L-3/T-2/MME **Date : 24/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **EIGHT** questions in this section. Answer any **SIX** questions.
The questions are of equal value.

1. A 301 stainless steel sheet work-hardened to about 480 Knoop hardness was welded, and in the HAZ the hardness dropped to a minimum of about 240. Explain the loss of strength in the HAZ. The weld reinforcement was machined off and the whole sheet including the weld was cold rolled. What was the purpose of cold rolling? You may seek help from Figure 1.

2. "The 2000-series (Al-Cu-Mg) and 6000-series (Al-Mg-Si) heat-treatable alloys are known to have a tendency to overage during welding, especially when welded in the fully aged condition (T6)" – validate this statement with an example from any of the above-mentioned alloy series.

3. Figure 2 shows the micrographs of gas-tungsten arc weld of 1018 steel, with relevant phase diagram and positions in the weld zone. Correlate differences among the microstructure at different positions of the weld (A, B, C and D). Figure 3 shows the HAZ microstructure in a1018 steel produced by a high-power CO_2 laser beam, welded at very high heating and cooling rates. What differences you see with Figure 2?

4. Severe liquation can occur in the partially melted zone (PMZ) during welding. In Figure 4, formation of PMZ in 2219 aluminum weld is shown: (a) Al-rich side of Al-Cu phase diagram; (b) thermal cycles; (c) transverse cross section. Identify different mechanisms of PMZ formation and discuss those mechanisms briefly.

5. What is solidification cracking? Solidification temperature range, content of S and P, and the reactions during terminal solidification are considered as important primary factors for solidification cracking - do you agree? Justify your answer.
6. Discuss the effects of welding speed on grain structure. You should put an emphasis on weld metal nucleation mechanisms.

7. What is micro-segregation in welding? Briefly describe the effects of dendrite tip undercooling on micro-segregation.

Contd P/2

MME 347

8. (a) During post-solidification phase transformations, schematically show the development of weld metal microstructure in austenitic stainless steels (or any other suitable alloy) welds. You should discuss on primary phases and morphologies of weld metal ferrite types.

(b) In Figure 5, vertical section of Fe-Ni-Cr phase diagram at 59% Fe shows seven alloys with Cr-Ni ratio ranging from 1.15 to 2.18. Figure 6 summarises the micro structural morphologies of small welds made by scanning an electron beam over a wide range of travel speeds and hence cooling rates. Explain how these morphologies and microstructures are obtained.

SECTION-B

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

9. (a) Which elements are included in a welding symbol? Draw the symbol with illustration of the following weld designations: **(8+9=17)**

Single – V butt weld, single bevel butt weld,
Single bevel butt weld with broad root face

(b) Define fusion welding. Why is GMAW also called MIG welding? During GMAW, molten metal is transferred from the tip of the electrode to the weld pool through several transfer modes. Narrate these modes briefly. **(18)**

10. (a) 'Diffusion welding offers some very special and often unique advantages.' – Explain the advantages. **(15)**

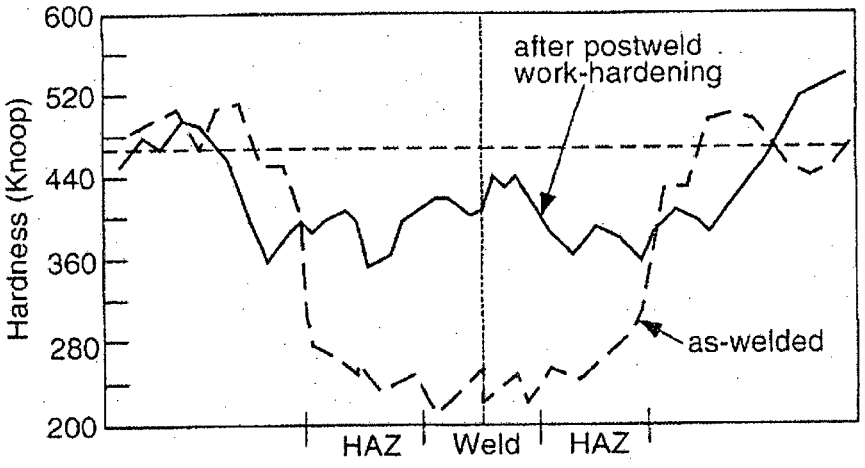
(b) Compare and contrast among Flash, Upset and Percussion welding. **(20)**

11. (a) Mention which criteria brazing operation must meet. Explain how you would choose a brazing filler metal for a particular job. **(17)**

(b) Describe how cast irons and stainless steels are brazed? **(18)**

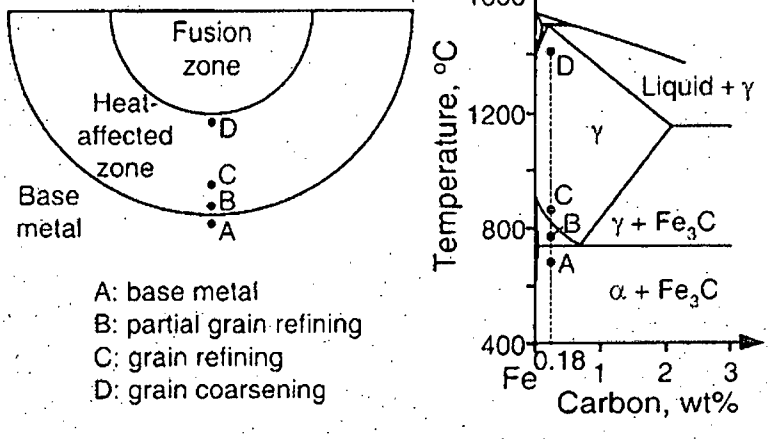
12. (a) What do you understand by soldering? Discuss the basic steps for good quality soldering. **(17)**

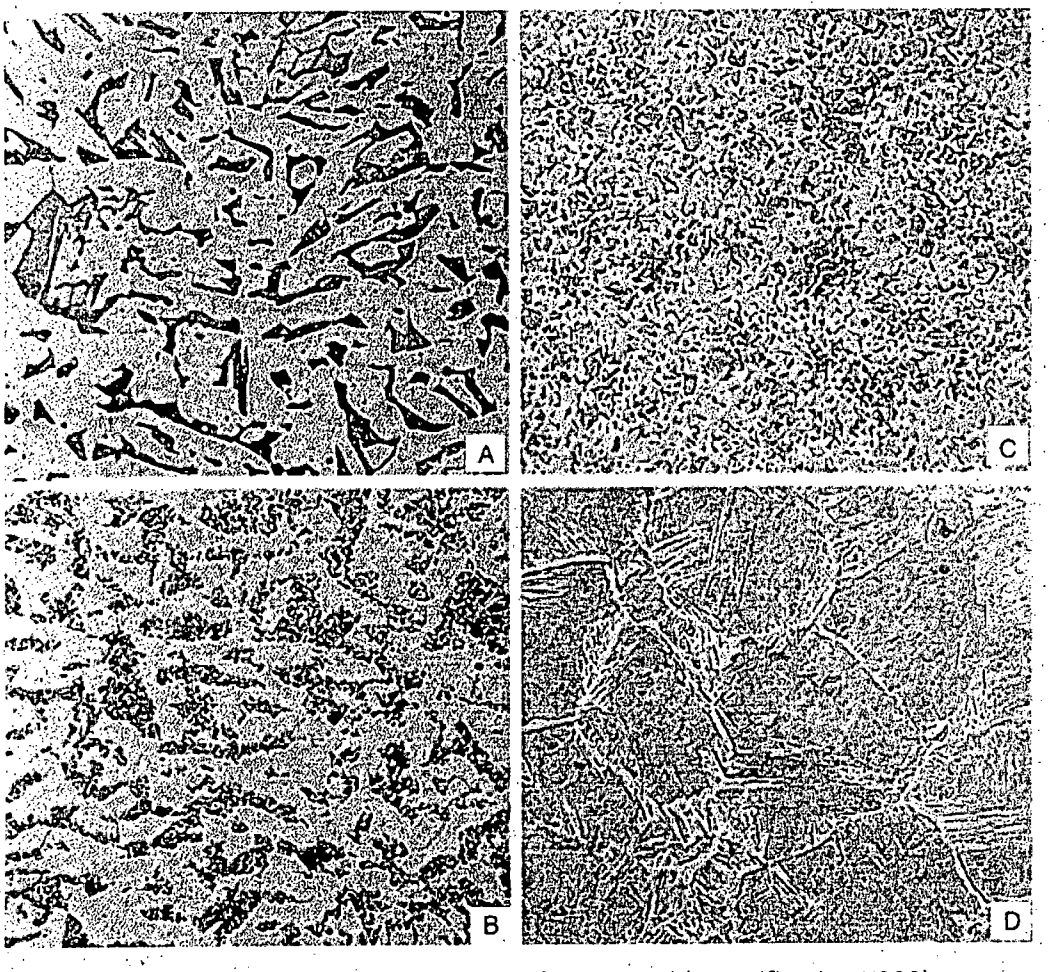
(b) Which current mode you will choose for welding (i) thin sheet, (ii) thick sheet and also which one to get good penetration and oxide cleaning action? Explain with necessary figures. **(18)**



W. P. Hatch, G. M. Orner and W. C. Malatesta, Welding Journal, **42**: 205s, 1963.

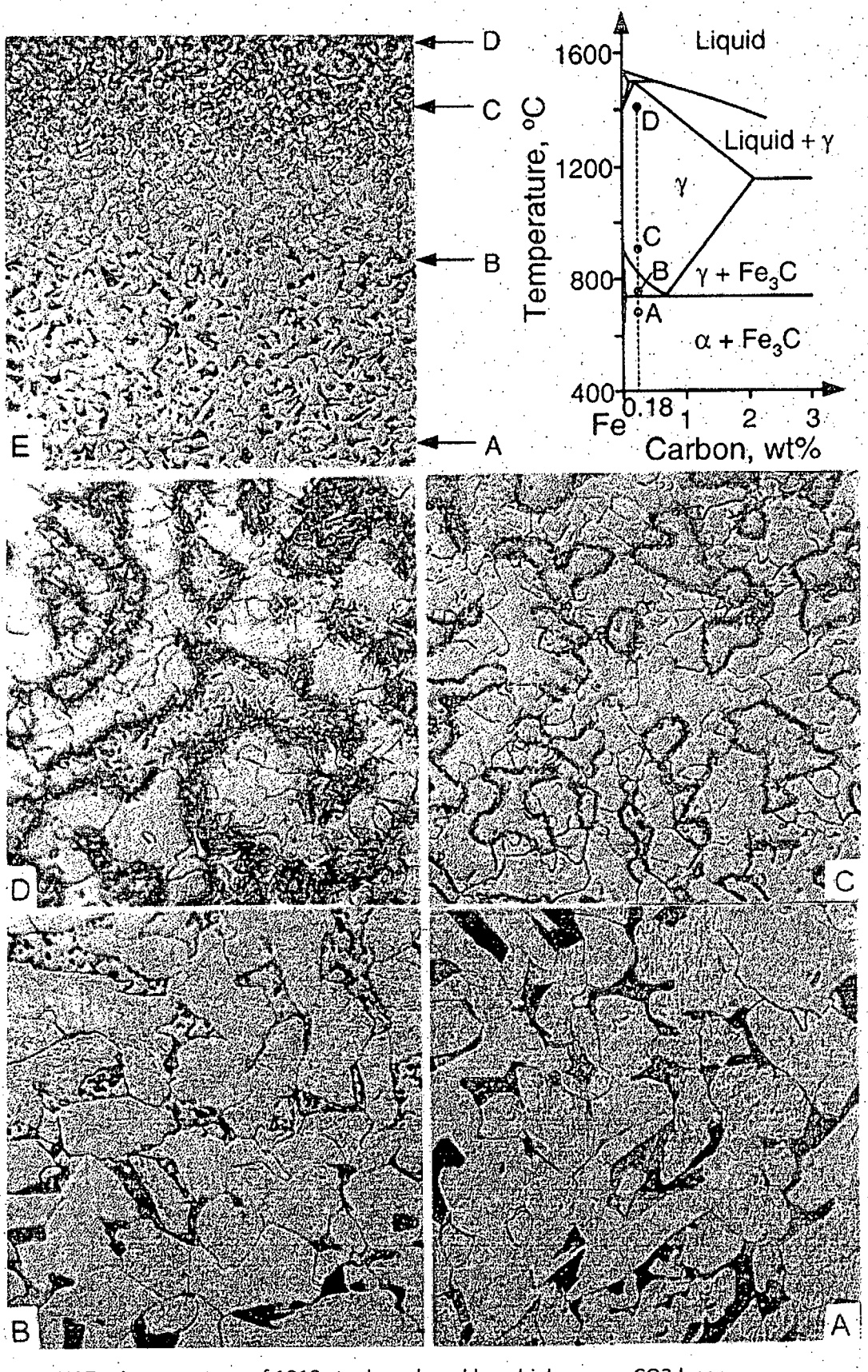
Figure 1 for Question No. ~~1(a)~~ 1.





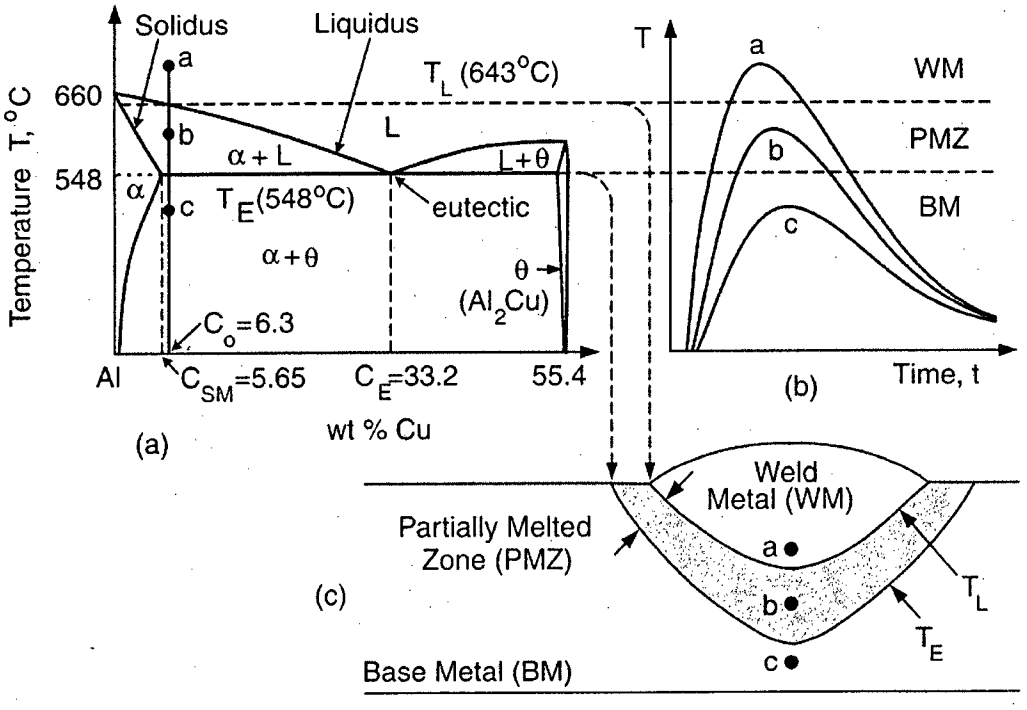
HAZ microstructure of a gas–tungsten arc weld of 1018 steel (magnification X200).

Figure 2 for Question No. 3



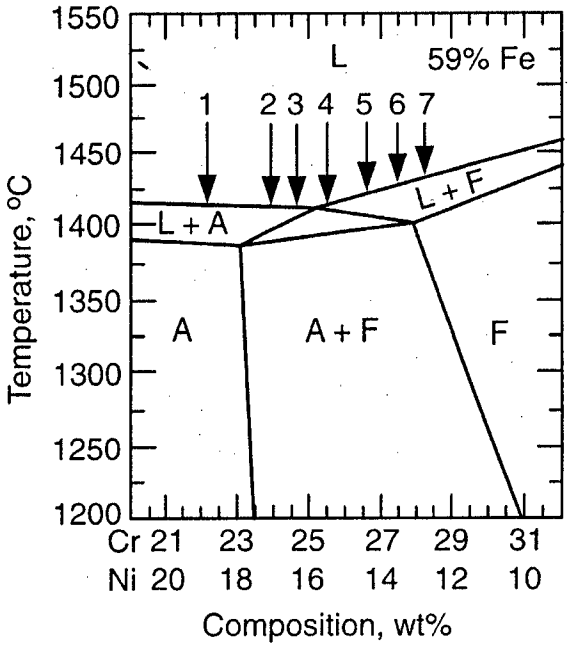
HAZ microstructure of 1018 steel produced by a high-power CO2 laser. Magnification of (A)–(D) X415 and of (E) X65. From Kou et al.

Figure 3 for Question No. 3



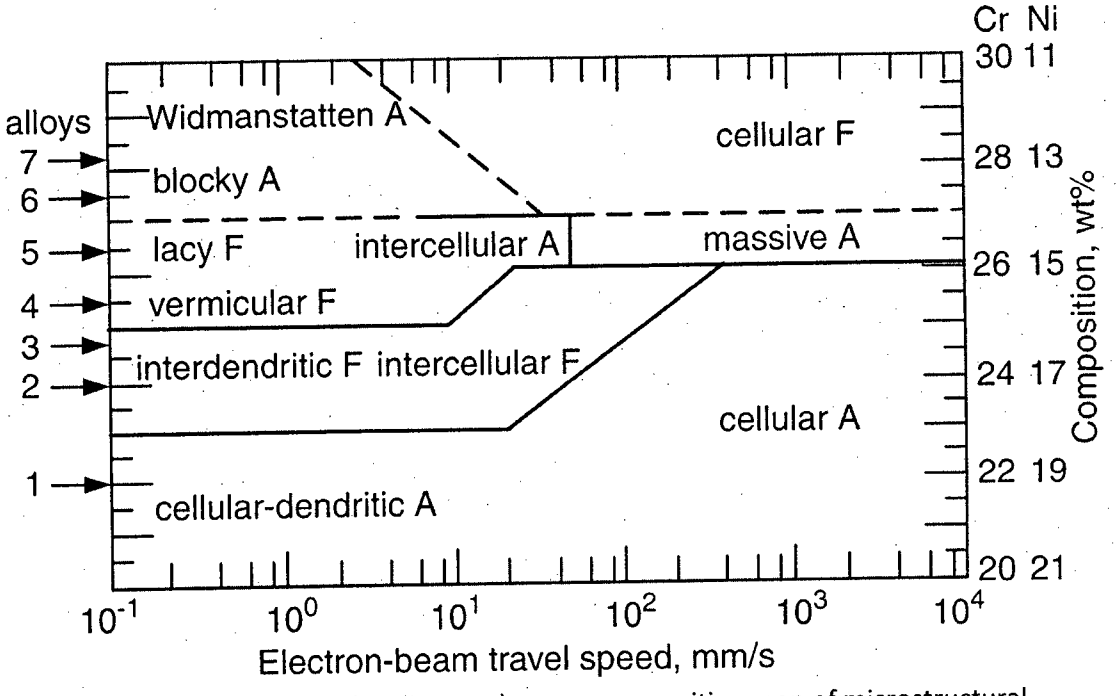
Formation of PMZ in 2219 aluminum weld: (a) Al-rich side of Al–Cu phase diagram; (b) thermal cycles; (c) transverse cross section.

Figure 4 for Question No. 4



Vertical section of Fe–Ni–Cr phase diagram at 59% Fe showing seven alloys with Cr–Ni ratio ranging from 1.15 to 2.18. Modified from Elmer et al.

Figure 5 for Question No. 8



Electron beam travel speed (cooling rate) versus composition map of microstructural morphologies of the seven alloys in Figure 5 (A and F denote austenite and ferrite, respectively). The solid lines indicate the regions of the four primary solidification modes, while the dashed lines represent the different morphologies resulting from postsolidification transformation from ferrite to austenite. Modified from Elmer et al.

Figure 6 for Question No. 8

L-3/T-2/MME **Date : 18/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section.

Answer **question number 1** and any **TWO** from the rest.

1. (a) Design a suitable feeding system for the casting shown in Fig. 1. Draw a 2 D diagram of the mould showing the position of the casting and feeder in the gating system. Assume reasonable values for any missing data. List all basis and assumptions you used during the design. **(30)**

   (b) A thin-walled cylindrical casting of 100 mm inside dimension, 10 mm thickness and 250 mm length is to be made using cast iron in green sand mould. Determine the following

   (i) Using 25% longer time than the solidification time, calculate the pouring time required for the casting. The mould constant in Chvorinov's rule is 2.2 s/mm^2. **(5)**

   (ii) Using suitable sprue and pouring basin/bush, calculate the effective liquid metal head required for the gating system. List all assumptions you made during this calculation. **(5)**

   (iii) Calculate the choke area for this gating system. Use 7.0 g/cc for liquid metal density and 0.80 for discharge coefficient. **(5)**

   (iv) Calculate sprue top and bottom areas, runner area and ingate area of the gating system. Use 500 mm/s as critical velocity for this unpressurised system which has a gating ratio of 1:1:2. Also use a safety factor of 25% to oversize the sprue top area. **(15)**

2. (a) Why is homogeneous nucleation of liquid metal difficult? How do foreign particles help in nucleating solid particles in liquid metal? What kind of foreign particles are most suitable for this job? **(12)**

   (b) Explain how the final form of ingot structure is formed during casting. List and discuss the functions of the variables that control the formation of such structure. **(20)**

   (c) Explain using neat sketches the concept of directional solidification and progressive solidification. **(8)**

3. (a) Explain the effect of freezing range and superheat on fluidity of cast metals. Why do eutectic alloys show maximum fluidity? **(25)**

   (b) Discuss how surface tensions play an important role during the filling of liquid metal into thin-sectioned casting. **(15)**

4. (a) Explain how continuity equation can be used in designing a gating system. **(12)**

   (b) How can the feeder size be reduced? What factors should be considered in determining feeder location? **(12)**

   (c) With a neat sketch explain the working principle of a blind feeder and an open feeder. Give their advantages and drawbacks. **(16)**

Contd P/2

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SECTION-B

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

5. (a) Why is casting process considered as a major manufacturing process? Discuss the disadvantages of the casting process. **(10 2/3)**

(b) What are the functions of the additives in a sand mold? Write down the type of additives added in sand mold to produce a casting of required dimension and good surface finish. Explain their working principles. **(14)**

(c) Discuss the effect of molding on density, hardness, green compressive strength and dry compressive strength of sand mold. **(22)**

6. (a) Suggest a casting method that is suitable to produce a large number of small parts per day and explain your choice. **(14 2/3)**

(b) What are the origins of the defects in castings? What type of defects take place in a casting of an alloy having poor fluidity? **(10)**

(c) Discuss the gas defects that are formed by the precipitation of gases in metal during solidification. What preventative measures should be taken for gas defects? **(22)**

7. (a) Shrinkage defects arise from failure to compensate for liquid and solidification contraction. Explain this assertion mentioning the different types of shrinkage defects. **(14)**

(b) What are the effect of defects in casting on yield strength/proof stress and ultimate tensile strength? **(10 2/3)**

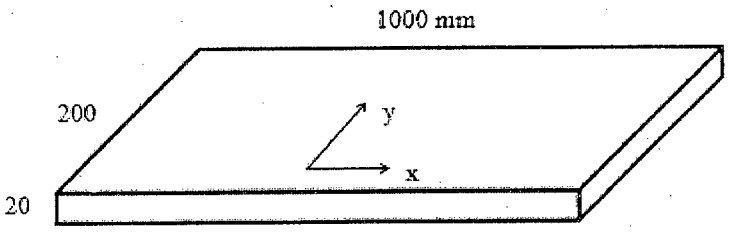
(c) Requirement of grey iron Grade 250 spout composition is TC-3.2, Si-2.0, Mn- 0.4. Foundry returns and pig irons to be used are 40% and 15% of the charge respectively. Si and Mn loss are 15% and 10% of the charge respectively. C gain is 15% of the charge. Determine the charge make up for 1000 kg charge. Composition of raw materials of are: **(22)**

Material	**C**	**Si**	**Mn**
Cast iron scrap	3.40	1.80	0.60
Steel	0.15	0.20	0.65
Pig	4.09	2.08	0.80
Foundry returns	3.55	2.20	0.75
Mn briquets	0	0	67.0
FeSi briquets	0	48.0	0

8. (a) Discuss how inoculation plays a major part in controlling graphite morphology and distribution in grey iron. **(15 2/3)**

(b) Explain how you would eliminate macro and micro shrinkages from Cu-base alloy castings using proper gating system. **(16)**

(c) Sketch a typical plant layout of a modern nonferrous foundry. Discuss the cleaning operations that are performed in the cleaning department in foundry. **(15)**



Aluminium casting
Density = 2.7 g/cc

Moulding system: Greensand

Fig. 1 for Q. #1: Shape and dimensions of the casting .

L-3/T-2/MME **Date : 28/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **HUM 211** (Sociology)

Full Marks: 140 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) How do you define natural environment and man-made environment? **(5 1/3)**

   (b) What are the main sources of global warming? **(10)**

   (c) Define with examples 'green' category industry and 'red' category industry. **(8)**

2. (a) How do you define industrialization and deindustrialization? **(5 1/3)**

   (b) Write down the important characteristics of capitalism. **(8)**

   (c) Illustrate the positive and negative impacts of capitalism on a society. **(10)**

3. (a) Define human migration. What do you mean by immigration and emigration? **(5 1/3)**

   (b) What are the major causes of rural to urban migration? **(8)**

   (c) Write down the different sources of social change in the context of Bangladesh. **(10)**

4. Write short notes on any THREE of the following: **(23 1/3)**

   (a) Consequences of global warming

   (b) Refuse, reduce, reuse and recycle (4R'S)

   (c) Social consequences of industrial revolution

   (d) Demographic transition theory.

SECTION-B

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

5. (a) 'Sociology is a general science of society' – explain this statement highlighting the nature of sociology. **(10)**

   (b) Critically explain the functionalist theoretical perspective of sociology. **(13 1/3)**

6. (a) What is deviance? Write the positive and negative effects of deviant behavior. **(10)**

   (b) Briefly discuss the E. Sutherland's cultural transmission theory of deviant behavior. **(13 1/3)**

Contd P/2

HUM 211

7. (a) Discuss vertical mobility and horizontal mobility with suitable examples. **(10)**

   (b) What do you understand by social stratification? Explain caste system and class system of social stratification. **(13 1/3)**

8. Write short notes on any three of the following: **(23 1/3)**

   (a) Ascribed status and achieved status

   (b) Social norms

   (c) Patriarchal family and nuclear family

   (d) Industrialization and the development of Sociology.

L-3/T-2/MME **Date : 28/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **HUM 305** (Economics of Development and Planning)

Full Marks: 140 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Symbols indicate their usual meaning.

1. (a) "Development is both a physical reality and a state of mind". Explain this statement with the help of three core values of development. **(8 1/3)**

   (b) Briefly discuss the policy measures that lead to the miraculous economic development of China. **(15)**

2. (a) How does a 'project evaluation' differ from a 'cost-benefit analysis'? Give examples in support of your answer. **(8 1/3)**

   (b) What is the main purpose of a cost-benefit analysis (CBA)? Briefly describe the procedure of a cost-benefit analysis (CBA). **(15)**

3. (a) Define 'Kuznets ratio' and 'Gini coefficient'. Using a typical size distribution of personal income, show how these concepts are measured. **(10)**

   (b) Why is inequality among those above the poverty line a matter of big concern in society? Discuss **(13 1/3)**

4. Write short notes on any THREE of the following: **(23 1/3)**

   (i) Absolute poverty and relative poverty;
   (ii) Foster-Greer-Thorbecke (FGT) index and Purchasing Power Parity (PPP)
   (iii) Lewis theory of economic development;
   (iv) Steps of strategic planning for regional economic development.

SECTION-B

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

5. (a) What is meant by Sustainable Development Goals (SDGs)? Describe the various goals of SDGs. **(10)**

   (b) Narrate the differences between Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). **(5)**

Contd P/2

HUM 305

Contd... Q. No. 5

(c) What are the achievements of Bangladesh in the MDG era? Point out the key challenges for Bangladesh for implementing the SDGs. **(8 1/3)**

6. (a) Mathematically derive the Harrod-Domar growth model of economic development. **(10)**

(b) What is meant by balanced growth? **(3 1/3)**

(c) Discuss the strategy of unbalanced growth in the context of a least developed country like Bangladesh. **(10)**

7. (a) What do you understand by development? Explain. **(5 1/3)**

(b) Discuss Professor Rostow's various stages of economic development with reference to the context of Bangladesh. **(10)**

(c) Briefly discuss the following factors of economic growth: **(8)**

(i) Dynamic entrepreneurship

(ii) Technological progress.

8. (a) What is meant by the concept of investment? Briefly narrate the criteria for making an investment decision. **(13)**

(b) Briefly discuss the various theories of economic development. **(10 1/3)**

L-3/T-2/MME **Date : 06/03/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Differentiate the volume-temperature (V-T) relationship between a typical glass-forming melt and a crystalline melt. **(8)**

   (b) Explain the Viscosity η versus temperature relationship for a typical soda-lime-silicate glass. **(18)**

   (c) Show the dependency of viscosity to glass composition with some examples. **(9)**

2. (a) How do you control the glass thickness in the Float Process of sheet glass making? **(8)**

   (b) Suggest the possible schedule for commercial annealing at 5°C above the rated annealing point of soda-lime-silicate glassware of 0.6 cm thickness coming out from pressing-type forming machine. Also calculate the total time for the completion of the annealing process. The glassware is cooled from one side only. Given thermal expansion coefficient is 90×10^{-7}/°C, annealing point and strain point are at 550 °C and 500 °C respectively. **(27)**

3. (a) Distinguish between soda lime glass and lead silicate glass in terms of composition, properties, advantages, disadvantages and applications. **(20)**

   (b) Depict the role of B_2O_3 in borosilicate glass. List the major limitations of borosilicate glass? **(10)**

   (c) "Most covalent ceramics are intrinsically hard" – Justify the statement. **(5)**

4. (a) Illustrate the hardening mechanism of cement. **(13)**

   (b) How can you increase the strength of concrete? **(7)**

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

Contd P/2

MME 365

Contd... Q. No. 5

SECTION-B

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

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

   (b) Give brief account on Jiggering process for white ware products. **(10)**

   (c) Discuss the various techniques for binder removal in the injection moulding process. **(10)**

6. (a) Mention the atomic mechanisms those occur during sintering. **(8)**

   (b) "Reactive liquid phase sintering is referred to as transient liquid sintering" – explain. **(11)**

   (c) Briefly describe how the initial particle size, shape and distribution affect final microstructure of the sintered ceramic body. **(16)**

7. (a) Compare and contrast between the properties of ionically and covalently bonded ceramics. **(10)**

   (b) Sketch neatly the crystal structures of cubic zirconia and Alumina. **(5)**

   (c) Discuss the characteristics of basic types of raw materials required to meet the functional aspects of a ceramic body. **(20)**

8. (a) Discuss the mechanism of achieving high strength in a fired body from its green state. **(15)**

   (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 : 12/03/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Draw the force equilibrium diagram for a body on an inclined plane and deduce the equation for expression of static co-efficient of friction. **(7)**

   (b) For a cylindrical shape wear debry pressed into a softer body, derive equation for ploughing component of the co-efficient of friction. Consider different geometrical positions of the wear debry. **(18)**

   (c) 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/s. **(10)**

2. (a) What is metallurgical compatibility? Describe metallurgical compatibility, structural effect and grain boundary effect on wear rate. **(18)**

   (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 hr. 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 and density of brass = 8500 kg/m^3.)

3. (a) Draw and explain the schematics of abrasive wear processes as a result of plastic deformation by three deformation modes. **(21)**

   (b) Derive the equation to calculate wear volume in ploughing type of abrasive wear. **(14)**

4. (a) How will you prove that transfer of material occurs from one surface to another in adhesive type of wear? **(7)**

   (b) Narrate, with schematic diagrams, the two general situations of abrasive wear. **(8)**

   (c) How are blunting and clogging of abrasive surfaces affect wear? **(6)**

   (d) Write short note on the followings: **(14)**

   (i) BNF Jet test

   (ii) Copper Accelerated Salt spray test.

Contd P/2

SECTION-B

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

5. (a) Differentiate between regular co-deposition and induced co-deposition. **(14)**

   (b) Briefly describe how variation in temperature and pH of plating bath effect electro deposition of alloys. **(16)**

   (c) Why does corrosion provide a major source of failure in metallic structures? **(5)**

6. (a) Electrical double layer formation is important in electroplating – explain. **(9)**

   (b) With appropriate mathematical relationship along with necessary examples, show that complex plating bath is required for quality deposition. **(20)**

   (c) Write down the functions of surfactant present in an electroplating bath. **(6)**

7. (a) Compare and contrast physical vapour deposition with chemical vapour deposition. **(20)**

   (b) Briefly describe six principles of alloy deposition. **(15)**

8. (a) Select and describe a coating deposition technique suitable for depositing ceramic coating on a metal plate. **(18)**

   (b) How does electroless plating overcome the difficulties that are associated with electroplating? **(10)**

   (c) Mention the usefulness of laser surface alloying over laser surface melting. **(7)**
