UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: DND 2073
COURSE	: MAGNETIC PARTICLE TESTING
SEMESTER/SESSION	: 1-2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **all** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) The first use of magnetism to inspect objects took place in the 1860's when cannon barrels were tested for defects by first magnetizing the barrel and then running a compass down the length of the barrel. By monitoring the needle of the compass, defects within the barrel could be detected.

i. Define magnetism. (2 marks)

ii. Identify type of material that can be inspected using Magnetic Particle Testing. (2 marks)

iii. State the unit for Flux Density and Magnetic Field Strength. (2 marks)

b) Metal material can be divided into two categories which are magnetic and non-magnetic material.

i. Define permeability. (2 marks)

ii. Give the formula for permeability. (2 marks)

iii. Describe **two (2)** properties of magnetic lines of force. (2 marks)

iv. Explain the terms of ferromagnetic and paramagnetic material. (4 marks)

v. Sketch a figure represents hysteresis loop. (2 marks)

QUESTION 2

a) Codes are generally the top-tier documents, providing a set of rules that specify the minimum acceptable level of safety for manufactured, fabricated or constructed objects.

i. State **two (2)** codes usually referred in performing Magnetic Particle Testing. (2 marks)

ii. Give the minimum irradiance UV-A light (unit $\mu W/cm^2$). (1 mark)

iii. Give maximum ambient background lighting (lux) for fluorescent Magnetic Particle Testing. (1 mark)

iv. Define fluorescence. (2 marks)

b) Discontinuities at the surface will be indicated by Magnetic Particle Testing. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications.

i. Define indication. (2 marks)

ii. Give **one (1)** another example of false indication. (1 mark)

iii. Describe **three (3)** indications will be considered when evaluating. (6 marks)

c) All surfaces to be examined shall be free of the following:

- Relevant linear indications. No crack or linear indication is acceptable.
- Relevant rounded indications greater than 3/16" inch (4.8 mm) will not be acceptable.
- Four or more relevant rounded indications in a line separated by 1/16" inch (1.6 mm) or less, edge-to-edge.

Assess the following indications based on acceptance criteria stated above:

i. Linear indication with 5 mm in length. (2 marks)

ii. Porosity with rounded indication with 4 mm in diameter. (2 marks)

QUESTION 3

a) In Magnetic Particle Testing, the detecting medium plays important role to provide indications. The detecting medium should be normally in accordance with BS EN ISO 9934-2: 2002 Detection Media.

i. List **two (2)** main considerations when producing and selecting detecting medium. (2 marks)

ii. Classify **two (2)** types of detecting medium. (2 marks)

iii. Compare between **two (2)** types of detecting medium. (6 marks)

iv. Describe **four (4)** basic requirements for magnetic particle. (8 marks)

b) Demagnetization of a specimen may be required before testing, between successive shots / magnetizing positions and after testing in order to remove any residual magnetism in the specimen.

i. Describe **two (2)** reasons of demagnetization should be carried out. (4 marks)

ii. Explain **three (3)** methods of demagnetization. (9 marks)

c) Magnetic Particle Testing using electrical apparatus can use several types of ammeter to quantify the amount of current employed which can measure the waveform of the current.

i. State the main disadvantage of using Alternating Current (AC). (1 mark)

ii. Calculate the RMS value for 3 mA and 5 mA. (2 marks)

iii. Sketch the figure representing Alternating Current (AC) (2 marks)

QUESTION 4

Figure 1 shows a solid cylinder with two different areas to be inspected using magnetic particle inspection bench equipment technique. Given that:

1. Tangential Field, H = 2 kA/m
2. Constant for AC source (rms), K = 22000
3. Number of turns (rigid coil), N = 5

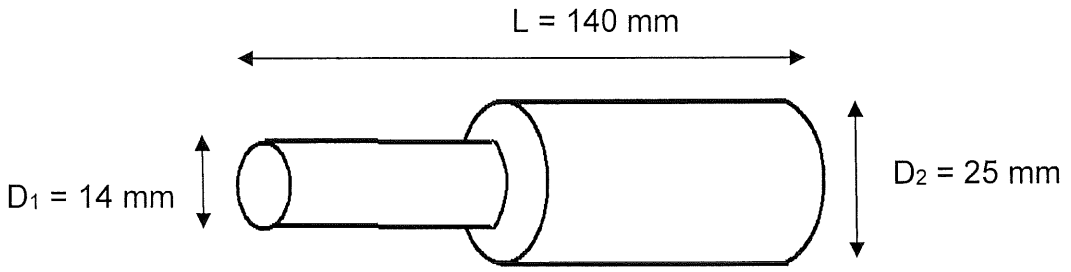

Figure 1

a) State ASTM equation for magnetization using coil of parts with low fill factor. (2 marks)

b) List **two (2)** techniques in Magnetic Particle Testing used to inspect this cylinder bar. Make sure those two techniques will cover in finding longitudinal and transverse cracks. (2 marks)

c) Give **four (4)** techniques of magnetizing that will produce circular magnetic field. (4 marks)

d) Describe the continuous and residual magnetization methods in Magnetic Particle Testing. (4 marks)

e) Calculate cross section change of the cylinder bar and determine whether each area should be inspected using same or different value of current. (3 marks)

f) Calculate fill factor for D_1 inside a coil with diameter of 80 mm. (2 marks)

g) Calculate fill factor for D_2 inside a coil with diameter of 80 mm. (2 marks)

h) Calculate **four (4)** value of current required to find longitudinal and transverse crack for this cylinder. (8 marks)

----------End of question----------

List of Formula

1. $$I = H \times p$$
2. $$NI = \frac{0.4H \times K}{L/D} \ (BS\ EN\ ISO)$$
3. $$I = 2.5H \times p$$
4. $$NI = \frac{K}{L/D}$$