POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION

DECEMBER 2011 SESSION

JF302 : MATERIAL TECHNOLOGY 1

DATE : 03 MAY 2012 (THURSDAY)
DURATION : 2 HOURS (2.30 PM - 4.30 PM)

This paper consists of **NINE (9)** pages including the front page.
Section A: Objective (25 questions – answer all)
Section B: Structured (4 questions – answer 3 questions)

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(CLO stated at the end of each question is referring to the learning outcome of the topic assessed. The CLO stated is only for lectures' references.)

SECTION A
OBJECTIVES (25 marks)

INSTRUCTION:
This section consists of **TWENTY FIVE (25)** objective questions.
Answer **ALL** questions in the answer booklet.

1. *"The number of protons (positively charged particles) which are in its nucleus and in a neutra state it is equal to the number of electrons in its charge cloud"* .....[CLO 1]

   A. Atomic Number
   B. Atomic Masses
   C. Atomic Structure
   D. Quantum Number

2. What are elements? [CLO 1]

   A. A combination of two or more atoms of different types, but not chemically.
   B. A combination of two or more atoms chemically of different types.
   C. A combination of two or more atoms of the same type. It is in the original condition.
   D. Elements are natural and no combination of atoms.

3. A solid solution is a solid that consists of _____. [CLO 1]

   A. two or more elements dispersed in a single phase sturcture.
   B. two or more structure dispersed in a 2-phase element.
   C. two elements dispersed in a three-phase structure.
   D. two compound in a mixture of a metal.

4. Indentify the characteristics of steel alloy. [CLO 1]

   A. Steel alloy rust easier than carbon steel.
   B. Steel alloy is brittle.
   C. Steel alloy contain more than 1% of other elements, other than carbon and iron.
   D. Steel alloy is an iron ore.

5. Electron sea exists in _____. [CLO 1]

   A. polar bonds
   B. ionic bond
   C. covalent bond
   D. metallic bond

6.

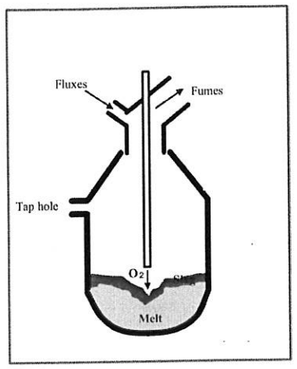

Figure 1

The diagram in **Figure 1** is used in the process of steel production. Which of the methods below best describes the diagram. [CLO 1]

A. Basic oxygen.
B. Basic Electric.
C. Electric Arc.
D. Combustion.

7. Refer to **Figure 2**. Which statement is **FALSE** about the process of solidification for pure metal and alloy according to the cooling curve. [CLO 1]

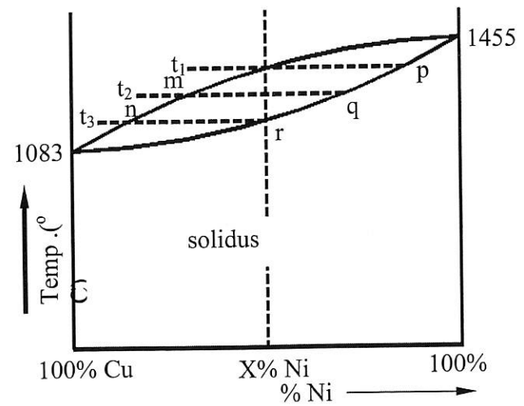

Figure 2

A. The highest temperature is 14550 °C.
B. Metal solidification is complete at t_3.
C. The highest temperature is 10830 °C.
D. Metal solidification starts at t_2.

8. Fine grain size usually cannot be obtained during one of the following processes. [CLO 1]

A. Slow cooling.
B. Increasing nucleation rate.
C. Retarding grain growth.
D. Fast cooling.

9. Commercially pure iron contains up to 0.008% C and steel up to 2% C. What are the carbon content in Cast Iron? [CLO 1]

A. More than 2% C.
B. Up to 4% C.
C. Up to 10% C.
D. Up to 7% C.

10. Which is **TRUE** about the binary alloy in the phase diagram. [CLO 1]

A. A mixture of two or more atoms.
B. The combination of different elements.
C. Only exist in liquid state.
D. Affiliate / listing close two or more components (metallic and non-metallic elements) and exists either in the solid or liquid.

11. The boundary line between (*liquid*) and (*liquid+solid*) regions must be part of _____. [CLO1]

A. Solvus
B. Solidus
C. Liquidus
D. Tie-line

12. The characteristics of Stainless Steel are determined by _____. [CLO 1]

A. resistance
B. high Stress
C. cobalt content
D. chromium content

13. State the percentage of *Hematite* iron content. [CLO 1]

A. 40% to 65% of iron.
B. 10% to 25% of iron
C. 30% to 45% of iron.
D. 70% to 95% of iron.

14. The role of flux during smelting of ore is to _____. [CLO 1]

A. make the ore porous
B. remove gangue
C. facilitate reduction
D. frecipitate slag

15. The craft of shaping metal without heat is called _____. [CLO 2]

A. cold Work
B. hot Work
C. warm Work
D. casting

16. What is the application of cast iron? [CLO 2]

A. Car body
B. Engine blocks
C. Bridge
D. Hammer

17. A cast iron _____. [CLO 2]

A. has a carbon content in the range 0.2 to 0.2 wt % C
B. has a carbon content up to 2% C
C. always contain pearlite
D. always contain martensite

18. Hardening and strengthening steel involves _____. [CLO 2]

A. heating
B. cooling
C. melting
D. solidifying

19. Which of the following is a non-destructive test?

A. Brinell.
B. Vickers.
C. Rockwell.
D. X-ray.

20. Which of these is not a heat treatment process parameters ?. [CLO 2]

A. Heating rate.
B. Temperature.
C. Cooling rate.
D. Atmosphere.

21. A measure of the ability of a material to absorb energy up to fracture is the mechanical properties of _____.

A. strength
B. ductility
C. toughness
D. hardness

22. Select the advantages of plastic materials. [CLO 1]

A. Cheap and durable.
B. Dimensions may vary due to humidity.
C. Brittle easily at low temperature.
D. Highly flammable plastic part.

23. Which of the following is the property of a polymer material? [CLO 2]

A. High temperature stability
B. High mechanical strength
C. High elongation
D. Low hardness

24. Which of the following can be used for cathodic protection?

A. Aluminum (Al)
B. Cadmium (Cd)
C. Copper (Cu)
D. Zink

25. Listed below are the characteristics of a thermoset, **EXCEPT** _____. [CLO 2]

A. not heat sensitive
B. can be remelted and remoulded
C. harder, more rigid and more brittle
D. less soluble in organic solvents

SECTION B

STRUCTURED (75 marks)

INSTRUCTION:

This section consists of **FOUR(4)** structured questions.

Answer **THREE(3)** questions only.

QUESTION 1

a) Define the following terms : [CLO 1]

i. Atom
ii. Compound

(4 marks)

b) List **THREE (3)** types of atomic bonds and give suitable examples for each type. [CLO 1]

(6 marks)

c) With a suitable diagram, explain the following types of solid solution . [CLO 1]

i. Substitutional sold solution.
ii. Interstitial solid solution.

(8 marks)

d) With the aid of a diagram, explain briefly the growth of crystals and grains during the solidification process for metal. [CLO 1]

(7 marks)

QUESTION 2

a) Define the following terms; [CLO 2]

i. Cold Work
ii. Hot Work

(4 marks)

b) Explain the principles of *Hot Rolling* showing its effect on granular structure. [CLO 2]

(8 marks)

c) What is the meaning of *Heat Treatment?*. Give **THREE (3)** stages that are used in the *Heat Treatment* process. [CLO 2]

(8 marks)

d) List out **FIVE (5)** tools used in *Sand Casting*. [CLO 2]

(5 marks)

QUESTION 3

a) Cite the differences between ferrous and non-ferrous metal and list **THREE (3)** types of non-ferrous metals commonly used in the industry.

(6 Marks)

b) X-ray and Gamma ray are methods used to perform Non-Destructive Testing as categorized under Radiographic Testing. Briefly explain how X-ray is produced and the working principles of X-ray to detect any defect existing in a material or product.

(11 marks)

c) Explain **TWO (2)** methods of controlling corrosion below.

i. Sacrificial coatings.

ii. Design considerations and practices.

(8 Marks)

QUESTION 4

a) Define the following terms. [CLO1]

i. Monomer

ii. Polymer

(4 marks)

b) Describe the *Extrusion* process of Thermoplastic, using a suitable diagram. [CLO1]

(9 marks)

c) List **THREE** (**3**) advantages and **THREE** (**3**) disadvantages of *Extrusion Moulding*.

[CLO2]

(6 marks)

d) List **THREE** (**3**) types of *thermoset* and **THREE (3)** types of *thermoplastics*.

[CLO2]

(6 marks)