



## UNIVERSITY COLLEGE TATI (UC TATI)

## FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DND 2073
COURSE	: MAGNETIC PARTICLE TESTING
SEMESTER/SESSION	: 1-2023/2024
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**

MAGNETIC PARTICLE TESTING (DND 2073)

---

**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)

## MAGNETIC PARTICLE TESTING (DND 2073)

---

**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  $\mu\text{W}/\text{cm}^2$ ). (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)

## MAGNETIC PARTICLE TESTING (DND 2073)

---

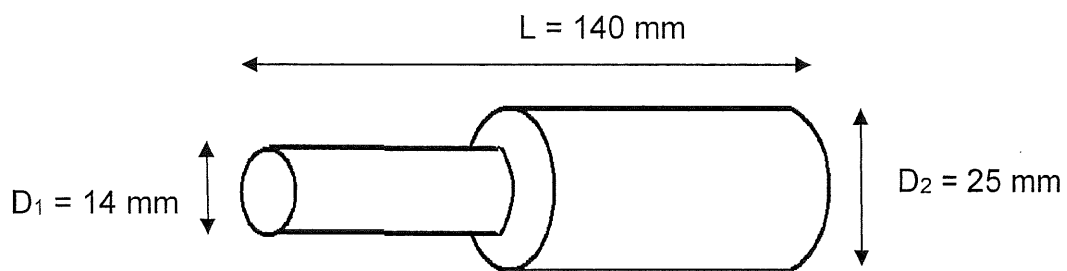
**QUESTION 3**

- 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,  $H = 2 \text{ kA/m}$
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**-----

MAGNETIC PARTICLE TESTING (DND 2073)

---

**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.  $NI = \frac{K}{L/D}$