BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210   Time: 3 Hours

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. In the case of rolling with smaller diameter rolls larger diameter back-up rolls are essential — why? Schematically show the thread rolling process and discuss its various advantages.

2. With neat sketches show the distribution of pulling-in and rejecting forces in a sheet rolling process. Discuss the effects of passive roll gap on these forces and the maximum angle of bite.

3. A piece of steel of 250 mm thick is rolled in a two high rolling mill having roll diameter of 500 mm where the maximum possible draft is 110 mm. When the roll radius was changed from 500 mm to 1.5 m the maximum draft of the rolling system increased by 80%. Find out the friction condition of the rolling system. Assume reasonable value for any missing data.

4. Diagrammatically show the possibility of controlling the roll flattening effect in flat rolling and also determine the yield stress of a copper plate (width 800 mm, thickness 75 mm, Young's modulus 1.01 MN/mm^2 and Poison's ratio 0.35) that changed the roll radius from 250 mm to 251.6 mm to reduce the plate thickness by 20%. Assume reasonable value for any missing data.

5. What do you understand by the term "mill modulus"? Discuss how this can affect the accuracy of gauge control of the rolled product.

6. The dimension of roll opening of the first stand of an intermediate rolling is 60×60 mm, where billet of 30000×100×100 mm enters after the final roughing stand at 1000°C. The roller is very smooth and included angle at neutral point is 20°. Other conditions are: working roll diameter = 700 mm, rotation of roller = 85 rpm, forward slip = 10%, strain hardening exponent at 1000°C = 0.25 and average specific heat 0.166 kcal/kg°C. Calculate the temperature of the rolled product just after leaving this intermediate stand. Assume reasonable value for any missing data.

MME 447

7. Identify practical situations when you will prefer diamond die over other conventional dies in wire drawing and explain why copper/brass coating is better as lubricant for drawing high strength steel wire.

8. Differentiate between TMR and TMR+A_cC. Discuss how product of TMCP shows better performance in aggressive environment compared to the conventional one having exactly the same chemical compositions.

SECTION – B
There are **FOUR** questions in this section. Answer any **THREE**.
The figures in the margin indicate full marks.

9. (a) What do you understand by Bauschinger Effect? Evaluate the magnitude of this effect and determine the reasons for observation of this effect. **(20)**

   (b) Determine the value of the strain-hardening exponent for a metal that will cause the average flow stress to be $\frac{3}{4}$ of the final flow stress after deformation. **(15)**

10. (a) "The working (deformation) behaviour of metals is greatly influenced by the presence of alloying elements in the form of solute atoms and second phase particles" — explain this statement for plain carbon steel and aluminium alloys. **(25)**

    (b) Schematically show microstructural development during hot rolling. **(10)**

11. (a) A component is designed to manufacture by magnesium alloys. The forming method is forging. What factors would you consider during fabrication of parts from these alloys? **(15)**

    (b) What is fibre flow lines? What's its importance in determination of mechanical properties? Use examples of Damascus steel and Crane Hook to explain the greater strength obtained by forging and flow lines. **(20)**

12. (a) Hydroforming is a new technique used in transportation industries. Why this method of forming is important in these industries? Explain sheet hydroforming and tube hydroforming processes with the help of schematics of blank holder force vs pressure. **(15)**

    (b) What is superplasticity? What are the minimum criteria for a material to be superplastic? Design a blow forming and vacuum forming process for a material in the superplastic region. Consider a bar that starts to neck. Prove that strain rate at the unnecked region is rather higher than that of the necked region. **(20)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2016-2017

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

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 are Schottky defects and Frenkel defects? Deduce a relation for the equilibrium concentration of Schottky defects that may form in a ceramic material at a given temperature. **(17)**

   (b) Calculate the equilibrium number of vacancies formed in MgO at 1000 K for which the enthalpy for defect formation is 2 eV. The vibrational frequencies of normal atoms and vacancies are 1.6×10^{-15} Hz and 0.6×10^{-15} Hz respectively. In that case, the coordination number of vacancies is 4. Given that 1 eV = 1.6×10^{-19} J and Boltzmann's constant (k) = 1.38×10^{-23} J/K **(10)**

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

   (i) Metal loss from ZnO

   (ii) Dissolution of Nb_2O_5 in TiO_2

2. (a) "Nowadays cubic zirconia is considered suitable electrolyte for solid oxide fuel cell (SOFC)" - do you agree or not with this statement? Justify your opinion. **(12)**

   (b) A good solid electrolyte should have an ionic conductivity of at least 0.01 $(\Omega\text{-cm})^{-1}$ with an electronic transference number that should not exceed 10^{-4}. At 1000 K, show that the minimum band gap for such a solid would have to be $\approx$ 4 eV. Assume that both electronic and hole mobilities are equal to 100 cm²/V·s. State all other assumptions. **(13)**

   (c) Illustrate the effect of oxygen partial pressure on the conductivity of non-stoichiometric ceramic. **(10)**

3. (a) Discuss briefly when and how $BaTiO_3$ ceramic becomes dielectric material. **(10)**

   (b) The ionic polarization observed in NaCl crystal is 4.3×10^{-8} C/m². Calculate the displacement between Na^+ and Cl^- ions. Given that lattice parameter of NaCl is 5.5 Å. **(8)**

   (c) "Piezoelectric quartz exhibits directional polarization" - Explain this phenomenon with suitable illustrations. **(10)**

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

MME 467

4. (a) How can you make better thick film using tape casting process? **(8)**

(b) Distinguish between two high temperature Y-Ba-Cu-O and Bi-Sr-Ca-Cu-O superconductors. **(10)**

(c) Calculate the saturation magnetization for Fe_3O_4. Given that each cubic unit cell contains 8 Fe^{2+} and 16 Fe^{3+} ions, and the unit cell edge length is 0.839 nm. Using aforementioned data design a cubic mixed-ferrite magnetic material that has a saturation magnetization of 4.52×10^5 A/m.

SECTION – B

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

5. (a) Discuss Pauling's rule for the formation of ionic crystal with appropriate examples. **(10)**

(b) 'Ceramic materials are better for implants than metals and polymers'- analyze the statement by comparing their properties. **(9)**

(c) Zirconia ceramics have better properties than alumina ceramics in biomedical application, but there are some concerns with Ziconia ceramics-explain. **(6)**

(d) Explain why plastic deformation in polycrystalline ceramic is more difficult than that in single crystal ceramic. **(10)**

6. (a) Describe the significance of weibull modulus. Does increasing K_{IC} of a truly brittle material increase weibull modulus? Justify your answer. **(7+8=15)**

(b) A series of square section bars are tested in 3-point bend test. Determine
   a. the weibull modulus, m
   b. the median strength, σ_m (for which $P_f = 0.5$)
   c. the normalized stress (σ_o) of the ceramic. **(10+5+5=20)**

The failure strengths (MOR) (MPa) data: 178, 318, 345, 210, 296, 235, 248, 276, 262.

7. (a) Using the Force-Interatomic Distance diagram, show that stiffness and theoretical strength of ceramic material can be related to the shape of the curve. **(10)**

(b) 'Even a small flaw in ceramics is extremely critical' - Justify the statement by analyzing the effect of flaws and porosity on the strength of ceramic materials. **(15)**

(c) Explain 'condensed phase corrosion' in terms of ceramic materials. **(10)**

8. (a) Why pure zirconia and fully stabilized zirconia do not show any toughening behavior? For transformation toughening in Ca-PSZ, discuss the effect of CaO addition on firing temperature and resultant microstructure and also the effect of ageing time on strength and toughness of PSZ. **(10+10=20)**

(b) Discuss the typical creep curve for ceramic material. List and state how the factors affect the creep rate of ceramic materials. **(5+10=15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2016-2017

Sub : **MME 457** (Powder Metallurgy)

Full Marks : 140   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) "In upset forgings, toughness will be higher in the longitudinal orientation." – Explain why. **(7)**

   (b) Comment on the densification in terms of pore closure for different types of forging systems. **($7\frac{1}{3}$)**

   (c) What are the recent developments adopted for the production of automobile parts through powder metallurgy technology? **(9)**

2. (a) Illustrate the steps to produce brown part with more than 95% of the pore-free density (PFD). **(7)**

   (b) Schematically depict the pressure-time relationship for mold filling to produce green metal parts in injection molding. **($7\frac{1}{3}$)**

   (c) Differentiate between catalytic debinding and supercritical debinding in terms of materials involved and process parameters. **(9)**

3. (a) Delineate the factors affecting the strength of titanium-based alloys for biomedical application. **(8)**

   (b) "Mg alloys reduce the risk of stress-shielding as surgical implants." – justify the statement. **($4\frac{1}{3}$)**

   (c) Distinguish between the different mechanisms of lubricant operation mode for bearig materials. **(11)**

4. (a) Describe the processing steps for producing aluminum foam by powder metallurgy technique. **(6)**

   (b) List the importance of powder metallurgy in the field of hard magnetic materials? **(3)**

   (c) Enlighten the recent developments in powder metallurgy on cemented carbide hard metals. **($14\frac{1}{3}$)**

MME 457

SECTION – B

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

5. (a) What is atomization? Mention its advantages. Compare gas atomization and water atomization in respect of atomizing media, powder characteristics, economy and process energy efficiency. $(12\frac{1}{3})$

(b) Explain sol-gel technique. Mention the main benefits of sol-gel processing. **(6)**

(c) How does attrition milling differ from other conventional ball milling? **(5)**

6. (a) With a neat sketch, show the powder elements in powder metallurgy terminology. **(5)**

(b) What are the major functions of powder compaction? Is it necessary to add binder to the metal/ceramic powder? Explain. **(4+4=8)**

(c) Suggest a pressing process that is suitable for making spark plug insulators. Describe the process with neat sketch. $(10\frac{1}{3})$

7. (a) What is sintering? Mention the criteria of sintering. With neat sketch, describe the changes that occur during the initial stage of sintering. **(2+2+6=10)**

(b) 'Sintering is more efficient when the compact features high surface energy and self-diffusivity and the particles are fine.' – explain. $(6\frac{1}{3})$

(c) What are the requirements of the sintering atmosphere? Also mention the limitations of inert atmosphere. **(4+3=7)**

8. (a) Differentiate between electroplating and electroless plating on metal powders. **(6)**

(b) Why machining in P/M parts is difficult? List some additives that can improve machinability of P/M parts. **(3+4=7)**

(c) Explain how powders are produced by freeze-drying process. $(10\frac{1}{3})$

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2016-2017

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) A material is required to manufacture the teeth of a scoop for a digger truck that must cut earth, scoop stones, crunch rock, often in the presence of water and worse. Translate these requirements into a prescription of Function, Constraints, Objectives and Free variables.   **(5)**

   (b) 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 beam (Fig. 1) of length L, specified strength and minimum weight. Once the material index is determined, select the top three candidate materials for this beam using materials property chart (Fig. 2). [Attach Fig. 2 with the answer].   **(15)**

   (c) 'Polymers are not suitable for load limited designs as their fracture toughness (K_{1C}) 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. 3). [Attach Fig. 3 with the answer].   **(15)**

2. (a) When a pressure vessel (Fig. 4) has to be mobile; its weight becomes important. Aircraft bodies, rocket casings and liquid natural gas containers are examples; they must be light, and at the same time they must be safe and that means that they must not fail by yielding or by fast fracture. The table below summarizes the needs: **(17)**

Function	Pressure vessel
Constraints	Must not fail by yielding
	Must not fail by fast fracture
	Diameter 2R and pressure difference P specified
Objective	Minimise mass M
Free variables	Wall Thickness, t
	Choice of material

Data for the four candidates for the column are listed below. Use these to identify the best candidate material where R = 1 m, P = 25 MPa and a_c = 2 mm.

MME 445

Contd ... Q. No. 2(a)

Material	Density, ρ (kg/m^3)	Fracture Toughness, K_{IC} (MPa.m$^{1/2}$)	Yield Strength, σ_y (MPa)
Granite	2600	3	20
Cast iron	7150	35	276
Al-alloy 6061	2700	24	240
Structural steel	7850	50	250

2. (b) Compressed air cylinder (Fig. 5) used for braking and other power-actuated systems in trucks are usually made of low carbon steel, and they are heavy. The task is to explore the potential of alternative materials for lighter air tanks, recognizing that there must be a trade-off between mass and cost. The table summarizes the design requirements:

Function	Air cylinder for truck
Constraints	Must be fail by yielding Diameter 2R and length L specified
Objective	Minimise mass M Minimise material cost C
Free variables	Wall Thickness, t Choice of material

(i) Show that the mass and material cost of the tank relative to one made of low-carbon steel are given by the equations:

$$\frac{m}{m_0} = \left(\frac{\rho}{\sigma_y}\right)\left(\frac{\sigma_{y,o}}{\rho_o}\right) \quad and \quad \frac{C}{C_o} = \left(\frac{C_m \rho}{\sigma_y}\right)\left(\frac{\sigma_{y,o}}{C_{m,o}\rho_o}\right) \qquad \textbf{(8+10=18)}$$

Where ρ is the density, σ_y the yield strength and C_m the cost per kg of the material, and the subscript "o" indicates values for mild steel.

(ii) Explore the trade-off between relative cost and relative mass, considering the replacement of a mild steel tank with one made, first, of low alloy steel, and, second, one made of filament-wound CFRP, using a relative exchange constant a* for 1 and 100 and the material properties in the table below.

Material	Density, ρ (kg/m^3)	Yield Strength, σ_c (MPa)	Price per /kg, C_m ($/kg)
Mild steel	7850	314	0.66
Low alloy steel	7850	775	0.85
CFRP	1550	760	42.1

MME 445

3. (a) Use the 4-segment chart (Fig. 6) for strength-limited design to compare the mass per unit length, m/L, of a section with $Z\sigma_f = 10^5$ Nm (where Z is the section modulus) made from

(i) Mild steel with a shape factor $\Phi_B{}^f = 10$, strength, $\sigma_f = 200$ MPa and density, $\rho = 7900$ kg/m^3 **(15)**

(ii) 6061 grade Aluminium alloy with a shape factor $\Phi_B{}^f = 3$, strength, $\sigma_f = 200$ MPa and density, $\rho = 2700$ kg/m^3, and

(iii) Titanium alloy with a shape factor of $\Phi_B{}^f = 10$, strength, $\sigma_f = 480$ MPa and density, $\rho = 4420$ kg/m^3. [Attach Fig. 6 with the answer].

(b) Calculate the change in structural efficiency for both bending stiffness and strength when a solid flat panel of unit area and thickness t is foamed to give a foam panel of unit area and thickness h, at constant mass. The modulus E and strength σ_f of foams scale with relative density ρ/ρ_s as **(14)**

$$E = \left(\frac{\rho}{\rho_s}\right)^2 E_s$$

$$\sigma_f = \left(\frac{\rho}{\rho_s}\right)^{3/2} \sigma_{f,s}$$

(c) Explain the concepts of penalty function and exchange constant. **(6)**

4. (a) Explain the effect of local buckling on shape efficiency of different materials. **(8)**

(b) Explain the concept of percolation and, using suitable example, examine its importance as a design tool for hybrid materials. **(12)**

(c) A chart (Fig. 7) for exploring stiff composites with light alloy or polymer matrices is attached. The criteria of excellence (the indices E/ρ, $E^{1/2}/\rho$ and $E^{1/3}/\rho$) for light, stiff structures are shown; they increase in value towards the top left. Use the chart to compare the performance of an aluminium-matrix composite reinforced with (i) Zirconium carbide ZrC, (ii) Saffil alumina fibers, and (iii) Nicalong silicon carbide fibers. [Attach Fig. 7 with the answer]. **(15)**

SECTION – B

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

5. (a) "Tool steels should be at least double-tempered." – Discuss this statement giving emphasis on the mechanism of tempering in tool steel. **(15)**

(b) How do Function, Material, Shape and Process play a role in materials selection process? **(10)**

(c) How can you obtain ultra-high strength in maraging steel? **(15)**

MME 445

6. (a) Which stainless steel is the best suited for petroleum refining equipment? Explain your selection. **(15)**

 (b) What is Muntz metal? Why is it heat-treatable? **(10)**

 (c) How do Copper, Magnesium and Zinc improve strength in Aluminium alloys? **(10)**

7. (a) Compare commercially pure titanium and titanium alloys with regard to corrosion resistance. **(10)**

 (b) What are nickel-based superalloys? How do they attain high strength at elevated temperature? Mention some of their applications. **(15)**

 (c) How can hybrid materials be used to fill holes in material property space? **(10)**

8. (a) What is design? In your opinion, what does drive the materials engineers: market pull or technology push? Give one example where design historically changes the shape and look for a product. **(12)**

 (b) Using a design flow chart, correlate among design tools, market need and material data. **(10)**

 (c) Use the fracture toughness - modulus chart (Fig. 8) to find materials that have fracture toughness K_{1C} greater than 100 MPa.m$^{1/2}$ and a toughness $G_{1C} = K_{1C}^2 / E$ greater than 10 kJ/m^3. **(13)**

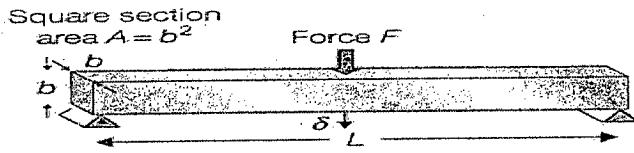
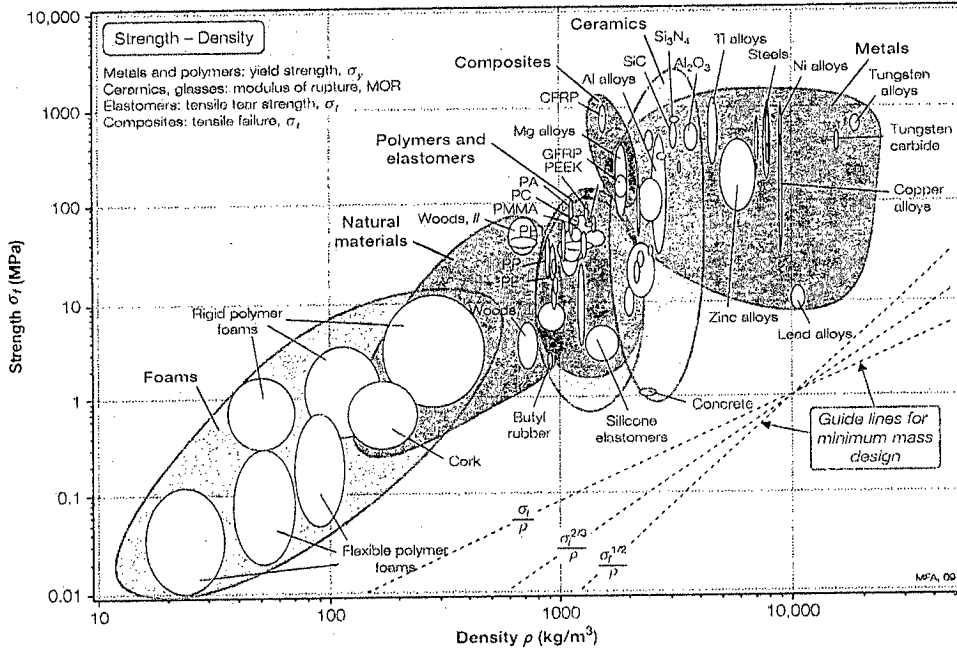Fig. 1 for Ques. 1(b)

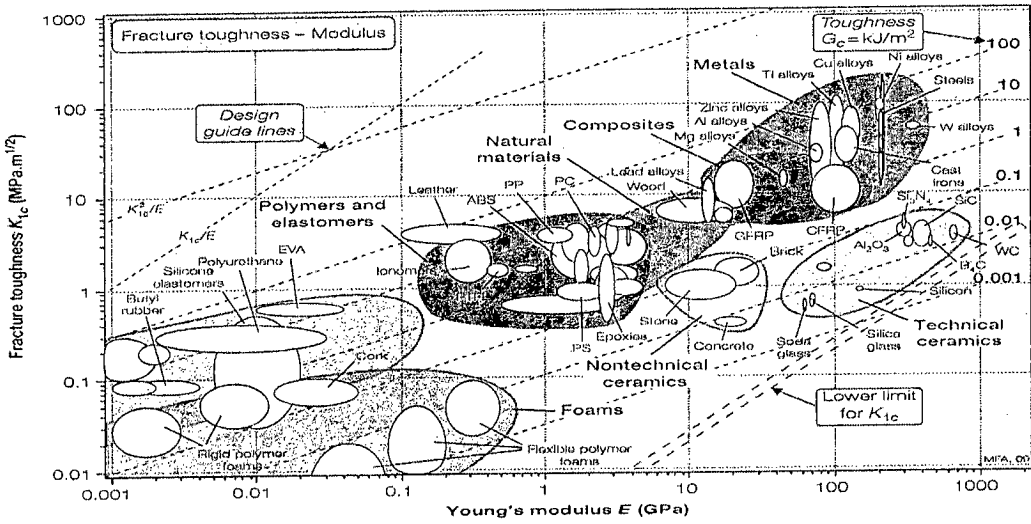Square section area $A = b^2$
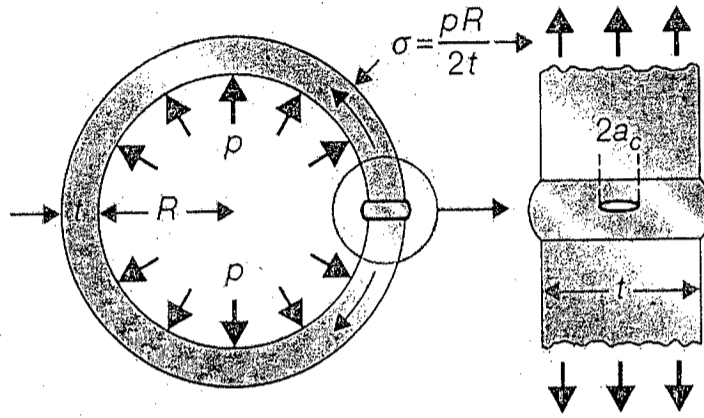
Force F

Fig. 1 & 2 for Ques. 1(b)
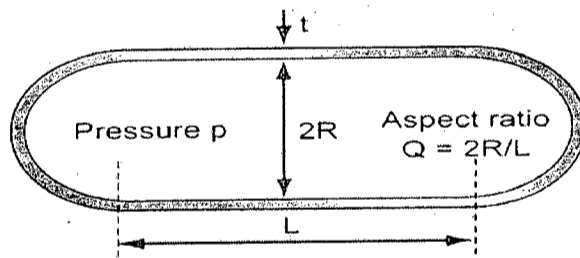
Fig. 3 for Ques. 1(c)
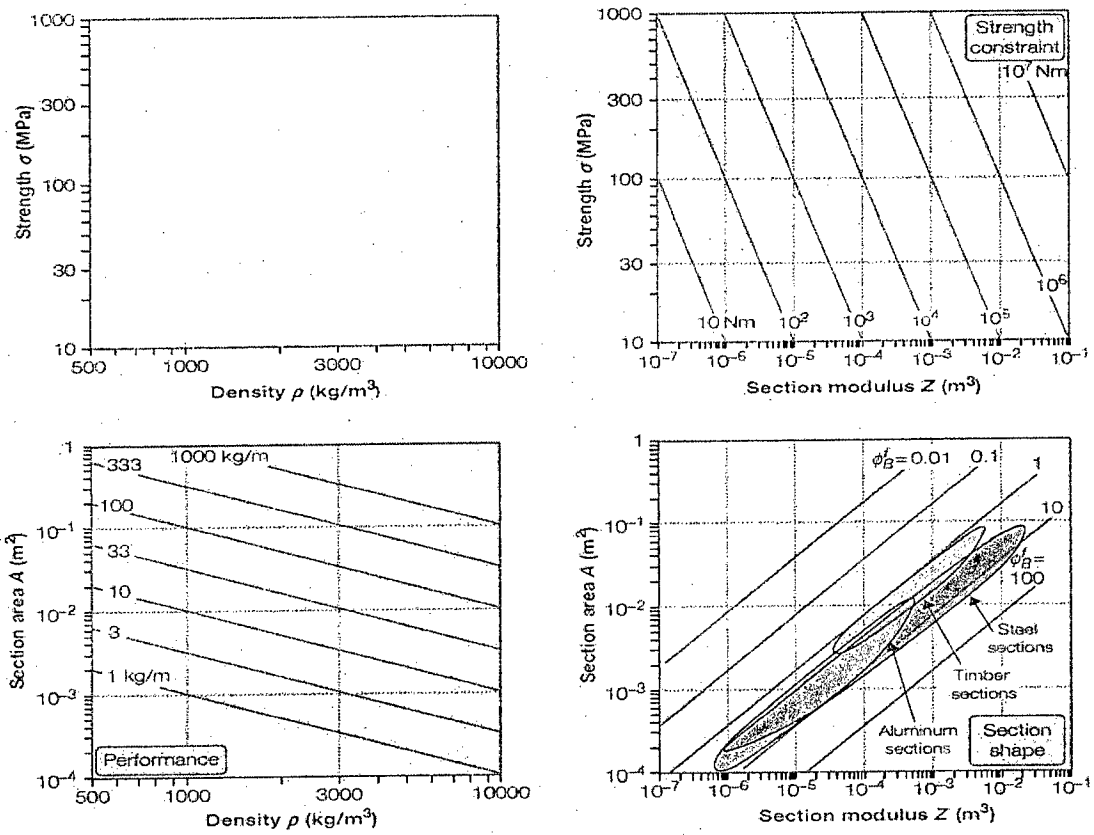
Fig. 4 for Ques. 2(a)
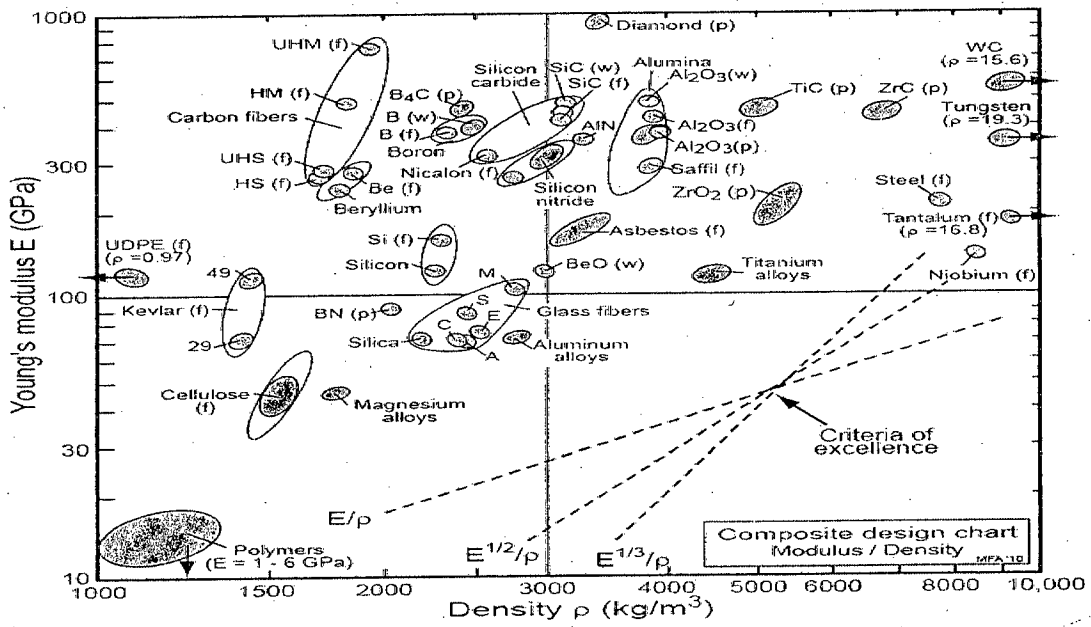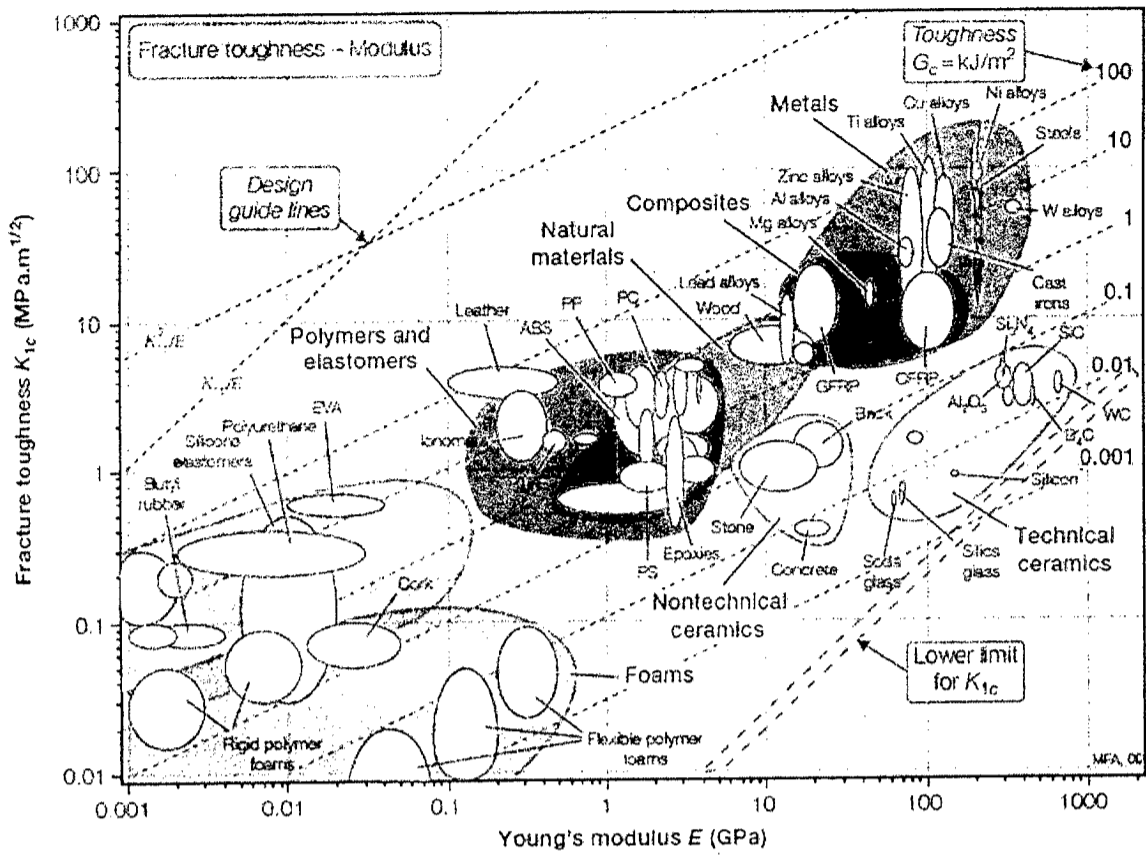

Fig. 5 for Ques. 2(b)

Fig. 6 for Ques. 3(a)

Fig. 7 for Ques. 4(c)

Figure for question no. 8 (c)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2016-2017

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**.

1. (a) Write down the advantages and limitations of "U-shaped layout".   **(10)**

    (b) What are the steps for "Method Study"? Discuss in details.   **(10)**

    (c) A company X wants to get involved in social welfare activities in order to increase its goodwill. The company has taken 4 (four) locations– A, B, C and D in consideration and wants to establish 2 (two) clinics in two of those locations. Find the locations of two clinics at the lowest weighted travel-distance cost. Collected information about four locations is summarized in the following table: **(15)**

From Community	Distance to Clinic (miles)				Population Size	Relative Weight
	A	B	C	D		
A	0	8	12	11	12,000	0.40
B	8	0	10	16	16,000	0.25
C	12	11	0	20	13,000	0.15
D	11	17	20	0	15,000	0.20

2. (a) Describe the factors affecting "Facility location decisions".   **(12)**

    (b) "Utilization" is always less than "Efficiency" — discuss.   **(5)**

    (c) Write down the requirements for "Effective production planning and control".   **(6)**

    (d) A job consists of three work elements and all are performed by the same operator. An analyst conducted "work sampling" to determine the standard time for the job. The duration of the study is 400 minutes of effective time. The total number of acceptable units produced during the study period is 45 units. Determine the "standard time" by assuming allowance of 8 percent. The details of the observations are summarized in the following table: **(12)**

Work Element	Frequency of Performance	Performance Rating
A	303	80%
B	208	110%
C	189	100%

IPE 483

3. (a) Discuss briefly about the "Determinants of effective capacity". **(10)**

    (b) Write down the advantages and limitations of "Job production system". **(10)**

    (c) In a workshop, 5 jobs– A, B, C, D and E have arrived in order. The corresponding processing time and due date is summarized in the following table: **(15)**

Job	Processing Time (Days)	Due Time (Days)
A	7	7
B	5	12
C	4	5
D	3	5
E	7	17

    (i)   Determine the sequence of the jobs as per dispatching rules of SPT and EDD.

    (ii)   Calculate the values of average number of jobs in the system and average job lateness for both the dispatching rules.

    (iii) In the above problem, which dispatching rule is more suitable to obtain–
           (I) Lower WIP inventory
           (II) Lower customer dissatisfaction.

4. (a) Discuss briefly about priority rules for dispatching jobs. **(8)**

    (b) Discuss briefly ECRS technique. **(7)**

    (c) Write down the limitations of "Cellular layout". **(5)**

    (d) Suppose, a company is willing to produce one assembled machine every 13 minutes. An assembly line requires a total of 10 tasks, and the job times (in minutes) along with the precedence relationships are summarized in the following table: **(15)**

Task	Preceding Tasks	Time (minutes)
A	–	12
B	A	6
C	A	6
D	B	6
E	B	3
F	C	12
G	C, D	3
H	G	5
I	E	4
J	F, I, H	3
		Total = 60

    (i)   What is the value of cycle time?

    (ii)   Draw the precedence diagram.

    (iii) Balance the line stating which tasks would be done in each work station.

    (iv)   What is the efficiency of the line?

    (v)   Determine total idle time.

IPE 483

SECTION – B

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

5.   (a) Formulate a production schedule problem to meet demand requirements by varying workforce size for the following problem: **(18)**

The monthly forecasts for the Product D for January, February, and March are 1,000, 1,500, and 1,200, respectively. Safety stock policy recommends that half of the forecast for that month be defined as safety stock. There are 22 working days in January, 19 in February, and 21 in March. Beginning inventory is 500 units. Manufacturing cost is $200 per unit, storage cost is $3 per unit per month, standard pay rate is $6 per hour, overtime rate is $9 per hour, cost of stock-out is $10 per unit per month, hiring and training cost is $200 per worker, layoff cost is $300 per worker, and worker productivity is 0.1 unit per hour. Assume that you start off with 50 workers and they work 8 hour per day.

  (b) Describe different production planning strategies.   **(12)**

  (c) Define four relevant costs associated with production planning.   **(5)**

6.   (a) One unit of A is composed of two units of B and three units of C. Each B is composed of one unit of F. C is made of one unit of D, one unit of E, and two units of F. Items A, B, C, and D have 20, 50, 60, and 25 units of on-hand inventory respectively. Items A, B, and C use lot-for-lot (L4L) as their lot-sizing technique, while D, E, and F require multiples of 50, 100, and 100, respectively, to be purchased. B has scheduled receipts of 30 units in Period 1. No other scheduled receipts exist. Lead times are one period for Items A, B, and D, and two periods for Items C, E, and F. Gross requirements for A are 20 units in Period 1, 20 units in Period 2, 60 units in Period 6, and 50 units in Period 8. Find the planned order releases for all items.   **(25)**

  (b) Discuss the importance of master production schedule in an MRP system.   **(10)**

7.   (a) Explain the factors associated with location selection for logistics facilities.   **(15)**

  (b) Formulate the following problem as a transportation problem.   **(15)**

Bindley Corporation has a one-year contract to supply motors for all washing machines produced by Rinso Ltd. Rinso manufactures the washers at four locations around the country: New York, Fort Worth, San Diego, and Minneapolis. Plans call for the following numbers of washing machines to be produced at each location:

IPE 483
<u>Contd... Q. No. 7(b)</u>

New York	50,000
Fort Worth	70,000
San Diego	60,000
Minneapolis	80,000

Bindley has three plants that can produce the motors. The plants and production capacities are

Boulder	100,000
Macon	100,000
Gary	150,000

Due to varying production and transportation costs, the profit Bindley earns on each 1,000 units depends on where they were 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 1,000.)

Produced at	Shipped to			
	New York	Forth Worth	San Diego	Minneapolis
Boulder	7	11	8	13
Macon	20	17	12	10
Gary	8	18	13	16

Given profit maximization as a criterion, Bindley would like to determine how many motors should be produced at each plant and how many motors should be shipped from each plant to each destination.

(c) Write short note on 'Adaptive Forecasting'. **(5)**

8. (a) Describe the ABC inventory planning model. **(10)**

(b) Weekly demand of a product is 2500 units. The supplier takes 12 days to deliver an order. It costs Tk. 80,000 to carry out 2 orders. Monthly holding cost is 1% of the cost per unit of the product. Per unit cost depends on ordering quantity and is given as follows: Tk. 1100 if order quantity is 0 to 7000 units; Tk. 980 if order quantity is 7001 to 10,000; Tk. 850 if order quantity is 10001 or more. Determine the economic order quantity and the re-order point. **(18)**

(c) Mention the assumptions of basic fixed order quantity model. **(7)**