BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examination 2018-2019

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

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

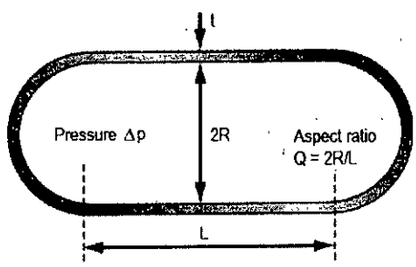
SECTION – A

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

1. (a) Car bumpers are used as mobile barriers to protect drivers and passengers of road vehicles. In an impact, the barrier is loaded in bending. Its function is to transfer load from the point of impact to the support structure, where reaction from the foundation or from crush elements in the vehicle supports or absorbs it. To do this, the material of the barrier must have high yield strength, be adequately tough, and able to be recycled. The barrier must meet these constraints with the minimum mass as the objective, since this will reduce the overall life energy most effectively. Determine the material index for this static barrier. **15**

(b) Use a limit stage to apply the constraints on fracture toughness K_{1C} = 18 MPa.$\sqrt{m}$ and the requirement of recyclability. Then use yield strength - density chart (Figure 1) and apply a selection line with the appropriate slope to represent the index for the mobile barrier. List what you find to be the best three candidates. **15**

2. (a) Trucks rely on compressed air for braking and other power-actuated systems. The air is stored in one or a cluster of cylindrical pressure tanks like that shown in the figure below (length L, diameter 2R, hemispherical ends). Most are made of low carbon steel and are heavy. The task is to explore the potential of alternative materials for lighter air tanks. **15**



For simplicity, tensile stress in the wall is

$$\sigma = \frac{R\,\Delta p}{2t}$$

The first constraint is that the tank should not yield—that is, the tensile stress in the wall should not exceed σ_y. The second is that it should not fail by fast fracture; this requires that the wall stress be less than

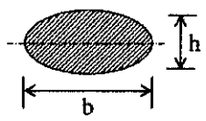
$$\frac{K_{1c}}{\sqrt{\pi c}}$$

where K_{1C} is the fracture toughness of the material of which the tank is made and c is the length of the longest crack that the wall might contain. Use each of these constraints to identify two material indices and a coupling relation between them.

(b) Data for three possible candidates for the tank are listed in the following table. Use these to identify candidate materials when Δp = 250 MPa, R = 75 mm, L = 300 mm, and c = 5 mm. **15**

Material	Density ρ, kg/m^3	Yield strength σ_y, MPa	Fracture toughness K_{1c}, MPa$\sqrt{m}$
Mild steel	7850	315	20
Low alloy steel	7850	775	100
Ductile iron	7150	250	38

3. (a) Derive shape efficiency factors of the following shape for both stiffness-limiting and strength-limiting design in bending. Given that A, I and Z for the given shape are $\pi bh/4$, $\pi bh^3/64$ and $\pi bh^2/32$ respectively. **10**



(b) A beam of length L, loaded in bending, must support a specified bending stiffness S and be as light as possible. Show that to minimize the mass of the beam, one should select a material and a section-shape to maximize the quantity **20**

$$\frac{(\phi_B^e E)^{1/2}}{\rho}$$

As a thumb-rule, bridges are designed with a bending stiffness S such that the central deflection δ of a span under its self-weight is less than 1/300 of the length L (thus $S \geq 300$ mg/L, where m is the mass and g is the acceleration due to gravity, 9.81 m/s^2). Use this information to calculate the minimum shape factor ϕ_B^e necessary to make a bridge of span L = 132 m and mass m = 650 tonnes. Use ρ = 7900 kg/m^3, E = 205 GPa, and C_1 = 76.8.

4 (a) Discuss how microscopic shape of material play its role in determining structural efficiency of solid. **10**

(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 **20**

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

SECTION – B

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

5 (a) 'Iteration, looping back to explore alternatives, is an essential part of the design process.'- Explain the assertion. **10**

(b) In strength-limited applications, deflection is acceptable provided that the component does not fail; strength is the active constraint. Derive the material index for selecting materials for a beam (Figure 2) of length L, specified strength and minimum weight. **14**

(c) 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. **06**

6. (a) Suppose you have ordinary low carbon steel (%C<0.2) and the option of adding C, Ni, Cr, Mo, W and V as alloying elements. Your target is to make steel blades suitable for surgical and dental instruments. State with clear reasoning(s) which alloying elements you will add and provide typical grade of the selected material. **20**

(b) 'Micro-alloyed high strength low alloy steels outshine the carbon and high strength low alloy steels in producing concrete reinforcing bars.'- Do you agree or disagree with this statement? - Justify your answer with appropriate explanations. **10**

7. (a) Select a tool steel which to be used as a cutting tool and must have high hardness, wear resistance and resistance to softening at elevated temperature. Mention the typical grade and effect of the alloying elements that should be present in the selected tool steel. **14**

(b) Between Muntz Metal and Naval Brass, which one is suitable for salt-water environment applications and why? **06**

(c) Suggest a non-ferrous material with appropriate reasoning(s) for designing a turbine blade which has to withstand an operating temperature of around 1500°C and the problems associated with creep and fatigue. **10**

8. (a) Between 7075 and 713.0 aluminum alloys, which one will you choose for making automotive parts when you don't have access to solution hardening and you can't cold roll the product? **10**

(b) Select a suitable material with appropriate reasoning(s) for spring applications from the following Titanium-based materials: **20**

(i) Grade 2
(ii) Grade 11
(iii) Ti-3Al-2.5V
(iv) Ti-6Al-4V
(v) Ti-3Al-8V-6Cr-4Mo-4Zr

The selected material must fulfill the following criterions:

- Must have good forming and shaping characteristics
- Must have good resistance to hydrogen embrittlement
- Must have good ductility (minimum elongation 500%)
- Must be solution treatable

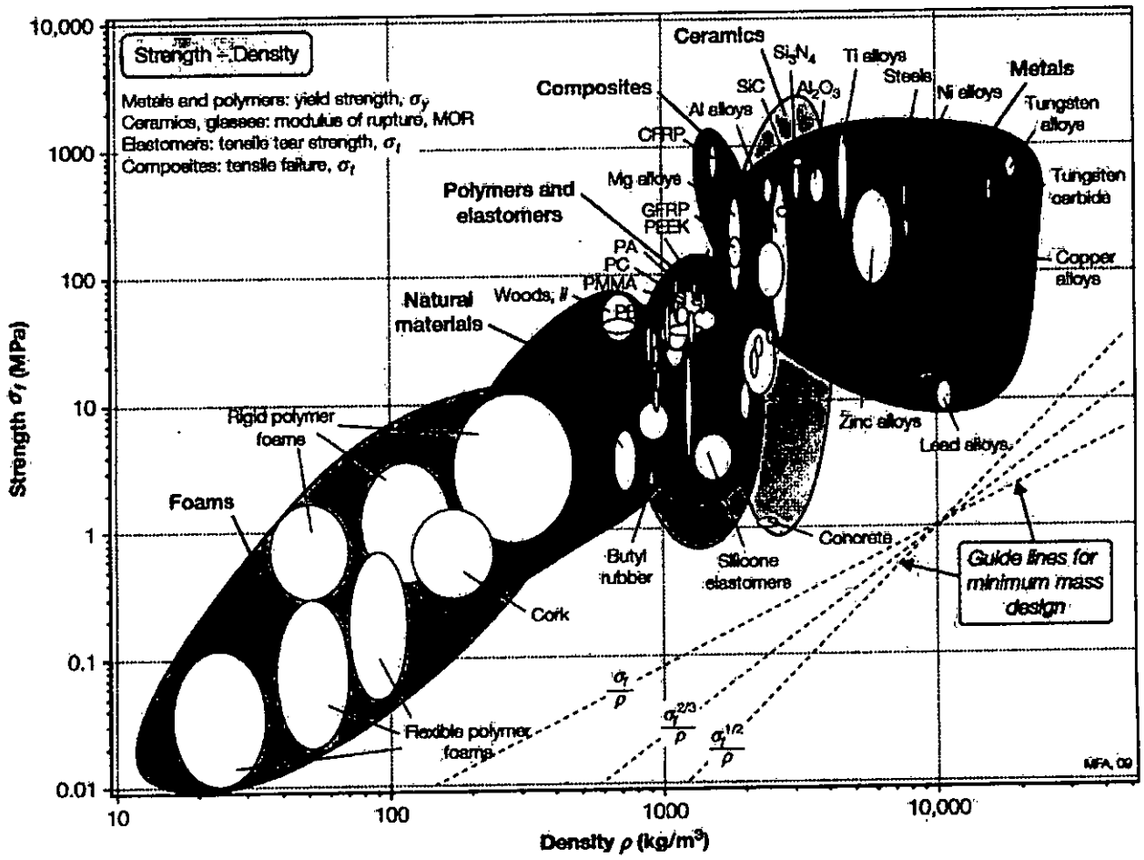


Figure 1 for Question 1(b)

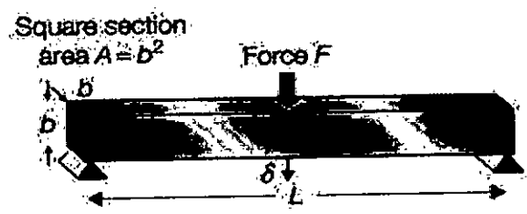


Figure 2 for Question 5(b)

L-4/T-2/MME Date: 09/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examination 2018-2019

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

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

(THIS IS AN OPEN-BOOK EXAM)

SECTION-A

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

1. With increase in the dislocation density, metal shaping in the reverse stress system increases the cold workability of most of the engineering materials, however, the life of the product under cyclic loading condition decreases. Explain the underlying reasons of such behaviours of the material under reverse shaping system and cyclic loading condition. **(30)**

2. A steel wire of AISI 1080 steel should bear at least 800MPa stress before yielding. Design a suitable cold working schedule for the targeted product. If 1.5% manganese and 1.0% silicon are added in the steel, what changes are needed to make in the cold rolling process? Use Figs.1 and 2 for necessary data. Consider the stock material is in normalized condition. Assume reasonable value for any missing data. **(30)**

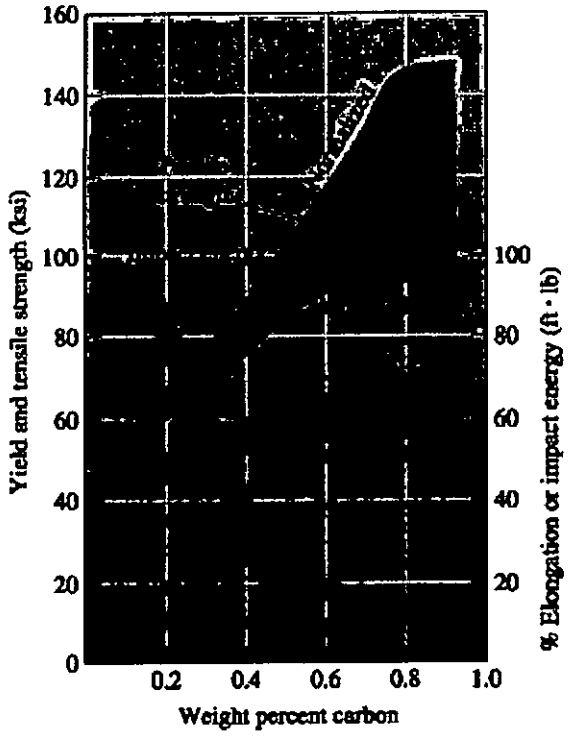


Figure 1 for Question Number 2.

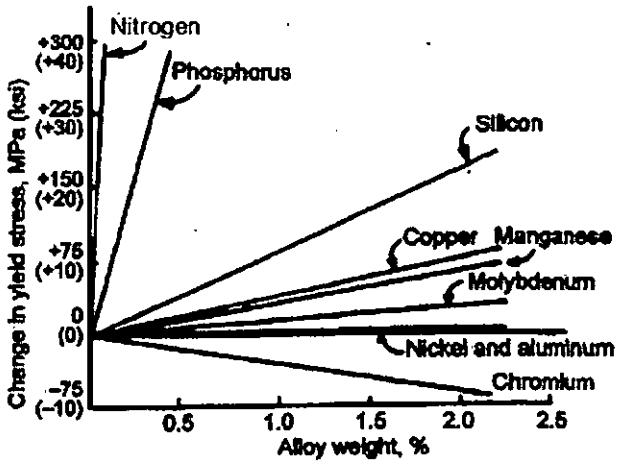


Figure 2 for Question Number 2.

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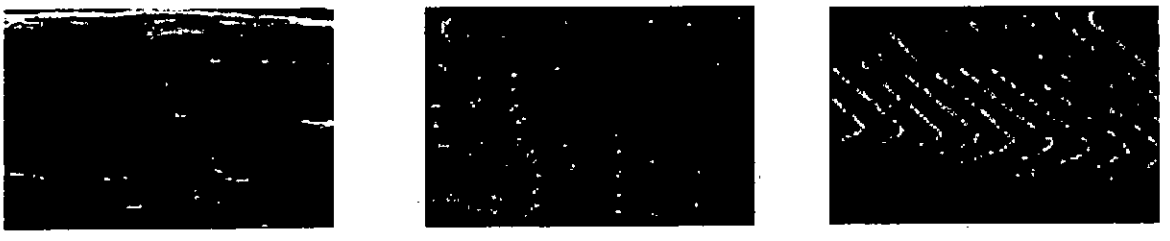
3. Grain flow patterns of three knives are shown in Fig.3. Carefully observe these grain flow patterns and explain (with necessary sketches) how these grain flow patterns are possible to incorporate in the microstructures of the finished products. Also explain which one will be the best choice for cutting operation under impact and steady frictional loading. In the Fig.3, the bottom sides are the cutting edges of the knives. **(30)**



(a) (b) (c)

Figure 3 for Question Number 3.

4. A low carbon steel (yield strength 300MPa) work piece of 100mm width (Fig.4) and 10mm thickness is to be forged. Calculate the forging pressure at five different positions (1, 2, 3, 4 and 5) of the work piece from one edge toward the centre and draw the friction hill curve on a plane graph paper. **(30)**

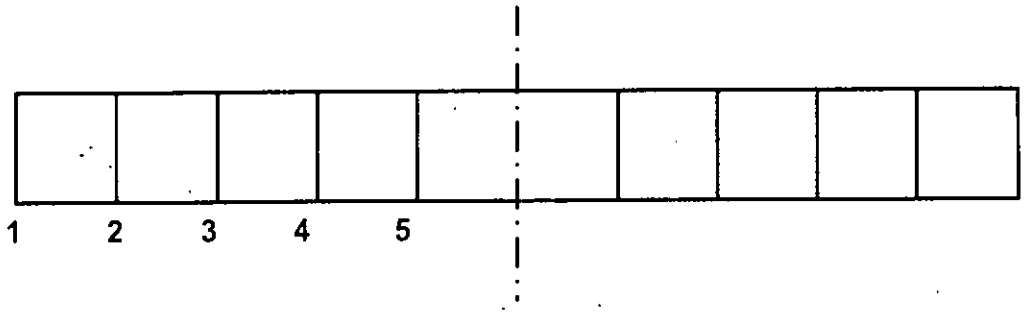


Figure 4 for Question Number 4.

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MME 447

SECTION-B

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

5. How does TMCP allow to control strength of a micro-alloyed steel? Your judgement would focus on grain refinement and toughness. Between Ti and Nb, which element would you choose for TMCP of steel? Fairly assess your answer. Also, how do you obtain a dual-phase steel microstructure? **(30)**

6. It has been stated that during wiredrawing of carbon steel, curling effects may be observed. Is it limited only to carbon steels? Is it possible to obtain curling effect for non-ferrous alloys – such as magnesium alloys? Consider your response based on information provided in your class materials. Also, how does wire drawing process vary from extrusion process? Write down your critical thinking on this based on operational schematics and deformation behaviour. **(30)**

7. You want to extrude an aluminium alloy – say 2XXX series – for producing cross-sections for window railings. There are four types of extrusion methods: direct extrusion, indirect extrusion, impact extrusion and hydrostatic extrusion. Which process would suit your requirement better (in terms of superior product quality)? Design the process by showing a schematic diagram of operation and explaining its outstanding features. **(30)**

8. In metallurgical terms, how does rolling process differ from forging process? Your evaluation would focus on deformation behaviour, process sequence, and mechanical properties obtainable. If the final product material is MS sheet of thickness 0.2 mm, and you want to keep your product in coils, which working process would you choose and why? **(30)**

L-4/T-2/ MME Date: 12/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examination 2018-19

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

Full Marks: 120 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) Explain how microstructure is developed by the formation of grain and elimination of pores during solid phase sintering starting with loose powder. **(12)**

   (b) During intermediate-stage sintering, there are spherical pores of radius r located at the edge of the grains of size G. A condition is arises where the porosity does not change, but grain growth and pore growth continue. What is the required relation between the rates of pore and grain coarsening that to occur? **(8)**

2. (a) How is activated sintering performed to enhance the sintering rates? **(10)**

   (b) Discuss how crystallization of Ni—Zr amorphous alloys by mechanical milling is performed. **(10)**

3. (a) Ni-Zn ferrite as soft magnetic materials is used in transformer and inductor cores. Describe the manufacturing method of Ni-Zn ferrite by powder metallurgy process. **(10)**

   (b) Dry-lubricated bearings are mostly used where a liquid lubricant cannot be tolerated such as in the food processing, pharmaceutical and textile fields. Explain this assertion. Write down the steps of fabrication of bearing materials. **(10)**

4. (a) The classical method of production of cemented carbide tips is the double sintering process. Briefly explain the method. List the causes of failure of cemented carbide tips. **(12)**

   (b) Discuss briefly the materials and process competition need to consider in designing a component to be made by powder metallurgy technique. **(8)**

SECTION-B

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

5. (a) With a neat sketch show the powder elements in powder metallurgy terminology. List the basic characteristics of metal powders. How does the shape of powders influence the apparent density and flow rate? **(11 1/2)**

   (b) Why is preliminary heat treatment necessary before mixing or blending of metal power? Differentiate between high temperature and low temperature heat treatment. **(8 1/2)**

6. 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. **(11 1/2)**

   (b) Explain how cobalt powders are precipitated by hydrometallurgical method. **(8 1/2)**

7. (a) If powders are of different specific gravities, the heavier one will be separated and fall to the bottom of the mixture. Explain how you will obtain a uniform mixture of powders having different specific gravities. **(11 1/2)**

   (b) Suggest a pressing process that is suitable for making spark plug insulators. Describe the process with neat sketch. **(8 1/2)**

8. (a) Describe a method of shaping technique that is used for the production of ceramic articles. **(11 1/2)**

   (b) What is the effect of stress distribution on the products compacted by unidirectional pressing and isostatic pressing? **(8 1/2)**

L-4/T-2/ MME

Date: 23/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B.Sc. Engineering Examination 2018-2019

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

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) 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 $= 1.6 \times 10^{-19}$ J and Boltzmann's constant (k) $= 1.38 \times 10^{-23}$ J/K. **(12)**

   (b) Write the defect reactions:

   i. Dissolution of Nb_2O_5 in TiO_2

   ii. For the formation of fully ionized oxygen vacancies and electrons when oxygen is lost in the reaction, $MO_2 (s) = MO_{2-x} + (x/2)\ O_2 (g)$. **(4+4=8)**

   (c) How can you make better thick film using tape casting process? **(10)**

2. (a) 'Dielectric constant varies in wider range for different materials.' Explain this phenomenon with two suitable examples. **(7)**

   (b) A stoichiometric oxide, M_2O_3 has a band gap of 5 eV. The enthalpy of Frenkel defect formation is 2 eV, while that for Schottky defect formation is 7 eV. Further experiments have shown that the only mobile species are cation interstitials, with a diffusion coefficient $D_{M,\,int}$ at 1000K equals to 1.42×10^{-10} cm^2/s. The mobilities of the holes and electrons were found to be 2000 and 8000 $cm^2/$ (V.s), respectively. The density of states for holes and electrons is of the order of 10^{22} cm^{-3}. At 1000K, would you expect this oxide to be an ionic, electronic or mixed conductor? Justify your conclusion with proper calculation. Assume that number of interstitial sites is equal to twice the number of atomic sites. Additionally, the molecular weight of the oxide is 40 g/mole, density = 4 g/cm^3, 1 eV= 1.6×10^{-19} J. Assume any relevant data. **(15)**

   (c) Illustrate the effect of oxygen partial pressure on the conductivity of non-stoichiometric ceramics. **(8)**

3. (a) Show that nonmagnetic Zn substitution in $Cu_{1-x}Zn_xFe_2O_4$ ferrites (where x = 0, 0.2, 0.4, 0.6, 0.8 and 1) increases the theoretical magnetic moments gradually. Explain why experimental values decrease when $x \sim 0.5$ with the help of Yafet-Kittel model. Atomic number of Zn, Cu, Fe is 30, 29 and 26 respectively. **(15)**

   (b) Calculate the saturation magnetic moments and lattice parameters of $Zn_xCu_{1-x}Fe_2O_4$ mixed spinel ferrite. r_{Zn2+}= 0.74 Å, r_{Cu2+}= 0.745 Å, r_{Fe3+}= 0.645 Å, R_o= 1.42 Å.

   i. For x=0.1

ii. For x=0.9 where Yafet-Kittel angle, α_{Y-K}= 80° (15)

4. (a) Analyse the suitability of using ceramic materials for biological applications. List different types of bio ceramics based on their chemical reactivity in the body. **(8+4=12)**

(b) Mention two important applications of piezoelectric SiO_2 and pyroelectric $LaTiO_3$. (6)

(c) '$BaTiO_3$ has gained great attention due to its electrical properties'. Discuss this statement. (12)

SECTION-B

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

5 (a) Why do pure zirconia and fully stabilized zirconia not show any toughening behavior? (06)

(b) Briefly describe the toughening mechanisms associated with fiber reinforced ceramic composites. (24)

6 (a) Examine the concept of Weibull modulus in determining the reliability of brittle ceramic materials. (10)

(b) A series of square section bars are tested in 3-point bend test. The modulus of rupture (MOR) data: 178, 318, 345, 210, 296, 235, 248, 276, 262 MPa. Determine (20)

i. the Weibull modulus
ii. the median strength
iii. the normalized stress of the ceramics

7 (a) How do pre-stressing and crack-deflection contribute to strengthen ceramics? (15)

(b) Explain the effect of viscosity and microstructure on creep of polycrystalline ceramic. (15)

8 (a) State and explain Pauling's Rules for determining ceramics structures based on the packing of its ions. (15)

(b) Using Energy-Interatomic Distance diagram, explain the melting point and thermal expansion behavior of ceramic materials. (15)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations (January 2020 Term)

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

Full Marks: 180 Section Marks: 90 Time: 2 Hours (Sections A + B)

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) The following information concerns a new project your project is undertaking:

Activity	Immediate Predecessor	Time (days)
A	--	10
B	--	11
C	A, B	9
D	A, B	5
E	A, B	8
F	C,E	13
G	C, D	5
H	G	10
I	F, G	6
J	H	9
K	I, J	11

A. Draw the AON network diagram
B. Find the project completion time
C. Find the critical path
D. Find Early Start (ES) / Early Finish (EF) and Late Start (LS) / Late Finish LF for each of the activities
E. If you reduce the time required for activity D & E by 2 days each, find the project completion time and critical path as well. **(20)**

(b) Assign the jobs to the machines such that each job will be assigned by only one job to minimize the total cost. Find at least two multiple solutions if there is any.

Jobs \ Machines	1	2	3	4	5
A	10	9	9	18	11
B	13	9	9	18	11
C	3	2	4	18	10
D	18	9	12	17	11
E	11	11	14	18	13

(15)

(c) Define BOM and Lead time with suitable example. **(10)**

2. (a) The number of heart surgeries performed at Heartville General Hospital has increased steadily over the past several years. The hospital's administration is seeking the best method to forecast the demand for such surgeries in year 6. The data for the past 5 years are shown.

Year	Demand
1	45
2	50
3	52
4	56
5	8

(20)

The hospital's administration is considering the following forecasting methods.

A. Exponential smoothing, with α = 0.6. Let the initial forecast for year 1 be 45, the same as the actual demand.
B. Exponential smoothing, with α = 0.9. Let the initial forecast for year 1 be 45, the same as the actual demand.
C. Two year moving average.
D. Two year weighted moving average, using weights 0.6 and 0.4, with more recent data given more weight.
E. Regression model Y =42.6 + 3.2X, where Y is the number of surgeries and X is the index for the year (e.g., X = 1 for year 1, X = 2 for year 2, and so forth).
F. If MAD is the performance criteria chosen by the administration, which forecasting method should it choose?

(b) There are following seven jobs and they must pass through Machine 1 and Machine 2. Operating time for both the machines is shown below for each of the job.

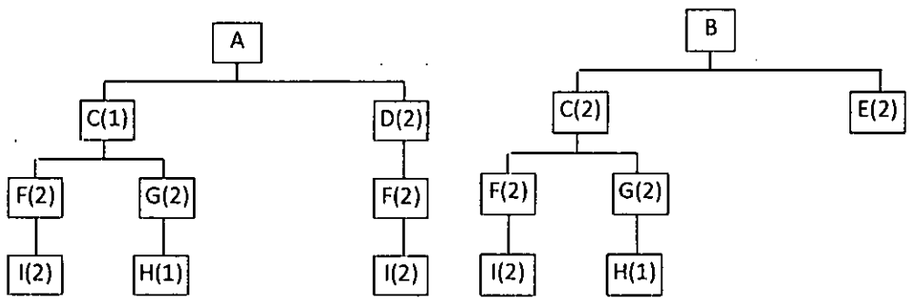
Job	Operations Time for machine 1	Operations Time for machine 2
A	9	6
B	8	5
C	7	7
D	6	3
E	1	2
F	2	6
G	4	7

A. Schedule (job sequence and show the arrangement in diagram for machine 1 & 2) the seven jobs through two machines in sequence to minimize the flow time using Johnson's rule.
B. Find the job completion time.
C. Find the slack time or idle time for machine 1 & 2, separately. (15)

(c) Discuss the effect of inaccurate forecasting in any business organization. (5)

(d) What do you mean by value addition? Explain with example. (5)

3. (a) Brown and Brown Electronics manufacture a line of digital audiotape (DAT) players. While there are differences among the various products, there are a number of common parts within each player. The bill of materials, showing the number of each item required, lead times and the current inventory on hand for the parts and components, follows:



Demand of products A & B and demand of spares components are shown below:

Item	Demand on 9th week	Demand on 7th week	On-Hand	Lead Time (weeks)
A	500	400	30	1
B	1000	----	50	2
C	-----	270	75	1
D	320	320	80	2
E	-----	280	100	1
F	-----	100	150	1
G	----	-----	40	1
H	-----	-----	200	1
I	-----	-----	300	1

Prepare a MRP schedule to satisfy demand (Sample MRP table is attached for reference) (35)

(b) What do you mean by MRP? How does it work in practical situation? **(5)**

(c) What are the benefits of Network Diagram and Gantt chart in Project management? What do you understand by critical path? **(5)**

SECTION – B

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

Normal Distribution Table is attached. Assume Reasonable Values for missing Data, if any.

4. (a) Solve the following problem using the Big-M method.

Maximize $Z = 4x_1 + 2x_2 + 3x_3 + 5x_4$.

subject to

$$2x_1 + 3x_2 + 4x_3 + 2x_4 = 300$$
$$8x_1 + x_2 + x_3 + 5x_4 = 300$$

and

$x_j \geq 0$, for $j = 1, 2, 3, 4$.

(Students are suggested to show two/three calculations (matrix operations) of the executed iterations). **(35)**

(b) How does an operating characteristic (OC) curve help industrial managers design a sampling plan? Provide a practical example. **(10)**

5. XYZ Manufacturing produces parts and materials for the heating, ventilation, and air conditioning industry. One of its facilities produces metal ductwork in various sizes for the home construction market. One particular product is 6-inch diameter round metal ducting. It is a simple product, but the diameter of the finished ducting is critical. If it is too small or large, contractors will have difficulty fitting the ducting into other parts of the system. The target diameter is 6 inches exactly, with an acceptable tolerance of ±.03 inches. Anything produced outside of specifications is considered defective. The line supervisor for this product has data showing that the actual diameter of finished product is 5.99 inches with a standard deviation of 0.01 inches.

(i) What is the current capability index of this process? What is the probability of producing a defective unit in this process?

(ii) The line supervisor thinks he will be able to adjust the process so that the mean diameter of output is the same as the target diameter, without any change in the process variation. What would the capability index be if he is successful? What would be the probability of producing a defective unit in this adjusted process? **(45)**

6. (a) Imagine a hypothetical industrial case and apply the DMAIC cycle to the case to improve the industrial process. Justify your logic behind your suggested steps for the DMAIC cycle. **(25)**

(b) Design an ABC inventory system with a hypothetical numerical example. The example should be different from others/other sources. **(20)**

Table entry for z is the area under the standard normal curve to the left of z.

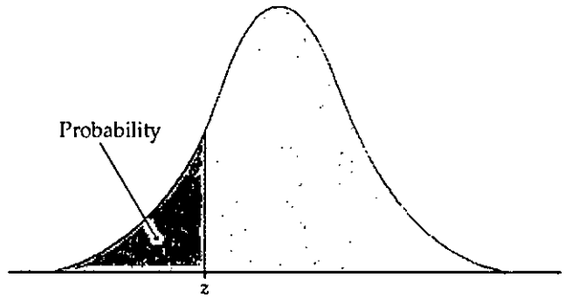


TABLE A

Standard normal probabilities

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

Table entry for z is the area under the standard normal curve to the left of z.

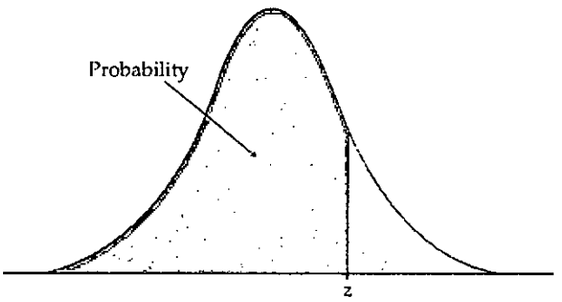


TABLE A

Standard normal probabilities (continued)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

You can reproduce this table in you answer script and fill up accordingly for ***Question # 3 (a)***

Sample MRP Schedule										
Item		Week/day								
		1	2	3	4	5	6	7	8	9
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									
	Gross Requirement									
	On Hand =									
	Net Requirement									
	Order Receive									
	Order Release									