THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020-21

Sub : Advanced Welding Technology (AME-24(E) / C24(R))

Full Marks : 100
Pass Marks : 40   Time : 3 Hours

Answer any five
Parts of a question should be answered at one place

1. a) State the differences between the flame spraying with powder and plasma spraying.
(b) Compare the quality of the surfaces produced by laser cladding and plasma spraying.
(c) Discuss stainless steel cladding on MS with arc welding and its applications.
(8+5+7)

2. Explain the difficulties involved in fusion welding of (**any five**)   (5x4)
(a) Titanium alloys
(b) Nickel-chrome alloys
(c) Aluminium and its alloys
(d) Magnesium and its alloys
(e) Stainless steel
(f) Inconel.

3. Explain with schematic diagrams, working principles of the following processes- (a) ultrasonic welding (b) electron beam welding and (c) hot blade welding for polymers.   (7+7+6)

4. (a) Explain with schematic sketch the basic principle and the key variables involved in friction stir welding process mentioning different shapes of the tool used.
(b) What are the advantages of friction stir welding process for which it can be suitable for dissimilar material welding?
(c) Why is friction stir welding of thick plates in butt joint configuration is difficult?   (10+5+5)

5. (a) State the two types of plasma arc welding processes with schematic diagrams.
(b) Explain the working principle along with the key process variables of plasma arc welding.
(b) Provide one example each for plasma arc welding and electron beam welding that are not easily compatible in other fusion welding processes.   (8+8+4)

6. (a) State and explain the main difficulties of joining of two dissimilar metallic materials.
(b) Explain with schematic sketches two basic joining technologies along with proper examples that are utilized in joining of two dissimilar metallic materials.
(c) How can ceramics be joined with some metallic materials?   (6+10+4)

7. Draw the weld bead dimensions in a square butt joint with labelling. What is meant by heat input? How can the rate of heat input influence weld bead dimensions in a fusion welding process? Make a short note on the usefulness of flux and shielding gas in welding.   (5+3+6+6)

8. Write short notes on (**Any four**):   (4x5= 20)
(a) diffusion welding,
(b) magnetic pulse welding,
(c) friction welding,
(d) high frequency welding,
(e) robotic welding,
(f) eletroslag welding,
(g) joining of Material Matrix Composites.

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020-21

Sub : Computational Method & Computer Programming (AME - 18)

Full Marks : 100

Pass Marks : 40   Time : 3 Hours

Answer any five
Parts of a question should be answered at one place

1. Answer all of the following: (8x2½= 20)
a. What are the functions of a system program?
b. What do you understand by conditional statement in C?
c. Give an example of pointer to function in C.
d. What is multi dimensional array in C?
e. Can you write program assuming C for H/W drivers?
f. What is void data type?
g. What are the differences between ASCII and UNICODE?
h. State the examples of WHILE and DO WHILE control statements.

2. a. Write a C program to store name and address of five persons and display accordingly.
b. What are the differences between compiler and interpreters?
c. Write a C program to check whether a given year is a leap year or not.   (10+4+6)

3. a. Find the sum of first n terms of a series: $1/1! + 2/2! + 3/3! + ... + n/n!$, when n>0.
b. Write a c program to check whether a given no is a prime number or not.
c. Write a c program to compute square of a given number using calling function.   (8+6+6)

4. a. Write a C program to find number of words in a statement.
b. What are the advantages and disadvantages of arrays in C language? Give examples.
c. State some input devices for a PC.   (8+7+5)

5. a. What is assembly Language programming? Give an example.
b. What are the differences between machine level, assembly level and high level languages?
c. Write the functions of output devices of any PC.   (6+8+6)

6. a. Convert the following Nos.
i) 11011_2 to octal, ii) 64_D to Hexadecimal, iii) $9A_H$ to binary.
b. Write down the differences between DOS, WINDOWS and LINUX operating systems.
c. Write a programme to check whether a given number is a prime number.   (9+6+5)

7. Write short notes on **any four** from the following: (4x5= 20)
a. Compiler
b. Personal Computer
c. File IO in C language
d. Bit-wise operator in C language
e. Recursion implementation in C language
f. Logic Gates

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020-21

Sub : Heat Transfer (AME - 14)

Full Marks : 100
Pass Marks : 40   Time : 3 Hours

Answer any five
Parts of a question should be answered at one place

1. a. Why are metals good thermal conductors while non-metals are poor conductors of heat?
b. Derive the three dimensional heat conduction equation in Cartesian coordinate system considering anisotropic material, heat generating and transient heat flow.
c. What is critical radius of insulation? Derive an expression for critical radius of insulation.
d. What do you mean by effectiveness of a fin?   (4+6+8+2)

2. a. Define fin effectiveness. When is the use of fins not justified? What are the criteria of selection of fins? What makes you determine the proper Length of fins attached to a surface?
b. An electric motor is to be connected by a horizontal steel shaft of 25 mm diameter to the impeller of a pump circulating liquid metal at a temperature of 540°C. If the temperature of the electric motor is to be limited to a maximum value of 52°C with the ambient air at 27°C, what length of shaft should be specified between the motor and the pump? Take K for steel = 42.56 W/mK and h = 40.7 W/m^{2}K.
(10+10)

3. a. Consider a sphere and cylinder of equal volume made of copper. Both the sphere and the cylinder are initially at the same temperature, and are exposed to convection in the same environment. What do you think will cool faster, the cylinder or sphere? Why.
b. A hot cylinder ingot of 50 mm diameter and 200 mm length is taken from the furnace at 800°C and then dipped in water till its temperature falls to 500°C (h= 200 W/m^{2}K). Then it is directly expanded in air till its temperature falls to 100°C (ha= 20 W/m^{2}K). The temperature of air and water is 30°C. Taking the properties of ingot as ρ= 800 kg/m^3, c= 0.2 kJ/kJK, k= 60W/mK, find the total time required for the ingot to reach the temperature from 800°C to 100°C.
c. What are the uses of Heisler's Charts?   (7+10+3)

4. a. Define laminar and turbulent flows. What is Reynolds number for flow over a flat plate? What is boundary layer thickness? What is laminar sub-layer? What is critical Reynolds number and on what factors does it depend?
b. Nitrogen gas at 0°C is flowing over a 1.2m, long 2m wide plate maintained at 80°C with a velocity of 2.5 m/s. For nitrogen, ρ= 1.2 kg/m^3, C= 1.04 kJ/ kJK, γ= 15.63x10^{-6} m^2/s and K= 0.0262 W/mK. Find (i) the average heat transfer coefficient and (ii) the total heat transfer from the plate.   (10+10)

5. a. Atmospheric air at 300 K and a bulk stream velocity of u= 10 m/s flows through a tube with inside diameter of 2.5 cm. Calculate the pressure drop per 100 m length of the tube for a smooth tube (f = 0.028) and a commercial tube (f= 0.0315).
b. The maximum allowable surface temperature of an electrically heated vertical plate 15 cm high and 10cm wide is 100°C. Estimate the maximum rate of heat dissipation from both sides of the plate at 20°C. The radiation heat transfer coefficient is 8.72 W/m$\frac{1}{2}$k. For air at 80°, take λ=21.09x10^{-6} m^2/s, Pr = 0.692 and K = 0.03 W/mK. For Ra <10$_9$, you may use Nu = 0.59 (Ra)$^{1/4}$.
c. What is nucleate boiling? Why is it important?   (6+10+4)

6. a. What is an opaque body? How can its absorptivity be increased or decreased?
b. On what factors does the radiant heat exchange between two bodies depend? What is shape factor?

c. State Stephen Boltzman equation and state its significance in heat transfer. What is a black body?

d. A pipe carrying steam has an OD of 20 cm and run in a large room. It is exposed to air at 30° Calculate the loss of heat to surroundings per metre length of pipe due to radiation. The emissivity of pipe surface is 0.8. Find the reduction in heat loss if the pipe is enclosed in a 30 cm brick conduit of emissivity 0.9. (3+5+5+7)

7.a. Define effectiveness and NTU of a heat exchanger. What is the limitation of the F-LMTD (Logarithmic Mean Temperature Difference) method? How is E-NTU method superior to F-LMTD method, where F is the correction factor.

b. In an oil cooler, oil enters at 160°C. If water entering at 15° flows parallel to oil, the exit temperatures of oil and water are 90°C and 70°C respectively. Determine the temperatures of oil and water if the two fluids flow in the opposite directions. Assume that the flow rates of the two fluids and U remain constant.

c. What do you mean by fouling factor? What are the causes of fouling? (6+10+4)

8. Write notes on (**Any Four**): (4x5= 20)
a. Planck's law of thermal radiation
b. Regenerative heat exchanger
c. Film condensation
d. Biot number & Fourier number
e. Raynolds analogy
f. Kirchoff's law of radiation
g. Dimensional analysis in heat transfer.

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020-21

Sub : INDUSTRIAL SOCIOLOGY (AME-06(E) / A06(R))

Full Marks : 100
Pass Marks : 40   Time : 3 Hours

Answer any five
Parts of a question should be answered at one place

1. What do you mean by the term 'Sociological Perspective' and 'anthropology'? Discuss different types of sociological perspective.   (6+14=20)

2. Define the two terms, 'Status' and 'Role'. Discuss the functionalist and conflict perspective on social stratification.   (2+18=20)

3. Define the term 'Culture'. Explain different elements of culture. What is the significance of modernisation and westernisation?   (3+12+5=20)

4. Define the terms 'Science' and 'Technology'. How would you explain the impact of science and technology on culture and civilization. What is Technology Transfer and what is its importance?
                                                                              (3+12+5=20)

5. What do you mean by the term 'Environment'? Explain the socio-economic factors which are responsible for destruction of an eco-friendly environment.   (2+18=20)

6. Define the term, 'Women Workers'. Discuss the present condition of women workers in Indian perspective.   (3+17=20)

7. What is meant by the term Industrial dispute? Explain the causes of Industrial disputes and discuss on their solution.   (2+18=20)

8. What do you mean by Trade Union? What are different categories of workers? What is incentive? Explain the nature of Trade Union movement in Indian Political system.   (2+4+4+10=20)

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020, January 2021
Sub : Material Science [AME – 09(E), B - 09(R), AME - 101(N)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer question 1 and any 4 questions from
among the rest questions.
Parts of a question should be answered at one place.

1.   Answer briefly the following questions (any ten)
   a)   What is isomorphous system ? Give example
   b)   What is peritectic reaction
   c)   Define Berger vector
   d)   Explain Buschinger's effect
   e)   Define glass transition temperature
   f)   What is preferred orientation ?
   g)   Define critical resolved shear stress
   h)   Explain slip system in FCC crystal system
   i)   Define degree of polymerization
   j)   Differentiate engineering stress and true stress

2. a)   Describe various types of Bravais lattice in crystalline   10
          materials. Calculate atomic packing factor (APF) of BCC
          crystal structure.
   b)   Explain Bohr atomic model   5
   c)   Differentiate among ionic, covalent and metallic bond   5

3.   a. Differentaite between Frenkel and Schottky defect   5
    b. Draw following planes and directions in cubic crystal structure   5
       a) [110]   b) [121]   c) [012]   d) (111)   f) (123)

    c. Calculate the radius of a vanadium atom, given that vanadium has   5
       a BCC crystal structure, a density of 5.96g/cm^3 and atomic wieght
       of 50.9g/mol.
    d. Describe the Hume Rothery rules for formation of substitutional   5
       solid solution
4.   Write short Notes on the following :   4x5
   a)   Buschinger effect
   b)   Polymorphism
   c)   Edge and screw dislocations
   d)   Structure of silica and silicate

5. a) Differentiate between slip and twin formation during deformation of metals.   5

   b) Draw a ideal creep curve and explain various stages of creep.   5

   c) Discuss in brief various strengthening mechanism in metals and alloys.   10

6. a. What are glass ceramics ? Explain characteristics of glass ceramics.   5

   b. Describe various refractory with their engineering applications   5

   c. Define degree of polymerization. Explain addition, condensation and copolymerzation.   10

7. a. Draw the schematic iron-iron carbide phase diagram and explain in detail including phases, reactions.   10

   b. Explain the fundamental differences in the Steel, Alloy Steel and Stainless Steel.   10

8a. Define fatigue in metal. Describe the fatigue test and draw S-N curve and explain the importance of endurance limit   10

   b. Define Hardness. Explain Vickers Hardness test in detail   10

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, 2020, January 2021
Sub : Production Engineering [AME – 103(N)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer any Five question
Parts of a questions should be answered at one place

1. (a) Distinguish clearly between a machine and a machine tool.   4

   (b) With a neat sketch showing different shear / deformation zones, explain the mechanism of machining.   5

   (c) What are the elements of a SPTT ? Explain it's geometry with a neat sketch.   6

   (d) What is external cylindrical grinding ? Elaborate with suitable sketches.   5

2. a) With neat sketches explain the various allowances provided on patterns and core boxes.   10

   b) Explain the suitability of any three of the following types of patterns depending upon the size, shape and its complexity of the casting and on the quantity of production.   10

   Split pattern, solid pattern, skeleton pattern, match plate pattern.

3. a. How does extrusion vary from rolling and forging ?   4

   b. Waht is the difference between closed die and open die forgings ?   4

   c. With a neat sketch explain the process of punching and blanking. State the need of angular clearance.   7

   d. In a rolling process, sheet of 25 mm thick is rolled to 20 mm thickness, roll is of diameter 600 mm and it rotates at 1000 rpm. What will be the roll strip contact length ?   5

4. a) What are the properties required in a cutting tool material ? Name any three cutting tool materials and point out and their areas of application — 10

b) What is tool life ? — 2

c) How is tool life dependent on the following cutting parameters ? — 8
Depth of cut, cutting speed, feed and use of coolant.

5. a. What are the different types of chips produced in machining ? Explain the conditions fevourable for producing each type of chip. — 5

b. With a neat sketch, show the forces acting on the tool during turning operation. — 4

c. Explain the essential properties of cutting fluid. Briefly explain the different methods of fluid application in machining. — 6

d. A high speed steel tool is used for mechining a job at a cutting speed of 35 m/min and has a tool life of 55 mins. Funjd the tool life at a cutting speed of 40 m/min. Assume n = 0.13. — 5

6. (a) How does grinding operation differ from other conventional machining operations ? — 5

(b) What are the different modes of tool failure ? — 5

(c) Explain the different mechanisms of tool wear. — 5

(d) Differentiate between shaping and planing operations. — 5

7. a. Explain PVD and CVD processes. — 6

b. Differentiate between coating and cladding. — 6

c. What do you mean by case hardening ? Explain the general characteristics and typical applications of carburizing, carbonitriding and cyaniding. — 8

8. Write short notes on any three of the following. — 20

a) Investment casting

b) Gear shaping.

c) Centre less grinding.

d) PERT and CPM.

e) Re-order point in inventory control.

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Season, 2020, January 2021
Sub : Strength of Materials [AME – 102(N)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer question 1 and any four from the rest.

1. Answer briefly the following questions (Any ten)   10x2=20
   i)   What is the maximum value of Poisson's ratio for any material?
   ii)   Up to which point does Hook's law hold good?
   iii) What is the expression of section modulus for a circular section of diameter d?
   iv)   What do mean by working stress?
   v)   What will be the shear stress along the principal plane subjected to principal stresses σ_1 and σ_2?
   vi)   What will be the strain energy stored in a prismatic bar subjected to normal axial force F and having deformation of δ ?
   vii) A simply supported beam of span L is carrying a point load W at the mid span. What is the deflection at the centre of the beam?
   viii) For what value of bending moment the shear force along a section is zero?
   ix)   Find out power transmitted if means torque is 'T' Nm and 'N' is shaft rotational speed in RPM
   x)   What will be the shape of the shear force diagram for a cantilever beam loaded with uniformly distributed loading?
   xi)   Define toughness of a material.
   xii) Define proof resilience.

2. a) Give neat sketches of engineering stress strain diagrams for mild steel with appropriate labeling.
   b) Discuss about the regions of stress strain diagram and the significance of different points on it.
   c) The round bar of steel was tested in an universal testing machine till fracture. The following are the test data: 4+6+10 = 20
       Diameter: 20 mm
       Load at yield point: 6860 N
       Maximum load during test: 11760 N
       Gauge length after fracture: 192 mm
       Diameter at fracture: 14.2 mm
       Calculate : a) Yield stress, b) Ultimate stress, c) % of elongation at fracture, d) % of reduction in area at fracture, e) true stress.

3. a) Establish the expression for shear strain energy of a stressed body. Use standard notations in the expression.
   b) Deduce the relationship among three constants namely Elastic Modulus (E), Poisson's Ratio(p) and Bulk Modulus(k).
   c) A steel tube 4.6 m in diameter and 3.2 mm thick enclosed centrally a solid copper bar of 3 cm diameter. The bar and the tube are connected together at the ends at a temperature of 20^0 C. find the stress in each metal when it is heated to 170^0 C. Also find the increase in length if the original length of the assembly is 30 cm. The co-efficient of expansion of steel and copper are 1.08 X 10^{-5} mm/^{0}C and 1.7 X 10^{-5} mm/^{0}C respectively. Take E_S = 2.1 X 10^{11} N/m^2 and E_C = 1.1 X 10^{11} N/m^2

                                                                       4 + 6 + 10 =20

4.   A cantilever 2 m long carries a uniformly distributed load of 2 KN/m over its entire length, and two point loads of 4 KN and 5 KN at distance of 0.5 m and 1 m respectively from the fixed end. Draw the shear force and bending moment diagrams. Show where the maximum shear force and bending moment occur in the diagram and calculate their absolute values along with sign.   20

5. a) The biaxial state of stress on an element is shown in Fig. 1. Using Mohr's Circle, determine
   i) Principle stress and their plane
   ii) Normal stress and Shear stress on a plane 25^0 inclined to Y direction
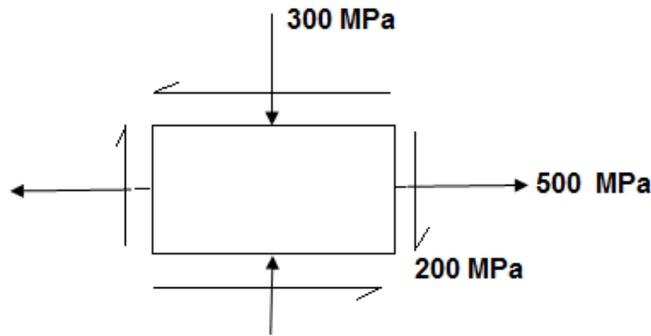   iii) Maximum shear stress

15

Fig. 1

b) Define principle stress and principle planes. Mention relevant formula.   5

6. a) Establish the relationship between Hoop stress and longitudinal stress in a thin cylinder pressure vessel. Use standard symbols for the same.

   b) Draw the shear stress distribution for a hollow cross-section and explain the economy   aspect in designing efficient shaft.

   c) A thin cylindrical boiler is of internal diameter 1 m, thickness of 12 mm and the permissible tensile stress of the plate is 90 MPa. The efficiencies of the longitudinal and circumferential joints are 60% & 45% respectively. Calculate i) the permissible steam pressure, ii) the longitudinal & circumferential stresses in the solid plate.   4 + 6 + 10 = 20

7. a) Define torsional rigidity. Derive its expression for circular cross section.   4 + 6 + 10 = 20

   b) A solid steel shaft of diameter 'd' and length 'L' is subjected to a torque 'T'. After the deformation is complete a brass sleeve of thickness 't' and of same length is securely fitted to the shaft so that there is no relative slipping. Now the torque is removed. Determine the resultant shear stresses in both materials and their angle of twists.

   c) Derive the expression for shear stress at a depth of 'y' from the neutral axis of a beam cross section; the cross section having any arbitrary shape and the width of the section is 'b' at y. the shear force at the section under consideration is V and I is the area moment of inertia of the cross section with respect to its neutral axis.

8. a) State and explain moment area theorems in finding defection of a beam.   5 + 15 =20

   b) A beam of span 8.0 m is rested over two simple supports at two ends. The beam is carrying U.D.L. at an intensity of 2.0kN/m up to 4.0 m length from left end. A concentrated load of 5.0 kN at a distance of 6.0 m is applied on the beam. In addition to these loads the beam is also subjected to a couple of 20 kNm anticlockwise at left end and 30 kNm clockwise at the right end respectively. Find maximum deflection using double integration method and moment area theorem. Also draw the deflection shape of the beam.

FULL MARKS : 100   **TIME : 3 Hours**
PASS MARKS: 40

Question No. 1 is compulsory. Answer any Four questions from the rest.
Parts of a questions should be answered at one place

1. Answer briefly any ten questions from the following.   2 X 10 = 20
   a) Name the gas shielded arc welding process where 100% CO2 gas is used as shielding gas?
   b) How can you recognize an acetylene cylinder?
   c) Name the mixture of gases used for GTAW process.
   d) Name the welding process for which constant voltage (CV) type power source are mostly preferred.
   e) Is friction stir welding is a fusion welding? Comment on it.
   f) What is short circuiting?
   g) What is the function of chipping hammer?
   h) Mention one limitation of MIG and TIG each.
   i) Name two welding processes in which non-consumable electrodes are used.
   j) Mention only the name of types of SAW process.
   k) Name two welding processes you mostly preferred for aluminium welding.
   l) What are the functions of flux coating on electrode?

2. a) Differentiate between fusion and solid state welding   5
   b) Discuss about carburizing, neutral and oxidising flames   6+3=9
      mentioning their specific application areas.
   c) Draw schematically different types of flames with label.   6

3. a. Briefly describe SMAW process mentioning the type of   12
      consumable (filler wire / electrodes), the type of power
      source, shielding gas if any, welding positions possible
      materials suitable for welding by this process, suitability for
      manual / semi automatic / automatic operation.

b. What are the functions of flux coating on the electrodes in SMAW process ? Mention the different types of electrodes based on type of flux coating.   4+4

4. a) Describe the three types of flames associated with oxy-acetylene gas welding. Which of the three flames is mostly used in welding ferrous materials ? Which type of flame uses oxygen and acetylene in the ratio of 1 : 1.1 (by volume) ? Which type of flame produces more soot ? After oxy-acetylene welding, which gas should be closed first ?   5+1+1+1+1+1

b) What is OCV in a welding power source ? How does it affect the performance of electrodes in SMAW ? What type of power source (characteristics) is used in SMAW ? Describe. Why such type of power source is used in SMAW ? In which other welding processess similar power sources are used ?   10

5. a. Define welding arc ? Explain the mechanism of arc initiation and its maintenance.   9

b. Why coating of electrode is necessary ? What are the different types of coating ? Explain in brief.   6

c. How GTAW and GMAW differentiated from each other on the basis of process, parameters, equipments, uses and applications ?   5

6. Why shielding is required in arc welding of metals ? How shielding is provided in MMA, TIG and MIG and Submerged arc welding processes ?   10

Mention the important defects seen in the welds made by the above mentioned processes.   10

7. a) State the types of metal transfer in arc welding. Which are the applications corresponding different types of metal transfer ? Give reasons.   8

b) What are meant by DC SP and DC RP ?   2+6=8

Compare the application areas with DCSP, DCRP and AC with reasons.   4

c) Write a note on temperature distribution in on arc.

8. Write short notes on (any four) :   4x5
   a) Pulsed MIG welding
   b) Arc blow and its prevention
   c) Diffusion bonding

d) FCAW
e) Defects in SMAW weld
g) Give reasons for using AC TIG process instead of the popular DCSP TIG to weld alluminium.

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session, 2020-21

Sub : WELDING APPLICATIONS (AME-21(E) / C21(R))

Full Marks : 100
Pass Marks : 40   Time : 3 Hours

Answer any five
Parts of a question should be answered at one place

1. a. State the composition and physical properties of a commonly used steel that is used in piping and pressure vessels working under moderate pressure.
b. What is Duplex Stainless Steel? State its applications and reasons for its use.
c. Discuss different components of estimating cost of welding for fabrication of a component. (**7+6+7**)

2. a. Explain the functions of the flux coating of a covered electrode. State the types of coating and the purpose of their specific uses.
b. How is a covered electrode specified under Indian Standard?
c. What are the uses of cladding in a pressure vessel?   (**9+6+5**)

3. a. Explain the term "Weldability" as applied to different types of Ferrous and Non Ferrous metals and alloys.
b. List the problems normally encountered in welding due to poor weldability of a metal or alloy.
c. State and explain different edge preparations needed in welding.   (**8+6+6**)

4. a. Discuss in detail the ultrasonic testing and radiography test to judge soundness of a weldment.
b. Describe the various safety precautions needed while doing arc welding.   (**10+10**)

5. a. State the description of the matter for which the code stands for
I. ASME BPVC Section IX
II. AWS D01.1
iii. API 1104
iv. ISO 9606
v. IS 814:2004
vi. IS 5206 : 1983
vii. ASME BPVC Section V
viii. AWS D10.11
b. What is WPS? List the essential and non-essential variables to be written in a Welding Procedure Specification.   (**8+12**)

6. a. What is Hardfacing? Why is it used? Give examples where it is used effectively.
b. A coal cutting equipment works under heavy wear and abrasion. Suggest the composition of a suitable hardfacing electrode to deposit the requisite weld metal.
c. What is Cladding? Give examples of cladding used effectively in the manufactured products. What metals are normally used for cladding?   (**7+6+7**)

7. Write short notes on (**Any Four**):   (**4x5= 20**)
a. Weld Crack, its types, and possible reasons.
b. Residual Stress and Distortion.
c. Welders' Certification Tests.
d. Fitness for purpose.
e. Duty Cycle
f. DP Test.

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THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session 2020, January 2021
Sub : Welding Metallurgy – I [AME -16 (E), B-16 (R)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer question 13 (4x5) and any 8 questions (5+5)x8 = 100

1. a) Compare the solidification processes during ingot casting and weld metal solidification and show how they are different.
   b) Explain the continuous casting process.
2. a) What are the harmful impurities that are commonly present in steel?
   b) What is the role played by slag in a steel making process in controlling the presence of such impurities?
3. a) Draw the detail iron-iron carbide phase diagram and explain reactions.
   b) Define martensite and temper martensite; explain the effect of tempering heat treatment variables on mechanical properties.
4. a) Define TTT diagram and explain the pearlitic and banitic phase transformation with reference to TTT diagram.
   b) Explain how recrystallization is proceeding more rapidly in pure metals than alloys.
5. a) Compare the crystal structure of aluminium and iron at room temperature.
   b) Show with the help of neat sketches the difference in the microstructures of a polycrystalline metal before and after cold work.
6. a) How will you estimate the amount of cold work from the microstructure of a cold rolled steel sheet?
   b) What is the effect of cold work on the properties of steel?
7. a) Sketch a diagram that describes the effect of transformation temperature on the microstructure that develops in eutectoid steel. What is this diagram commonly known as?
   b) Define hardenability. Explain the effect of quenching medium and specimen size on hardenability test.
8. a) Explain quenching and tempering of steel. What is temper brittleness?
   b) Define weldability and explain the carbon equivalent and its relevance.
9. a) Explain the fundamental difference between steel, alloy steel and stainless steel; name the various steel grades and its applications.
   b) What is meant by closed gamma loop forming element?
10. a) Explain the effect of heat input on the HAZ grain size of mild steel.
    b) Explain with sketches, the microstructural changes taking place in the HAZ of mild steel during arc welding.
11. a) Explain relevance of pre heat, interpass temperature and post heating during welding.
    b) Define heat input and effect of heat input on cooling rate.
12. a) What is crystal defects? Explain different types of grain boundary.
    b) Why fine grain structure is stronger and harder in comparison with coarse grain structure?
13. Write short notes on any five of the following:
    a) Carburizing
    b) Porosity and inclusions
    c) Single pass and multi pass welding
    d) Age hardening
    e) Spheroidizing
    f) Electro slag refining

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session 2020, January 2021
Sub : Welding Metallurgy – II [(AME -20(E), C - 20(R)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer question 13 (4x5) and any 8 questions (5+5)x8 = 100

1. a) Name the appropriate electrode materials for joining two pieces of grey cast iron by fusion welding and why.
    b) State the advantages and limitations of joining cast irons by brazing.

2. a) How will the micro structure of the weld deposit vary from HAZ to the centre of the weld deposit?
    b) What do you mean by buttering prior to welding?

3. a) What is the difference between MIG and MAG welding? Explain with examples.
    b) Explain the effects of increasing welding current and wire feeding rate in MIG welding on the characteristics of the weld deposit.

4. a) What is meant by the term redox potential? On what does it depend?
    b) What is the difference between electro chemical series and galvanic series?

5. a) Explain the mechanism of corrosion protection of steel by coatings of zinc and tin.
    b) Why do you need to keep aluminium anodes in a solution having chloride ions to protect steel from corrosion?

6. a) Why is Mn present in most grades of commercial steel? In which phases or constituents of steel it is likely to be present?
    b) A Tee joint has been made by welding two C-Mn plates having banded structure. The weld direction is perpendicular of the rolling direction of both the plates. Which of the two plates is more susceptible to cracking? Describe with reason.

7. a) What is the principle of hard facing? Explain its advantages.
    b) Explain how the clad steels are welded.

8. a) What is weld decay? How can you prevent weld decay in austenitic stainless steels?
    b) Why do you retain a small volume fraction of delta ferrite in an austenitic stainless steel weld deposit?

9. a) What are the factors that determine the magnitude of residual stress in a welded structure?
    b) Show with a neat sketch the main micro structural features in different zones of a pair of cold rolled butt welded aluminium plates. The weld joint is perpendicular to the rolling directions of the plates.

10. a) Explain the Schaffeler diagram with a neat sketch.
    b) Explain how the Schaffeler diagram is useful during welding of stainless steels.

11. a) Explain the mechanism of absorption of gases during welding such as Oxygen, Hydrogen and Nitrogen.
    b) What will be the effect on quality of weld if high amount of gases are absorbed in weld?

12. a) Describe various types of coating on the electrodes and its function.
    b) Explain the characteristics of shielding gases.

13. Write short notes on any five of the following:
    a) Liquation cracking
    b) Weld bend test

c) Pitting corrosion
d) Ultrasonic test of weld deposits
e) Metallurgy of soldering
f) Knife edge attack

THE INDIAN INSTITUTE OF WELDING
Associate Membership Examination
Winter Session 2020, January 2021
Sub : Weldment Design and Weld Procedure [(C-23(R)]

FULL MARKS : 100   TIME : 3 Hours
PASS MARKS: 40

Answer question 8 (2x10) and any 4 questions (10+10)x4 = 100

1. a) What are the five basic types of weld joints? Illustrate with sketches. Explain the suitability of the basic joints for static and dynamic loading.
   b) Draw weld symbols to specify:
      i) 6mm fillet weld on both sides of the joint
      ii) Double Vee butt weld with top weld surface machines flat
      iii) 10mm stitch weld at a gap of 100mm
      iv) Weld all round a Tee joint
      v) A Tee joint with one side convex fillet weld and the other side a bevel welded joint

2. a) Explain modulus of elasticity and elastic limit with reference to a typical stress-strain curve. What is shear modulus? Give its relation to modulus of elasticity.
   b) A shell of diameter 1000mm with 25mm wall thickness is to be welded. Discuss the various options available to design the joint and its advantages in terms of minimizing the weld metal and reducing distortion.

3. a) What is a WPS? Explain the terms 'P' number, 'F' number and 'A' number with examples as used in a WPS.
   b) Write down the Essential and Non-essential variables required to prepare a WPS for butt welded pipes of 304L material of 80mm OD with 6mm wall thickness. You may choose welding process and filler material to produce leak proof radiographic weld.

4. a) Define:
      i) Ultimate Tensile Strength of a material on construction and its design use
      ii) Endurance Limit and its design use
      iii) Creep strength and its Standard
      iv) Notch Toughness
   b) Draw a Mohr's Circle for a Bar under simple tension and explain its use in weld design.

5. a) What is a weld discontinuity? State the major weld discontinuities, its causes and preventive measures.
   b) Draw the sketch of a 25mm butt welded joint to show in details the:
      i) Penetration
      ii) Heat affected zone
      iii) Grain structures from the centre of weld to the parent metal unaffected by weld heat
      iv) Stress distribution after welding

6. a) State the problems faced at workplaces for repair of defective weldments and the steps to be taken for proper quality of welds to be made on repair.
   b) A crack is visibly detected in a block of cast iron fixed to a machine and cannot be dismantled for repair. State and explain a step repair procedure with special reference to consumables to be used.

7. a) Write short notes on the following Standards:
     i) ISO 3834
     ii) ASME Section VIII
     iii) IS 7310
     iv) AWS D1.1

   b) Write short notes on the following:
     i) Testing of welds – different Methodology and applications
     ii) Distortion control of weldments

8. Draw the standard Reference line with tail and arrow line for weld symbols and indicate the following on the line:
     i) Reference line
     ii) Arrow connecting the reference line
     iii) Basic weld symbol
     iv) Size of weld
     v) Length of weld
     vi) Unwelded length
     vii) Finish symbol
     viii) Contour symbol
     ix) Weld all around symbol
     x) Field weld symbol