Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B. TECH (IP ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2019

SUBJECT: THEORY OF METAL FORMING [MME 4045]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Draw neat and proportionate sketches wherever necessary.

1A. With a suitable illustration, describe the hot working process and list its advantages. **3**

1B. Derive the relationship between engineering stress and true stress. What is the merit of using true stress-strain curve in metal forming processes? **3**

1C. A strip of metal is originally 1.5 m long. It is stretched in three steps. First, to a length of 2.25 m, then to 2.75 m and finally to 3.0 m. Show that, the true strains are additive. Also show that using engineering strains, the strain for each step cannot be added to obtain total strain. **4**

2A. With a neat sketch, explain the working of a mechanical press used in forging operation. **3**

2B. How does the flash assists in die filling, especially in hot forging? Explain with a suitable sketch. **3**

2C. Cold forging of a cylindrical billet of initial height 50 mm and initial diameter 25 mm, results in a final reduced height of 33 mm. The material has flow stress given by the expression: $Y = 352\varepsilon^{0.24}$ MPa. The coefficient of friction between the billet and die surfaces can be assumed to be 0.14. What is the forging force required at the reduced height? **4**

3A. In a drawing process, show that the drawing stress σ_d, in plane-strain drawing of a flat sheet is given by the expression: **3**

$$\sigma_d = \sigma_o^{'}\left(1+\frac{\tan\alpha}{\mu}\right)\left[1-\left(\frac{h_f}{h_o}\right)^{\mu\cot\alpha}\right]$$

3B. What is a land in a die? What is its function? Explain with sketches the advantages and disadvantages of having no land? **3**

3C. Wire is drawn through a die with an entrance angle of 15°. The starting diameter of the wire is 2.5 mm and its final diameter is 1.5 mm. The co-efficient of friction at work-die interface is 0.1. The metal has a strength co-efficient of 205 MPa and strain hardening exponent of 0.2. Determine the drawing force considering the redundant work. **4**

4A. A large rocket nose cone needs to be manufactured. Which HERF process would you prescribe? Justify your selection. With suitable sketches, explain the production process for the same. **3**

4B. With a neat sketch outline the working of conventional spinning operation. Compare the same with shear spinning operation. **3**

4C. Cup shaped components were produced using deep drawing process. At the end of production process, certain defects were noted on few of the drawn components as seen in Figure 1. Identify the defects and list the probable causes leading to these defects. Also, with suitable sketches describe the mechanism involved in successful production of these components. **4**

Figure 1 Defects observed in deep drawn parts

5A. Explain in depth the effects of front and back tension on a strip during rolling process with suitable sketches and comment on the ways to provide it. **4**

5B. Determine the expression for maximum thickness reduction during rolling process. **3**

5C. A single-pass rolling operation reduces a 20 mm thick plate to 16 mm. The starting plate is 200 mm wide. Roll radius is 250 mm and rotational speed is 12 rev/min. The work material has a strength coefficient is 600 MPa and strain hardening exponent is 0.22. Determine, (a) Roll force, (b) Torque per roll and (c) Total power required for this operation if frictionless condition exists. **3**