

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

MECHANICAL ENGINEERING – 2ND YEAR DEGREE

SECOND SEMESTER EXAMINATIONS – 2022

ME 322 – METAL CUTTING AND MACHINE TOOLS

WEDNESDAY, 26th OCTOBER 2022 – 12.50 PM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES

1. You have 10 minutes to read the paper. You **must not** begin writing during this time.
2. Answer **All the** questions.
3. **Use only ink.** Do not use pencil for writing except for drawings and sketches.
4. Start each question on a new page and show all your calculations in the answer book provided. No other written material will be accepted.
5. Write your **NAME** and **NUMBER** clearly on the front page. **Do it now.**
6. Calculators are permitted in the examination room. Notes and textbooks are not allowed.

MARKING SCHEME:

Question Number 1	10
Question Number 2	10
Question Number 3	05
Question Number 4	05
Question Number 5	05
Question Number 6	05
Question Number 7	06

Question Number 1 (07 marks)(Answer all questions Each Question carries 1 mark)

Fill in the blanks

- a If the spindle speed is 90 r.p.m. and cross feed is 0.3 mm/revolution, the time taken to face a work piece of 80 mm diameter is _____.
- b It is required to divide the periphery of a job into 28 equal divisions. The indexing arrangement will be _____.
- c A shaft of length 90 mm has a tapered portion of length 55 mm. The diameter of the taper is 80 mm at one end and 65 mm at the other. If the taper is made by tail stock set over method, the tail stock set over is _____.
- d A milling cutter of 70mm diameter with 12 teeth is operating at a cutting speed of 22 m/min and a feed of 0.05 mm/tooth. The feed per minute is _____.
- e The angle between the face and the flank of the single point cutting tool is known as _____.
- f Given cutting speed(cs) = 50 mm/minute, depth of cut(d) = 10mm, feed(f) = 0.1 mm/revolution. Metal removal rate in this case (in mm*mm*mm/minute) is _____.
- g In an electrical discharge machining process, the breakdown voltage across inter electrode gap (IEG) is 200V and the capacitance of the RC circuit is 50 μ F. The energy (in J) released per spark across the IEG in Joules is _____.

Question Number 2 (07 marks)(Answer all questions Each Question carries 1 mark)

Choose the correct option

- a A good cutting fluid should have
i) Low thermal conductivity ii) High Specific heat
iii) High Viscosity iv) High Density
- b Galvanic wear, seldom occurs when the
i) work and tool materials are electrically conductive
ii) cutting zone temperature is high and
iii) the cutting fluid acts as an electrolyte
iv) All of these
- c A straight teeth slab milling cutter of 100 mm diameter and 10 teeth rotating at 200 r.p.m is used to remove a layer of 3 mm thickness from a steel bar. If the table feed is 400 mm/min, the feed per tooth in this operation will be :
i) 0.2 mm ii) 0.4 mm iii) 0.5 mm iv) 0.6 mm
- d Determine the rpm(n) of the shaft. diameter(d) = 25 mm, cutting speed(cs) = 50 m/min.
i) 636.9 ii) 202.83 iii) 10.615 iv) none of the mentioned
- e Conditions for discontinuous chips is
i) Ductile materials at high speed ii) Ductile materials at low speed
iii) Brittle materials at high speed iv) Brittle Materials at low speed

f Which of the following statements are false?

- i) Quick return mechanism is responsible for ram movement.
- ii) The base of the shaper is able to withstand the vibration
- iii) Saddle slides along the ram.
- iv) The stroke can be adjusted according to the length of the work piece to be machined.

g Determine the current required for machining iron (Atomic weight= 55.85 g, valency = 3, and density= 7.86 g/mm³) for achieving volume removal rate of 15 cm³/s

- i) 6801.32 A ii) 12930.13 A iii) 3204.39 A iv) 10185.6 A

Question Number 3 (5 marks)

A 160 mm long 15 mm diameter rod is reduced to 14 mm diameter in a single pass straight turning. If the spindle speed is 450 r.p.m. and feed rate is 225 mm/min, determine:

- (i) Material removal rate.
- (ii) Cutting time.

Question Number 4 (5 marks)

Calculate the time required to mill a slot of 350 mm × 30 mm in a work piece of 350 mm length with a side and face milling cutter of 120 mm diameter, 30 mm wide and having 20 teeth. The depth of cut is 6 mm, the feed per tooth is 0.1 mm and cutting speed is 34 m/min. Assume over travel distance of 5 mm.

Question Number 5 (5 marks)

Explain continuous chip with BUE.

Question Number 6 (5 marks)

Sketch and Explain the Electron Beam Machining Process

Question Number 7 (6 marks)

In an EDM process using RC relaxation circuit, a 12 mm diameter, through hole is made in a steel plate of 50 mm thickness using a graphite tool and kerosene as dielectric. Assume discharge time to be negligible. Machining is carried out under the following conditions.

Resistance = 40 ohms

Capacitance = 20 μF

Supply voltage = 220 V

Discharge voltage = 110 V

Find Average power input (in kW) and Cycle Time.