

ENGINEERING - MATERIALS AND TECHNOLOGY
(Higher Level - 300 marks)

5996

FRIDAY, 25 JUNE, AFTERNOON 2.00 to 5.00

Answer Question 1, Sections A and B, and Four other questions

1.

(100 marks)

SECTION A - 50 marks

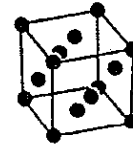
Give brief answers to any ten of the following:

- (a) Describe how any one electrical hazard may be prevented.

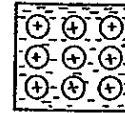


- (b) Name one physical property of metals which can be used to facilitate ore dressing.

- (c) Explain why slippage occurs more easily in FCC structures.



- (d) A metallic bond is shown, outline briefly its main properties.

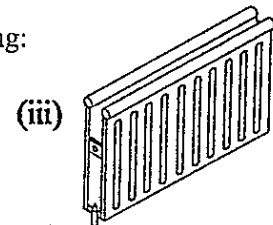
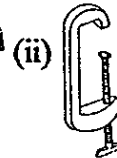
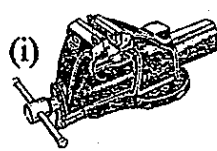


- (e) State two ways of ensuring good quality joints when using adhesives.

- (f) Select any three of the abbreviations shown and explain their meaning:

(i) IC; (ii) PTFE; (iii) RAM; (iv) LCD; (v) VDU.

- (g) State the main process used to manufacture any two of the following:



- (h) Two electronic devices are shown, identify only one and describe its purpose.



- (i) Outline three main ways of preventing corrosion in metals.

- (j) Suggest any two applications of the dial gauge shown.



- (k) How does hardening occur in the aluminium Y-alloy?

- (l) Outline the purpose of the gauge shown opposite.



- (m) Describe a contribution to technology by any one of the following:

(i) Joseph Henry; (ii) Michael Faraday; (iii) Ivan Sikorsky.

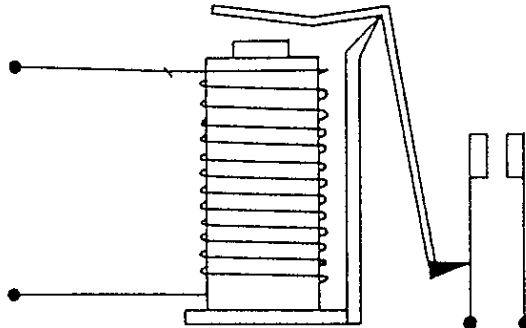
SECTION B - 50 marks

Answer all of the following:

(n) Describe the energy conversion that takes place in an electromagnet.

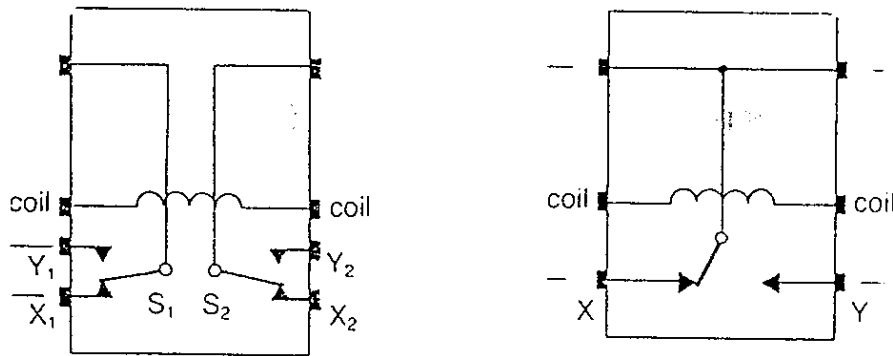
(o) Using the electromagnetic relay shown, identify;

- (i) the armature; (ii) the solenoid; (iii) the contactors.

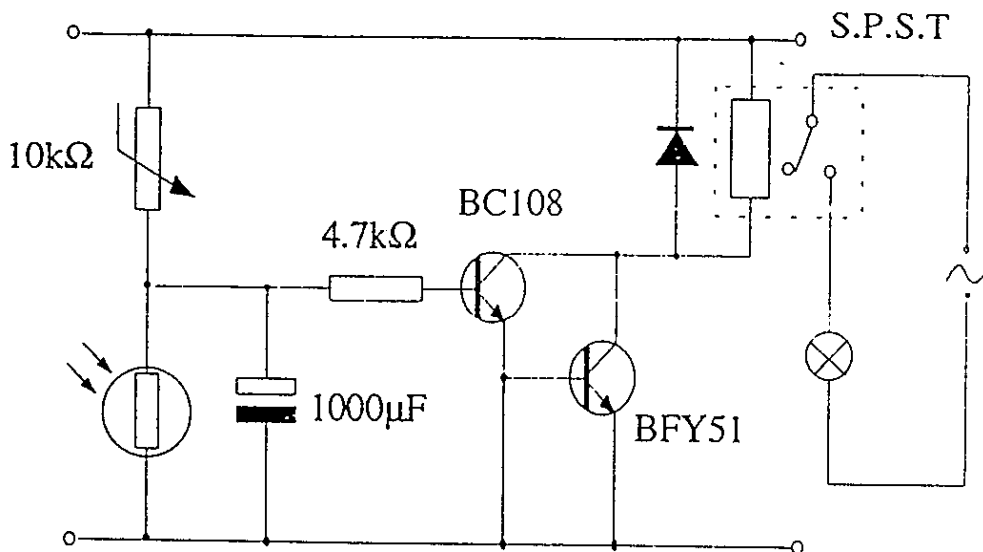


(p) Distinguish between a normally open (NO) and a normally closed (NC) type of relay.

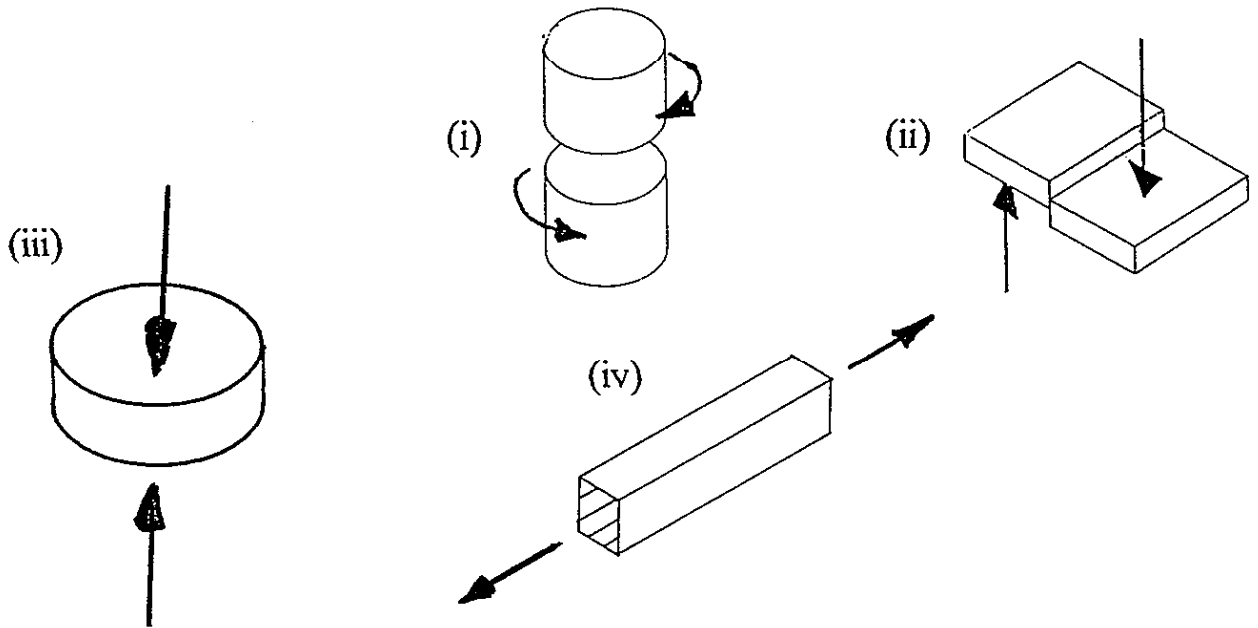
(q) Using the diagrams given below, distinguish between a double pole double throw (DPDT) and a single pole double throw (SPDT) relay.



(r) The circuit diagram shows a relay controlled mains lamp. Outline the operation of the circuit and describe the purpose of the diode positioned near the relay.

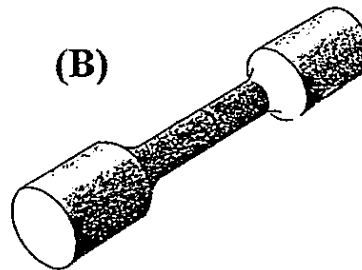
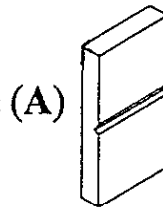


(a) Distinguish clearly between the following forces:



(b) Two common test specimens are shown at A and B. Select one specimen and describe fully the test associated with it using the following guidelines:

- (i) Test name and purpose;
- (ii) Test procedure;
- (iii) Results.

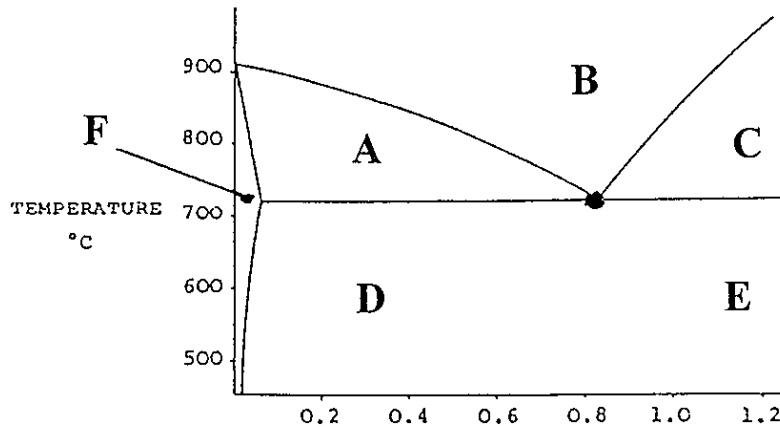


(c) Describe the principles of any two of the following non-destructive tests:

- (i) Ultrasonic;
- (ii) Magnetic;
- (iii) Radiographic.

In each case selected, state its suitability for the detection of internal or external faults.

- (a) (i) The diagram shows a simplified iron-carbon equilibrium diagram. Redraw the diagram into your answerbook and insert the names of the microstructures at A, B, C, D, E and F.

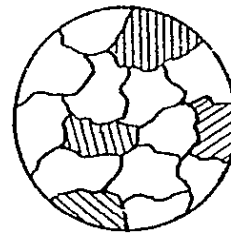


- (ii) Identify and explain the meaning of the *Eutectic* point.

- (b) The diagrams represent the microstructures of medium carbon steel (0.5%) when quenched rapidly from 870°C and slowly cooled from 870°C. Describe both structures and explain their differences.



(i)

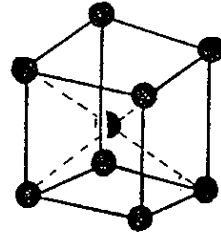
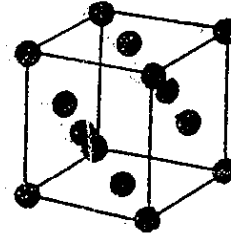
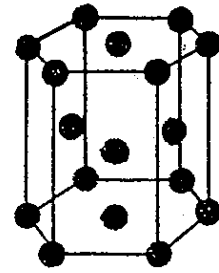


(ii)

- (c) Describe how high temperatures are measured in heat treatment furnaces.

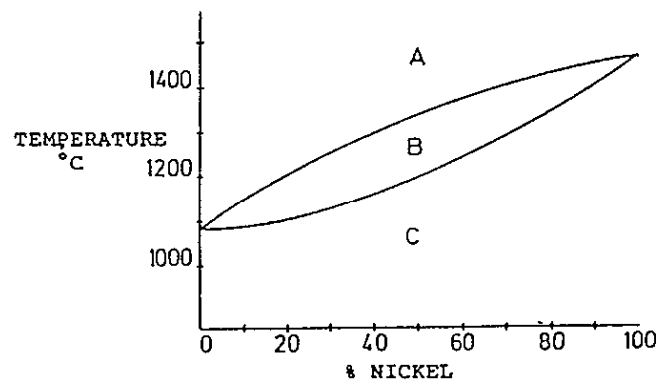
(a) Answer any three of the following:

- (i) Name the three unit cells represented.
- (ii) Which structure is most associated with brittleness in metals?
- (iii) Explain the term *allotropic*.
- (iv) Name a metal based on each structure, under normal conditions.
- (v) Distinguish between *crystalline* and *amorphous* structures.



(b) A thermal equilibrium diagram for a copper / nickel alloy system is shown.

- (i) Name the upper and lower curves and explain what the areas at A, B and C represent;
- (ii) With reference to the alloy containing 40% nickel, determine from the diagram the compositions of the phases at 1200°C.



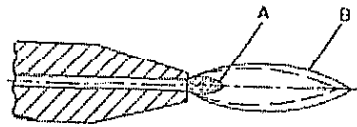
(c) Distinguish between a *substitutional* solid solution and an *interstitial* solid solution.

5.

(50 marks)

(a) Answer **one** of the following:

(i) Describe the two stage combustion in the neutral oxy-acetylene flame shown at A and B;



(ii) Differentiate between a carburising and an oxidising flame.

(b) Metal Inert Gas (MIG) welding is a common welding process. Describe the process using the following guidelines:

(i) Name and applications;

(ii) Main features and operation.

(c) Describe **any two** different ways of protecting welds from atmospheric contamination.

OR

(c) In relation to robotic control of welding, describe how robots are driven.

6.

(50 marks)

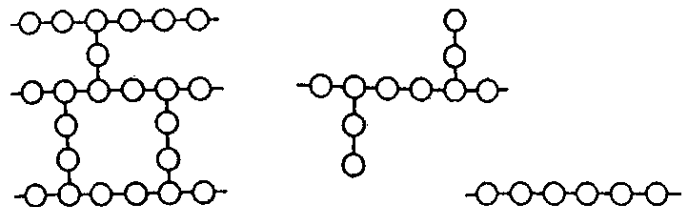
(a) Three polymer chain structures are shown. Describe these structures using the following guidelines:

(i) Name and characteristics;

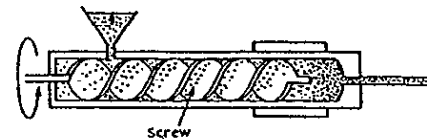
(ii) Properties and bond type;

(iii) Polymerisation type;

(iv) Examples of polymers with these structures.



(b) Describe the principles and main features of the moulding process shown diagrammatically.



(c) State the purpose of **any two** of the following in the production of polymers:

(i) Catalysts;

(ii) Promoters;

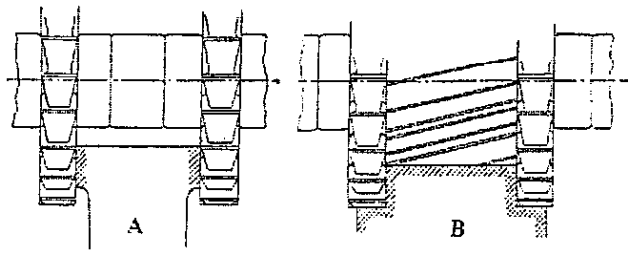
(iii) Inhibitors;

(iv) Fillers.

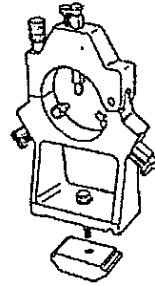
(a) Describe the positive effects of using cutting fluids on metal cutting operations.

(b) Answer **any two** of the following:

(i) Distinguish between the two milling operations shown at A and B;

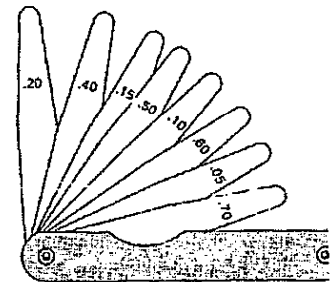
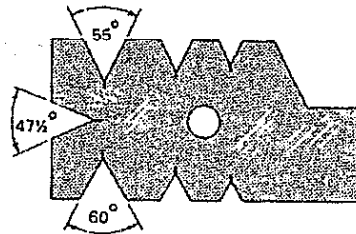
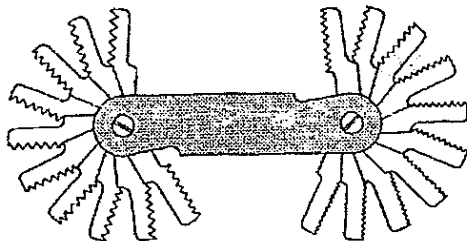


(ii) Outline a use for the lathe accessory shown.



(iii) Explain the terms *loading* and *glazing* of a grinding wheel.

(c) Select **any two** gauges shown and describe their use.

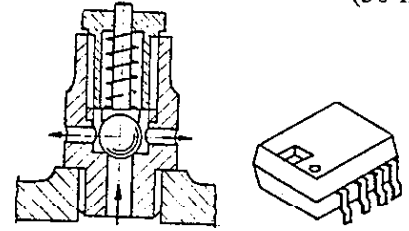


OR

(c) With reference to a CNC lathe, explain **any three** of the following terms:

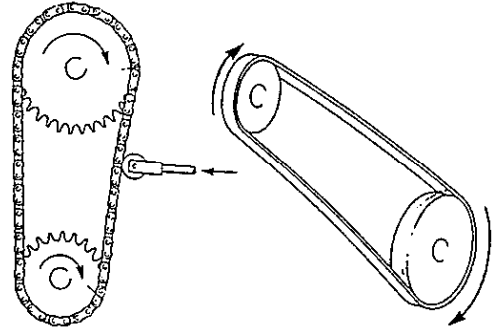
- (i) Canned cycle;
- (ii) Stepper motor;
- (iii) X-axis;
- (iv) Z-axis;
- (v) G codes.

- (a) Explain the function and suggest an application of any one item shown opposite.

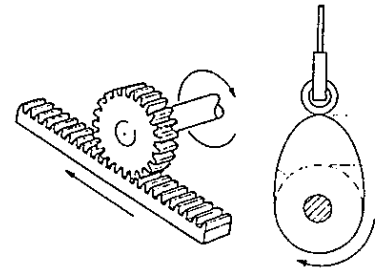


- (b) Answer any two of the following:

- (i) Compare the two drive mechanisms shown, identifying the advantages and disadvantages of both systems.

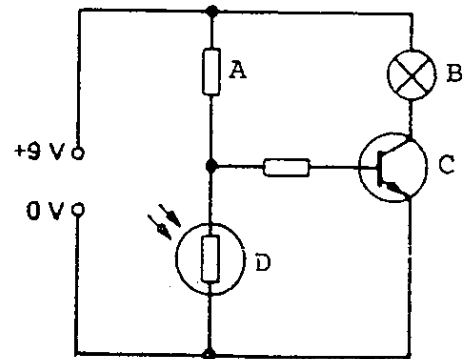


- (ii) The two mechanical devices may cause a similar change of motion to occur, state the type of motion that occurs. Suggest an application for each device.



- (iii) State the energy conversion that occurs in both an electric motor and a car battery.

- (c) Identify the electronic components marked at A, B, C and D. Outline an application of the circuit.



OR

- (c) Describe how drilling speeds can be varied on a V-belt drive. Describe how maximum and minimum speed is achieved.

