

SECTION – A

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

1. (a) With neat sketches, briefly describe the mechanism of sintering for the agglomeration of iron ore. (20)
- (b) Draw and discuss the heat balance and mass balance of sintering process. (16 $\frac{2}{3}$)
- (c) Discuss the different types of sinter products according to the amount of flux added. (10)
2. (a) Discuss the different types of lining materials used in different zones of blast furnace. (20)
- (b) What are the benefits of box girders for the construction of blast furnace? (10)
- (c) Discuss the working principle of electrostatic precipitator in blast furnace gas cleaning system (with neat sketches). (16 $\frac{2}{3}$)
3. (a) Mention the causes and possible remedies of common irregularities in an iron blast furnace. (36)
- (b) Explain the external desiliconisation process in iron making. (10 $\frac{2}{3}$)
4. (a) Explain the mechanism of preheating of air in hot blast stoves for blast furnace operation. (16 $\frac{2}{3}$)
- (b) List the modern trends generally adopted to increase the productivity of blast furnace. Describe them in brief. (30)

SECTION – B

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

5. (a) Discuss the sources and role of slag in steel making processes. (18)
- (b) How can sulphur and phosphorus be removed during the refining period of steel making? (12)
- (c) Why has LD steel making process replaced the Bessemer and open-hearth steel making processes? Explain. (16 $\frac{2}{3}$)

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6. (a) Discuss the sequence of operation of LD steel making process along with the graph showing the removal of impurities during the refining period. **(20)**
- (b) Why is degassing necessary in steel making process? Discuss Ladle-to-ladle degassing, circulation degassing and batch degassing processes. **(26 $\frac{2}{3}$)**
7. (a) How do the LDAC, Kaldo and Rotor processes differ from the LD process? Discuss the benefits aimed or resulted in these modified processes over LD process. **(20)**
- (b) Explain the induction furnace steel making process. Mention its advantages and disadvantages over the electric arc furnace steel making process. **(26 $\frac{2}{3}$)**
8. (a) What are the defects that are developed during ingot casting? What is segregation? Using neat sketch, discuss the various types of segregations that are formed in a steel ingot. **(26)**
- (b) Why is continuous casting gradually replacing the conventional ingot casting process? With the help of a neat sketch explain how billets can be produced by a continuous casting machine? **(20 $\frac{2}{3}$)**
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EXTRA

L-4/T-2/MME

Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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

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**.

1. (a) Estimate the roll force and power for annealed low-carbon steel strip 200 mm wide and 10 mm thick, rolled to a thickness of 6 mm. The roll radius is 200 mm, and the roll rotates at 200 rpm. Given, $\mu = 0.1$, $K = 530$ MPa, $n = 0.26$. (10)
(b) "The smallest ferrite grain size obtained commercially using thermo-mechanical processing is about 1 μm ". Explain the reasons. (7 1/2)
2. A round rod of annealed brass 70-30 is being drawn from a diameter of 6 mm to 3 mm at a speed of 0.6 m/s. Assume that the frictional and redundant work together constitute 35% of the ideal work of deformation. (i) Calculate the power required in this operation, and (ii) calculate the die pressure at the exit of the die. Material property data: $K = 895$ MPa and $n = 0.49$. (17 1/2)
3. Describe cold rolling processing route of TRIP steel along with microstructural changes that occur during such thermo-mechanical processing. (17 1/2)
4. A rectangular work-piece has the following original dimensions: $2a = 100$ mm, $h = 30$ mm and width = 20 mm. The metal has a strength coefficient of 400 MPa and a strain hardening exponent of 0.3. It is being forged in plane strain with $\mu = 0.2$. Calculate the force required at a reduction of 20%. (17 1/2)
5. Briefly discuss the hot rolling procedure during production of beverage can body sheet made of aluminium. Also, explain the microstructural changes that occur during the process. (17 1/2)
6. Narrate the production routes for (a) heads of fasteners such as bolts and (b) ball bearings by forming techniques. Draw schematic diagrams for each processing routes. (17 1/2)

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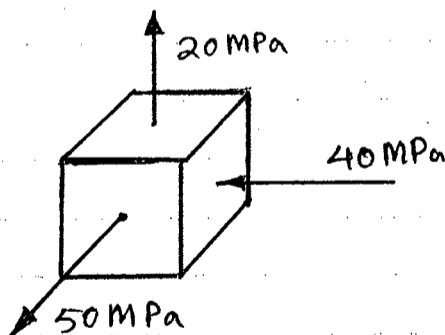
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7. (a) What do you understand by chatter during rolling? Write down the vibration mode commonly encountered in rolling. (8)
- (b) Briefly discuss the different types of basic extrusion processes. (9 1/2)
8. How threaded screws and bolts are formed by rolling method? Also, explain why rolled threaded screws are superior in quality to machined threaded screws and bolts. (17 1/2)

SECTION - B

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

9. (a) Discuss the effect of temperature and strain rate on the stress-strain behavior of materials. (20)
- (b) Show that the true strain at the onset of necking is numerically equal to the strain-hardening exponent. (7)
- (c) The strength co-efficient (K) and strain hardening exponent (n) of a low carbon annealed steel are 965 MPa and 0.14 respectively. Calculate the true ultimate tensile strength and the engineering ultimate tensile strength of this metal. (8)
10. (a) Explain the distortion-energy criterion for predicting the onset of yielding in ductile metals. (12)
- (b) Distinguish between dynamic recrystallization and static annealing process. Why are dynamic recovery and dynamic recrystallization important in metal working process? (8)
- (c) A metal is yielding plastically under the stress state shown in the accompanying figure. (15)



- (i) Label the principle axes according to their proper numerical convention (1, 2, 3).
- (ii) What is the yield stress using the Tresca criterion?
- (iii) What if the Von Mises criterion is used?
- (iv) The stress state causes measured strains of $\epsilon_1 = 0.4$ and $\epsilon_2 = 0.2$, with ϵ_3 not being measured. What is the value of ϵ_3 ?

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11. Derive an expression for the stress required to draw a wide sheet under plane-strain condition (consider friction). (20)

(b) List the name of creep mechanisms. (5)

(c) What factors influence the temperature in a workpiece in metal working? Compare the temperature rise when a cylinder of aluminium and titanium is quickly deformed to $\bar{\epsilon} = 1.0$ at room temperature. Fraction of deformation converted into heat is found 0.90. Materials properties are given in the following table: (10)

	$\bar{\sigma}$ (MPa)	ρ (kg m ⁻³)	C (J.kg ⁻¹ .K ⁻¹)
Al	200	2690	900
Ti	400	4500	519

12. (a) Give a classification of defects that are produced during thermo-mechanical processing. Briefly discuss the causes and remedies of the deformation induced surface defects orange peel, roping and wrinkling. (15)

(b) What is additive manufacturing (AM)? Briefly discuss the different stages of AM process. Write the purpose and benefits of the AM process for product development by metal working. (20)

SECTION – A

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

1. (a) Explain how hydrodynamic lubrication mode works in bearings and how the hydrodynamic conditions are established. (10 1/3)
 (b) Describe in detail the production of oil-impregnated porous bronze bearings. (13)

2. (a) 'Cemented carbide is the best choice as a material for its combined properties of strength, hardness and toughness' – Explain it from the applications point of view including high temperature properties using grain size and binder content as parameters. (13 1/3)
 (b) Discuss the production of cemented carbides with a flow chart. (10)

3. (a) Classify ferrites and differentiate between soft and hard ferrites. (7 1/3)
 (b) Explain the garnet crystal structure and hence calculate the theoretical magnetic moment of $Gd_3 Fe_5 O_{12}$ per formula unit. (10)
 (c) Mention with specific example why substitution of nonmagnetic Zn^{2+} for a magnetic ion enhances magnetic moment of spinel ferrites. (6)

4. (a) What is 'Lotus effect' and state where this unique bio-inspired property is applied in surface engineering. (8 1/3)
 (b) Elucidate the self-cleaning, photocatalytic and antibacterial properties of surfaces coated with TiO_2 and Ag nanopowder. (15)

SECTION – B

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

5. (a) Discuss electrodeposition. What are the advantages and disadvantages of electrodeposition? (15)
 (b) Explain the water atomization method with the help of a labelled diagram. (8 1/3)

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6. (a) With the help of labelled diagrams explain spray drying method. **(13 1/3)**
(b) What are the advantages of wet milling and dry milling? **(10)**
7. (a) What is sintering? Explain the different stages of sintering using labelled diagrams. **(15 1/3)**
(b) State some advantages and disadvantages of powder metallurgy. **(8)**
8. (a) Use necessary figures to explain wet bag isostatic pressing. State the advantages and disadvantages of this process. **(12)**
(b) Explain dip wating process with the help of labelled diagrams. **(11 1/3)**
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24/5/14

L-4/T-2/MME

Date : 24/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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) Describe production system. What are the types of production systems? (10)
- (b) The times required to complete each of eight jobs in a two-machine flow shop are shown in the table that follows. Each job must follow the same sequence, beginning with machine A and moving to machine B. (15)
- (i) Determine a sequence that will minimize makespan time.
- (ii) Construct a chart of the resulting sequence, and find machine A and B's idle time.

Job	Operations time	
	Machine A	Machine B
a	16	5
b	3	13
c	9	6
d	8	7
e	2	14
f	12	4
g	18	14
h	20	11

- (c) Compare different types of plant layout based on their advantages, disadvantages and applications. (10)
2. (a) A small manufacturing firm uses roughly 3,400 pounds of chemical dye a year. Currently the firm purchases 300 pounds per order and pays \$ 3 per pound. The supplier has just announced that orders of 1,000 pounds or more will be filled at a price of \$ 2 per pound. The manufacturing firm incurs a cost of \$ 100 each time it submits an order and assigns an annual holding cost of 17 percent of the purchase price per pound. (15)
- (i) Determine the order size that will minimize the total cost.
- (ii) If the supplier offered the discount at 1,500 pounds instead of 1,000 pounds, what order size would minimize total cost?
- (b) Briefly discuss the JIT building blocks. (10)
- (c) What are the elements of JIT? Briefly describe the benefits of JIT Systems. (10)

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3. (a) Briefly describe MRP II. Distinguish aggregate planning and capacity planning. (12)
- (b) In an attempt to increase productivity and reduce costs, Rho Sigma Corporation is planning to install an incentive pay plan in its manufacturing plant. In developing standards for one operation, time-study analysts observed a worker for 30 minutes. During that time the worker completed 42 parts. The analysts rated the worker as producing at 130 percent. The base wage rate of the worker is \$ 5 per hour. The firm has established 15 percent as a fatigue and personal time allowance. (15)
- (i) What is the normal time for the task?
- (ii) What is the standard time for the task?
- (iii) If the worker produced 500 units during an eight-hour day, what wages would the worker have earned?
- (c) Define work sampling. Explain the steps involved in making a work sampling study. (8)
4. (a) What is master scheduling? Describe the inputs and outputs of master scheduling. (8)
- (b) Briefly describe the functions of inventory. (7)
- (c) SummerFun Inc., produces a variety of recreational and leisure products. The production manager has developed an aggregate forecast: (20)

Month	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Forecast	50	44	55	60	50	40	51	350

Use the following information to model the aggregate planning problem of the firm as a balanced transportation model.

Regular Production Cost	\$ 80 per unit
Overtime Production Cost	\$ 120 per unit
Regular capacity	40 units per month
Overtime capacity	8 units per month
Subcontracting cost	\$ 140 per unit
Subcontracting capacity	12 units per month
Holding Cost	\$ 10 per unit per month
Backorder Cost	\$ 20 per unit per month
Beginning Inventory	0 units

Develop an aggregate plan using each of the following guidelines and compute the total cost for each plan. Which plan has the lowest total cost?

- (i) Use regular production. Supplement using inventory, overtime, and subcontracting as needed. No backlogs allowed.
- (ii) Use a level strategy. Use a combination of backlogs, subcontracting, and inventory to handle variations in demand.

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SECTION - B

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

5. (a) Describe different input sources of judgmental forecast. **(10)**

(b) The following table shows a tool and die company's monthly sales for the current year. **(25)**

Period	Month	Sales	Period	Month	Sales
1	January	37	7	July	43
2	February	40	8	August	47
3	March	41	9	September	56
4	April	37	10	October	52
5	May	45	11	November	55
6	June	50	12	December	54

(i) Compute the monthly sales forecast for July through January using a 5-month moving average.

(ii) Compute the monthly sales forecast for July through January using a 3-month weighted moving average. Use weights of 0.5, 0.33, and 0.17, with the heavier weights on the more recent months.

(iii) Use exponential smoothing with smoothing parameter $\alpha = 0.5$ to compute the sales forecast for July through January.

(iv) Compute the mean absolute deviation for July through December for each of the methods used. Which method would you use to forecast sales for January?

6. (a) Briefly describe the Delphi technique. What are its main benefits and weaknesses? **(10)**

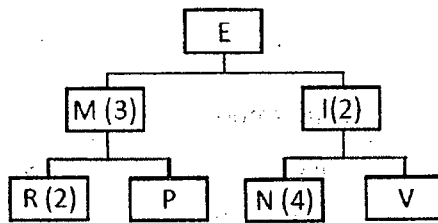
(b) A company is setting up an assembly line to produce 192 units per 8-hour shift. The following table identifies the work elements, times and immediate predecessors: **(25)**

Work Element	Time (sec)	Immediate Predecessor(s)
A	40	None
B	80	A
C	30	D, E, F
D	25	B
E	20	B
F	15	B
G	120	A
H	145	G
I	130	H
J	115	C, I
Total = 720		

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Contd ... Q. No. 6(b)

- (i) Draw the precedence diagram.
 - (ii) What is the desired cycle time (in seconds)?
 - (iii) What is the theoretical minimum number of workstations?
 - (iv) Assign task to workstations using this rule: assign tasks according to greatest number of following tasks. In case of a tie, use the tiebreaker of assigning the task with the longest processing time first.
 - (v) What is the efficiency of the solution found?
7. (a) Briefly describe the ABC classification of inventory. (10)
- (b) What are three levels of planning that involve operations managers? What kinds of decisions are made at the various levels? (10)
- (c) The product structure tree for end item E follows. The manager wants to know the material requirement for ordered part R that will be needed to complete 120 units of E by the start of week 5. Lead times for items are one week for level 0 items, one week for level 1 items and two weeks for level 2 items. There is a scheduled receipt of 60 units of M at the end of week 1 and 100 units of R at the start of week 1. Lot for lot ordering is used. (15)



8. (a) What factors are to be considered while selecting a region for facility location? (10)
- (b) What are the main objectives of work center scheduling? (5)
- (c) Ballston Electronics manufacturers small electrical devices. Products are manufactured on five different assembly lines (1, 2, 3, 4, 5). When manufacturing is finished, products are transported from the assembly lines to one of the five different inspection areas (A, B, C, D, E). Transporting products from five assembly lines to five inspection areas requires different times (in minutes). Develop an assignment plan that will minimize the transportation time. (20)

Assembly line	Inspection area				
	A	B	C	D	E
1	10	4	6	10	12
2	11	7	7	9	4
3	13	8	12	14	15
4	14	16	13	17	17
5	19	11	17	20	19

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

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 – AThere are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Suppose you have to select a set of engineering materials for a safe pressure vessel. With proper modeling select some materials using the chart shown in Fig. 1. (20)
 (b) Suggest suitable materials with reason of your selection for the production of any three of the following machine components: (15)
 - (i) Crank shaft used in a truck
 - (ii) Propeller blade used in a ship
 - (iii) Liner used in a ball mill of cement factory
 - (iv) Turbine blade used in a power plant
 Mention also their production route.

2. (a) Distinguish between ferritic stainless steel and martensitic stainless steel with respect to their composition and transformation characteristics. (18)
 (b) What is meant by the term 18/8 stainless steel? Can this steel be hardened by heat treatment? Give reasons for your answer. (11)
 (c) Which stainless steel is best suited for (i) pump shaft, (ii) surgical instrument and (iii) food processing equipment? Give reasons for your answer. (6)

3. (a) Distinguish between hot work tool steel and high speed tool steel. Mention the functions of alloying elements present in them. Describe briefly how '18-4-1' type high speed tool steel is hardened by heat treatment and the microstructural changes that occur during heat treatment. (25)
 (b) Discuss how 'faulty steel' and 'faulty heat treatment' cause tool failure? Suggest their probable remedies. (10)

4. Answer any two of the following: (17 1/2 × 2 = 35)
 - (a) The yield strength and tensile strength of annealed 25% nickel grade of maraging steel are respectively about 40000 psi and 132000 psi. After maraging treatment, yield strength and tensile strength are increased to about 250000 psi and 270000 psi respectively. Explain the heat treatment cycle you will follow to achieve such a higher strength while maintaining adequate level of ductility.

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Contd ... Q. No. 4

- (b) What are the requirements of HSLA structural steels? Discuss briefly the factors that control the yield strength and toughness of HSLA structural steels.
- (c) Draw and discuss the industrially important part of Cu-Zn equilibrium diagram. Describe the effect of tin, manganese and nickel additions to plain brass. Mention the application of phosphor bronze, naval brass and German silver.

SECTION - B

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

5. (a) Distinguish between magnetic-hard and magnetic-soft alloys. Discuss the factors that affect the magnetic hardness of an alloy. (18)
- (b) Discuss the important magnetic hard alloys with their approximate compositions, properties and applications. (17)
6. (a) Define performance indices. Discuss the procedure for selecting materials in the basis of primary constraints and performance maximising criteria. (18)
- (b) Briefly discuss the design flow chart showing how important design tools and materials selection are at different stages. (17)
7. (a) What do you understand by materials selection chart? (7)
- (b) In a modulus-density chart for materials, different types of materials, such as metals, polymers and elastomers, occupy different positions. Explain the reasons for such differences. (20)
- (c) Differentiate between K-Monel and R-Monel. (8)
8. (a) Briefly discuss different heat treatment procedures for K-Monel. (8)
- (b) Briefly describe the important properties of inconel. (8)
- (c) Describe the general requirements of a bearing metal. (10)
- (d) Write down the important characteristics of Ni-base alloys. (9)

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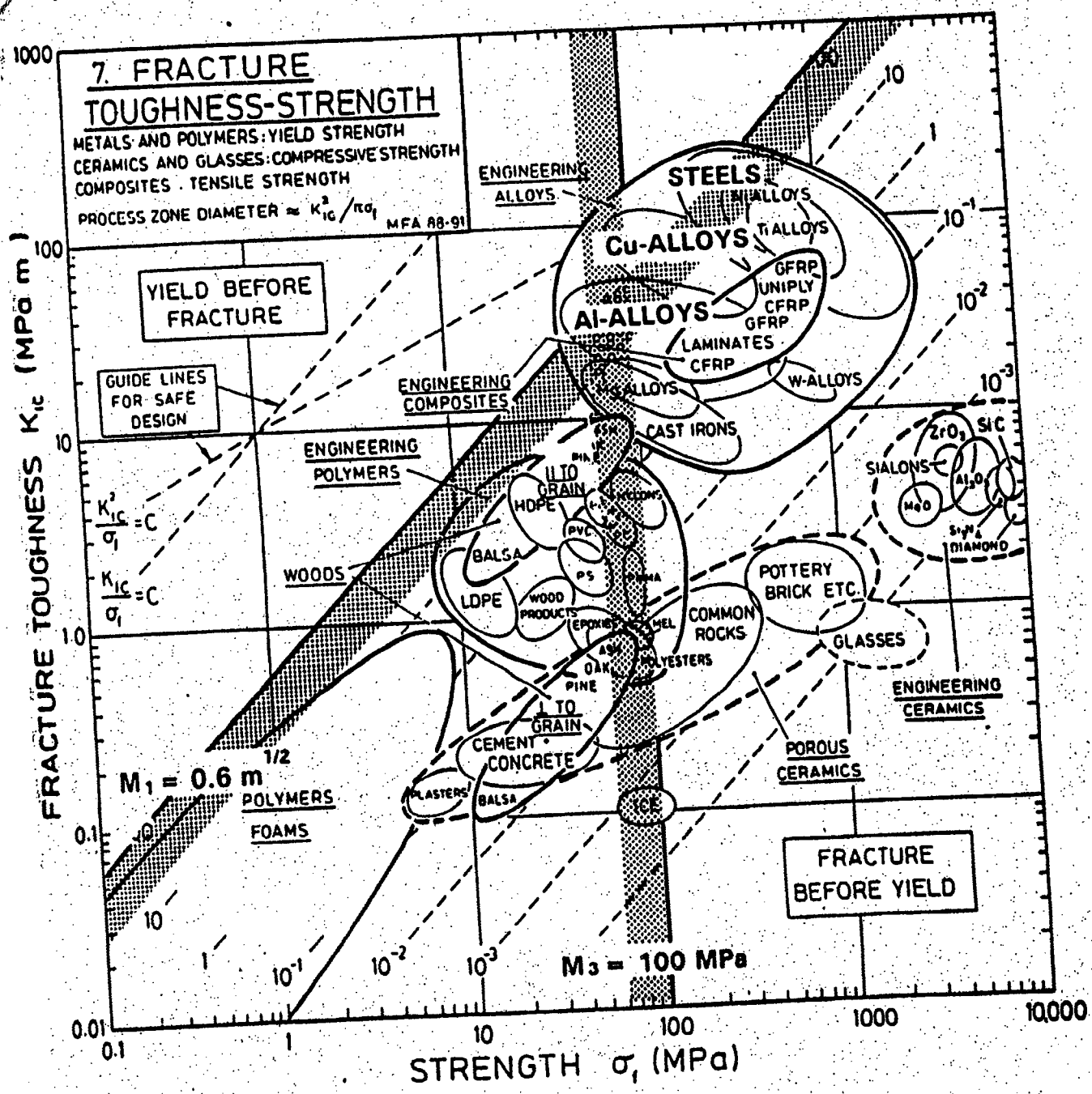


Fig. 1 for Q. No. 1(a)