BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **MME 323** (Physical Properties of Materials)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Draw the energy band diagrams of a pnp BJT in both the active and the saturation mode. **(20)**

   (b) Draw the minority carrier concentration profile across the Emitter, Base and Collector of a npn transistor in the cut off, saturation, and inverted mode. **(15)**

2. (a) Explain the operation of a Schottky and ohmic contact by drawing appropriate energy band diagrams. **(20)**

   (b) Would it be helpful to use a low bandgap semiconductor as a channel material in a MOSFET device? Justify your answer. **(10)**

   (c) What do you understand by accidental degeneracy? **(5)**

3. (a) Calculate the saturation magnetization for Fe_3O_4 given that it has an inverse spinel crystal structure. The unit cell edge length is 0.839 nm. **(15)**

   (b) Design a cubic mixed-ferrite magnetic material by doping Fe_3O_4 such that the saturation magnetization of the material is 4.5×10^5 A/m. **(20)**

4. (a) What causes the existence of a channel in a MOSFET in the absence of an applied gate voltage? Draw energy band diagrams to explain your answer if necessary. **(12)**

   (b) What do you understand by quantum mechanical tunneling? Explain the operation of a tunnel diode with the help of necessary diagrams. **(18)**

   (c) Explain degenerate doping with the help of band diagrams. **(5)**

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Derive a relationship between the relative permeability (μ_r) and the magnetic susceptibility (χ_m). **(12)**

(b) Discuss the effect of temperature on the saturation magnetization for ferromagnetic materials. **(10)**

(c) Briefly describe the phenomenon of magnetic hysteresis and also explain why it occurs for ferromagnetic and ferrimagnetic materials. **(13)**

6. (a) Describe with illustration, the BCS theory of superconductivity in terms of electron-phonon interaction. **(17)**

(b) Briefly describe the Meissner effect. Also cite the difference between type I and type II superconductors. **(18)**

7. (a) What do you understand by absorption, spontaneous emission, stimulated emission, and population inversion? Use illustrations to describe each term. **(10)**

(b) With the help of illustrations, describe the different stages of the working principle of a solid state Ruby laser. **(10)**

(c) Describe two-level and three-level laser systems and explain which system is more efficient. **(15)**

8. (a) Derive expressions for the conductivity of intrinsic and extrinsic semiconductors. **(15)**

(b) Calculate the conductivity of intrinsic silicon, for which, at room temperature $\eta_i = 1.6 \times 10^{16} m^{-3}$; $\mu_e = 0.14\, m^2\, v^{-1} s^{-1}$ and $\mu_n = 0.05\, m^2\, v^{-1} s^{-1}$. Assume any missing data. **(10)**

(c) Evaluate the mean free path in copper for which Fermi energy is 7.0 eV, given $\tau = 2.4 \times 10^{-14} s$. Assume any missing data. **(10)**

L-4/T-1/MME **Date : 07/07/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **MME 411** (Principles of Materials Characterization)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Show schematically the effects of lattice strain on the position and width of a diffraction peak. (13)

   (b) Draw and discuss the typical XRD patterns of a single crystal, an amorphous solid and a monatomic gas. (12)

   (c) Discuss the phenomenon of absorption edge of a solid. (10)

2. (a) Discuss the functions of an interferometer in FTIR with suitable diagram. (18)

   (b) Mention the application of FTIR spectroscopy. (7)

   (c) How can you differentiate the FTIR peaks of O-H bond from N-H bond? Explain with suitable diagrams. (10)

3. (a) Describe the chemical ionization process of a mass spectrometer with typical examples. (10)

   (b) Prove that a cylindrical energy analyzer (CEA) can not work as a mass analyzer. (11)

   (c) Derive a formula for a circular path of an ion in a magnetic mass analyzer. (14)

4. (a) In Roman spectroscopy, explain the effects of wavelength of laser light source on the signal intensity using suitable diagram. (10)

   (b) Differentiate between atomic absorption and atomic emission in terms of signal intensity and also discuss the reasons(s) behind. (10)

   (c) Explain the working principle of a photo multiplier detector in UV-Vis spectroscopy. (15)

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) How would you obtain SEM images with the best resolution by adjusting operational parameters. (10)

   (b) Discuss the interaction between incident beam of SEM and specimen. (15)

   (c) Explain how compositional image of a specimen is found in SFM. (10)

6. (a) Compare and contrast the energy dispersive X-ray spectroscopy (EDS) and the wavelength dispersive spectroscopy (WDS). What change in EDS spectrum would you expect when a specimen is tilted to the face of the detector of SEM? (13)

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(b)"The specimen preparation for Transmission Electron Microscopy (TEM) is a tedious task". Explain. (10)

(c) Explain how defects of a specimen are identified by using bright-field (BF) and dark-field (DF) imaging of TEM. (12)

7. (a) What type of thermal events occur in a material during heating and cooling? List the similarities and differences between DTA and DSC. (14)

(b) Show the glass transition temperature , recrystalization temperature and melting temperature from a typical DSC spectrum. (9)

(c) Determine a binary phase diagram from DTA spectra. (12)

8. (a) Explain the main features of a TG curve with the help of an appropriate example. What are the major differences between TGA and DTA? (13)

(b) List the name of non-destructive testing (NDT) techniques that are used for the detection of surface defects and internal defects of components. (7)

(c) Explain how internal cracks of a non-ferrous component are identified by a suitable NDT technique. (15)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **MME 443** (Physical Metallurgy of Steels and Heat-treatment)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What is meant by the term 'thermo-mechanical treatment of steels'? (7)

   (b) Explain how grain size is controlled during controlled rolling of high-strength, low-alloy steels. (15)

   (c) Distinguish between 'ausforming' and 'isoforming'. Mentioin the effect of composition of steel on ausforming. (13)

2. (a) What is the purpose of surface hardening? Mention the principal methods of surface hardening. (5)

   (b) Describe briefly how a mild steel shaft is carburized by the process of pack carburization. Discuss the factors that control the flow of carbon from the surface to the interior of the shaft during carburization. (20)

   (c) Suggest a suitable heat-treatment process with a neat sketch for the pack carburized shaft. Explain the process with detailed microstructural changes and hardness. (10)

3. (a) Distinguish between nitriding and carbonitriding. Mention the advantages and limitations of each. (10)

   (b) With reference to the iron-nitrogen equilibrium diagram explain how a nitrided case is formed. (20)

   (c) Indicate the effect of carbon, aluminium, chromium and molybdenum on the hardness and the depth of the nirided case. (5)

4. Answer any two of the following: $(17\frac{1}{2} \times 2 = 35)$

   (a) Classify and discuss morphologies of ferrite proposed by Dibe when austenite/ferrite transformation temperature is lowered for plain carbon steels. Discuss the structure-property relationship of plain low carbon – manganese steels.

   (b) How does a ferritic malleable cast iron differ from a pearlitic malleable cast iron? Discuss with a typical heat-treatment cycle how a ferritic malleable cast iron is produced from white cast iron. Show the microstructural changes in different stages of the heat-treatment cycle.

   (c) Mention the different types of heat-treatment that are generally applied to ductile cast iron. Describe them briefly.

Contd P/2

MME 443

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) White is meant by hardenability? How can hardenability of a steel be increased? (10)
   (b) "Hardening a high carbon steel part by quenching is almost, always immediately followed by tempering" – why? (5)
   (c) Mention the effect of tempering temperature on the hardness, toughness and microstructure of a quenched high carbon steel part. (20)

6. (a) Explain solid solution strengthening by interstitial and substitutional atoms. (25)
   (b) What will be the nature of the residual stresses after hardening of high carbon steel? (10)

7. (a) What do you understand by austempering? What are the principal advantages of austempering compared with the conventional quench and temper method? (17)
   (b) Describe how an isothermal-transformation (I-T) diagram is determined experimentally? (18)

8. (a) Define actual cooling rate. What factors influence the actual cooling rate? Explain. (23)
   (b) How is the actual cooling rate determined? (12)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **MME 475** (Polymer and Composites)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **EIGHT** questions in this section. Answer any **SIX**.

The questions are of equal value.

1. Discuss various mechanisms to improve the toughness of ceramic matrix composites.

2. Options for the development of ceramic matrix Composites by self-reinforcement are limited – why? Briefly discuss the working principle of infrared burner.

3. Mention two supper conducting metal matrix composites and discuss their production processes in details.

4. In the case of selection of reinforcing materials for composites, it is wise to seek light weight materials having a high density of covalent and directional bonds, rather than a very high level of strength only.

5. What types of polymeric filler materials should be selected for composites and why? Discuss in details.

6. What do you understand by the term "Critical fiber length" in composite materials? Discuss the importance of critical fiber length on the load bearing capacity of composite materials.

7. Define discontinuous aligned fiber in composite materials. For loading in transverse direction of continuous fiber reinforced composites, derive the following relationship.

$$E_{ct} = \frac{E_m E_f}{(1-V_f)E_f + V_f E_m}$$

All symbols have their usual meanings.

8. Write short notes on the following for polymer matrix composite production.
   (a) prepreg system
   (b) pultrusion technique

Contd P/2

MME 475

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

9. (a) Outline the main features of injection molding process with an aid of a schematic diagram. (17)

   (b) Describe the fabrication process suitable for plastic film production. (18)

10. (a) Differentiate between (i) block copolymer and graft copolymer, (ii) branched polymer and crosslinked polymer and (iii) syndiotactic polymer and atactic polymer. (8+8+8)

    (b) "Glass transition temperature is important during in-service applications of polymer" – explain. (6)

    (c) The density for two polytetrafluorothylene materials are 2.144 g/cm^3 and 2.215 g/cm^3 respectively, while the associated percent crystallinity of those materials are 51.3 and 74.2 respectively. Calculate the density of totally crystalline polytetrafluorothylene material. (5)

11. (a) Compare and contrast thermoplastic polymer with thermoset polymer. (17)

    (b) Explain the importance of crazing in polymer. (10)

    (c) Mention four roles of additives in plastics. (8)

12. (a) Sketch and describe different stages of deformation corresponding to a semicrystalline polymer. (25)

    (b) Define vulcanization. Behaviour of vulcanized rubber is different from that of unvulcanized rubber – Explain. (2+8=10)

L-4/T-1/MME **Date : 09/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **IPE 491** (Engineering Management)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Briefly discuss the factors that need to be considered in selecting a forecasting model. (6)

(b) For Product B, forecasting including trend for the month of August was 1040 units including trend effect of 40 units. But actual demand turned out to be 1240 units. Determine the forecast including trend for the month of September. The values of α and δ are .70 and /30 respectively. (9)

(c) Sales data of different quarters for years 2012 to 2014 are given below: (20)

Year 2012	Sales	Year 2013	Sales	Year 2014	Sales
1st Quarter	780	1st Quarter	880	1st Quarter	1000
2nd Quarter	440	2nd Quarter	520	2nd Quarter	620
3rd Quarter	1260	3rd Quarter	1500	3rd Quarter	1750
4th Quarter	600	4th Quarter	750	4th Quarter	860

Forecast sales for each quarter of 2015 using linear regression technique.

2. (a) Define different types of inventory costs. (6)

(b) Determine the economic order quantity, re-order point and inventory cost for the following information:

Weekly demand for 7 consecutive weeks = 8400, 7800, 8550, 7600, 8400, 7550, 8200; Lead time = 12 days; Ordering cost = Tk. 300 for 5 order; Holding cost =1.5% of the purchase price per quarter, Purchase price = Tk. 70 per unit. (15)

(c) Mention the assumptions of the fixed order quantity model. Show that

$$Q_{opt} = \sqrt{\left(\frac{2DS}{H}\right)}$$ (6+8=14)

3. (a) Define a work center. Mention the major shop floor control functions. (3+6=9)

(b) A company has three manufacturing plants (MPs) where it produces different parts and 2 distribution centers (DCs). The company wants to build an assembly plant (AP). Parts produced in MPs will be assembled in the assembly plant and then will be delivered to the DCs. The existing locations of the MPs and DCs and the amount that will be transferred between MPs and DCs with the assembly plant are given below: (11)

Contd P/2

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Contd ... Q. No. 3(a)

Facility	X Co-ordinate	Y Co-ordinate	Amount (Truck Load)
MP 1	400	240	700
MP 2	670	120	600
MP 3	340	350	400
DC 1	560	780	1000
DC 2	780	620	700

** Per unit cost to transport from the MPs to AP is Tk. 8000 and from AP to DCs is Tk. 10000.

Determine the location of the assembly plant.

(c) Determine the sequence of jobs, total time required to complete all jobs in both machines, and idle time of machine 2 for the following information. (15)

Jobs	Processing Time on Machine 1 (weeks)	Processing Time on Machine 2 (weeks)
A	9	12
B	2	6
C	3	4
D	8	13
E	15	7
F	4	9
G	10	11
H	3	1

4. (a) Discuss factor rating system of location selection. (8)

(b) Explain different types of capital budgeting decisions in business organizations. What factors need to be considered regarding capital budgeting decisions? (5+9=14)

(c) Determine the average flow times and average delay times using shortest processing time and earliest due date rule for the following data. Jobs have arrived according to the given sequence. (13)

Jobs	Processing Time (Weeks)	Due Date (Weeks)
A	5	10
B	7	9
C	3	8
D	2	6
E	8	15
F	10	12

Contd P/3

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SECTION-B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are different managerial levels? Discuss the differences between functional and general managers. (15)

   (b) Who is considered as the founder of 'Classical Management School? Discuss this principles of management. (20)

6. (a) What is Hawthorne experiment? Describe the experiment and the insights obtained from it. (12)

   (b) Discuss the issues that we have to consider while selecting the location for setting up a new facility. (23)

7. (a) Discuss ERG theory of motivation. What are the difference between ERG and Maslow's need theory? (10)

   (b) Discuss the contribution and limitations of scientific management theory. (10)

   (c) There are two alternative business proposals. Proposal A requires an initial Investment of $44000, whereas Proposal B requires $60000. The prospective annual incomes from the alternative proposal from the year after investment are as follows: (15)

Year	Proposal A	Proposal B
1	18	35
2	24	15
3	16	20
4	16	15
5	14	12

   If the interest rate is 12%, then determine which proposal is better in terms of Present worth.

8. (a) Discuss equity theory with appropriate examples. (12)

   (b) Describe the following terms: (8)

   i. Forward scheduling

   ii. Infinite loading

   iii. Cost of capital

   iv. Internal rate of return

   (c) Seven jobs must be processed in two operations: A and B. All seven jobs must go through A and B in that sequence – A first, then B. Using the times below, determine the optimal order in which the jobs should be sequenced through the two processes. Also draw the optimum schedule with time indication. (15)

Contd P/4

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Job	Process A	Process B
1	9	6
2	8	5
3	7	7
4	6	3
5	1	2
6	2	6
7	4	7