BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **IPE 483** (Production Planning and Control)

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**.

Assume reasonable values for any missing data.

1. (a) Derive the economic order quality (EOQ) model. **(10)**

   (b) A company makes bicycles. It produces 450 bicycles a month. It buys the tires for bicycles from a supplier at a cost of $20 per tire. The company's inventory carrying cost is estimated to be 15% of material cost and the ordering is $50 per order. **(15)**

   Find

   (i) The EOQ;

   (ii) The number of orders per year;

   (iii) The average annual ordering cost;

   (iv) The average annual carrying cost; and

   (v) The cycle length in days.

   (c) How can a manager apply the North-West Corner Rule method in production planning and control? Explain it with an example. **(10)**

2. (a) Jobs A, B, C, D, E are to be processed on two machines - Machine 1 and Machine 2. The processing time, given in hours, of each job on each machine is as follows. **(20)**

Jobs	Machine 1	Machine 2
A	4	2
B	3	5
C	5	1
D	7	3
E	8	6

   Required:

   (i) Using Johnson's algorithm, find the order of the jobs.

   (ii) How many hours will it take to finish all the jobs?

   (iii) How many hours is Machine 1 idle?

   (iv) How many hours is Machine 2 idle?

   (b) ABC company assembles three types of toys, namely trains, trucks, and cars, using three operations. The daily limits on the available times for the three operations are 430, 460 and 420 minutes, respectively, and the revenues per unit of toy train, truck, and car are 3, 2 and 5 dollars, respectively. The assembly times per train at the three operations are 1, 3 and 1 minutes, respectively.

Contd P/2

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Contd ... Q. No. 2(b)

The corresponding times per train and per car are (2,4,0) and (1,2,0) minutes (a zero time indicates that the operation is not used). The company wants to analyze and maximize the profits of this product mix scenario using linear programming (LP) technique. Formulate the associated LP model for this problem. If we want to solve the problem using simplex method, what would be the initial simplex tableau? **(15)**

3. (a) The production scheduler for BUET Machine Tools Laboratory has six jobs ready to be processed that can each be assigned to any of six different workstations. Due to the characteristics of each job and the different equipment an skills at the workstations, the time to complete a job depends on the station it is assigned to. The following is data on the jobs and the time it would take to do each job at each workstation. Assign each job to a machine in order to minimize total processing time. **(20)**

	Job Completion Time at Workstation (hours)					
Job	1	2	3	4	5	6
A	3.2	3.5	2.9	3	4	3.6
B	2.7	2.9	2.3	3	3.1	3.7
C	3.8	4	4.3	4.5	4.1	3.6
D	2.8	2.1	2.9	2.5	3	2.2
E	6.1	6.5	6.7	7	6	6.2
F	1.5	1.3	1.9	2.9	4	3.6

(b) A retailer sells various types of gift items on special occasion such as Pahela Baishakh, Pahela Falgun and so on. For Pahela Baishakh 2019, he wants to purchase various gift items. The purchasing price of such a gift item, say product X, is $10 and the selling price of the item is $30. After the Pahela Baishakh, any unsold unit of the item will be salvaged at $5. Product X has the following demand information. Using the given information, perform marginal analysis for the product. How many units of product X should he purchase for Pahela Baishakh 2019 to maximize his expected frofit? **(15)**

Demand (in units)	Probability
100	0.10
200	0.15
300	0.15
400	0.20
500	0.15
600	0.15
700	0.10

4. (a) Consider the following two bill of materials (BOM). Generate a material requirement planning (MRP) table for part 300. The required information is given following the BOM: **(25)**

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Contd ... Q. No. 4(a)

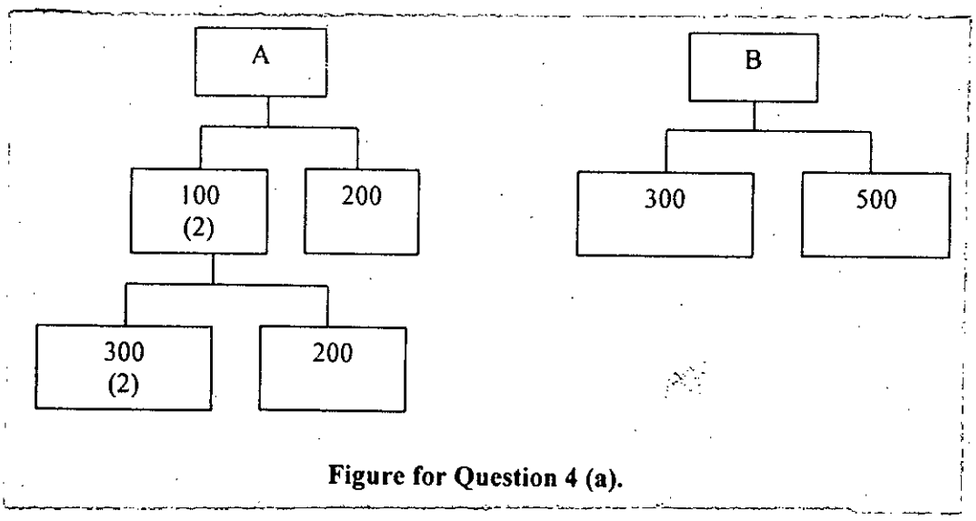

Figure for Question 4 (a).

-Master production schedule (MRS) for Part A

Part A	1	2	3	4	5	6	7	8
Gross requirements	15	20	50	10	30	30	30	30

-Master production schedule (MRS) for Part B

t	1	2	3	4	5	6	7	8
Demand	10	15	10	20	20	15	15	15

Inventory data, scheduled receipts, and other information for Part A are given below.

-On hand inventory is 20 units.

- A scheduled receipt of 10 units was due in week 1, but it needs to be deferred for one week. Another scheduled receipt of 100 units was due in week 4, but it needs to be expedited by one week.

-Lot-sizing rule is fixed order period (FOP) of the weeks.

-Lead time is 2 weeks.

Inventory and part data for Part B, 100, 300, and 500 are as follows.

Part Number	Current On-Hand	SRs		Lot-Sizing Rule	Lead Time
		Due	Quanity		
B	40	0		FOP, 2 weeks	2 weeks
100	40	0		Lot-for-lot	2 weeks
300	50	2	100	Lot-for-lot	1 week
500	40	0		Lot-for-lot	4 weeks

(b) How can you distinguish MRP II and ERP? Mention some benefits and drawbacks of an ERP system. **(10)**

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SECTION – B

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

5. (a) Write short note on 'Project Crashing'. **(8)**

(b) Determine project completion time, critical path of the project, and slack time for each non critical activity for the following information: **(22)**

Activity	Immediate Predecessor	Time (Weeks)
A	None	6
B	None	7
C	A,B	8
D	A,B	6
E	A,B	9
F	C,D	6
G	D,E	3
H	F	7
I	G	9
J	A,B	20
K	H,J	5
L	I,J	4
M	K,L	7
N	K,L	6
O	K,L	7
P	M,N	6
Q	N,O	4

(c) Explain the significance of strategic capacity planning in managing operations. **(5)**

6. (a) Explain the following concepts of lean supply chain: **(3×4=12)**

(i) Lean suppliers, (ii) Lean manufacturing, (iii) Lean logistics.

(b) Briefly describe 'lean layout' principles for developing lean supply chain. **(14)**

(c) How can value stream mapping help in increasing productivity of a system? **(9)**

7. (a) Explain any 4 important factors associated with location selection for constructing a warehouse facility for a retail super store brand. **(12)**

(b) 'B' corporation has a one year contract to supply motors for all washing machines produced by 'A' Ltd. 'A' manufactures washing machines at 4 locations around the country: DHK, CHT, SYT and RAJ. Plans call for the following numbers of washing machines to be produced at each location: **(15)**

Contd P/5

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Contd ... Q. No. 7(b)

Location	Quantity
DHK	50,000
CHT	70,000
SYT	60,000
RAJ	80,000

'B' corporation has three plants that can produce the motors. The plants and production capacities are:

Location	Quantity
BOU	100,000
MAC	100,000
GAR	150,000

Due to varying transportation and production costs, the profit 'B' earns on each 1,000 units depends on where they are produced and where they were shipped. The following table gives the accounting department estimates of the dollar profit per unit (shipment will be made in lots of 1000)

	Shipped To			
Produced At	DHK	CHT	SYT	RAJ
BOU	7	11	8	13
MAC	20	17	12	10
GAR	8	18	13	16

Given profit maximization as a criterion, 'B' would like to determine how many motors to produce at each plant and how many motors should be shipped from each plant to each destination. Construct this problem as a transportation problem.

(c) Briefly explain factor rating system for location selection. **(8)**

8. (a) Define different components of demand with appropriate example. **(10)**

(b) Quarterly demand of a product from 2016 to 2018 is given below. Predict quarterly demand of that product for the year 2019 using appropriate technique. **(16)**

2016	Demand	2017	Demand	2018	Demand
1st Quarter	620	1st Quarter	1070	1st Quarter	1750
2nd Quarter	700	2nd Quarter	1280	2nd Quarter	1600
3rd Quarter	830	3rd Quarter	1230	3rd Quarter	1810
4th Quarter	1040	4th Quarter	1720	4th Quarter	2350

(c) Mention the benefits and limitations of using past trend in predicting future demand. Mention some benefits of exponential smoothing technique of forecasting. **(9)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **MME 445** (Metallic Alloys and Material Selection)

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) 'Iteration, looping back to explore alternatives, is an essential part of the design process.' – Explain the assertion. **(11)**

(b) The body of a precision instrument can be modelled as a beam with length L, second moment of area I, and mass per unit length m_0. It is made of a material with density ρ and Young's modulus E. For the instrument to have highest possible accuracy, it is desired to maximize the first natural frequency of vibration, which is given by the equation: **(10)**

$$f = \frac{C_2}{2\pi}\sqrt{\frac{EI}{m_0 L^4}}$$

where, C_2 is a constant. If the beam has a square cross section $b \times b$, where the value of b is free to be selected by the designer, and the stiffness S is fixed by the design, determine the material index that will maximise performance of the instrument.

(c) What are materials properly charts? Explain the uses of these charts. **(7)**

(d) 'Long, thin bubbles are observed for metals in strength vs. density material property chart.' – Discuss the underlining physics behind this. **(7)**

2. (a) 'Polymers are not suitable for load limited designs as their fracture toughness (K_{IC}) varies from 0.5 to 3 whereas polymers are preferred when the design is displacement limited.' Explain this with the concept of material index by using materials property chart (Fig.-1). [Attach Fig.-1 with the answer]. **(15)**

(b) A material for eyeglass lenses must have optical-quality transparency. The lens may be moulded or ground with precision to the required prescription. It must resist sweat and be sufficiently scratch-resistant to cope with normal handling. The mass market end of the eyeglass business is very competitive so price is an issue. Translate these requirements into a prescription of Function, Constraints, Objectives and Free variables. **(5)**

(c) Using car windshield as example, discuss the strategy for materials selection. **(15)**

Contd P/2

MME 445

3. (a) 'Shape factor depends on shape, not on scale,' – justify the assertion with appropriate example. **(8)**

(b) Derive the expression for the shape-efficiency factor ϕ_B^f for strength-limited design for a beam loaded in bending with each of the three sections in Figure 2. Do not assume that the thin-wall approximation is valid. **(15)**

(i) a closed circular tube of outer radius $5t$ and wall thickness t,

(ii) the channel section of thickness t, overall flange width $5t$ and overall depth $10t$, bent about its major axis; and

(iii) a box section of wall thickness t, and height and width $h_I = 10t$.

(c) Calculate the gain in bending efficiency , ψ_B^e, when a solid is formed into small, thin-walled tubes of radius r and wall thickness t that are then assembled and bonded into a large array, part of which is shown in the Figure 3. Let the solid of which the tubes are made have modulus E_s and density ρ_s. Express the result in terms of r and t. **(12)**

4. (a) In strength-limited applications, deflection is acceptable provided the component does not fail; strength is the active constraint. Derive the material index for selecting materials for a shaped beam (Fig.-4) of length L, specified strength and minimum cost. **(10)**

(b) The best choice of material for a light strong column depends on its aspect ratio (the ratio of its height H to its diameter D) (Fig.-5). This is because short, fat columns fail by crushing; tall slender columns buckle instead. Derive two performance equations for the material cost of a column of solid circular section and specified height H, designed to support a load F large compared to its self-load, one using the constraints that the column must not crush, the other that it must not buckle. The table below summarizes the needs: **(25)**

Function	Column
Constraints	Must not fail by compressive crushing Must not buckle Height H and compressive load F specified
Objective	Minimize materials cost C
Free variables	Diameter D Choice of material

(i) Data for four possible candidates for the column are listed below. Use these to identify the best candidate material when $F = 10^7$ N and H = 2 m.

Material	Density, ρ (kg/m^3)	Unit Cost, C_m (\$/kg)	Modulus, E (MPa)	Compressive Strength, σ_c (MPa)
Wood	700	0.50	10,000	25
Brick	2100	0.35	22,000	95
Poured concrete	2300	0.08	20,000	13
Structural steel	7850	0.40	210,000	300

(ii) Identify and plot coupling lines for selecting materials for a column with $F = 10^7$ N and H = 2 m in figure-6. Attach the figure with answer.

Contd P/3

MME 445

SECTION – B

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

5. (a) Bending dominated structures have high structural efficiency; stretch dominated structures have low – do you agree with this statement? Explain. **(10)**

   (b) Why are most copper-zinc alloys not age-hardenable? **(10)**

   (c) Compare aluminium and magnesium based alloys with regard to corrosion resistance. **(15)**

6. (a) How does Cu-Al-Ni alloy system recover previously defined shapes after being subjected to thermomechanical cycle? **(12)**

   (b) What changes in properties do you expect for high and low tempering temperature on tool steel? **(10)**

   (c) How does maraging steel attain high tensile strength? **(13)**

7. (a) How does ferromagnetic hybrids exhibit superior properties compared to monolithic ferromagnetic materials? **(10)**

   (b) What outstanding properties do aluminium-silicon alloys have? Give some typical applications. **(10)**

   (c) Name one commonly used titanium alloy for aerospace application. Explain why the two phase titanium alloys are stronger than the single phase alpha alloys. **(15)**

8. (a) What are the carbide phases present in stainless steel? What role do these phases play regarding the mechanical properties of stainless steel? **(15)**

   (b) Which of the nickel-based alloys would you recommend for rocket engine? How does this alloy attain properties suitable for aforementioned application? **(10)**

   (c) Why is high-strength low-alloy steel termed as high-purity steel? How is this alloy an ideal choice for making automobile bodies? **(10)**

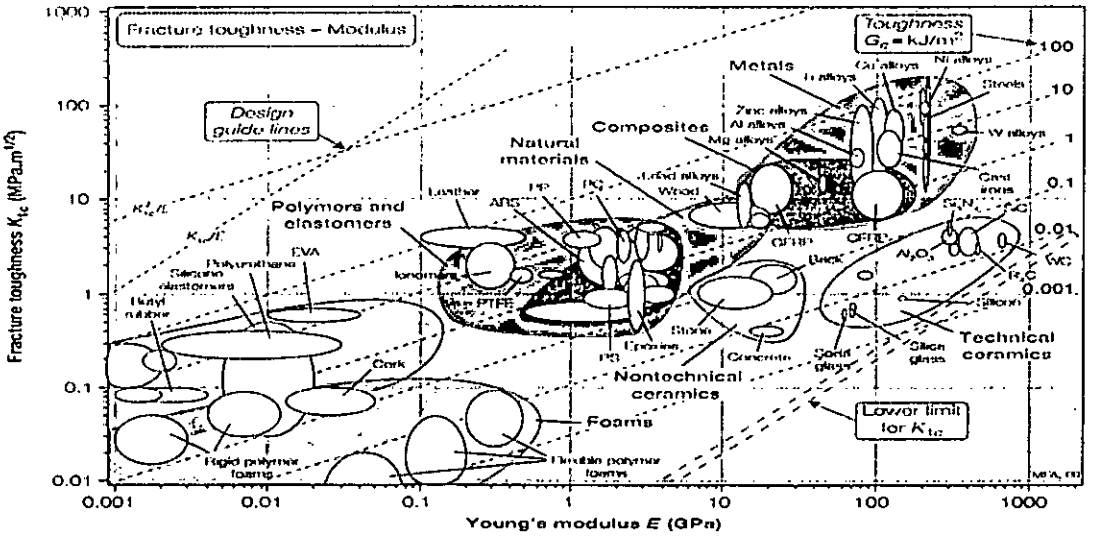

Figure-1 for Question 2(a)

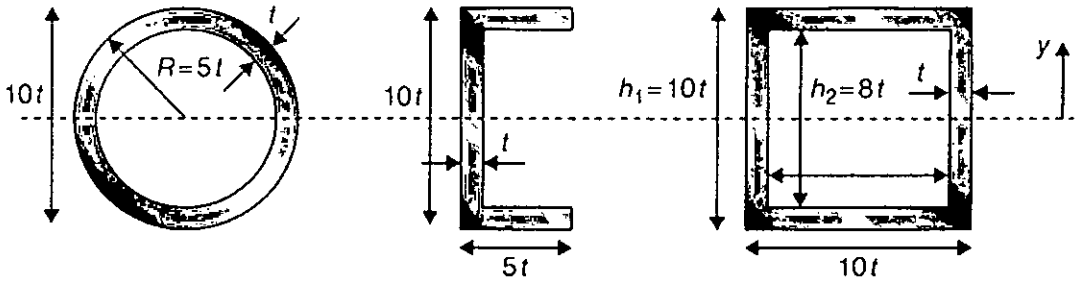

Figure-2 for Question 3(b)

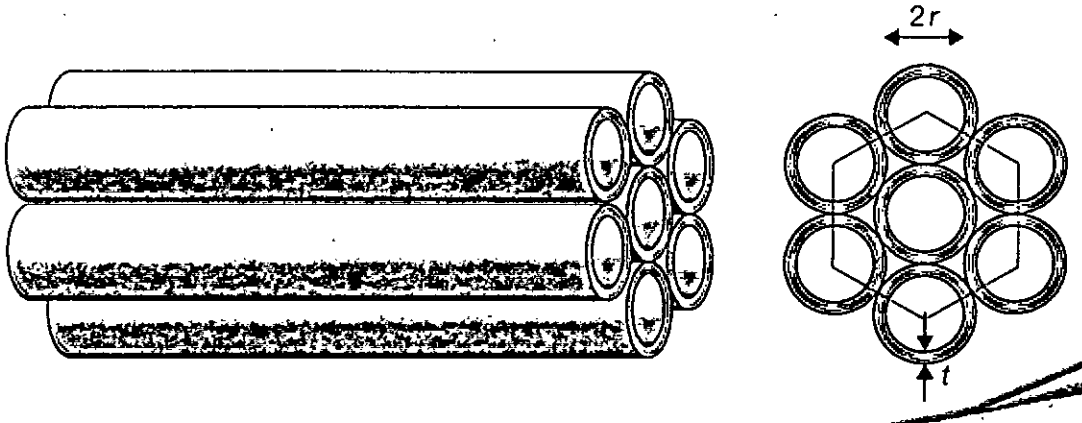

Figure-3 for Question 3(c)

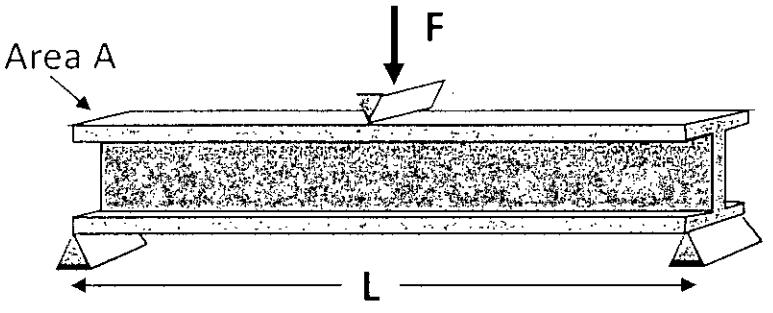

Figure-4 for Question 4(a)

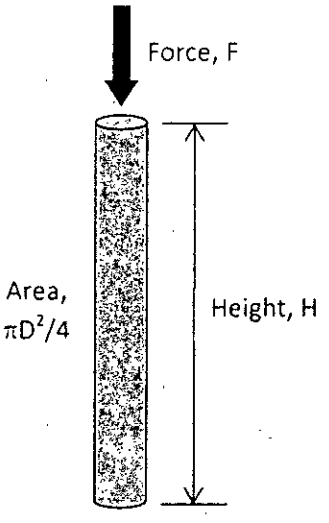

Figure-5 for Question 4(c)

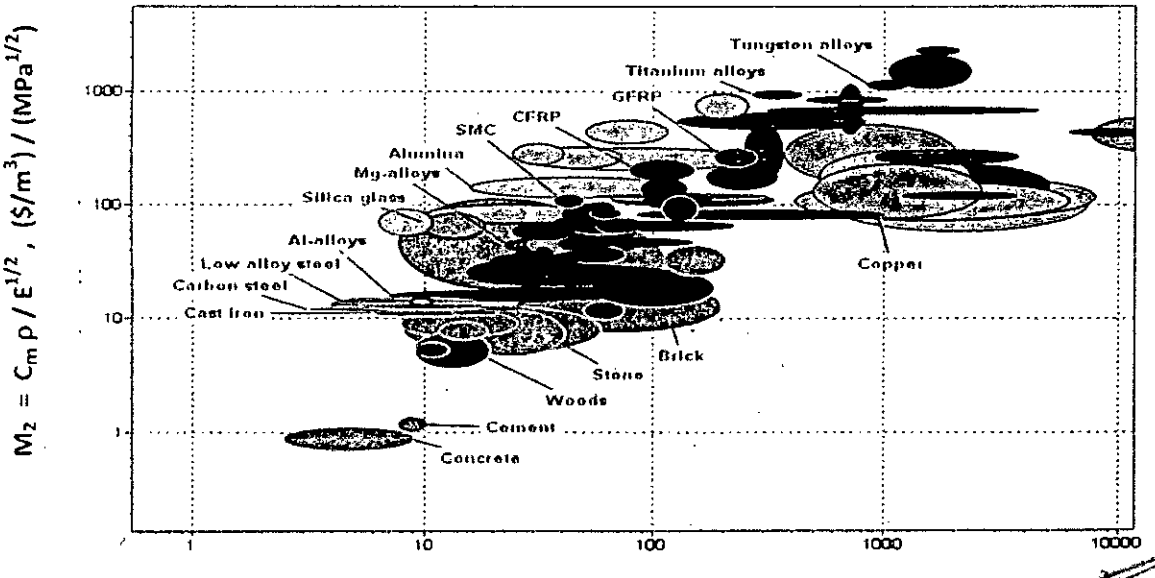

Figure-6 for Question 4(c)

L-4/T-2/MME **Date: 27/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **MME 467** (Ceramics for Advanced Applications)

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** questions.

1. (a) State and explain Pauling's rules for determining ceramic structures based on the packing of its ions. **(15)**

   (b) Discuss the main steps of sol-gel method. What are the basic differences between sol-gel and Pechini methods? **(12)**

   (c) Discuss the application of ceramics in automobile and aerospace industries. **(8)**

2. (a) Deduce an expression for the defect concentrations as a function of the equilibrium constant, thermodynamic parameters and temperature. Also explain how these concentrations are influenced by temperature. **(17)**

   (b) A non-stoichiometric oxide $Fe_{1-y}O$ has a lattice parameter of 429 pm and a density of 5.63 g/cm^3. Moreover, $Fe_{1-y}O$ has rock salt structure. **(10)**

   (i) What is the composition of the oxides? (ii) Calculate the density of defects (no. per unit volume). Assume any missing data.

   (c) Write the defect reactions: **(4+4=8)**

   (i) Incorporating Si into SiO_2 (ii) Incorporating MgO into Al_2O_3

3. (a) Explain the common structural features of a Fast Ion Conductor. **(12)**

   (b) Illustrate an effective way to improve the conductivity of insulator MgO. **(8)**

   (c) Using Fig. for Q. 3(c), calculate maximum polarization per cubic centimeter and total charge that can be stored per square centimeter for Barium Titanate ($BaTiO_3$) **(15)**

4. (a) Explain the effect of temperature and frequency of applied electric field on the dielectric constant of a material. **(10)**

   (b) Analyze the suitability of using ceramic materials for biological applications. List and discuss different types of bio-ceramics based on their chemical reactivity in the body. **(18)**

   (c) Mention two important applications of piezoelectric SiO_2 and pyroelectric $LaTiO_3$. **(7)**

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MME 467

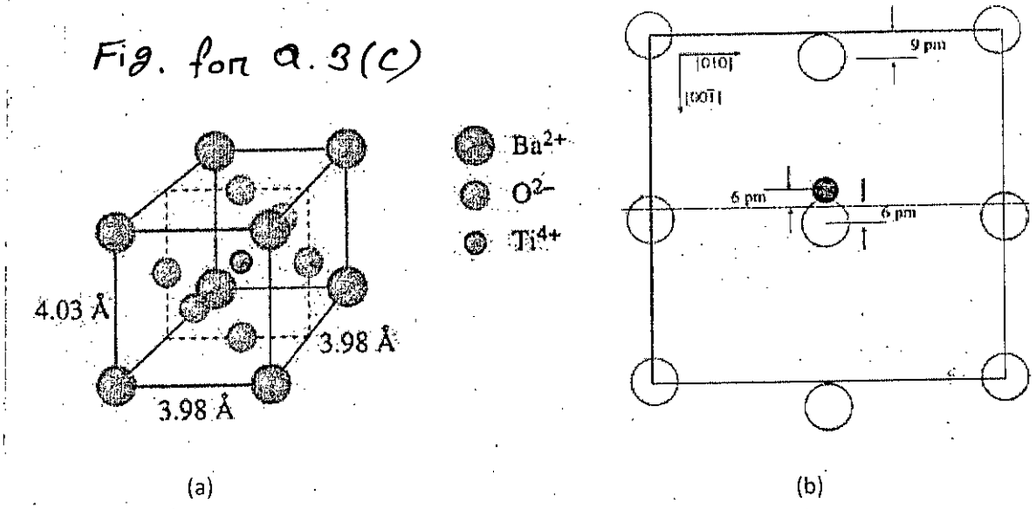

Figure : (a) In the tetragonal unit cell of $BaTiO_3$ the Ba ions occupy the unit cell corners, while Ti is near the center of the cell. The oxygens are near the centers of the faces. (b) Projection of the (100) face. Because the ions are displaced with respect to the symmetric position, the center of negative charge does not coincide with the center of positive charge, resulting in a net dipole moment per unit cell.

SECTION – B

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

5. (a) Explain the anomaly between theoretical and experimental magnetic moments of (1 –x) $NiFe_2O_4$ –x$Zn\ Fe_2O_4$; (x = 0.5-1) solid solution system. **(18)**

   (b) 'Meissner effect is responsible for Magnetic levitation' – Explain the assertion by taking magnetic levitated train as example. **(17)**

6. (a) Discuss the effect of porosity, pore shape and pore-crack combination on the strength of ceramic. **(15)**

   (b) Explain the transformation toughening mechanism of partially stabilized ZrO_2 with Y_2O_3. Mention the effect of elevated temperature and full stabilization with rate earth doping on transformation toughening of ZrO_2. **(20)**

7. (a) How do pre-stressing and crack-deflection contribute to strengthen ceramics? **(12)**

   (b) Explain the effect of viscosity and microstructure on creep of amorphous ceramic. **(12)**

   (c) What sort of information can be found form variable-stressing rate experiment of ceramics? **(11)**

Contd P/3

MME 467

8. (a) Give a brief account on ferrimagnetisms and anti-ferromagnetism with suitable example. **(10)**

(b) Discuss the factors that affect Weibull Modulus. **(13)**

(c) A series of tests on a ceramic component indicate that 20% of the samples fail at stresses below 207 MPa whereas only 8% fail at stresses below 198 MPa. Determine the Weibull modulus and the maximum allowable stress if only 1 failure per 1000 specimens can be tolerated. **(12)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **MME 447** (Industrial Metal Working Processes)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The questions are of equal value

SECTION – A

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

1. What are the possible practical consequences that forced us in selecting smaller diameter rolls in rolling mills? Discuss the limitations related to the use of smaller diameter rolls in rolling mills and suggest their remedies.

2. For the same rolling mill, the mill torque value in hot rolling is higher than that of cold rolling-why? A steel strip 185 mm wide, 2.5 mm thick is reduced 30% in a cold rolling mill with 650 mm diameter rolls having the coefficient of friction of the rolls to be 0.15. Note that the theoretical power required to run the mill at 200 rpm is 580 kN. Calculate the mean yield stress of the steel. Assume reasonable value for any missing data.

3. Explain the situation that leads to roll flattening. In a certain sheet rolling process various defects as shown in "Figure for Question No. 3" were observed. Discuss possible reasons of formation of these defects.

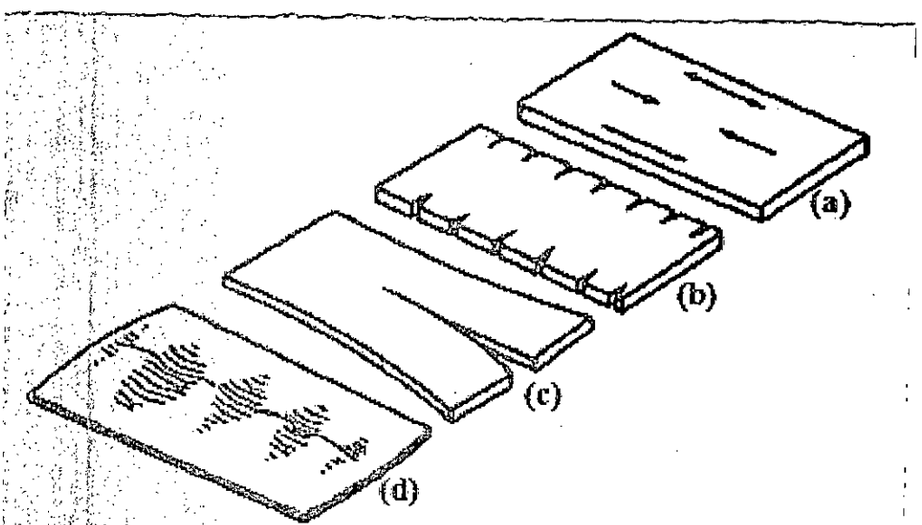

Figure for Question No.3.

4. What would be the impact of higher forward slip on the finished product? Calculate the rolling speed where a bloom of cross-sectional area 50000 mm^2 is rolled to 40000 mm^2 by rolls having working diameters 700 mm. Note that the rollers are very smooth and included angle at neutral point is 26°. Assume reasonable value for any missing data.

Contd P/2

MME 447

5. Outline the motivational factors that contributed to utilize the slitting technology in the case of industrial deformed bar production. What will be the possible increase in productivity if 5 slitting technology is used to replace the conventional one for producing 8 mm diameter deformed steel bar from a square billet (120×120 mm^2) of length 12 m? In conventional process the rolling speed is 10 m/sec, which is 8 m/sec for slitting process. Assume reasonable value for any missing data.

6. After finishing rolling a steel bar is air cooled on the cooling bed from just above its upper critical temperature and another one is water quenched in such a way that 20% tempered martensitic case is formed without having any distinctive transition zone. Given that the UTS/YS ratios for the air cooled and quenched bars are respectively 1.35 and 1.20. If both steel bars are produced from the similar billet compositions having 0.2% C what will be the grades of these two bars. Assume reasonable value for any missing data.

7. Compared to low carbon steel what are the sources of additional strength in cold drawn high carbon steel? What are the important factors to be controlled carefully in hot extrusion and why?

8. What is the unique behavior of TRIP steel in the case of heavily load bearing applications? Explain how carbon content in the retained austenite of the TRIP steel microstructures helps in performing this.

SECTION – B

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

9. Draw schematic stress-strain diagrams showing rigid behavior, linear elastic behavior and plastic behavior. Based on these diagrams, recommend a typical stress-strain behavior for metallic materials. Judge your answer.

10. As a materials engineer, you work in a plant where steels are hot-worked to make plates and pipes. The management is interested in increasing revenue by initiating cold-working processes. You have prepared two proposals for cold-working to manufacture sheet materials of thickness 0.01 mm. The major differences between the proposals are usage of two different FCC metallic materials- one has strain hardening exponent of 0.20 and the other has 0.44 at room temperature. Draw the corresponding engineering stress-strain diagrams for both materials. You have decided to finalize the proposal with the material having strain hardening exponent of 0.44. How effective is your choice?

Contd P/3

MME 447

11. During softening of a metallic material, drastic drop of hardness or strength is typically observed during high temperature recrystallization compared to low temperature recovery or medium temperature recovery and recrystallization. Using a hypothetical Hardness vs Time (log scale) plot, illustrate the trends for the above-mentioned three conditions during softening. With the help of microstructural features such as grains, sub-grains, dislocations, etc., explain the differences in the curves due to the differences in temperature during softening processes.

12. What is dynamic recrystallization? Name a structural material which is deformed in this method. What is the reason for obtaining a plateau in the flow curve of a material underwent dynamic recrystallization?

13. Briefly discuss forging features for magnesium alloys.

14. Draw a schematic diagram for upset forging and describe its working principles.

15. In deep drawing process, four different zones can be identified. Using a diagram for stress and strain states in various points of the cup during deep drawing, explain the reasons for development of these four zones.

16. What is superplastic forming? What's its industrial significance? Draw schematic diagrams for blow-forming and thermo-forming processes with proper labeling.
