sheet metal operations plays an extremely important role in reducing the operation time and cost. To illustrate your answer show neat sketches of:
(i)   Progressive die and punch assembly
(ii) Compound die and punch assembly
for a particular component.

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