THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Sub: Materials Science (AME-101)

Full Marks : 80

Answer any 5 questions. Answer must be brief and to the point.
Parts of question (a, b, c etc.) should be answered at one place.

1. a. What is an atom? Describe briefly the important constituents of an atom.
   b. Deduce an expression for the binding energy of an electron in a hydrogen like atom according to Bohr's theory.
   c. The radius of first orbit of electron in a hydrogen atom is 0.529 Å. Show that the radius of the second Bohr orbit in a singly ionized helium atom is 1.058 Å.
   d. Assuming that the weight of an electron is negligible compared to the weight of proton and neutron, calculate the weight of copper atom. Assuming that weight of one proton is equal to that of one neutron, find the weight of on proton.

   Given, Atomic weight of copper = 63.54,
   Avogadro's numbers (N) = 6.023×10^{23} atoms/gm-mole.

   3+5+4+4

2. a. What are the important features of Miller Indices of Crystal Planes?
   b. Write a short note on space lattice.
   c. Draw the planes and directions of FCC structures (321) and (201).
   d. For the HCP crystal structure, show that the ideal c/a ratio is 1.633.

   4+4+4+4

3. a. What are dislocations? What do you understand by Burgers vector?
   b. Explain Schottky and stacking faults.
   c. Distinguish between Edge and screw dislocation.
   d. How point defects affect the properties of materials?

   (2+2) +(3+3)+4+2

4. a. What is a solid solution? Discuss the similarities and differences between substitutional and interstitial solutions.
   b. State and explain 'Gibb's phase rule', defining all terms with examples.
   c. Draw the cooling curves for a binary system forming eutective solution. Explain, how cooling curves are useful.

   (2+6)+4+4

5. a. What are elastic and plastic deformations? Compare elastic and plastic materials when they are subjected to tensile loads.
   b. What is critical resolved shear stress? On what factors does it depend?
   c. What is Bauchinger's effect? Explain, its effect in deformation of metals?
   d. What do you understand by recrystallization?

   (3+3)+(2+2)+(2+2)+2

6. a. What is hardness? How tensile strength is empirically related with Brinell hardness number.
   b. What is creep? Draw a continuous loading creep diagram at fixed temperature.
   c. Explain fatigue life of a sample with S-N curve. Write the stress ratio and amplitude ratio for fully reserved fatigue condition. What is Endurance limit?

(1+3)+(2+3)+(5+1+1)

7. a. Make a qualitative comparison of the properties between Metals and Ceramics.
   b. Describe the difference between thermoplastics and thermosetting polymers in terms of applied stress, increased temperature and atomic structure.
   c. For some ceramic materials, thermal conductivity first decreases and then increases with rising temperature, why?
   d. If the number-average molecular weight of a sample of PVC blue coloured classroom chair is 74.25×10^3 gram per mol, find degree of polymerization of that chair-sample. We know atomic Weights of C, H, and CL are 12.01, 1.01 and 35.45 gram/mol respectively.

5+5+3+3

8. a. What are Sintering and Vitrification?
   b.What is composite? What are the basic difference composites and alloy? Explain ceramics matrix composites and polymer matrix composites with few applications of them.
   c. What is polymerization? Write two applications of elastomers.

(2+2)+(2+3+4)+(1+2)

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, January 2022
Sub: Strength of Materials (AME-102)

Full Marks: 80 Time: 3 hours

Pass Marks: 32

Answer ***Question No. 1*** and ***any four (4)*** questions from the followings.
Parts of a question should be answered at one place

1. **Answer any eight:** 2x8=16
   a) Why I-section is preferred over rectangular section of beam?
   b) What is Factor of Safety? Why this is important?
   c) Stress Tensor has how many effective components? Is it Symmetric?
   d) How principal planes are defined?
   e) In stress- strain curve, what does the slope indicate?
   f) What are Hoop stress and longitudinal stresses for thin shells? Show with pictures.
   g) Euler theory is applicable for what type of column? What is slenderness ratio?
   i) Write the combined relation among elastic constant E, G and K.
   j) A Shaft transmits 10kW at 1000rpm. Taking maximum shear stress of material of shaft 150MPa, determine the safest diameter of the shaft.

2. a) A specimen of steel 25mm in diameter with gauge length of 200mm is tested to destruction. It has extension of 0.16mm under a load of 80kN and the load at elastic limit is 160kN. The maximum load is 180kN. The total extension at fracture is 56mm and diameter at the neck is 18mm. find the following.

i) Stress at elastic limit 8
ii) Young's Modulus
iii) Percentage Elongation
iv) Percentage reduction in area
v) Ultimate tensile strength.
b) Deduce the relation among elastic constants E, G and K. 8

3. a) Find the elongation of a bar due to its self weight. 4

b) A compound bar consists of a circular rod of steel with diameter 20mm rigidly fitted into a copper tube of internal diameter 20mm and thickness 5mm as shown in figure 1. If the bar is subjected to a load of 100kN, find the stresses developed in two materials. $E_s=2 \times 10^5$ N/mm^2 and $E_c=1.2 \times 10^5$ N/mm^2. 7

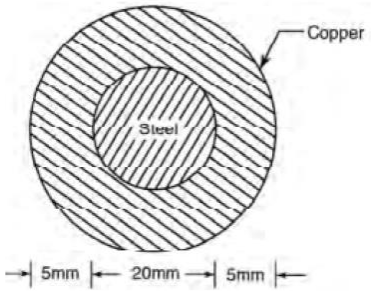

Figure 1

3. c) What are Von Mises and Trescas's Criteria. Relate two criteria. 5

4. a)

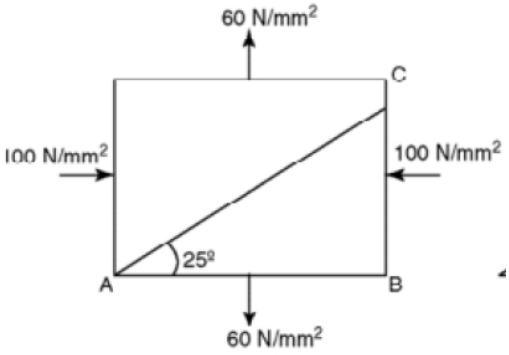

Figure 2

i) Find the stresses at AC plane. 10
ii) Find the angle of principal plane.
iii) Find Principal stresses
iv) Represent the stresses in Mohr's Circle.

b) For a beam prove that, 5

$$\frac{dV}{dx} = -w_o \; and \; \frac{dM}{dx} = V$$

Where M=bending moment, V= Shear force and w_o= distributed force.

5. a) Draw the shear force and bending moment of the beam as shown in figure 3. 10

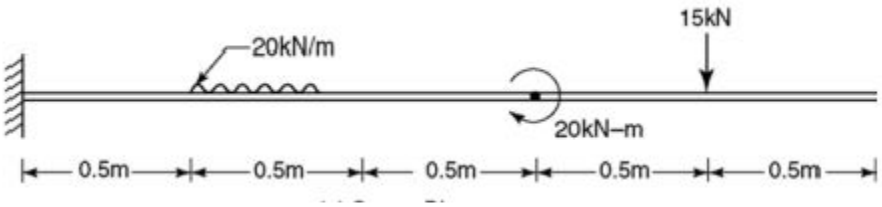

Figure 3

b) Prove the formula for beam, 6

$$\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$$

6. a) For simply supported beam with distributed load w, show that the central deflection of the beam is $5wl^3/(384EI)$. Solve by double integration method. 8

b) A beam is subjected to uniformly varying triangular load. Find the expression for shear force and bending moments. Also draw the SF and BM diagrams. 8

7. a) Show that a hollow shaft is stiffer than a solid shaft with same mass, length and material. 8

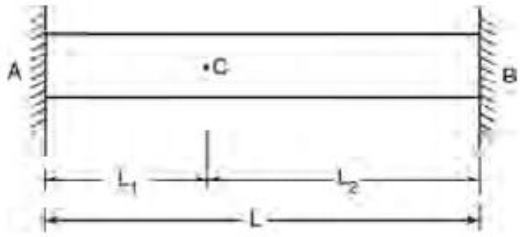

Figure 4

b) The shaft shown in figure 4 is subjected to an external torque T at C. Find the resisting torques at points A and B. 8

8. a) A cylindrical shell is of length 3m and having 1m internal diameter and 15mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in dimension of the shell, if it is subjected to an internal pressure of $1.5N/mm^2$. $E=2 \times 10^5$ N/mm^2 and Poisson's ratio=0.3. 8

b) Find the Euler's critical load for a coloumn with both end fixed. 8

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, January 2022
Sub : Production Engineering (AME-103)

Full Marks : 80 **Time : 3 Hours**
Pass Marks : 32

Answer any FIVE Questions
Parts of a Question should be answered at ONE PLACE

1. a) Explain with neat sketches the most important defects in casting along with the remedial measures adopted.
   b) What are the major criteria for design of riser in casting? Explain the different provisions for imparting favourable directional solidification.
   c) For casting a spherical metallic ball, what is the best suited type of pattern and why?
   d)Make a neat labelled sketch of Hot Chamber Die Casting set-up. [5+4+3+4=16]

2. a) Differentiate between nitriding and Carbonitriding.

   b) State the different PVD processes and discuss the sputter coating technique.

   c) Explain the surface hardening methods used for alloy steel and stainless steel.

   [4+6+6=16]

3. a) Explain the terms TIME STUDY and MOTION STUDY.

   b) Explain briefly the different policies adopted for effective inventory control.

   c) Explain with a suitable example the utility of Gantt Chart. [5+6+5=16]

4. a) Shafts of 75 $\pm$ 0.02mm diameter are to be checked by the help of a GO, NO-GO snap gauges. Design the gauge, sketch it,and show its GO size and NO-GO size dimensions. Assume normal wear allowance and gauge maker's tolerance.

   b) Describe he two-wire method to determine the effective diameter of screw threads.

   c) Explain with a neat sketch working of a Talysurf instrument for surface finish measurement. [6+5+5=16]

5. a) Explain briefly the mechanism of chip formation in machining. State how a ductile material like aluminium can produce fragmented chips**.**
   b) Explain briefly the different modes of tool failure. State with necessary sketches the different types of wear produced in cutting tools**.**
   c) Draw and label the MCD. State what may be the possible modifications in the diagram if flank surface friction is considered.

   d) With the help of a diagram, explain the different angles and surfaces of a SPTT.

[4+4+4+4=16]

6. a) Differentiate between DRAWING and DEEP DRAWING operation.

   b) Explain the different types of manual forging operations and their limitations.

   c) What are the different rolling mills used in industries. Explain with suitable sketches.

   d) Sketch and explain hydrostatic extrusion process. [4+4+4+4=16]

7. a) Discuss the mechanism of formation of arc in electric arc welding process.

   b) What do you mean by solid state welding? Explain briefly any two such welding processes.

   c) How does soldering differ from conventional welding?

   d) Discuss the effects of HAZ in welding. [5+5+3+3=16]

8. Write short notes on **any four**: [4x4=16]

   i) Cladding

   ii) ORS system of tool geometry

   iii) Dynamic recrystallization

   iv) Semi-centrifugal Casting

   v) Production Planning

   vi) Gating system elements

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, January 2022

Sub: Welding & Allied Processes I (AME-104)

Full Marks: 80 Time: 3 hours

Pass Marks: 32

Answer ***Question No. 1*** and ***any four (4)*** questions from the followings.
Parts of a question should be answered at one place

1.a) Name the gas shielded arc welding process where 100% CO_2 is used as shielding gas.
b) What is short circuiting?
c) What is the function of flux coating on electrode?
d) Write one limitation of TIG and MIG.
e) Name two welding processes where non-consumable electrodes are used.
f) What is penetration in welding?
g) What is neutral dot?
h) What is solid state welding?
i) Name the mixtures of gas used in GTAW process.
j) What is function of chipping hammer? 2 x 8=16

2. Write short notes on (any four)

a) FCAW
b) Hazard associated with welding power sources
c) AC and DC in TIG welding
d) Defects in SMAW welding
e) Diffusion bonding
f) Fluxes in SAW

3. a) Why shielding is required in arc welding processes? How shielding is provided in MMA, TIG, MIG and submerged arc welding processes? 4 + 6 =10
b) State the different types of metal transfer in arc welding process. 6

4. a) Differentiate between fusion and solid state welding. 4
b) Explain role of AC and DC in TIG welding. 4
c) Discuss about oxidizing, Carburizing and neutral flames. 4
d) Write short note on arc blow and its prevention. 4

5. (a) Explain the electrode geometry in TIG welding?
(b) Name the shielding gas and uses for the following metals for TIG welding?
i. Stainless steel
ii. Bronzes
and
iii. Ti and Mg
(c) Explain how the tungsten contamination in weld is minimized? [6+6+4=16]

6. (a) Explain the different types of welding electrodes used in arc welding process?
(b) Explain the function of electrode coating? [8+8=16]

7. a) Discuss the process variables in SAW.
(b) What are the advantages of SAW?
(c) Give the disadvantages and applications of SAW. 6+5+5=16

8. a) what is meant by DC SP and DC RP ? 2+6=8
b) Compare the application areas in DCSP, DCRP and AC with reasons. 4
c) Write a note on temperature distribution in arc.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, January 2022

Sub: Welding Metallurgy of Steels (AME-105)

Full Marks: 80 Time: 3 hours

Pass Marks: 32

Answer ***Question No. 1*** and ***any four (4)*** questions from the followings.
Parts of a question should be answered at one place
All Question carry 16 Marks each

1 Answer True or False and give reasons 1x16=16

a) Iron making is reduction process and steel making is an oxidation process
b) In steel making only impurity elements like S, P and Si are removed
c) Residual stress will be high in a weld joint made with a steel of high thermal expansion coefficient compared to that made with a steel with low thermal expansion coefficient
d) All type of flux coating will have some definite wt.% cellulose in them
e) SMAW electrodes of 2.5 mm diameter are often available in 250 mm length
f) Post weld heat treatment temperature is close to that of the tempering temperature recommended to the steel
g) Residual stress is a concern in weld joints put in service for both static and dynamic loading
h) Arc welding can be carried out only with filler addition
i) For a given welding process, to make a weld joint of two austenitic stainless steel plates, one is recommended to use the same welding parameters employed for welding of carbon steel plates of same dimensions
j) In martensite, carbon is in solid solution with iron
k) Strength in weld metal of carbon steel is achieved by high volume fraction of acicular ferrite in the weld metal
l) Weldability of martensitic stainless steels is similar to that of austenitic stainless steel
j) Minimum δ-ferrite content is specified in austenitic stainless steel weld metal to avoid sensitization of the weld metal
k) In duplex stainless steel primary objective of having ~50% ferrite is to increase the resistance to pitting corrosion of the steel.
l) In Ni_{eq} specified for predicting δ-ferrite content, maximum contribution is from C
m) Normalizing heat treatment (air cooling after heating above A3 temperature) would produce ferrite + pearlite structure in all steels
n) Synthetic electrodes are preferred for positional welding
o) For welding Ni steels used in cryogenic application, welding consumable matching in Ni content of the base metal is recommended irrespective of the Ni content in base metal
p) In HSLA steel, softening HAZ is the major concern in welding.

2 Define terms Heat input and thermal diffusivity. Explain how heat input varies with different processes and thermal diffusivity varies with different materials. Estimate thermal diffusivity for a material with thermal conductivity of 45W/(mK), specific heat 420J/kg°C and density 7.85g/cm^3. Show schematically how does the shape of the molten weld pool in a bead on plate would differ for two materials, one with thermal diffusivity of 97 mm^2/s and another with 4.7 mm^2/s 16

3 Explain how TTT diagram and CCT diagram are generated for a given steel. How does CCT diagram for a given steel differ from the TTT diagram for the same steel. What is importance of $t_{8/5}$ (time taken by the weld to cool from 800 to 500 C is important in steel welding. Why addition of alloying elements shift the TTT and CCT diagram away from the temperature axis? 16

4 Explain the terms full annealing, normalizing, quenching and tempering. Is there any difference between stress relieving and post weld heat treatment? Explain. Give the importance of hold time and cooling rate during stress relieving and post weld heat treatment. What are the precautions to be taken for localized heat treatment of weld joints? Why stress relieving heat treatment is not recommended for austenitic stainless steels? 16

5 Explain how the composition of weld metal of carbon steel is different from that of the base metal. How strength matching is achieved between weld metal and the base metal in carbon steel welds? Explain how carbon steel weld metal is less prone to HAC than the HAZ of the weld joining 16

6 List down the conditions required for cold cracking or hydrogen assisted cracking to occur in steel welds? What are the major sources of hydrogen in steel welds? Explain Graville diagram to assess the susceptibility of steel to cold cracking? How preheat temperature can be determined for carbon steel? What is the importance of post heating? What is the role of heat input in reducing risk of cracking in C-Mn steel welding? Explain how HSLA steel is less prone to cold cracking than thehigh strength steels even though their strength levels are comparable. 16

7 Give short notes on

a) Creep resistant steels and their weldability
b) Ferrite in austenitic stainless steel welds and duplex stainless steels
c) Factors affecting residual stress in weld joints and role of austenite to ferrite transformation in residual stress distribution in welds
d) Explain how carbon steel weld metal is different from base metal

4x4=16

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, January 2022

Sub: Economics of Welding & Fabrication (AME-106)

Full Marks: 80 Time: 3 hours

Pass Marks: 32

Answer ***any five (5)*** questions from the followings.
Parts of a question should be answered at one place

Answer any 5 (Five) questions **5×16=80**

1. a. Explain the concept of Demand with suitable example.
   b. Explain the terms Gross Elasticity of Demand and Price Elasticity of Demand. 4+6+6
2. a. What is Demand Forecasting? Explain the importance of Demand Forecasting in the world of Industrial Engineering with suitable case study.
   b. Explain any one method of calculating Demand Forecasting with suitable example. 4+6+6
3. a. Represent the concept of Break Even Analysis graphically.
   b. Explain how Break Even Analysis can be used as a parameter to evaluate business health. Justify your answer with a suitable example/ case study. 10+6
4. Describe the features of following market structure with suitable example:
   a. Perfect Competition
   b. Oligopoly
   c. Monopoly
   d. Monopsony 4×4
5. a. Explain the concepts of Cost, Price and Revenue with suitable example.
   b. Discuss the following types of Costs with suitable example:
   i. Opportunity Cost
   ii. Marginal Cost
   iii. Sunk Cost
   iv. Semi-variable Cost 4+(3×4)
6. a. Distinguish between Capital Market and Money Market
   b. Write short notes on the following:
   i. Net Present Value (NPV)
   ii. Internal Rate of Return (IRR)
   iii. Benefit-Cost ratio (B/C ratio)
   iv. Payback period 4×4

7. a. Describe the factors that are used to form the market structure. Briefly explain the features of Monopolistic competitions.
   b. Describe the difference between Market Price and Normal Price. 4+6+6

8. a. Explain the probable pricing strategy of a product in a monopoly market.
   b. Explain the objectives of pricing and determinants of pricing of a product. 8+8

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, January 2022
Sub : Welding Metallurgy of Non Ferrous Alloys,
Dissimilar Welding and Cladding (AME–202)

Full Marks : 80 **Time : 3 Hours**
Pass Marks : 32

Answer any FIVE Questions
All Question carry Equal Marks
Parts of a Question should be answered at ONE PLACE

1. **Elaborate the critical points in welding aluminium compared to steel as regards : (2 x 8 = 16)**
   a. **Melting point**
   b. **Coefficient of Thermal Expansion**
   c. **Coefficient of Thermal Conductivity**
   d. **Specific Heat**
   e. **Electrical conductivity**
   f. **Magnetic properties**
   g. **Modulous of Elasticity**
   h. **Heating and Cooling effect during welding.**

2. **(a). Explain the effect of oxide layer formation on Aluminium on welding aluminium and the effective measures to be taken before, during and after welding. (8)**
   (b). State the uses of different alloys of aluminium with series titles and the alloying elements in each. (8)

3. **(a). Which Grades of Titanium and its alloys are normally used in fabrication of industrial equipment? Why? (4)**
   (b). State the welding processes and the consumables used in welding Titanium and its alloys. (4)
   (c). What are the common defects found in welding Ti and its alloys ? How to prevent and rectify these defects? (4)
   (d). What is Contamination Cracking in welding Ti and its alloys? Explain the causes and preventive measures to be taken for Contamination Cracking. (4)

4. **State and explain the major physical and Chemical properties differentiating welding techniques of Copper and Alloys of Copper from steels. (16)**

5. **(a) Explain in details the similarities and dis-similarities of properties and structures of Nickel Alloys and Stainless Steels. (8)**

(b) Explain in step by step the welding techniques and processes to be applied for SS with Ni-base alloys. (8)

6. **(a) State and explain the different types of WEAR in industrial applications. Give examples. (4)**

(b) Define the differences between SURFACING and HARDFACING. (4)

(c) State and explain the different Surfacing and Hardfacing materials used with specific examples. (4)

(d) How can you control Cracking and Dilution during Hardfacing? (4)

7. **Write short notes on ANY FOUR : (4 x 4 = 16)**

(a) Weldability.

(b) Cladding

(c) Fabrication Defects.

(d) NDT

(e) Effect of Oxygen contamination in Ti and Ti-alloys during welding.

8. **(a) What are the welding processes that can be applied effectively to join Magnesium and Magnesium Alloys ? (4)**

(b) What are the properties and characteristics of Magnesium and Magnesium alloys that make its welding different from the welding of steel ? (4)

(c) Which shielding gas / combination of gases are used in the welding of Mg and Mg alloys? Explain why. (4)

(d) Explain how Hot cracking and Solidification Cracking can be prevented in welding Mg and Mg alloys. (4)

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THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, January 2022

Sub : : Occupational Health, Safety and Environmental Issues in Welding and Related Areas (AME–205)

Full Marks : 80 **Time : 3 Hours**
Pass Marks : 32

Answer any FIVE Questions
All Question carry Equal Marks
Parts of a Question should be answered at ONE PLACE

1. **(a).Define SAFETY. State and explain the Hazards at workplace. (8)**
   (b). Explain the causes and effects of UNSAFE ACTS at workplace. (8)

2. **(a) What is PPE ? List common PPEs used and the effectiveness of each to protect workmen at workplace. (8)**
   (b). What is NOISE ? How does it affect the workmen ? State and explain the protective devices used to protect the workmen from different levels of noise ? (8)

3. **(a). What is RADIATION ? What are the effects of Radiation on Welders ? How to mitigate the hazards of Radiation at the workplace ? (8)**
   (b). Filter Lenses are used in Welding Hand Shields and Head Shields. State the Filter Lens shade numbers for : (1 x 8 = 8)
   - **i. SMAW**
   - **ii. GMAW**
   - **iii. GTAW**
   - **iv. Plasma Arc welding.**
   - **v. Carbon Arc Gouging**
   - **vi. Soldering.**
   - **vii. Brazing**
   - **viii. Oxy-fuel Gas Cutting.**

4. **(a). What are the hazards and side effects of welding fumes? What are the sources of Gas and Fumes generation in welding ?State the protections taken against each. (8)**
   (b). State the health effects of welding fumes generated from welding :
   - **i. Aluminium (1 x 8 = 8)**
   - **ii. Cadmium**
   - **iii. Chromium**
   - **iv. Copper**
   - **v. Nickel**
   - **vi. Vanadium**
   - **vii. Zinc**

viii. Molybdenum

5. (a) Explain how an electrical circuit can cause shock hazard to workmen. List the levels of current and their effects on human body. (8)
(b). What are the steps to be taken in Welding set up to prevent Electric Shock to the welders and co-workmen ? (8)

6. (a). "Fire and Explosion are one of the major cause of welding hazard" – explain in details the causes and the preventive measures to be taken to mitigate each. (8)
(b). State the Safety Procedures for handling and storage of Gas Cylinders. (8)

7. In practicing Safety at Workshop different Standards, Codes and Specifications are used. State the specific purpose and use of the following Standards and Specifications IN THE TABLE : (2 x 8 = 16)

Standards/Codes/ Specifications	Use & Application
IS 812:1957	
IS 3016 : 1982	
IS 5896:	
ANSI Z287.1	
AWS C5.2	
AWS C5.	
ANSI Z41	
EN ISO 20345	

8. Write Short notes on (Any Four) (4 x 4 = 16)
   a. Welding Ergonomics.
   b. Welding in confined space.
   c. Fire prevention and Fire fighting.
   d. Hazards associated with NDT of welds and materials.
   e. Role of Safety Officer in a Factory as per Factories Act.

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THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination
Winter Session, January 2022
Sub : Advanced Welding Technology (AME–206)

Full Marks : 80 **Time : 3 Hours**
Pass Marks : 32

Answer any FIVE Questions
All Question carry Equal Marks
Parts of a Question should be answered at ONE PLACE

1. **(a). What is narrow gap welding ? Where it is applied? What are the ranges of narrow gap? (8)**
   (b). Elaborate the processes which can be used for Narrow Gap Welding. (8)
2. **(a). What is a Digital Power Source ? How does it work ? What are the inputs and outputs? (8)**
   (b). Explain how a Digital Power source can acquire welding data and use it for controlling welding parameters. (8)
3. **(a). What is CMT ? In which welding process it it applied ? What are the applications ? (8)**
   (b). Explain in details how CMT works. (8)
4. **(a). What is KTIG How does it differ from normal GTAW ? What are the advantages of KTIG ? What is the quality produced? (8)**
   (b) What are the equipment used in KTIG ? What are the normal welding parameters ? What are the consumables used ? (8)
5. **Write short notes on ANY FOUR (4 x 4 = 16)**
   (a). Narrow Gap SAW
   (b). Laser Hybrid MIG welding.
   (c). Robotic Welding.
   (d). Additive manufacturing using welding
   (e). Automation Controls.
6. **(a). What are the advantages of the applications of Automated/Mechanised Systems in Welding? (8)**
   (b). What are the functions a Mechanised System can operate and controlin welding? (8)

7. **(a). State and explain the factors to decide Automation of a welding process. (8)**
   (b) What are the drawbacks in changing manual /semiautomatic processes to Automation ? (8)

8. **(a). Explain how a Mathematical Model can be used for process control. What is SEAM TRACKING SYSTEM developed for process control?**
   (b). What is Genetic Programming ? State its application in FSW. (16)

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