L-3/T-2/MME Date: 17/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 343** (Surface Engineering of Materials)

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) How is internal stress of coating measured? **(5)**

   (b) Suppose you have to protect a cylindrical vessel from corrosion and wear. You have two options. Option A: You can use austenitic stainless steel which requires only installation (including material) cost of $ 2700. Option B: You can use mild steel with rubber lining which requires $ 1180 for mild steel, $320 for rubber lining and $ 500 for renewal of lining. As a designer, which option will you prefer for annual, 2 yearly and 3 yearly renewal of rubber lining? Discuss other factors that influence the design consideration. **(25)**

2. (a) With necessary diagram, derive the equation expressing the ploughing component of the co-efficient of friction for a spherical shaped wear particle in contact with a softer body. **(24)**

   (b) 'High friction interfaces exhibit high wear rates'. – Necessarily not true. Justify the statement with examples. **(6)**

3. (a) Explain the co-efficient of friction as a function of temperature for cobalt sliding on stainless steel at a normal load of 5 newton and sliding velocity of 25 mm/sec. **(10)**

   (b) Which type of wear does occur in the following cases? Draw schematic diagram of each type.

   i) Machining of a sample is done by WC cutting tool.

   ii) Steel sample is polished by emery paper for microstructural observation. **(8)**

   (c) How does wear rate change as a function of abrasive grit size, sliding velocity and sliding distance? **(12)**

4. (a) Why does cobalt with HCP crystal structure show lower wear than FCC aluminium? **(6)**

(b) The flat face of a brass annulus having an outside diameter of 20 mm and an inside diameter of 10 mm is placed on a flat carbon steel plate under a normal load of 10 newton and rotates about its axis at 100 rpm for 100 h. As a result of wear during the test, the mass losses of the brass and steel are 20 mg and 1 mg respectively. Calculate wear co-efficients and wear depths for the brass and the steel. Hardness of steel = 2.5 GPa, density of steel = 7800 kg/m^3; hardness of brass = 0.8 GPa, density of brass = 8500 kg/m^3. Assume reasonable values for any missing data. **(24)**

SECTION-B

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

5. (a) Select a coating deposition technique suitable for ceramic powder starting material. Justify your choice. **(13)**

(b) List the variables of alloy electrodeposition? Explain the effect of current density and concentration of complexing agents on alloy electrodeposition. **(4+13)**

6. (a) Write short note on i) hydrogen overvoltage; ii) cathode current efficiency; iii) chemisorption. **(15)**

(b) Discuss the importance of complex ion bath in electroplating. **(9)**

(c) Can you choose a vapor deposition technique for substrate with blind holes? Defend for your choice. **(6)**

7. (a) Among old techniques of coating, which one is suitable for coating on polymer substrate? Why? **(14)**

(b) In plating a continuous strip of 0.8m width and 1m length with Sn from an acid solution (valence change 2), the desired strip speed is 400m/min, current efficiency is 96% and the thickness of Sn is to be 0.35 micrometer (each side) at a current density of 5000A/m^2. How long the plating tank should be, if the strip passes straight through the tank with no return bends? (density of Sn is 7.31g/cc and A_{Sn} = 118.7. **(16)**

8. (a) What is the function of wetting agents in electroplating bath? **(8)**

(b) State the important principles of alloy electrodeposition. **(10)**

(c) Define solid state laser. Mention advantage of solid-state laser over CO_2 laser. **(12)**

L-3/T-2/MME

Date: 10/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 345** (Foundry Engineering)

Full Marks: 240 Time: 2 Hours

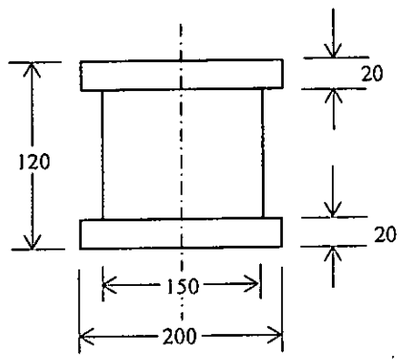
The figures in the margin indicate full marks.

USE SEPARATE SCRIPT FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1 and any TWO** questions from the rest. Question 1 is COMPULSORY.

1. (a) Consider the following Flange Roller as shown in Figure 1. Using Caine's method (Figure 2), design an appropriate feeder for the casting. Use a cylindrical feeder with H/D = 1. List all assumptions you made while designing this problem. **40**



Product description:

Material – EN24 Steel

Density – 7850 kg/m^3

Moulding system:

Greensand system

Pouring temperature:

1580 °C

Figure 1: Product image of flange roller. All dimensions are given in mm.

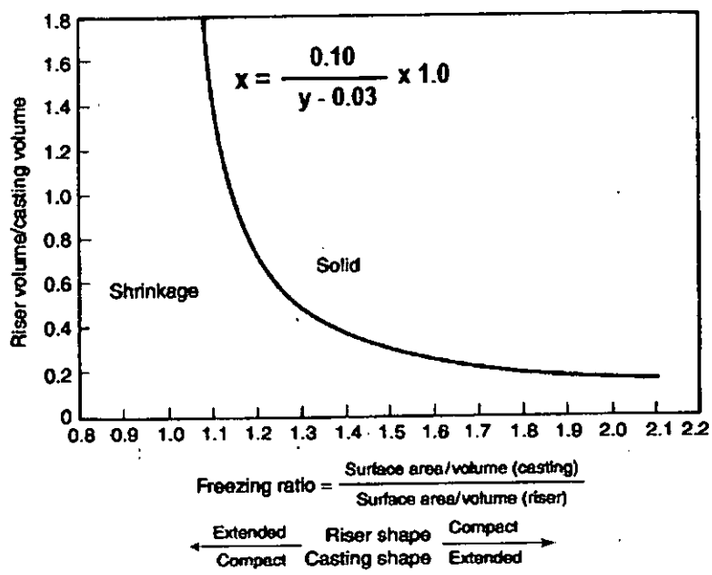


Figure 2: Caine's curve for minimum feeder head volume.

1. (b) Using a naturally pressurised system, design a suitable gating system for the casting shown in Figure 1. Do not include any feeder in your design calculation. **40**

The pouring time for this casting can be calculated using the formula:

$$t\ (seconds) = (2.4335 - 0.3953 \times \log W) \times \sqrt{W}$$

where W is the mass of the liquid metal to be poured (not including the feeder). Values for other design constants are: k = 1, f = 0.90, C = 0.8. List all assumptions you made while designing this problem.

2. What do you mean by progressive and directional solidifications? Examine how these two modes of solidification influence the solidification behaviour of metals and alloys. **20**

3. Why is homogeneous nucleation of liquid metal difficult? How does foreign particle help in nucleating solid particles in liquid metal? What kind of foreign particles are the most suitable for this job and why? **20**

4. Why is DAS more important than grain size in controlling properties of cast products? Explain how a high degree of solute segregation and chilling reduce DAS and improve mechanical properties? **20**

SECTION – B

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

5. (a) Why does segregation occur in a cast solidified structure? List the types of segregation that take place in an alloy when it is solidified under non-equilibrium condition. How will you remove these types of segregation? **25**

   (b) Hot tearing is highly specific to certain alloys while other alloys are virtually free from this problem. Specify the alloys that are prone to hot tearing. There are several factors that influence the hot tearing. Which one do you think the most important for hot tearing and why? **15**

6. (a) Why is casting of aluminium bronze alloy considered as one of the most difficult among the foundry alloys? Explain how surface films go into the castings. **25**

   (b) The fatigue performance of cast alloys is generally poor. Explain the reasons and also suggest how one can improve the fatigue performance of a cast product. **15**

7. (a) For mass production of a cast component, which casting method will you prefer? Give reasons for this selection by considering shape, material, quality and operating cost. **18**

   (b) A part made of cast iron requires wear resistant surface with tough core. Suggest a method to achieve the structures for obtaining these opposite properties in single parts. How will you control the chemical composition of the cast iron in cupola furnace by varying temperature and iron oxide concentration? **22**

8. (a) What factors do you need to consider during preparation of sand moulding for steel components casting? **20**

   (b) Explain how you will obtain austempered ductile iron from a grade of cast iron. **15**

   (c) 'Nonferrous alloy casting without porosity is almost impossible.' Explain this assertion. **5**

L-3/T-2/MME Date: 24/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 347** (Metal Joining Technology)

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. Consider a plain carbon steel of 10 mm thickness (0.10 wt.% carbon; average grain size 40 μm; ferrite and pearlite in microstructure) joined by single-pass TIG method. Draw a partial Fe-Fe_3C phase diagram [schematic, not entirely accurate] up to eutectic point, and identify FZ, PMZ, HAZ and base metal regions in the diagram drawn. Now, draw the welding joint showing regions mentioned above. Identify which portion of HAZ in the phase diagram would contain refined grains. Assess the reasons for such refinement with valid arguments. Your opinions shall consider the role of A_3 line. **(30)**

2. Consider a series of studies on liquation and solidification in the PMZ of aluminum welds. Figure 1 below shows five different PMZ liquation mechanisms. The phase diagram shown in the figure is similar to the Al-rich side of the Al–Cu phase diagram. Here, A_xB_y is an intermetallic compound, such as Al_2Cu in the case of Al–Cu alloys. Alloy C_1 is within the solubility limit of the α phase ($<C_{SM}$), and alloy C_2 is beyond it ($>C_{SM}$). In the as-cast condition, both alloys C_1 and C_2 usually consist of an α matrix and the eutectic $\alpha + A_xB_y$ along GBs and in between dendrite arms.

   For an alloy crossing the solvus line of the phase diagram, which mechanisms are responsible for partial melting? Briefly discuss those mechanisms for liquation. **(30)**

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MME 347

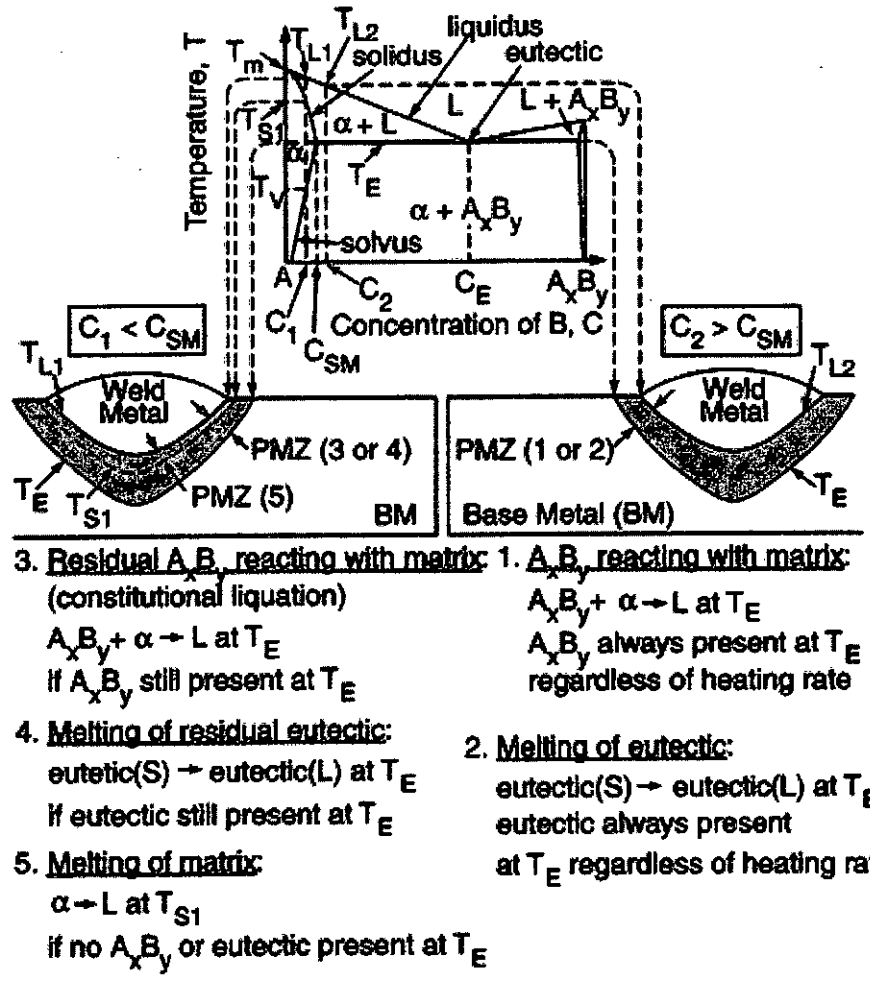


Figure 1 for Question No. 2

3. a) *Weld pool depth and width can be controlled by some driving forces for fluid flow – such as buoyancy force, Lorentz force, Marangoni Convection, surface tension and shear stress.* Do you agree with this statement? Give a strategic analysis (by showing fluid flow directions, etc.) to validate justification of your point of view. **(20)**

b) A bead-on-plate weld is being deposited along Line X-X (Figure 2). The welding arc, which is moving at velocity v, is presently located at Point O. The crosshatched area M–M' is the region where plastic deformation occurs. Section A–A is ahead of the heat source and is not yet significantly affected by the heat input; the temperature change due to welding, ΔT, is essentially zero. Along section B–B intersecting the heat source, the temperature distribution is rather steep. Along section C–C at some distance behind the heat source, the temperature distribution becomes less steep and is eventually

Contd. ... P/3

uniform along section D–D far away behind the heat source. Consider now the thermally induced stress along the longitudinal direction, σ_x. In the figure, stress distribution plots are given. Now, formulate the interpretation of the different behaviour of the stress plots in Section A-A and Section D-D. **(10)**

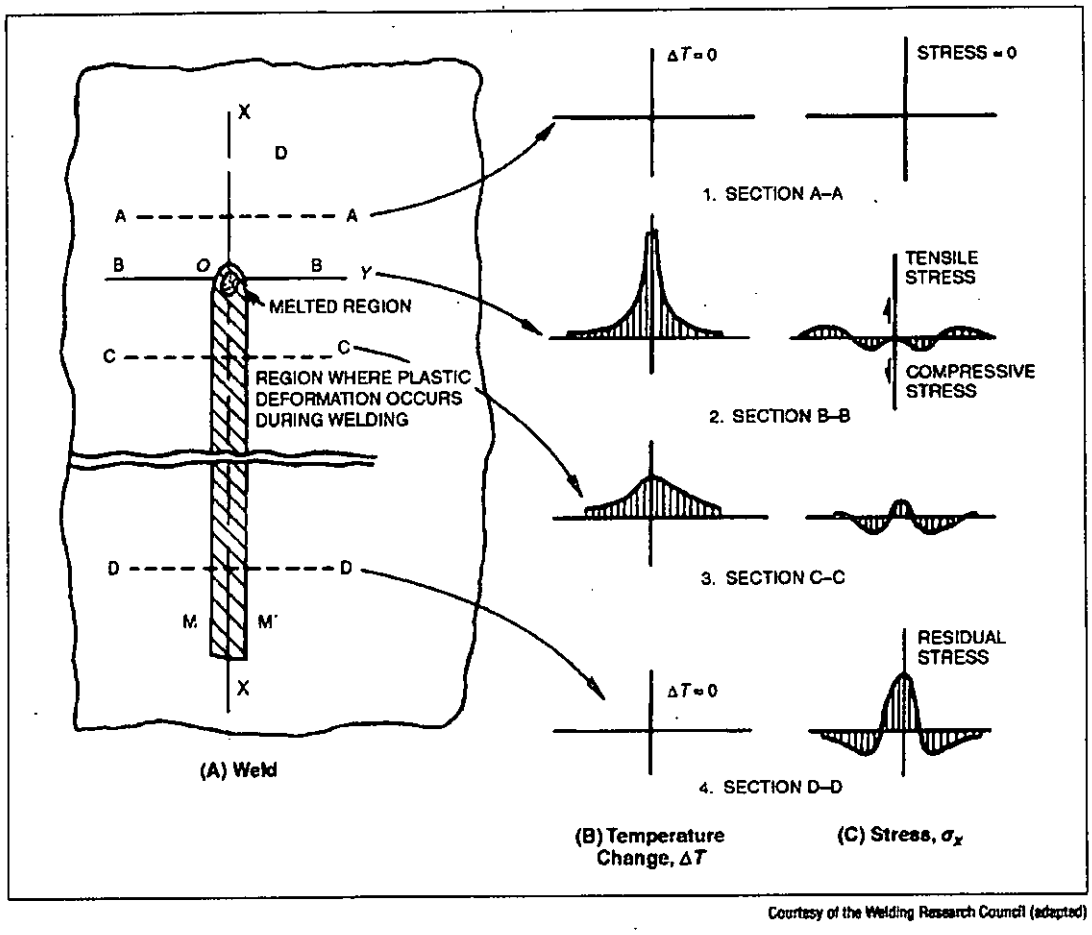


Figure 2 for Question No. 3

4. Consider a fusion welded aluminium or plain carbon steel plates. After careful grinding, polishing and etching of the welded region and surrounding areas, the following macrostructures were revealed (Figure 3). Now provide your critical thinking on the following statements. Hint: You may take help from Figure 4 and Table 1. **(30)**

   i) Competitive growth is observed.

   ii) Weld pool shape depends on welding speed.

   iii) Epitaxial growth of grains is found.

   iv) Axial grains are observed.

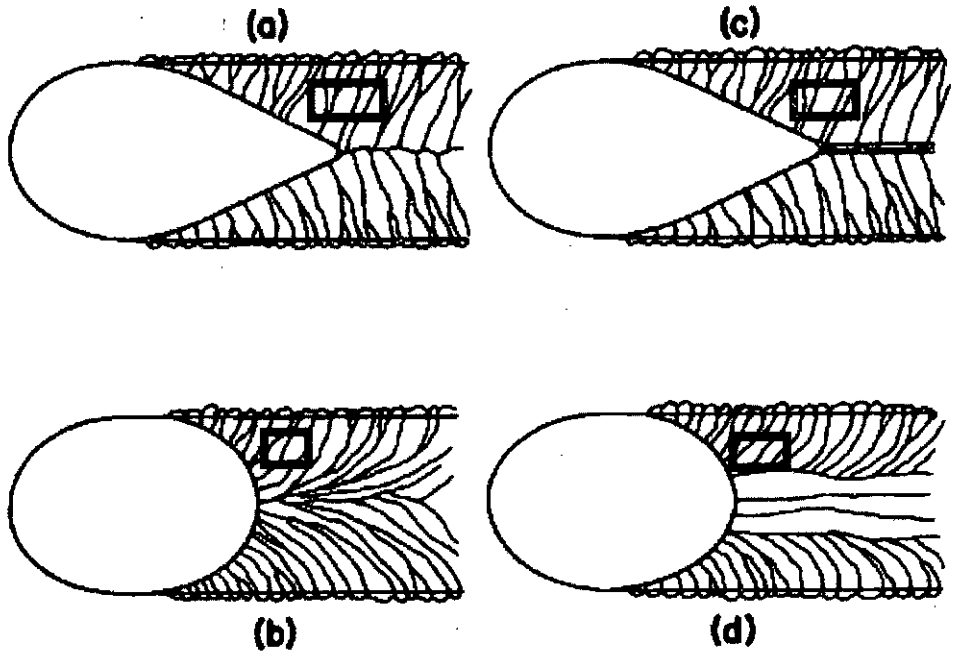


Figure 3 for Question No. 4

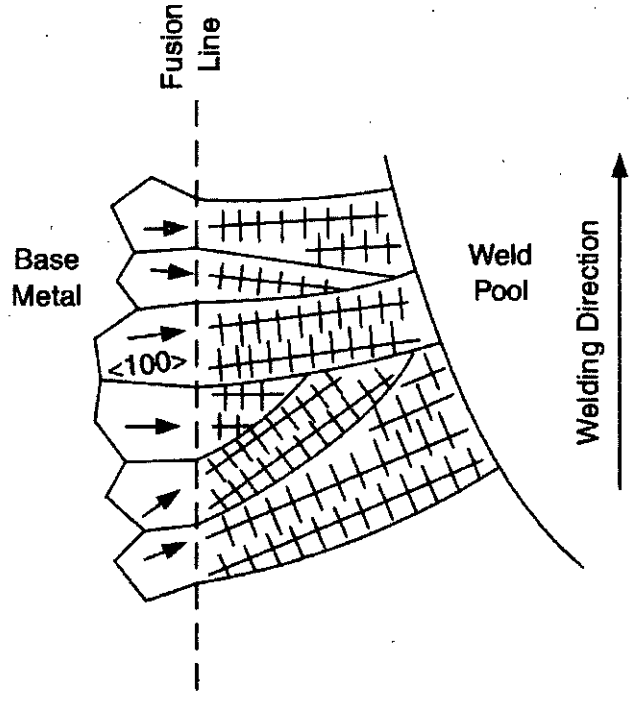


Figure 4 for Question No. 4 */*Figure 4 shows the pattern of grain growth in the regions marked by the rectangle in Figure 3.*/*

Contd. ... P/5

Table 1 Easy-Growth Directions

Crystal Structure	Easy-Growth Direction	Examples
Face-centered-cubic (fcc)	<100>	Aluminum alloys, austenitic stainless steels
Body-centered-cubic (bcc)	<100>	Carbon steels, ferritic stainless steels
Hexagonal-close-packed (hcp)	$<10\bar{1}0>$	Titanium, magnesium
Body-centered-tetragonal (bct)	<110>	Tin

Source: From Chalmers (12).

Contd. ... P/6

SECTION-B

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

5. (a) Draw the schematics of four basic positions of welding. Which one is the most extreme case and why? **(10)**

   (b) Write the most common thermit reactions involved in alumino-thermic welding. Mention merits and demerits of the process. **(20)**

6. (a) Which current mode would you choose for welding thin sheet in GTAW process? Compare the mode with other usable modes in terms of oxide cleaning action, heat balance in the arc and electrode capacity. **(20)**

   (b) 'Plasma arc welding is less susceptible to contamination than the electrode used for GTAW' – Explain why. **(10)**

7. (a) Compare and contrast between the followings. **(18)**

   i) GMAW and GTAW process

   ii) Electroslag process and submerged arc welding process.

   iii) Electron beam welding and LASER beam welding

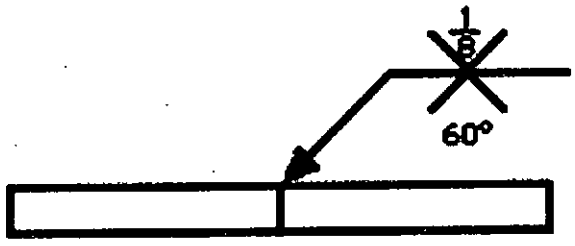
   (b) Mention the major types of resistance welding process. Why does resistance welding produce higher yield for steel than for copper? **(12)**

8. (a) Draw the diagram of desired welds from the weld symbols shown in Fig. 5 for Question No. 8(a). **(20)**

   (b) Will decreasing weld speed help reduce weld porosity in GTAW of aluminium if the source of hydrogen is on the workpiece surface? What about if the source of hydrogen is in the shielding gas? Explain why or why not. **(10)**

Fig. 5 for Question No. 8(a)

i)



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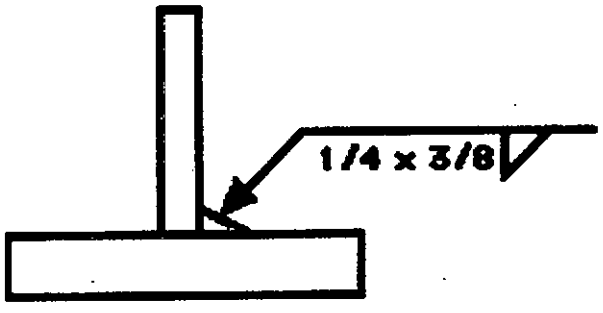

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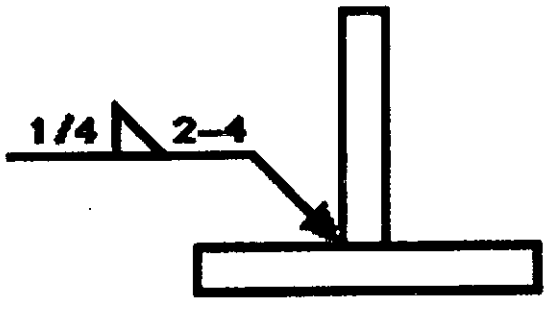
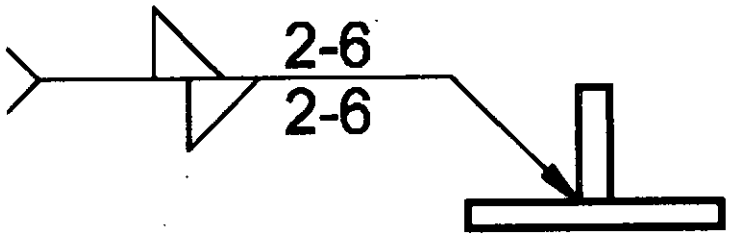


iv)



L-3/T-2/ MME

Date: 20/01/2020

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 365** (Ceramics and Glass Engineering)

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) Suggest different techniques to increase wetting characteristics for ceramic joining by glazing. **(06)**

   (b) Give a comparative picture between adhesive bonding and brazing in terms of processing, integrity and utilization for ceramics parts. **(24)**

2. (a) Briefly discuss the various mechanisms for permanent stress development in glass during processing. **(10)**

   (b) Show the dependency of viscosity to glass composition with some examples. **(10)**

   (c) Differentiate the volume-temperature (V-T) relationship between a typical glass-forming melt and a crystalline melt. **(10)**

3. (a) Schematically discuss the crack propagation behavior in ceramic materials. **(10)**

   (b) "Most ceramics are intrinsically hard"- explain. **(10)**

   (c) Describe the hardening mechanism of Portland cement. **(10)**

4. (a) Why do you need glaze in a state of compression on the finished product of a ceramic. **(15)**

   (b) Explain the relationship between body and glaze in terms of stress distribution and compositional variation along the interface. **(15)**

SECTION-B

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

5. (a) What are the general characteristics of ceramics? **(8)**

   (b) With neat sketch, discuss the crystal structures of cubic alumina, Al_2O_3 and cubic zirconia, ZrO_2. **(12)**

   (c) Classify ceramic raw materials according to their functional requirements. **(10)**

6. (a) What are the problems associated with uniaxial pressing? Explain their causes and suggest suitable remedial measures. **(15)**

   (b) Differentiate between wet-bag and dry-bag isostatic pressing **(7)**

   (c) Mention the key characteristics that should be considered during extrusion. **(8)**

7. (a) Mention the atomic mechanisms those occur during sintering. **(10)**

   (b) What is the major concern about solid state sintering? How can this problem be solved? **(8)**

   (c) "Reactive liquid phase sintering is referred to as transient liquid sintering" - explain. **(12)**

8. (a) What do you understand by triaxial composition of a white ware system? Draw a typical triaxial composition of wall tile product. **(10)**

   (b) Discuss the ways in which water can be present in a ceramic body. Explain the time dependent removal of water from ceramic body. **(20)**

L-3/T-2/MME Date: 13/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination- January 2020

Sub: **HUM 211** (Sociology)

Full Marks: 120 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 2 page(s) in this question paper.

SECTION – A

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

1. (a) What do you mean by natural green house and man-made greenhouse? (10)
   (b) Write about the main sources of global warming. Define the 'red' category industry with examples. (10)

2. (a) How would you explain industrialization and deindustrialization? (10)
   (b) Discuss the characteristics of the first, second, third and fourth industrial revolutions. (10)

3. (a) Define human migration. What is meant by 'pull factor' and 'push factor' in migration? (10)
   (b) Define crude birth-rate and crude death-rate. Describe the stages of demographic transition theory. (10)

4. (a) What are the main reasons for the growth of the cities? (10)
   (b) Discuss the classification of cities with examples. (10)

SECTION – B

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

5. (a) What do you mean by scientific research in sociology? (10)

   (b) How does sociology follow scientific method in its research work? Discuss with examples. (10)

6. (a) Differentiate between social stratification and social inequality with examples. (10)

   (b) Explain the basic forms of social stratification. (10)

7. (a) Why is socialization a lifelong process? (10)

   (b) Analyze how the family, school, peer-groups and the mass-media guide the socialization process. (10)

8. Write short notes on any **two** of the following: (20)

   a) Material and non-material culture

   b) Deviance and crime

   c) Gender socialization and anticipatory socialization

L-3/T-2/MME Date: 13/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examination, January 2020

Sub: HUM 305 (Economics of Development and Planning)

Full Marks: 120 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 03 page(s) in this question paper.

SECTION – A

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

All the symbols have their usual meanings

Assume reasonable values for missing data.

1. (a) Economic growth is said to be a necessary but not sufficient condition to eradicate absolute poverty and reduce inequality. What is the reasoning behind this argument? (10)

   (b) 'Social and institutional innovations are as important for economic growth as technological and scientific inventions and innovations', what is meant by this statement? Explain your answer. (10)

2. (a) How is Human Development Index (HDI) calculated? Explain in detail. (10)

   (b) What are some additional strengths and weaknesses of the HDI as a comparative measure of human welfare? If you were designing the HDI, what might you do differently, and why? (10)

3. (a) Show the distinctions between low levels of living and low per capita incomes. (10)

   (b) Can low levels of living exist simultaneously with high levels of per capita income? Explain with examples. (10)

4. Discuss with criticisms the Lewis Theory of Development. (20)

SECTION – B

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

All the symbols have their usual meanings

5. (a) Summarize the arguments for and against the role and impact of private foreign investment in less developed countries. (10)

(b) What strategies might developing countries adopt to make private foreign investment fit their development aspirations better without destroying all incentives for foreign investors?. (10)

6. (a) Explain different stages of project evaluation and methods of evaluation. (8)

(b) Define Net Present Value (NPV), Benefits to Cost Ratio (BCR) and Internal Rate of Return (IRR). How do you interpret the following values of NPV, BCR and IRR of a Development project? (12)

NPV (Lakh taka): 472,851.99

BCR : 1.398

IRR : 33.55%

7. (a) Explain in short, the 'Theory of Balanced Growth' and the 'Theory of Unbalanced Growth.' (10)

(b) What policies do you recommend for industrialization in Bangladesh that will help reach Sustainable Development Goals (SDGs) by 2030? (10)

8. (a) Under what conditions and terms do you think developing countries should seek and accept foreign aid in the future? (10)

(b) If aid cannot be obtained on such terms, do you think developing countries should accept whatever they can get? Explain your answer. (10)