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ANIPAL

# IV SEMESTER B. TECH. (AUTOMOBILE ENGINEERING)

## **END SEMESTER EXAMINATIONS, APRIL 2018**

### SUBJECT: AUTOMOTIVE PRODUCTION TECHNOLOGY (AAE 2253)

## **REVISED CREDIT SYSTEM**

#### (25/04/2018)

Time: 3 Hours

### MAX. MARKS: 50

### Instructions to Candidates:

- Answer ALL the questions.
- Assume missing data suitably by clearly stating the assumption.
- Give sketches/graphs/examples wherever necessary.
- **1A** Figure 1 represent shrinkage behavior of pure metals and eutectic alloys during **(05)** casting process. Explain the mechanism of shrinkage during stages (1), (2) and (3)? How shrinkage in each stage will be compensated?



Figure 1

- **1B** For casting of a steel product, the sprue leading into the runner of a certain mold has a length = 150 mm. The cross-sectional area at the base of the sprue is 600 mm<sup>2</sup>. The mold cavity has a volume = 0.002 m<sup>3</sup>. Determine: (i) the velocity of the molten metal flowing through the base of the down-sprue and (ii) the time required to fill the mold cavity?
- (i) Which die casting machines usually have a higher production rate, cold-chamber (03) or hot-chamber, and why?
  (ii) Which die casting machines usually use to die-cast alloys with comparatively higher melting point, cold-chamber or hot-chamber, and why?
- 2A With the aid of sketches, explain the process route for manufacturing of cutting tool (03) inserts?

- **2B** A cylindrical cup with inside diameter 75 mm, height 50 mm and inside corner radius **(02)** of 6 mm is to be made by drawing. (a) Check the feasibility of the drawing operation, if the starting blank size is 138 mm and the stock thickness is 2.4 mm.
- **2C** What is super plastic deformation? What are the necessary conditions to be satisfied **(03)** for superplastic deformation during forming processes?
- 2D Why is powder metallurgy technology so well suited to the production of gears and (02) bearings?
- 3A A bending operation is to be performed on 4.0 mm thick cold-rolled steel sheet that is (03) 25 mm wide and 100 mm long. The sheet is bent along the 25 mm direction, so that the bend is 25 mm long. The resulting sheet metal part has an acute angle of 30° and a bend radius of 6 mm. Determine (a) the bend allowance and (b) the length of the neutral axis of the part after the bend, if the length of the neutral axis before the bend = 100.0 mm.
- 3B A blanking operation is to be performed on 2 mm thick cold-rolled steel (half hard). (03) The part is circular with diameter= 75 mm. Determine the punch and die sizes for this operation. Determine the blanking force required, if the shear strength of the steel = 325 MPa and the tensile strength is 450 MPa.
- 3C A direct extrusion operation produces the cross section shown in Figure 2 from a brass (04) billet whose diameter = 125 mm and length = 350 mm. The flow curve parameters of the brass are K = 700 MPa and n = 0.35. In the Johnson strain equation, a = 0.7 and b =1.4. Determine (a) the extrusion ratio (b) the shape factor (c) the force required to drive the ram forward during extrusion at the point in the process when the billet length remaining in the container = 300 mm. Given that

$$K_{x} = 0.98 + 0.02 \left(\frac{C_{x}}{C_{c}}\right)^{2.3}$$



Figure 2 (All dimensions are in mm)

- **4A** External surface of a helical gear is to be deburred and finished to an average **(03)** roughness (Ra) value of 0.1μm. Suggest a manufacturing process for achieving the same and draw the tooling arrangement. What is the material removal mechanism of the identified process for this application?
- **4B** Much of the work at the Belco Manufacturing Company involves cutting and forming **(02)** of flat sheets of fiberglass for the pleasure boat industry. Manual methods based on portable saws are currently used to perform the cutting operation, but production is slow and scrap rates are high. The foreman says the company should invest in a plasma arc cutting machine, but the plant manager thinks it would be too expensive. What do you think? Justify your answer by indicating the characteristics of the process that make PAC attractive or unattractive in this application.

- **4C** A square hole is to be cut using Electro Chemical Machining (ECM) through a plate of pure copper (valence = 1 and specific removal rate,  $C = 7.35 \times 10^{-2} \text{ mm}^3/\text{As}$ ) that is 20 mm thick. The hole is 25 mm on each side, but the electrode used to cut the hole is slightly less than 25 mm on its sides to allow for overcut, and its shape includes a hole in its center to permit the flow of electrolyte and to reduce the area of the cut. This tool design results in a frontal area of 200 mm<sup>2</sup>. The applied current = 1000 amps. Using an efficiency of 95%, determine how long it will take to cut the hole.
- 4D An electric discharge machining operation is being performed on two work materials: (02) tungsten and tin. Determine the amount of metal removed in the operation after one hour at a discharge current of 20 amps for each of these metals. Use metric units and express the answers in mm<sup>3</sup>/hr. The melting temperatures of tungsten and tin are 3410°C and 232°C, respectively.
- 5A The unit melting energy for a certain sheet metal is 9.5 J/mm<sup>3</sup>. The thickness of each (03) of the two sheets to be spot welded is 3.5 mm. To achieve required strength, it is desired to form a weld nugget that is 5.5 mm in diameter and 5.0 mm thick with the aid of resistance arc welding. The weld duration will be set at 0.3 sec. If it is assumed that the electrical resistance between the surfaces is 140 micro-ohms, and that only one-third of the electrical energy generated will be used to form the weld nugget (the rest being dissipated), determine the minimum current level required in this operation.
- **5B** A heat source can transfer 3500 J/sec to a metal part surface. The heated area is **(02)** circular, and the heat intensity decreases as the radius increases, as follows: 70% of the heat is concentrated in a circular area that is 3.75 mm in diameter. Is the resulting power density enough to melt metal?
- **5C** With the aid of sketches compare the processes (a) Friction welding and (b) Friction **(03)** stir welding
- **5D** With the help of a sketch, brief on the principle of operation used in selective laser **(02)** sintering based additive manufacturing process.