

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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

Full Marks : 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – AThere are **EIGHT** questions in this section. Answer any **SIX**.

The questions are of equal value.

1. In industrial metal working operations control in both the macro and micro scale changes are getting more and more challenging – explain. How does high level of work hardenability ensure proper shaping of a complex product?
2. Discuss the influence of magnesium and copper on the dislocation movement in aluminium alloy. Both pure iron and austenitic stainless steel are deformed at 950°C. At this temperature the activation energy of pure iron (grain size 20 μm) and austenitic stainless steel; (grain size 12 μm) are 300 kJ/mole and 450 kJ/mole respectively. Find out the strain rate will result dynamic recovery in austenitic stainless steel equal to that in pure iron. Consider the relation between grain size and Zener-Hollomor constant to be: $d = 140 - 7.5 \log z$. Assume reasonable value for any missing data.
3. A carbon steel billet (0.25%C) is to be hot rolled for production of TMT bar. Discuss the effects of initial and finishing temperatures on the microstructures and properties of the bar. Briefly discuss the effects of Cu and Sn addition on the surface finish of hot worked stele bar.
4. Briefly discuss the importance of forming limit diagram in sheet metal working. The forming limit deformation of a steel sheet of 0.8 mm thickness is 0.3 mm. Calculate the strain hardening exponent of this sheet steel. Assume reasonable value for any missing data.
5. Explain how the friction forces between rolls and workpiece is responsible for the forward movement of the workpiece. With necessary freebody diagram of a typical rolling process show that $\mu = \tan\alpha_c$. All symbols have their usual meaning.
6. What do you understand by the term "plane stress flow stress"? A sheet of 0.6 m wide and 3 mm thick is rolled to 2.4 mm in a single pass using 30 cm diameter rolls by applying 750 MPa compressive stress and 30 MPa back tension. If the co-efficient of friction is 0.075, what will be the plane stress flow stress of the sheet material? Assume reasonable value for any missing data.

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7. What do you understand by the term "mean-absolute draught" and "mean relative draught" in roll pass design? A 0.2%C steel round billet of 120 mm diameter and 6 m long is rolled to 30 mm rod with six passes of the following sequences:

No. of passes :	0	1	2	3	4	5	6
Diameter, mm	120	100	80	60	50	40	30

The initial temperature of the billet was 950°C and the rolling time for the first pass was 5 sec. For subsequent passes, the rolling time was proportional to the length of the rolled product. The average specific heat of the billet material is 0.166 Kcal/kg°C for the temperature range 800 – 1000°C. Calculate the final temperature of the hot rolled bar and also draw the final microstructures of the normalized bar. Assume reasonable value for any missing data.

8. With necessary diagram discuss the effect of strain rate co-efficient on the variation of the thickness of superplastically formed sheet product. What is the mechanism of grain boundary cavity formation during superplastic forming?

SECTION – B

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

The figures in the margin indicate full marks.

9. (a) Draw the forging load vs. forging strokes curve of a typical closed die forging processes. (7)
 (b) Discuss various metallurgical factor that might influence the forgeability of engineering alloys. (20)
 (c) Write down the advantages of powder metallurgy forging. (8)
10. (a) Draw the curves of extrusion pressure vs ram travel for direct and indirect extrusion and explain them briefly. (10)
 (b) Discuss different types of extrusion defects and their remedies. (18)
 (c) What is upper hot working temperature for extrusion? (7)
11. (a) With a neat sketch, discuss the function of the different parts of a drawing die. (12)
 (b) For open die forging show that $1 - s = \frac{\ln(l_1/l_0)}{\ln(h_0/h_1)}$. All symbols have their usual meaning. (13)
 (c) Briefly describe the pattern of residual stress that are found in cold drawn rod and tubes produced by tube sinking. (10)
12. (a) What do you understand by the term forgeability. Briefly describe two methods that can be followed to improve forgeability. (12)
 (b) What is extrusion ratio? (8)
 (c) Write short note on: (15)
 (i) Cupping
 (ii) Cold shut

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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

1. (a) Describe briefly the ionic conduction mechanism in ceramics. (8)
- (b) Give a brief account on doped-ZrO₂ based oxygen sensor. (12)
- (c) Mention the required physical and chemical properties of anode, cathode and electrolyte materials for solid-oxide fuel cell (SOFC) and also mention appropriate examples. (15)

2. (a) Distinguish between type I and type II super conductors. (7)
- (b) Write short notes on 'Meissner' effect and 'Josephson' junction. (8)
- (c) "Microstructure of Bi₂O₃ based ZnO varistor controls its electrical behavior" – Explain. (20)

3. (a) Present a comparative analysis on Beta (β) and Beta'' (β'') alumina for their applicability in sodium ion battery. (17)
- (b) Calculate theoretical saturation magnetization (emu/g) of Ni_{1-x} Zn_x Fe₂O₄; when x = 0.25, 0.35 and 0.45. (18)

4. (a) Classify bioceramics according to their reactivity in body fluids. (5)
- (b) Discuss various aspects of using SiO₂ – Na₂O – CaO – P₂O₅ glasses in bioactive implants. (15)
- (c) Briefly describe the in-situ use of radioactive YAS glasses for cancer treatment. (15)

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

5. (a) Which parameters control the dielectric constant of BaTiO₃? Describe the possible polarization mechanisms in a dielectric ceramic materials. (25)
- (b) Mention some device applications utilizing direct and indirect effects of piezoelectric ceramics. (10)

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6. (a) Why class 3 capacitors have very high dielectric constant compared to class 2 capacitors. Explain briefly the fabrication process of Multilayer Chip Capacitors (MLCCs). (20)
- (b) Describe briefly the fabrication process of optical glass fibers by chemical vapor deposition (CVD) technique. (15)
7. (a) Explain the sol-gel processing for ceramic power production. (17)
- (b) Give brief outline of a suitable process for the production of (18)
- (i) SiC powder
- (ii) SiC fiber
8. (a) Why do pure zirconia and fully stabilized zirconia not show any toughening behaviour? (10)
- (b) Briefly describe the toughening mechanisms associated with fiber reinforced ceramic composites. (25)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) piston pin used in car
 - (ii) propeller blade used in a ship
 - (iii) liner used in a boll mill of cement factory
 - (iv) transmission gear of a helicopter
 - (v) turbine blade used in a power plant.
- Mention also their production route.
2. (a) Distinguish between martensitic stainless steel and ferritic stainless steel with respect to composition and transformation characteristics. Suggest suitable materials for making (i) pump shaft and (ii) furnace parts. Give reasons for your answer. (20)
- (b) What is meant by the term "Precipitation hardening stainless steel"? Explain the TH and RH hardening sequences of 17-7 PH grade of stainless steel with microstructural changes and their subsequent effect on properties. (15)
3. Answer any two of the following: (17 $\frac{1}{2}$ × 2)
- (a) Distinguish between hot work tool steel and cold work tool steel. Discuss the characteristics of hot work tool steels used in forging, extrusion and die casting.
 - (b) What is meant by the term '18-4-1' steel? Discuss briefly how 18-4-1 steel is hardened by heat-treatment and the microstructural changes that occur during heat-treatment.
 - (c) 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 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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4. (a) Draw and discuss the industrially important part of Cu-Zn equilibrium diagram. Describe the effects of tin and nickel addition to plain brass. Mention the application of phosphor bronze. (20)
- (b) What are the requirements of HSLA structural steels? Discuss the effect of grain size and precipitation on the yield strength and toughness of HSLA structural steels. (15)

SECTION – B

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

5. (a) Discuss in your opinion why nickel-base alloy is an important commercial choice for service conditions combining good engineering properties and resistance to several forms of corrosion except in reducing environment. (18)
- (b) Briefly describe important properties of wrought monel metals. Also, write a short note on different heat treatment procedures for K-Monel. (17)
6. Answer any two of the following: (17 1/2 × 2)
- (a) Distinguish between magnetic-hard and magnetic-soft alloys. Discuss the factors that affect the magnetic hardness of an alloy.
- (b) Discuss properties of commercially important magnetic-hard alloys.
- (c) Describe the significance of duralumin in aircraft industries. Also, explain the heat treatment schedules to strengthen duralumin.
7. (a) Discuss about design flow chart. Explain how design tools and materials data guide to obtain product following market need. (18)
- (b) Draw a schematic strength-density materials selection chart, and label regions for metal groups and polymer groups. Also, explain, in terms of density and strength, the reasons for different positions of metal group and polymer group in this chart. What is the reason for using logarithmic scale in this chart? (17)
8. (a) Define performance indices. (9)
- (b) Discuss with examples the procedure for selecting materials on the basis of primary constraints and performance maximising criteria. (17)
- (c) Derive the performance index for a cylindrical tie rod loaded axially in compression. (9)
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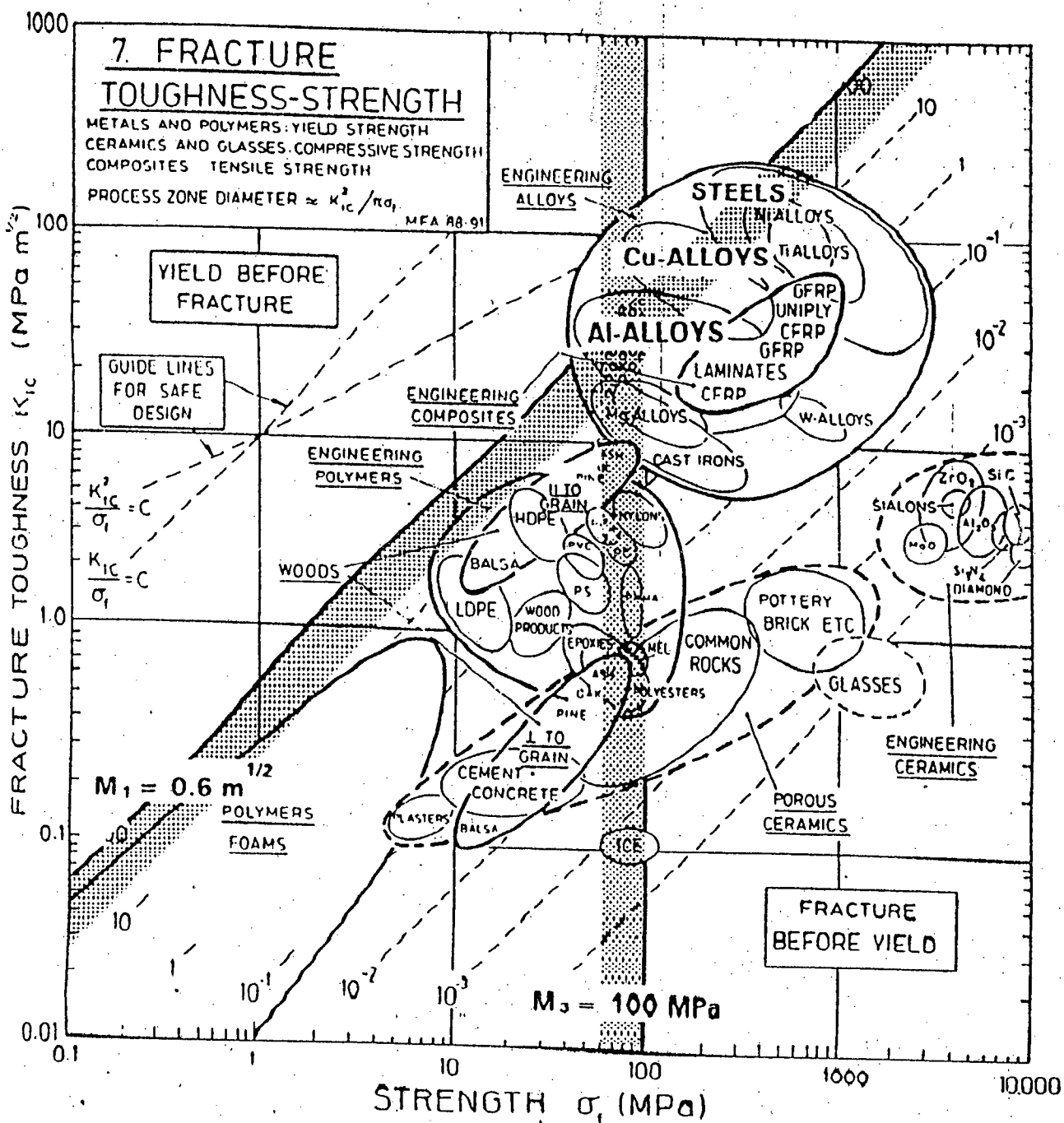


Fig. 1 for Q. No. 1(a)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) Contrast push and pull methods of moving goods and materials through production systems. (10)
- (b) The Dine Corporation is both a producer and a user of brass couplings. The firm operates 220 days a year and uses the coupling at a steady rate of 50 per day. Coupling can be produced at a rate of 200 per day. Annual storage cost is \$2 per coupling, and machine setup cost is \$70 per run. (10)
 - (i) Determine the economic run quantity.
 - (ii) Approximately how many runs per year will there be?
 - (iii) Compute the maximum inventory level.
 - (iv) Determine the length of the pure consumption portion of the cycle.
- (c) What advantages as a forecasting tool does exponential smoothing have over moving averages? (5)
- (d) What are the elements of JIT? (10)

- 2. (a) Explain briefly how JIT systems differ from traditional production system. (10)
- (b) Explain the location decision factors in location planning. (10)
- (c) What are the application of Geographic Information System (GIS) in location planning? (5)
- (d) The owner of a small hardware store has noted a sales pattern for window locks that seems to parallel the number of break-ins reported each week in the newspaper. The data are: (10)

Sales	46	18	20	22	27	34	14
Break-ins	11	5	5	7	6	7	4

- (i) Obtain a regression equation for this data.
- (ii) Estimate sales when the number of break-ins is Nine.

- 3. (a) What are the assumptions of basic EOQ model? (5)
- (b) Briefly describe each of the costs associated with inventory. (10)
- (c) Describe briefly the A-B-C approach to inventory control. (10)
- (d) A mail-order house uses 18,000 boxes a year. Carrying costs are 5 cents per box a month, and ordering costs are \$96. The following price schedule applies. Determine (10)
 - (i) The optimal order quantity.
 - (ii) The number of orders per year

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Contd ... Q. No. 3(d)

Number of Boxes	Price per Box (P)
1,000 – 1,999	\$1.25
2,000 – 4,999	\$1.20
5,000 – 9,999	\$1.15
10,000 +	\$1.10

4. (a) Job times (including processing and setup) are shown in the following table for five jobs waiting to be processed at a work center: (10)

Job	Job Time (hours)	Due Date (hours)
a	12	15
b	6	24
c	14	20
d	3	8
e	7	6

- (i) Determine the processing sequence that would result from EDD and SPT.
- (ii) Determine each of the following performance measures for first-come, first-served processing order: (I) Makespan (II) Average flow time (III) Average tardiness (IV) Average number of jobs at the workstation.

(b) Briefly describe project life cycle and work breakdown structure. (10)

(c) A construction project is broken down into the following 10 activities: (15)

Activity	Time (weeks)	Immediate Predecessors
1	4	-
2	2	1
3	4	1
4	3	1
5	5	2, 3
6	6	3
7	2	4
8	3	5
9	5	6, 7
10	7	8, 9

- (i) Draw the network diagram.
- (ii) Find the critical path and calculate the project completion time.
- (iii) If activities 1 and 10 cannot be shortened, but activities 2 through 9 can be shortened to a minimum of one week each at a cost of \$10000 per week, which activities would you shorten to cut the project by four weeks.

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SECTION – B

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

5. (a) What is forecasting? How do you classify forecasting methods? Briefly explain them. **(10)**

(b) The monthly sales for Telco Batteries, Inc., were as follows: **(10)**

Month	Sales
January	20
February	21
March	15
April	14
May	13
June	16
July	17
August	18
September	20
October	20
November	21
December	23

Forecast January sales using each of the following:

(i) A 3-month moving average

(ii) A 6-month weighted moving average using weight of 0.1, 0.1, 0.1, 0.2, 0.2 and 0.3.

(c) The sales of pen-drive Company for the last 8 months are given below. Determine the equation of the trend line and forecast sales for 9th, 10th, 11th and 12th month. The actual sales for these four months were 1000, 800, 700, 700. Also calculate MAD, CFE, MSE and TS for these four months. **(15)**

Month	Sales
1	1000
2	1200
3	900
4	1100
5	1050
6	1250
7	950
8	1230

6. (a) Describe the basic type of layouts in manufacturing. Differentiate product layout from process layout. **(15)**

(b) The following tasks and the order in which they must be performed according to their assembly requirements are shown in the following table. These are to be combined into workstation to create assembly line. The assembly line operates 7.5 hours per day. The output requirement is 2000 units per day. **(20)**

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

Task	Preceding Task	Time (seconds)
A	--	15
B	A	24
C	A	6
D	B	12
E	B	18
F	C	7
G	C	11
H	D	9
I	E	14
J	F, G	7
K	H, I	15
L	J, K	10

- (i) Draw the precedence diagram.
- (ii) What is cycle time?
- (iii) Calculate minimum number of workstation needed.
- (iv) Balance the line using longest task time.
- (v) What is the efficiency of your line balance?

7. (a) What do you understand by bottleneck operation? **(10)**
- (b) What is strategic capacity planning? Differentiate between design capacity and effective capacity. **(10)**
- (c) What is cost volume analysis? Explain its importance with equation and graphs. **(15)**
8. (a) What is a lean system? Briefly explain the building blocks of a lean system. **(8)**
- (b) What are the wastes in a lean system? Explain. **(10)**
- (c) Determine the number of containers needed for a workstation that uses 100 parts per hour if the time for a container to complete a cycle (move, wait, empty, return, fill) is 90 minutes and a standard container holds 84 parts. Inefficiency factor of 0.10 is currently being used. **(7)**
- (d) Explain the Toyota approach to lean operations. **(10)**

SECTION – A

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

1. (a) Describe few characteristic properties of bearing materials and specify some bearing alloys mentioning the role of each element. (10)
 (b) Name various mechanisms of lubrication in bearing materials. Explain hydrodynamic lubrication mode. Mention requirements to fulfill hydrodynamic conditions. (13 $\frac{1}{3}$)

2. (a) What is cemented carbide? Discuss the production of cemented carbides with flow sheet. (10)
 (b) Describe with graphs how the mechanical and thermal properties of tungsten-carbide are enhanced with the addition of cobalt and titanium-carbide. (8)
 (c) Write a short note on the uses of nano and ultrafine grade cemented carbide in printed circuit board (PCB) industry. (5 $\frac{1}{3}$)

3. (a) Why ferrites are important magnetic materials? Explain the crystal structure of garnet ferrites. (8)
 (b) Based on cation distribution, calculate the spin-only-magnetic-moments of garnets $Y_3Fe_5O_{12}$ (YIG) and $Gd_3Fe_5O_{12}$ (GdIG) in Bohr magneton. (7)
 (c) Briefly describe the synthesis of iron oxide nanopowder by chemical co-precipitation method and mention its biomedical applications. (8 $\frac{1}{3}$)

4. (a) Describe in detail the synthesis and fabrication of uranium-plutonium (U-Pu) O_2 nuclear fuel elements for power reactor by powder metallurgical process. What are the advantages of sol-gel over the powder metallurgical route? (15)
 (b) Explain briefly the wet chemical method to produce gold nanoparticles. Write some applications of gold nanoparticles in electronics diagnostics, catalysis and hyperthermia. (8 $\frac{1}{3}$)

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SECTION – B

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

5. (a) Discuss the advantages and disadvantages of powder metallurgy process. (7 1/3)
- (b) Write down the design guidelines that should be followed for the manufacturing of powder metallurgy products. (6)
- (c) What is double-action dry pressing process? Compare between hot pressing and isostatic pressing. (10)
6. (a) Suggest a pressing process that is suitable for the compaction of alumina powder. (4)
- (b) How does attrition milling differ from other conventional ball milling? (5 1/3)
- (c) Explain how powders are produced by freeze-drying process. (14)
7. (a) Discuss the manufacturing process of nano-structural ultra-soft magnetic materials from amorphous precursor. (15)
- (b) Explain the rapid solidification process. (5 1/3)
- (c) Mention the criteria of sintering. (3)
8. (a) Explain the sintering stages. (9 1/3)
- (b) What are the challenges for manufacturing of nanocrystalline ceramic materials? Discuss a suitable process that can be used to fabricate nanocrystalline ceramic products. (14)
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