UNIVERSITY OF GREATER MANCHESTER

SCHOOL OF ENGINEERING

MSc MECHANICAL ENGINEERING

SEMESTER TWO EXAMINATION 2024/2025

MECHANICS, MATERIALS AND MANUFACTURE PROCESSES

MODULE NO: AME7009

Date: **Wednesday 14th May 2025**   Time: **10:00am – 12:00pm**

INSTRUCTIONS TO CANDIDATES: There are **SIX** questions in total.

There are **TWO** sections with **THREE** questions in each.

Answer **ANY TWO** questions from each section. There are total of **FOUR** questions to answer.

All questions carry equal marks of 25. Marks for parts of questions are shown in brackets.

Electronic calculators may be used if necessary.

A formula sheet is provided following the questions.

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009
SECTION 1: MANUFACTURING – ANSWER ANY <u>TWO</u> QUESTIONS

Q1. Additive Manufacturing (AM)

a) Why is additive manufacturing becoming more popular than traditional manufacturing in the industry? List seven types of additive manufacturing processes.

(08 marks)

b) Polylactic acid (PLA) is commonly used in fuse deposition modelling (FDM)-based additive manufacturing. Outline the workflow involved in printing with PLA using FDM technology.

(12 marks)

c) Stereolithography (SLA), also known as photopolymerisation, is a widely used additive manufacturing (AM) technique. Discuss the benefits and limitations of the stereolithography (SLA)/photopolymerisation AM method.

(5 marks)

Total 25 Marks

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

Q2. Material Cutting

a) A Vertical Machining Centre (VMC) is a computer numeric control (CNC) machine used for precision milling. Explain how a vertical machining Centre (VMC) operates. List five examples of VMC machining features.

(10 marks)

b) Metal cutting processes are fundamental in manufacturing for shaping and finishing metal parts. Explain the classification of metal cutting processes. Provide examples for each category mentioned.

(10 marks)

c) Explain the differences between drilling, boring, and reaming in terms of their purpose and the tools used. Include the impact each process has on the size and finish of the hole.

(5 marks)

Total 25 Marks

PLEASE TURN THE PAGE…

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

Q3. Material Joining

a) In manufacturing, metal joining is a crucial process used to connect metal components to form complex assemblies and products. Describe the classification of metal joining processes and provide relevant examples.

(05 marks)

b) Why is soldering widely used in the electronics and jewelry industries? Discuss the role of the tin-lead alloy in the process and explain how the low melting temperature of the filler material influences its applications.

(08 marks)

c) Welding is a fundamental process in manufacturing used to permanently join metal parts. Explain gas welding, arc welding, friction stir welding (FSW), and resistance welding. Provide relevant examples for each technique.

(12 marks)

Total 25 Marks

END OF SECTION 1

PLEASE TURN PAGE FOR SECTION 2

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

SECTION 2: MATERIALS AND MECHANICS – ANSWER ANY <u>TWO </u>QUESTIONS

Q4. Materials Characterization and Testing

a) Material Describe with diagram the Body centered cubic (BBC), Face centered cubic (FCC) crystal structure and Hexagonal closely packed (HCP) crystal structure. Give ONE example of substance for each crystal structure.

(8 marks)

b) Compare thermoplastics and thermosetting plastics by outlining FOUR key differences between them. Support your answer with at least TWO examples of each type, along with their typical applications.

(5 marks)

c) What do you understand by the term Material Characterization? State FOUR application of Material Characterization.

(6 marks)

d) Describe the three main types of ceramics and give examples of each.

(6 marks)

Total 25 Marks

PLEASE TURN THE PAGE…

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

Q5. Advanced Materials

a) How Does Heat treatment influence the behavior of steel? Discuss three types of heat treatment you know?

(5 marks)

b) List FIVE alloying elements used in steel. Describe the effects of TWO of the elements on steel.

(7 marks)

c) Discuss any four challenges facing the implementation of advanced metals in the manufacturing industry.

(8 marks)

d) Discuss any FOUR classification of metals you were taught. Give one example of TWO of your classifications.

(5 marks)

Total 25 Marks

PLEASE TURN THE PAGE…

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

Q6. Mechanics

a) Material Characterization is very important in Engineering industries. Discuss two key objectives and List five common methods of material characterization in engineering and manufacturing processes.

(7 marks)

b) Briefly discuss on composite materials and describe THREE reinforcement constituents in composite materials.

(6 marks)

c) A team of aspiring material engineers at the University of Bolton is conducting a laboratory test to evaluate the mechanical properties of a steel bar intended for an industrial application as show in the figure below. The test sample is a bar with dimensions: 850mm in length, 15mm in thickness, and 45mm in width. The material is simply supported at both ends and has been measured to have a Young's modulus (E) of 15GPa. Calculate the stiffness of this material based on the given data.

Figure Q6: Steel bar

(12 marks)

Total 25 Marks

END OF QUESTIONS

FORMULA SHEET FOLLOWS ON NEXT PAGE

PLEASE TURN THE PAGE…

School of Engineering
MSc Mechanical Engineering
Semester Two Examination 2024/25
Mechanics, Materials and Manufacture Processes
Module No. AME7009

FORMULA SHEET

Second moment of area of a rectangular beam,

$$I = \frac{bd^3}{12}$$

where, b is width and d is thickness.

Maximum deflection,

$$\delta max = \frac{FL^3}{48EI}$$

where, F is force, L is length, and E is Young's Modulus, again,

$$F = mg$$

where, m is mass and g is gravity.

END OF FORMULA SHEET

END OF PAPER