UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

# FINAL EXAMINATION

# OCTOBER 2025 SEMESTER

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|---|---|---|
| COURSE CODE | : | SCB24503 ( V2 ) |
| COURSE TITLE | : | ENGINEERING MATERIALS |
| PROGRAMME NAME | : | BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MECHANICAL (AUTOMOTIVE) |
| DATE | : | 31 JANUARY 2026 |
| TIME | : | 9:00AM - 12:00PM |
| DURATION | : | 3 HOURS |

## INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☑ *Tick if applicable*

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

The mechanical properties of a material are those properties that involve a reaction to an applied load. The mechanical properties of metals determine the range of usefulness of a material and establish the service life that can be expected.

(a) Define the following terms related to the mechanical properties of materials under tensile testing:

i. Yield strength

(3 marks)

ii. Ultimate tensile strength

(3 marks)

iii. Fracture stress

(3 marks)

iv. Elastic deformation

(3 marks)

v. Plastic deformation

(3 marks)

(b) Sketch a typical engineering stress-strain diagram for a ductile material. In your diagram, identify and label the terms which has been mention in question (a).

(10 marks)

**Question 2**

Destructive testing involves subjecting a specimen to failure to understand its structural performance or material behavior under various loads. This method is most suitable and economical for objects that will be mass-produced, as the cost of destroying a small number of specimens is negligible. However, it is generally not economical to perform destructive testing when only one or a few items are to be produced.

(a) Given the following conditions in a Brinell hardness test: A 1500kg load is applied using a 10 mm diameter hardened steel ball, resulting in an indentation with a diameter of 3.2mm. Analyze the given data to determine the Brinell Hardness Number (BHN) for the metal. Show all your calculations.

(5 marks)

(b) Identify the two most common microhardness testing techniques. Analyze and compare two differences between these techniques, explaining how each difference impacts their application and results.

(10 marks)

(c) Describe the fracture evolution for moderately ductile material through fatigue. Analyze the stages of fatigue fracture.

(10 marks)

**Question 3**

Composites are found in nature. For example, wood is a natural composite, with long cellulose fibers bonded together by a weaker material called lignin. Humans have utilized composite materials for thousands of years.

(a) In your own words, explain what a composite material is.

(4 marks)

(b) Describe the primary difference between a matrix and a reinforcement in a composite material. Provide one example of each.

(6 marks)

(c) Classify three primary classes of composite materials and discuss their key characteristics.

(9 marks)

(d) Illustrate the fiber orientation for aligned continuous fibers and random discontinuous fibers. Provide clear sketches for each type.

(6 marks)

**Question 4**

Many materials are exposed to a variety of environmental conditions, which can lead to corrosion. This process degrades the material's mechanical strength, alters its physical properties, and affects its appearance, ultimately compromising its performance and longevity.

(a) Give the definition of corrosion.

(3 marks)

(b) State the deteriorative mechanism for metal, ceramic and polymer.

(9 marks)

(c) List and describe three different corrosive agents or environments.

(9 marks)

(d) For erosion corrosion, identify the conditions under which it occurs and discuss its effects on the material.

(4 marks)

**Question 5**

Metallography is the study of the physical structure and components of metals, typically using microscopy.

(a) Discuss the scientific discipline of metallography and its significance in understanding the microstructure and properties of metallic alloys.

(5 marks)

(b) Describe the five steps involved in the preparation of a metallographic sample, emphasizing the techniques and equipment used in each step, as well as the reasons for performing each step.

(20 marks)

END OF EXAMINATION PAPER

## APPENDIX

- Avogadro's number, $N_A = 6.023 \times 10^{23}$ atoms/mol
- Volume of cube, $V = a^3$
- Density, $\rho = \dfrac{nA}{V_C N_A}$
- $F_{net} = \dfrac{(Z_1 e)(Z_2 e)}{4\pi\varepsilon_0 r^2}$
- $\epsilon_0$ = permittivity of free space = $8.85 \times 10^{-12}$ $C^2/Nm^2$
- e = electron charge = $(-1.602 \times 10^{-19})$
- p = proton charge = $1.602 \times 10^{-19}$
- 1 eV = $1.6 \times 10^{-19}$ Joule
- $HV = 1.854\ (F/D^2)$
- $HB = \dfrac{2P}{\pi D\left[D - \sqrt{D^2 - d^2}\right]}$
- $\sigma = F/A$
- TS = 3.45 x HB
- Periodic table :

| 1 | | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H 1.008 | 2 | | | | | | | | | | | | | | | | 2 He 4.0026 |
| 3 Li 6.94 | 4 Be 9.0122 | | | | | | | | | | | 5 B 10.81 | 6 C 12.011 | 7 N 14.007 | 8 O 15.999 | 9 F 18.998 | 10 Ne 20.180 |
| 11 Na 22.990 | 12 Mg 24.305 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 Al 26.982 | 14 Si 28.085 | 15 P 30.974 | 16 S 32.06 | 17 Cl 35.45 | 18 Ar 39.948 |
| 19 K 39.098 | 20 Ca 40.078 | 21 Sc 44.956 | 22 Ti 47.867 | 23 V 50.942 | 24 Cr 51.996 | 25 Mn 54.938 | 26 Fe 55.845 | 27 Co 58.933 | 28 Ni 58.693 | 29 Cu 63.546 | 30 Zn 65.38 | 31 Ga 69.723 | 32 Ge 72.630 | 33 As 74.922 | 34 Se 78.97 | 35 Br 79.904 | 36 Kr 83.798 |
| 37 Rb 85.468 | 38 Sr 87.62 | 39 Y 88.906 | 40 Zr 91.224 | 41 Nb 92.906 | 42 Mo 95.95 | 43 Tc (98) | 44 Ru 101.07 | 45 Rh 102.91 | 46 Pd 106.42 | 47 Ag 107.87 | 48 Cd 112.41 | 49 In 114.82 | 50 Sn 118.71 | 51 Sb 121.76 | 52 Te 127.60 | 53 I 126.90 | 54 Xe 131.29 |
| 55 Cs 132.91 | 56 Ba 137.33 | 57-71 * | 72 Hf 178.49 | 73 Ta 180.95 | 74 W 183.84 | 75 Re 186.21 | 76 Os 190.23 | 77 Ir 192.22 | 78 Pt 195.08 | 79 Au 196.97 | 80 Hg 200.59 | 81 Tl 204.38 | 82 Pb 207.2 | 83 Bi 208.98 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra (226) | 89-103 # | 104 Rf (265) | 105 Db (268) | 106 Sg (271) | 107 Bh (270) | 108 Hs (277) | 109 Mt (276) | 110 Ds (281) | 111 Rg (280) | 112 Cn (285) | 113 Nh (286) | 114 Fl (289) | 115 Mc (289) | 116 Lv (293) | 117 Ts (294) | 118 Og (294) |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * Lanthanide series | 57 La 138.91 | 58 Ce 140.12 | 59 Pr 140.91 | 60 Nd 144.24 | 61 Pm (145) | 62 Sm 150.36 | 63 Eu 151.96 | 64 Gd 157.25 | 65 Tb 158.93 | 66 Dy 162.50 | 67 Ho 164.93 | 68 Er 167.26 | 69 Tm 168.93 | 70 Yb 173.05 | 71 Lu 174.97 |
| # Actinide series | 89 Ac (227) | 90 Th 232.04 | 91 Pa 231.04 | 92 U 238.03 | 93 Np (237) | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (251) | 99 Es (252) | 100 Fm (257) | 101 Md (258) | 102 No (259) | 103 Lr (262) |