FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF MATERIALS AND METALLURGICAL ENGINEERING
RAIN SEMESTER 2019/2020 EXAMINATIONS **Tuesday, 06/07/21**

COURSE: MME 518 (METAL FORMING PROCESSES) **TIME ALLOWED: 2½ hrs.**

INSTRUCTIONS: **(i) Attempt any four (4) questions in all. Each question carries 17.5 marks.**
(ii) Use illustrative sketches where applicable.

Question One

(a) Calculate the extrusion force for a 650 mm long round billet of Al alloy 6061 (HE-20) with 200 mm diameter extruded directly at 250 °C to a diameter of 150 mm if the strength coefficient and the strain hardening component of the alloy are 560 MPa and 0.55 respectively. [Take a = 0.8, b = 1.4]. **[9.5 mks]**

(b) What are the causes of Chevron cracking in extrusion and how can it be reduced? **[4 mks]**

(c) What is the importance of lubrication in metal forming manufacturing processes? **[4 mks]**

Question Two

(a) Describe the manufacturing process for the production of a 2.5 mm cross sectional area electrical cable from a 10 mm cross sectional area copper rod [Hint: Answer to cover pre-production, production and post-production activities]. **[11.5 mks]**

(b) Identify the four regions of the draw die used in drawing manufacturing process. **[4 mks]**

(c) State the significance of '*die angle*' in the wiredrawing process. **[2 mks]**

Question Three

(a) Differentiate between hot and cold extrusion. **[7 mks]**

(b) Define each of the parameters in the equation $F = A_0 k(\ln A_o / A_f)$ as they relate to extrusion processes. **[3.5 mks]**

(c) Describe the extrusion type used for the production of larger parts with hollow cores and thin wall thicknesses. **[7 mks]**

Question Four

(a) Use labelled sketches ONLY to illustrate the three types of forging operation. **[6 mrks]**

(b) A cylindrical workpiece is subjected to a cold upset forging operation wherein the starting piece is 112mm in height and 88mm in diameter. It is reduced in the operation to a height of 67mm. The workpiece has a flow curve defined by K = 550MPa and n = 0.23. Assuming a coefficient of friction of 0.45, determine the force: **(i)** just as the yield point is reached (yield at strain 0.002), **[6.5 mrks]** **(ii)** at a height of 67mm. **[5 mrks]**
[Hint: Neglect barrelling and assume constant volume]

Question Five

(a) By connecting a dynamometer to the cutting tool during orthogonal cutting operation, four (4) trigonometric relationships can be obtained to quantify the force-components that cannot be directly measured. State them and define the associated parameters. **[6.5 mrks]**

(b) The cutting force and thrust force are measured during an orthogonal cutting operation to give F_c = 2563N and F_t = 2097N. The chip thickness before the cut, chip thickness after the cut and the width of the orthogonal cutting operation are: 0.50mm, 1.125mm and 7.0mm, respectively. Based on these data, determine the shear strength of the work material if the shear plane angle $\phi = 25.4°$ and rake angle $\alpha = 31^0$. **[11 mrks]**

Question Six

(a) Define the following terms: **(i)** adhesive wear, **[2 mrks]** and **(ii)** solid-state diffusion wear **[2.5 mrks].**

(b) The following data were collected during tool life tests in turning: ***[1]*** when cutting speed = 210m/min, tool life = 549s; ***[2]*** when cutting speed = 76m/min, tool life = 1928s. Determine the n **[8 mrks]** and C **[4 mrks]** values in the Taylor Tool Life equation.