L-3/T-2/MME Date : 09/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

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 Q. No. 1 and any **TWO** from the rest.

Question No. 1 is Compulsory. Figs. 1-2 and Tables 1-3 are attached.

1. A foundry receives an order of manufacturing a prototype casting (Fig. 1) to be cast using gunmetal. As a foundry engineer of the company

   (a) explain the types of pattern and moulding systems you would use for this job, **(4)**

   (b) using necessary allowances, determine the size of the pattern and its core prints, **(5+5=10)**

   (c) if the moulding flask allows only a total length of 30 mm of core prints, examine the possibility of requiring a chaplet and its area, if required, **(6)**

   (d) design suitable feeding and gating systems for the casting listing all assumptions, if any, you made during the design, (assume reasonable value for any missing data), and **(15+15+5=35)**

   (e) draw a 2D diagram of the mould showing the parting line and proper positions of the mould cavity and the feeding and gating systems. **(5)**

   Given data:

   Gunmetal: Density = 8.7 g/cm^3, Volume expansion coefficient = 7.0%

   Pouring time, $t = 1.8\ (\delta W)^{1/3}$ sec. (δ = average thickness in mm, W = weight of casting in kg)

   Coresand: Density = 1.6 g/cm^3, Compressive strength = 0.35 kg/cm^2, Factory of safety = 4.

2. (a) Discuss how the otherwise protective aluminium oxide film becomes harmful while casting aluminium alloys. How do you rectify such problems? **(10+5=15)**

   (b) Between oxide film and microporosity, which one of has the maximum effect in reducing mechanical properties of casting materials? Examine the effect of defects on fracture toughness and ductility of castings. **(5+10=15)**

   (c) Why does the presence of microscopic defects have strong effect on tensile strength of casting while the proof strength remains mostly unaffected? **(4)**

   (d) List three ways by which you can improve the fatigue performance of cast materials. **(6)**

3. (a) Explain the terms 'thermal diffusivity' and 'volumetric heat capacity'. Discuss how these two terms influence in selecting and determining the dimension of chill material to control directional solidification. **(4+6=10)**

MME 345

Contd... Q. No. 3

(b) What do you mean by heterogeneous nucleation? Deduce an expression for the free energy change during the nucleation of a spherical cup sized solid on top of a foreign substrate floating inside the liquid metal. **(5+15=20)**

(c) Explain why $TiAl_3$ is used as grain refiners while a presence of Al_2O_3 helps nucleating gas porosity in aluminium alloys castings. **(10)**

4. (a) "Place the feeder top to feed downhill while place the gate bottom to fill uphill" – Explain. **(10)**

(b) What is segregation? Using neat sketch discuss the various types of segregation obtained in steel ingot. **(3+7=10)**

(c) Define fluidity. How does fluidity influence in selecting casting alloy? Discuss, using suitable data, the effects of mode of solidification, degree of superheat and surface tension on fluidity of liquid metal. **(2+3+15=20)**

SECTION – B

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

5. (a) List the principle manufacturing processes of materials. Why is casting process considered to be a major metal forming process? **(16⅔)**

(b) Write down the purpose of using the following ingredients in the green moulding sand aggregate: (i) silica flour, (ii) cereal, (iii) iron oxide and (iv) wood flour. **(8)**

(c) During the cooling of a casting from the molten state to shop temperature, the mechanical properties can be related to four stages of behaviour. Explain these four stages with the related defects that may occur during cooling. **(22)**

6. (a) What are the effects of sand grain size on the mold permeability and refractoriness? Discuss the effect of clay and moisture content on the green and dry compressive strength and as well as the permeability of green moulding sand aggregate. **(24)**

(b) Classify the casting defects. **(8⅔)**

(c) Discuss micro-segregation and macro-segregation. How can these segregation in castings be removed? **(14)**

Contd P/3

MME 345

7. (a) Why are die cast products usually not machined after casting? **(5⅔)**

(b) Why should special consideration be taken during melting and casting of magnesium alloys? **(10)**

(c) What types of melting furnaces are employed for copper base alloys? Which one do you prefer for your foundry? Give justification for your answer. **(16)**

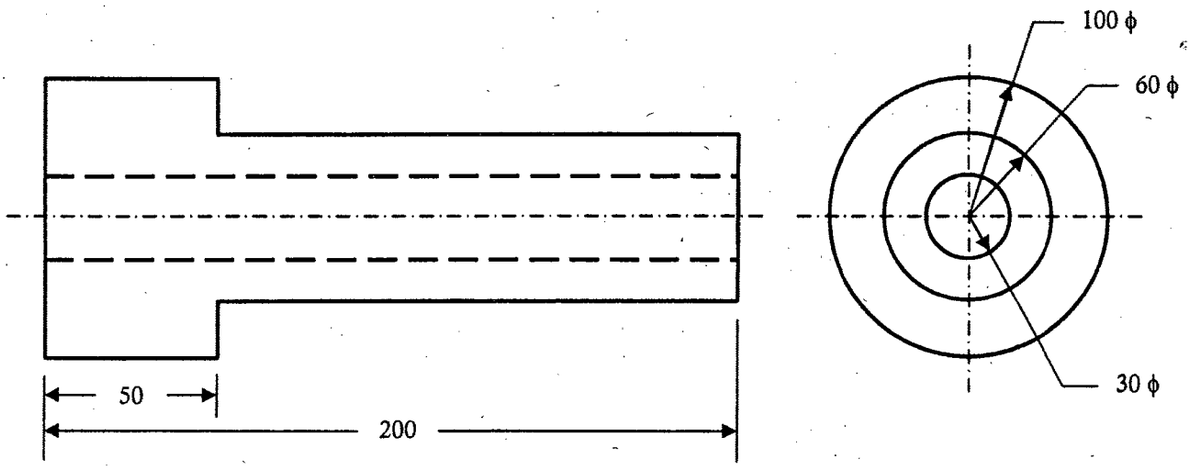
(d) Sketch a typical plant layout of a modern nonferrous foundry. Mention the cleaning operations that are performed in the cleaning department in the foundry. **(15)**

8. (a) Briefly discuss hot tear formation, metal penetration, burn-on and ceroxide formation in steel castings. **(14)**

(b) What are the common defects associated with cast aluminium and its alloy? How would you rectify these defects? **(16⅔)**

(c) How would you identify the internal defects in castings? Explain. **(14)**

Contd.....P/4



All dimensions are in mm.

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

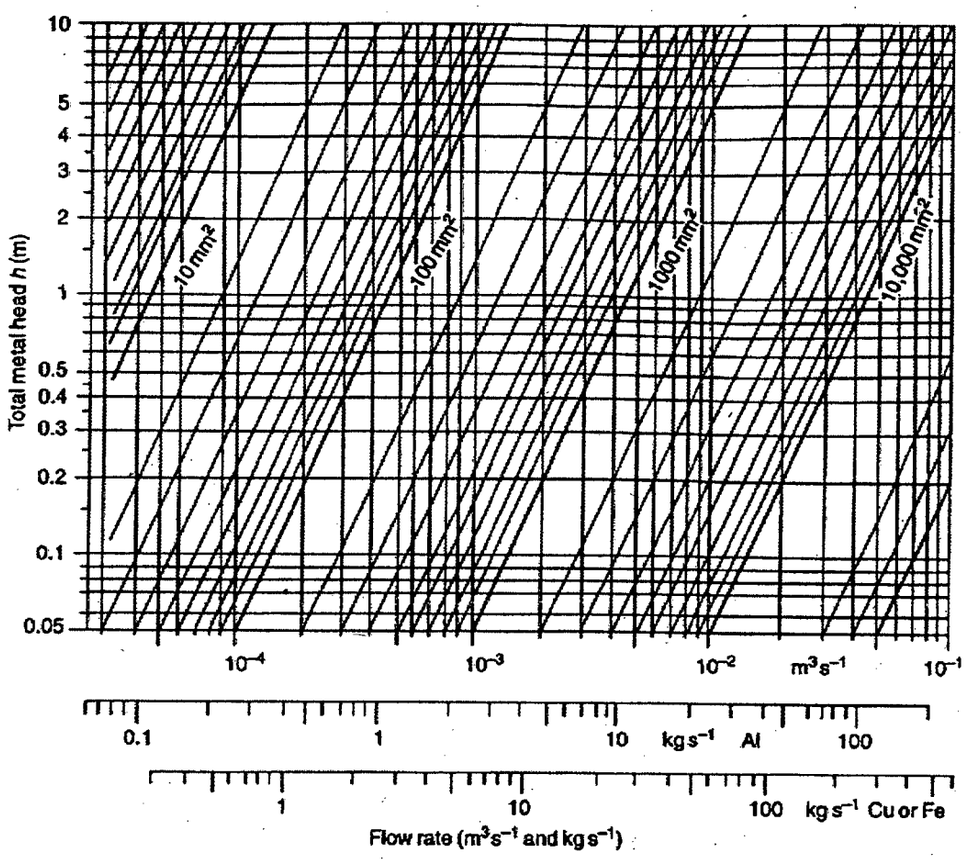


Fig. 2 for Q. #1: Nomogram giving approximate sprue area (mm^2) for light and dense metals as a function of initial flow rate and head height.

Contd -- P/5

Table 1 for Q. #1: Standards pattern shrinkage allowances

Contraction rule	*Materials used and place of use*
+8/1000	Cast iron in general, part of thin cast iron
+9/1000	Cast iron products of high shrinkage, part of thin cast steel
+10/1000	Same as above, and aluminium
+12/1000	Aluminium alloys, bronze, cast steel (thickness 5-7 mm)
+14/1000	High tension brass, cast steel
+16/1000	Cast steel (thickness over 10 mm in general)
+20/1000	Large cast steel
+25/1000	Large cast iron

Table 2 for Q. #1: Standards machining allowances

Type of metal and alloys	*Machining allowance (mm)*
Cast irons:	
(i) Large size castings (>1000 mm)	10.0
(ii) Medium size castings (<150 mm)	3.0
Cast steels:	
(i) Large size castings (>1000 mm)	12.0
(ii) Medium size castings (<150 mm)	4.3
Non-ferrous materials:	
(i) Large size castings (>1000 mm)	5.0
(ii) Medium size castings (<150 mm)	1.5

Table 3 for Q. #1: Data for approximate taper allowances

Height of pattern (mm)	*Shell Moulding*	*Sand moulding*		
		Metal	*Wood*	
		Machine drawn	*Manual drawn*	*Machine drawn*
Up to 20	0° 45'	1° 30'	3°	3°
20 to 50	0° 30'	1°	1° 30'	1° 30'
:	:	:	:	:
100 to 200	0° 20'.	0° 30'	0° 45'	0° 45'

L-3/T-2/MME **Date : 12/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 211** (Sociology)

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Describe sociological imagination with examples from your own experiences. **(10)**

   (b) What is social research? Discuss the procedures used in social research. **(13 ⅓)**

2. (a) Define socialization. Explain the sociological perspectives of socialization. **(13 ⅓)**

   (b) What is meant by culture? What are the elements of culture we usually use? **(10)**

3. (a) What is the meaning of deviance? Describe the types of deviance in our society with examples. **(10)**

   (b) What do you mean by juvenile delinquency? Discuss the social factors affecting Juvenile delinquency in society. **(13 ⅓)**

4. Write short notes on any **THREE** of the following: **(23 ⅓)**

   (a) Types of social mobility

   (b) Ideal types of stratification

   (c) Ethnocentrism

   (d) Types of crime.

SECTION – B

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

5. (a) How do you define physical environment and man-made environment? **(6)**

   (b) Define with examples, orange category A industry and orange category B industry. **(8)**

   (c) Briefly explain the potential consequences of global warming. **(9 ⅓)**

6. (a) What do you understand by social change? Discuss the characteristics of social change? **(13 ⅓)**

   (b) Briefly describe the sources of social change. **(10)**

Contd P/2

HUM 211

7. (a) Write down the important characteristics of capitalism. **(13 ⅓)**

   (b) Critically discuss the evolution of cities. **(10)**

8. Write short notes on any **THREE** of the following: **(23 ⅓)**

   (a) The factors responsible for population growth.

   (b) The major effects of rural to urban migration.

   (c) Globalization and modern life

   (d) The demographic transition theory.

L-3/T-2/MME Date : 19/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

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**.

1. (a) Compare and contrast regular co-deposition with irregular co-deposition. **(20)**

   (b) Briefly describe how variation in bath composition does effect electrodeposition of alloys. **(10)**

   (c) Draw a typical curve of metal percentage in deposit versus metal percentage in bath for regular co-deposition. **(5)**

2. (a) Electrical double layer formation is important in electroplating – explain. **(10)**

   (b) Describe four purposes of electroplating. **(16)**

   (c) Define cathode current efficiency and polarization. **(9)**

3. (a) Differentiate between physical vapour deposition and chemical vapour deposition. **(20)**

   (b) List five advantages and five disadvantages of diffusion bonding. **(10)**

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

4. (a) Select and describe a coating deposition technique suitable for using ceramic powder as starting coating material. **(18)**

   (b) How does laser surface alloying overcome the difficulties that are associated with laser surface melting? **(10)**

   (c) Mention the usefulness of electroless plating over electroplating. **(7)**

SECTION – B

There are **EIGHT** questions in this section. Answer any **SIX**.

5. Define static friction. For a spherical asperity in contact with a softer body, derive an equation for ploughing component of friction. **(17½)**

6. (a) Explain the effects of temperature and normal load on the coefficient of friction with necessary diagram. **(12½)**

   (b) Make a neat sketch of friction transition curve for sliding showing various zones. **(5)**

Contd P/2

MME 343

7. (a) Describe the grain boundary effect on coefficient of friction. **(5½)**

   (b) A hard ball is sliding against a soft and flat surface at two different loads. At one load the coefficient of friction is 0.20 and the groove width is 0.5 mm and at another load, the coefficient of friction is 0.25 and the groove width is 1 mm. Calculate the radius of the ball and the adhesive component of the coefficient of friction. Assume that the dominant sources of friction are adhesion and ploughing and these are additive. **(12)**

8. (a) Explain two deformation modes by which material is removed from a surface via plastic deformation during abrasive wear. **(12)**

   (b) Explain the effect of relative hardness of abrasive medium to workpiece on wear coefficient with necessary sketches. **(5½)**

9. What is chemical (corrosive) wear? Derive Archard's equation of adhesive wear. **(17½)**

10. (a) Write short notes on **(6½+5=11½)**

    (i) B.N.F jet test.

    (ii) Ferroxyl test.

    (b) Differentiate between free rolling and tractive rolling. **(6)**

11. (a) Schematically illustrate the following interface geometries used for the sliding friction and wear tests. **(12)**

    (i) pin on disk

    (ii) pin on flat

    (iii) pin on cylinder

    (b) Describe how the solid particle erosion test is carried out. **(5½)**

12. (a) Discuss how abrasive wear rate changes with sliding distance. **(7½)**

    (b) Briefly discuss the influence of normal load on friction behaviour of cu–cu sliding in air. **(7)**

    (c) Write down the ways that can be followed to reduce the deformation component of friction. **(3)**

L-3/T-2/MME **Date : 26/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2012-2013

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

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. Question No. 1 is COMPULSORY. Answer any **TWO** from the rest.

Q. NO. 1. COMPULSORY

Following your recent visit to Shinepukur Ceramics Ltd., answer any five of the following questions: **(5×7=35)**

(a) What are the raw materials used in Shinepukur Ceramics? Distinguish between china clay and ball clay in terms of origin, particle size and properties.

(b) Briefly explain the effects of $MgCl_2$ and Na_2SiO_3 on the stability of clay suspension.

(c) What is the feeding material for Jiggering machine? How can a shape be given by Jiggering?

(d) What are the parameters need to be carefully controlled during Jiggering to produce good quality green product?

(e) How many stages of firing are being used by the plant? Do you think it would be possible to develop an idea of single stage firing? Give reasoning.

(f) Mention the temperature used for different firing process by the plant.

(g) Recommend the most cost-effective forming process to produce the following products: (i) a tea-cup (ii) a plate.

2. (a) What factors determine the crystal structure for an ionically bonded ceramic? Calculate the most likely CN for the cation in a structure made up of Mg^{2+} and O^{2-}. Given that Ionic Radii of Mg^{2+} = 0.72 °A and O^{2-} = 1.40 °A. What is the approximate degree of covalent character of MgO? Electronegativity of Mg = 1.2 and that of O = 3.5. **(13)**

(b) Identify the structural difference among the sheet, double and single chain silicate structures. Give example in each cases. **(10)**

(c) Draw the crystal structure of two basic units of Kaolinite. Explain the two main origins of charge deficiencies in the clay particles. **(12)**

3. (a) Suggest suitable triaxial composition for earthenware, sanitary ware, and hard porcelain with reasoning. **(12)**

(b) Briefly illustrate the stages involved in making plaster molds. **(10)**

Contd P/2

MME 365

Contd ... Q. No. 3

(c) What is tape casting, and how does it differ from slip casting? Mention some important applications of tape casting. **(13)**

4. (a) Discuss the particle size and shape effects on the rheological behavior of casting slips. **(10)**

(b) Explain the critical moisture content and its influence on the quality of ceramic white wares. Mention the different dying defects encountered in a ceramic plate and causes of the defects. **(18)**

(c) Calculate the total heat requirement for the drying of a dinner plate weighing 0.5 kg having moisture content from 25 per cent to 5 per cent. Given data: **(7)**

The specific heat of water is 4.18 kJ kg^{-1} $^{o}c^{-1}$. The specific heat of body is 0.8 kJ kg^{-1} $^{o}c^{-1}$. Latent heat of evaporation of water is 2.27 $MJkg^{-1}$.

SECTION – B

There are **EIGHT** questions in this Section. Answer any **SIX** questions.

5. (a) Find a suitable recipe for the glaze using following segar formula of the glaze body:

0.06 CaO 0.1 Al_2O_3 1.85 SiO_2

0.02 K_2O

0.92 PbO

Given the molecular weight of the minerals litharge (PbO), whiting ($CaCO_3$), Clay (Al_2O_3. 2 SiO_2. $2H_2O$), flint (SiO_2), Potash feldspar (K_2O. Al_2O_3. 6 SiO_2) are 223.2, 100.1, 258.2, 60.1, 556.8 g/mol respectively. **(13½)**

(b) Draw a typical heat treatment cycle for 'Corningware' glass-ceramics. **(4)**

6. (a) Briefly discuss unique properties and advantages of hot pressing. **(10)**

(b) Describe a viscosity measurement technique for a glass having viscosity greater than 10^6 Pa.S. **(7½)**

7. (a) Mention the atomic mechanisms occur during sintering. **(7½)**

(b) "Reactive liquid phase sintering is referred to as transient liquid sintering" - Explain. **(10)**

8. (a) How can the proper selection of body and glaze composition improve the strength of whiteware product? **(8)**

(b) Briefly describe how the initial particle size, shape and distribution affect final microstructure of the Sintered ceramic body. **(9½)**

Contd P/3

MME 365

9. Discuss the purpose and processing of glass toughening by tempering and chemical strengthening. **(17½)**

10. Briefly describe the fining of glass melts using different fining agents. **(17½)**

11. (a) Write short note on borosilicate glass. **(6½)**

    (b) "For most ceramic materials, the strength measured in compression is roughly 15 times larger than that measured in tension" - Explain. **(11)**

12. (a) Briefly describe the hardening mechanism of portland cement. **(10)**

    (b) Give a brief account on glass coating. **(7½)**

L-3/T-2/MME **Date : 02/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2011-2012

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

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**.

1. (a) How can the width of a weld bead be predicted? **(8)**

(b) For a point heat source moving at a speed v along the negative x-direction on a thick plate derive the following expressions:

(i) Cooling rate at any point x along the central axis of the weld relative to the source as origin. **(5)**

(ii) Cooling rate at temperature T along the central axis of the weld. **(4)**

(c) Bead-on-plate welding of a wide thick steel plate is carried out using GTAW process at a welding speed of 2 mm/s with a welding current of 200 A at 18 volts.

Given:

Thermal conductivity of steel = 35 W/m.°C

Thermal diffusivity of steel = 1.4×10^{-5} m^2/s

Melting point of steel = 1500°C, Ambient temperature = 25°C

Heat source efficiency = 0.7

(i) Predict the width of the weld bead. **(8)**

(ii) Calculate the cooling rate at 125 mm from the heat source along the central axis of the weld. **(3)**

(iii) Calculate the cooling rate at temperature 550°C along the central axis of the weld. **(3)**

(iv) If preheating is required to keep the maximum cooling rate of 15°C/s at 550°C along the central axis of the weld, what must be the preheating temperature? **(4)**

2. (a) Discuss the weld metal nucleation mechanisms. **(10)**

(b) How can grain refinement of the weld metal be achieved by inoculation? **(5)**

(c) Explain the formation of partially melted zone during welding. **(10)**

(d) Discuss the problems associated with the partially melted zone in welding. **(10)**

Contd P/2

MME 347

3. (a) Explain the reduction in strength in the heat affected zone of precipitation-hardening materials that are in fully artificially aged condition. **(10)**

(b) Is it possible to recover full strength of the weldment of precipitation-hardening material that was fully aged condition before welding? Explain. **(5)**

(c) What is weld decay? Where and how does it form? Explain. **(10)**

(d) Explain the remedies of the formation of weld decay. **(10)**

4. (a) How does residual stresses develop in a weldment? **(10)**

(b) What is lamellar tearing in a weldment? How does it form? How many the lamellar tearing be avoided by modifying the design of a weldment? **(10)**

(c) What are blowholes? How does they form in the weld metal? **(5)**

(d) How can blow holes be detected by NDT method? Outline the principles of any suitable NDT method to detect blow holes in weldment. **(10)**

SECTION – B

There are **EIGHT** questions in this section. Answer any **SIX**.

5. (a) Draw a neat sketch of shielded metal arc welding (SMAW) process and label properly. **(6)**

(b) For welding ship hulls and storage tanks, which welding procedure would you suggest? Justify your answer. **(6)**

(c) "Friction stir welding (FSW) is becoming popular for joining dissimilar metallic alloys." Explain. **(5½)**

6. (a) Why is cleaning important before performing soldering operation on a substrate? Briefly discuss the methods of cleaning the surfaces of the parts to be joined by soldering. **(10)**

(b) With a neat sketch discuss wave soldering. **(7½)**

7. (a) What do you understand by brazing? Narrate its basic principles of operation and discuss the reasons for using fluxes in brazing. **(10)**

(b) Write a short note on molten chemical bath method of dip brazing. **(7½)**

Contd P/3

MME 347

8. (a) Explain different types of oxyacetylene flames obtained during oxyfuel gas welding (OFW). **(10)**

   (b) Write down the working principle of cutting processes with oxyacetylene flames. **(7½)**

9. Using schematic sketches, discuss different modes by which molten metal at the electrode tip can be transferred to the weld pool. **(17½)**

10. (a) Draw a neat sketch of plasma arc welding (PAW) process and narrate different welding modes possible in this process. **(12½)**

    (b) What are the distinguished advantages of electron beam welding (EBW)? **(5)**

11. (a) In diffusion welding, explain the roles of key parameters such as time, temperature and pressure. **(10)**

    (b) What do you understand by solid state welding? Write a short note on roll welding. **(7½)**

12. (a) What are the basic types of joints observed in weld design? Draw neat sketches of each types of joint. **(10)**

    (b) Briefly discuss the major elements of weld symbols. **(7½)**
