

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Physics (AME - 02, A-02 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any ten questions**

**Parts of a question should be answered at one place**

1. a) Show that in free space motion of pendulum is simple harmonic ? Determine an expression of its frequency. 3+2  
b) Show that total energy in SHM remains conserved. 5
2. a) Write down the standard expression for damped harmonic oscillation. On increased amount of damping force differentiate between overdamped, underdamped and critically damped condition and also show this diagrammatically. 2+2+2  
b) Define log decrement and use it to determine amount of damping present in a system. 2+2
3. a) what is the nature of image in a convex lens when the object is at a long distance from it ? What kinds of defects are observed in the image of large object ? What measures will you suggest to minimize these defects apart from chromatic aberration ? 2+3+3  
b) What is meant by focusing of an optical instrument ? 2
4. a) Alternate dark and yellow lines are observed in the opposite wall as sunlight enters in a dark room from a small hole in the window. Name this phenomena and explain how is it produced. 3  
b) State the difference between Fresnel and Fraunhofer diffraction ? 2  
c) A grating has 300 lines per cm, it is illuminated by sodium light of wave length 5893Å. How many orders will be visible in the spectrum ? If the width of grating is 2 cm find the resolving power of the grating for the highest visible order ? 3+2
5. a) What is meant by coherency ? Mention two ways to produce coherent sources. 2+2

- b) Draw the experimental set up of Lloyd's mirror experiment. Starting the nature of coherent sources produced there explain the phenomena of interference and find an expression for fringe width. 2+4
6. a) Draw the Newton's ring experimental set up. If interference fringes are observed through yellow light of wavelength 589 nm the radii of the 9th and 24th rings are 4mm and 10mm respectively. Find the radius of curvature of the plano-convex lens used. If the space between the plano-convex lens and the plane glass plate is filled with water of refractive index 1.3 what will be the difference in radii of 9th and 24th rings ? 2+3+2
- b) What difference do you observe in the central fringe when observed through reflected and transmitted light and why ? 3
7. a) Define positive and negative crystal. A ray of light passes normally through a birefringent crystal of width 5 cm, the refractive index of o-ray is 1.54 and that of the e-ray is 1.61. If the wavelength of the light is 500 nm find the phase difference between them on emergence from the crystal. 2+3
- b) With the suitable diagram explain the principle of action of Bi-quartz polarimeter. What is tint of passage ? 4+1
8. a) Define spontaneous and stimulated emission. 3
- b) What is population inversion ? How can it be achieved ? 2+1
- c) Describe operation of CO<sub>2</sub> laser through energy level diagram. 4
9. a) Draw and explain the operation of a step index optical fiber. 2+3
- b) Define numerical aperture and determine it for a typical single mode optical fiber made of glass with refractive index of core 1.62 and that of cladding 1.52. Also determine acceptance angle. 2+2+1
10. a) State the use of condenser in the function of an ac motor, Calculate the amount of phase change introduced in a C-R circuit of C=20 $\mu$ F and R = 100 $\Omega$ . 2+2
- b) Draw the power triangle for the above C-R circuit and find the power loss when it is connected to a supply of 200 sin 100  $\pi$  t volt. 4+2
11. a) Find the expression for magnetic field on the axis of a long current carrying solenoid. If the number of turns per unit length of the solenoid wound on nonmagnetic material is 200 per cm and its diameter is 5 cm find the magnetic field on the axis when current of 5A passes through it. 3+3

- b) If 1m of the above solenoid is taken find its self inductance. If iron core of permeability 200 is inserted when will be the value of self inductance. 3+1
12. a) Define magnetomotive force and reluctance in a magnetic circuit and state their units. 2+2
- b) For the solenoid with iron core and of length 1m as given in Q.11 determine magnetic flux, magnetomotive force and reluctance. 6
13. a) Draw the phasor diagram of a series L-C-R circuit and from it find the expression for impedance, phase angle between current and voltage and power factor. What will be the value of these parameters at resonant condition ? 2+3+3
- b) Define quality of resonance. 2
14. a) What is the wave length range of ultrasonic ? How is it used in navigation ? 2+4
- b) Write down the characteristics of a good auditorium and state Sabine's formula in relation to it. 2+2

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination  
Summer Session, June 2018  
Sub : General English (AME - 04, A-04 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer all questions**

**Parts of any question should be answered at one place**

1. Write an essay in about 300 words on any one of the following topics : - 20
- a. Skilled workforce is the urgent need of the day.
  - b. Success and limitation of multiparty democracy.
  - c. Your idea of a successful man.

2. Read the passage below and answer the questions that follow 20  
(any five) 4x5=20

People came to know about Neanderthals only in the mid - 1800. Their size of brain area as big as ours but their bodies were shorter and stockier. By the early 1900s, scientists described Neanderthals as gorilla like beasts, an extinct branch of humanity that could not compete with slender, brilliant humans. Yet evidence from both fossils and DNA indicates that Neanderthals and living humans descend from a common ancestor who lived about 6,00,000 years ago. Our own branch probably lived mostly in Africa.

Earlier it was believed that Neanderthals were very low in their intelligence and their basic tools were crude type of stone axes and spear blades. But, this February 2018 a team of researchers offered compelling evidence that Neanderthals bore one of the chief hallmarks of mental sophistication : They could paint cave art. The new finding suggests that they could think in symbols and had the capacity of abstract thinking.

However, Neanderthals disappeared abruptly afterward about 40,000 years ago leaving behind as fossil record of their own from Spain to Siberia, Stockier than their African cousins, they appear to have evolved physical adaptations to harsh climates. They made stone tools of their own, which they used to hunt for game,

including rhinos and other big mammals. They could use feather and bird claws as ornaments. Some anthropologists argued that these activities show that they might have lived near modern humans and were smart enough to copy such activities - but not intelligent enough to invent them.

Researchers visited a number of caves in Spain to find more about cave painting. They applied radio carbon dating. But that method works only if the paint contains carbon bearing ingredients such as charcoal. Also, if other materials like Ochre (a type of red/yellow earlier used as a coloring in paints) are used radio carbon dating does not work. Thirdly radio-carbon dating becomes increasingly unreliable beyond about 40,000 years. Uranium dating however can ascertain the age of objects upto 1,15,000 years old.

These studies provide strong evidence that Neanderthals could make cave art and jewellery. They were making these things long before modern humans - a blow to the idea that they simply copied their cousins.

- a. Who are the Cousins of Neanderthals ? Why are they called so ?
  - b) What were the early beliefs about Neanderthals ?
  - c) What are the new findings about Neanderthals ?
  - d) Which animals did they hunt and what kinds of jewellery did they wear ?
  - e) What is radio active dating ? What are the limitations of this process ?
  - f) What is the alternative method of studying the age of prehistoric objects ? Why do researchers adopt this method ?
  - g) Where do you find the fossils of Neanderthals ? At what time did they appear on earth ?
3. Make a precis of the passage given above and suggest a suitable little for it ? Use your own language. 15  
(12+3)
4. Write a report on any one of the following topics in about 200 words. 20
- a. You are the supervisor of a group of newly recruited trainees for the welding section. Prepare a training schedule for the newly recruited trainees.

- b. Some useful Machines of your unit have become old and need replacement. You write a report on the machines that need replacement and their expected cost.
  - c. As a part of employee welfare activities, you have been asked to make a list of activities that can be introduced in your unit.
- 5 Fill in the blanks of the passage with appropriate articles (a / an / the). In case no articles is required put a cross (x). 5 (1x5)

Mohamed Nuful of Cairo sets off for   1   Football World Cup in   2   Russia on   3   bicycle. After about 65 days on   4   roads he hopes to reach Moscow to see his country playing the cup. It will indeed be   5   exciting experience to him.

6. Rewrite the following sentences according to the instructions given in brackets. (any ten) (1x10) =10
- a. Try to reach on time or you will be punished.  
(change it into a Complex sentences.)
  - b. No other city is as populous as Kolkata.  
(change it into a Superlative sentence)
  - c. Father said to Satya, "You are irregular in your studies"  
(change it into the indirect form of speech)
  - d. Asoka was grater than most other Indian rulers (change it into a positive sentence)
  - e. What a price of work is man ! (change it into on Assertive sentence)
  - f. Subham went to Delhi last month (change it into a question with 'where')
  - g. The Sun is so hot that we cannot go out now. (Rewrite the sentence using too)
  - h. He has three daughters. He must find husbands for them  
(combine them into a simple sentence)
  - i. He is angry \_\_\_\_\_ me (Fill in the blank using with/at.)
  - j. He died \_\_\_\_\_ a disease (use either of / from)
  - h. The poor man was hungry. He are every thing given to him  
(change it into a simple sentence)
  - k. None other than Ravi can save you (change it into an assertive sentence)

5

- l) His handwriting is not \_\_\_\_\_ (choose the right word : eligible / legible). 5
7. Fill in the blanks with suitable word from the alternative given. 1x5=5
- a. He always takes care of his \_\_\_\_\_ (dependants/ dependent)
  - b. Printing was \_\_\_\_\_ in China (discovered / invent)
  - c. The holy man was \_\_\_\_\_ for his good deeds (notorious / famous)
  - d. He is highly \_\_\_\_\_ and writes fantastic stores (imaginative / imaginary)
  - e. In the past intolerant leaders often \_\_\_\_\_ all religious beliefs other than their our own (prescribed / proscribed)
8. a. Rewrite the following sentences correctly. 1x5=5
- a. Bring the any water to drink.
  - b. The jealousy is an evil passive.
  - c. Each of them were presented with a gold watch.
  - d. The rain has ceased yesterday
  - e. She finished her dinner when I met her.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Applied Mechanics (AME - 05, A-05(R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Parts of a questions should be answered at one place**

Answer any Five questions

- |    |                                               |   |
|----|-----------------------------------------------|---|
| 1. | a. State the Law of Coloumb's friction.       | 2 |
|    | b. Defore angle of friction, angle of repose. | 2 |
|    | c. Prove that for Flat belt,                  | 4 |

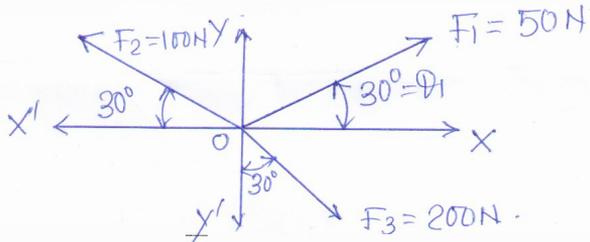
$$\frac{T_1}{T_2} = e^{\mu\theta}$$

- |  |                                                        |       |
|--|--------------------------------------------------------|-------|
|  | d. What is self locking scrolls.                       | 2     |
|  | e. State and prove Lami's Theorem                      | 1+4=5 |
|  | f. Defene centroid and centre of gravity               | 2     |
|  | g. State the condition of equilibrium of a rigid body. | 2     |
|  | h. State D'Alambert's Principle.                       | 1     |

- |    |                                                           |   |
|----|-----------------------------------------------------------|---|
| 2. | a. A force vector is defined by                           |   |
|    | $\vec{F} = 100 (2\hat{i} + 3\hat{j} + \hat{k}) \text{ N}$ | 5 |

Force  $\vec{F}$  is acting at a point A (2, 3, 5). Find the moment of the force about the point B (0, 3, 2)

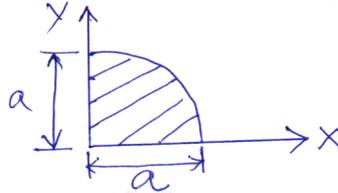
- |    |                                                    |       |
|----|----------------------------------------------------|-------|
| b. | State and Prove Varignon's theorem for two forces. | 2+4=6 |
| c. | Find the resultant of the forces show in figure    | 5     |



- |    |                                                                                                                                                                                                                                           |     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| d. | A ball thrown downward with a velocity $v_0$ from a height of 10m. The ball losses its 50% of K.E. at the ground and rebounds back upward to the same height. Find $V_0$ . If the ball were thrown upward upto what height it would gain. | 4+1 |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

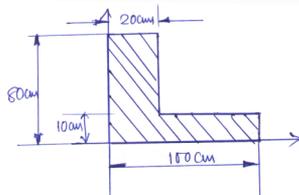
3. a. Find the Centroid of the Quarter of a circle.

10



b. Find the M.I. of the figure about centroidal axes.

10

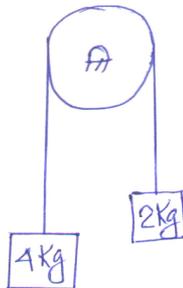


4. a.  $S = (3 + 5t^{5/2} - 5t^2 + 4t + 5) \text{ m}$

5

Find the distance, velocity and acceleration after 2 seconds

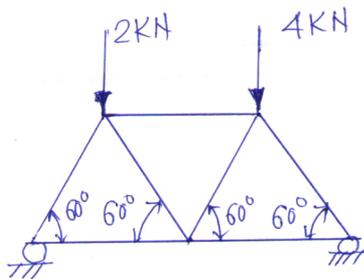
b.



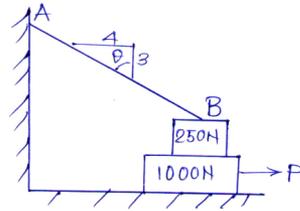
Find the tension in the rope and acceleration of masses.

c. Calculate the magnitude and nature of stresses in the all members of the trues.

5



5. a.  $\mu = 0.3$  for all surfaces AB is a indired string. Find the magnitude of horizontal process P, applied to the lower block as shown, that will be necessary to cause slipping to impeded.



10

- b. A ladder whose weight is 960 M and whose length is 5M rests with one end against a smooth vertical wall and with other end upon ground; If it be prevented from sliding by a peg at its lower point, and if the lowest point be distant 1.4m from the wall, find the reactions of the peg by the ground and wall.

10

6. a. A body of negligible size and 10N is suspended from a roof of a railway carriage which is moving with a constant speed of 40 km/hr. in a curved radius of 100m. Find the inclination of the card to the vertical and tension in it.

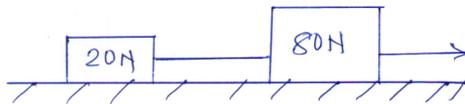
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- b. Two adjacent guns having the muzzle velocity 400 m/S fire simultaneously at an angle  $\theta_1$  and  $\theta_2$  for the same targets at a range of 5000 m. Calculate the time difference between the hits.

10

7. a. Two weights 80N and 20N are connected by a thread and move along a rough horizontal plane under the action of 40N applied to the first weight 80N as shown in figure.

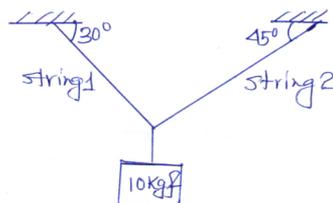
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The Co-efficient of friction between sliding surface4 and weights and place is 0.3

Determine the acceleration of the weights and the tension is the thread using D'Alambert's principal

- b. Find the tension in the string 1 and string2.



# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Industrial Sociology (AME - 06, A-06 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

**Parts of a questions should be answered at one place**

- |       |                                                                                        |    |
|-------|----------------------------------------------------------------------------------------|----|
| 1. a) | Define the terms norms, Conventions and custom.                                        | 3  |
| b)    | Explain The socio cultural bases of these three aspects.                               | 17 |
| 2. a) | What is meant by the term 'tribe' ?                                                    | 2  |
| b)    | Discuss the socio-economic issues related with the problems of tribal society in India | 18 |
| 3. a) | Define the term 'Social Stratification'.                                               | 3  |
| b)    | Explain the functionalist approach to social stratification.                           | 17 |
| 4. a) | What is meant by 'Development'                                                         | 2  |
| b)    | Elucidate the role of 'State' and 'Market' in the process of development.              | 18 |
| 5. a) | What do you mean by The term Technology Assessment ?                                   | 2  |
| b)    | Discuss the advantages and disadvantages of Technology Assessment.                     | 18 |
| 6. a) | Define the term women workers.                                                         | 3  |
| b)    | Analyse the socio-economic sufferings of Indian women workers.                         | 17 |
| 7. a) | Explain the meaning of 'Child labour'.                                                 | 2  |
| b)    | Elucidate the socio-economics factors for the continuation of child labour.            | 18 |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Strength of Materials (AME - 07, A-07 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer any five question

Parts of a question should be answered at one place

1. a) Explain the following terms : 10
- i) Working stress
  - ii) Engineering stress
  - iii) Statically determinate
  - iv) Thermal stresses
  - v) Proof stress
- b) Define the term factor of safety and its importance 4
- c) Fig.1 shows a steel cylinder is placed centrally on a bronze cylinder and their ends are secured between two rigid supports. If the stress in the cylinder is zero at a temperature of 30° C. Find the stresses in each cylinder when the temperature rises to 60°C. 6
- For steel  $E=207\text{GPa}$ ,  $\alpha =6.50 \times 10^{-6}/^{\circ}\text{C}$ ,  $L =203.2 \text{ mm}$   
 $A = 968 \text{ mm}^2$   
bronze  $E=83 \text{ Mpa}$ ,  $\alpha =10.5 \times 10^{-6}$ ,  $L=152.4 \text{ mm}$ ,  $A=1290 \text{ mm}^2$

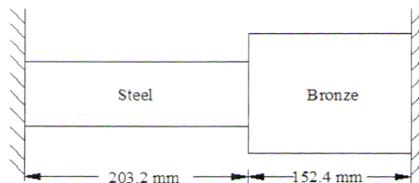


Fig.1

2. a. Derive a relation between young's modulus, modulus of rigidity and Poisson's ratio. 6
- b. Define the term Poisson's ratio ? State the importance. 4
- c. A bar 12mm is diameter is acted upon by an axial load of 20 kN, the change in diameter is measured as 0.003 mm. Determine (i) Poisson's ratio (ii) the modulus of elasticity and the bulk modulus. (the value of the modulus of rigidity is 80 Gpa). 6
- d. What is Mohr's stress circle ? How is it useful in the solution of stress analysis problems ? 4

3. a. Indicate the shapes of bending moment and shear force diagrams for uniformly distributed load, triangular load and point load on a simply supported beam. 6
- b. A cantilever is loaded as shown in Fig.2. Draw the shear force and bending moment diagrams. 8

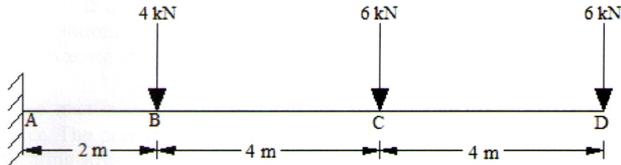


Fig.2

- c) Explain theory of Simple Bending. What are the assumptions made in the theory of Simple Bending? 6
4. a. Explain the governing Differential equation of beams. What are its limitations? 6
- b. What is neutral axis of a beam? Give a sketch to show the variation of bending stress along the cross section of a beam. 4
- c. Fig.3 shows A simply supported beam 8m length carries two point loads of 64kN and 48kN at 1m and 4m respectively from the left hand end. Find the deflection under each load and the maximum deflection.  $E = 210\text{GPa}$  and  $I = 180 \times 10^6 \text{mm}^4$ . 10

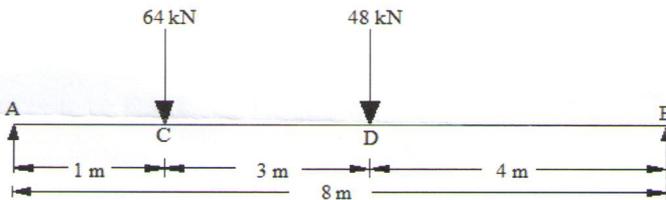


Fig.3

5. a. Define slenderness ratio of column. What is its importance? 5
- b. A straight cylindrical bar of 15mm dia. and 1.2m long is freely supported at its two ends in a horizontal position. It is loaded with a concentrated load of 100N at the centre where the centre of deflection is observed to be 5mm. If placed in the vertical position and loaded vertically, what load would cause it to buckle? Also find the ratio of the maximum stress in the two cases. 6

- c. Draw the elastic curve of the simply supported beam as shown in Fig.4

9

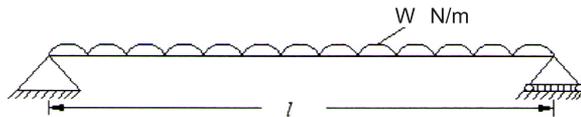


Fig.4

6. a. A solid steel shaft transmit 100kN at 150 rpm. Determine the suitable diameter of the shaft if the maximum torque transmitted exceeds the mean by 20% of each revolution. The shear stress is not to exceed 60Mpa. Also find the maximum angle of twist in a length of 4m of the shaft.  $G = 80$  GPa. 6
- b. Find the maximum Torque that can be applied safely to a shaft of 300 mm diameter. The permissible angle of twist is 1.5 degree in a length of 7.5m and the shearing stress is not to exceed 42 N/mm<sup>2</sup>. Take  $C = 84.4$  kN/mm<sup>2</sup>. 8
- c. What is shear stress and shear strain ? Show a sketch of them. 6
7. a. Write short notes on 8
- i) Necking
  - ii) Point of inflection
  - iii) Shear force
  - iv) Short and long column
- b. What assumptions are taken in the analysis of thin cylinders ? Deduce expressions for the circumferential and longitudinal stresses developed in them. 6
- c. A thin cylinder of 200 mm inside diameter is 4mm thick. the ends of the cylinder are closed by rigid plates and then it is filled with water under pressure. If an external axis pull of 50kN is applied to the ends, the water pressure falls by 0.12 Mpa. Find the value of the Poisson's ratio.  $K = 2100$  Mpa and  $E = 150$  GPa. 6

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Electrical Engineering and Electronics

(AME - 08, A-08 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

## PART - A

Parts of a questions should be answered at one place

Answer any one question

1. a. State and explain Kirechhoff's current law. 2+3  
 b. Find the equivalent resistance for the circuit shown in Fig.1b.

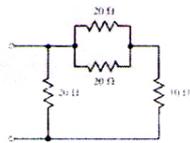


Fig.1b

5

2. a. A star connection contains three equal resistance R. Find its equivalent delta connection. 5  
 b. Find the resistance across the A-B terminals in the electric circuit of Fig.2B using Delta Star transformation.

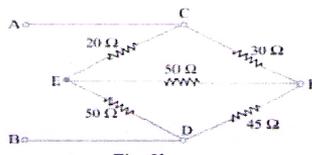


Fig.2b

5

## PART - B

Answer any three question

3. a. State and explain Thevenin's Theorem. 3+4  
 b. Use Superposition Theorem to find I in the circuit of Fig.3B

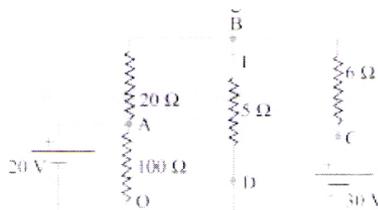


Fig.3

8

- |       |                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 4. a. | Explain B-H curve of a magnetic material                                                                                                                                                                                                                                                                                                                                                                                   | 7 |
| b.    | A ballistic galvanometer, connected to a search coil for measuring flux density in a core, gives a throw of 100 scale divisions on reversal of flux. The galvanometer coil has a resistance of 180 ohm. The galvanometer constant is $100 \mu\text{C}$ per scale division. The search coil has an area of $50 \text{ cm}^2$ , would with 1000 turns having a resistance of 20 ohm. Calculate the flux density in the core. | 8 |
| 5. a. | Draw the phasor diagram of series R-L-C circuit.                                                                                                                                                                                                                                                                                                                                                                           | 8 |
| b.    | Derive the expression of resonance frequency of series R-L-C circuit.                                                                                                                                                                                                                                                                                                                                                      | 7 |
| 6. a. | Derive the expression of apparent power, active power and reactive power and find the relation between them.                                                                                                                                                                                                                                                                                                               | 7 |
| b.    | An alternating current varying sinusoidally with a frequency of 50 Hz has an RMS value of 20 A. Write down the equation for the instantaneous value and find this value a) 0.0025 second b) 0.0125 second after passing through a positive maximum value. At what time, measured from a positive maximum value, will the instantaneous current be 14.14 A?                                                                 | 8 |
| 7. a. | Write the advantage of AC supply system over DC supply system.                                                                                                                                                                                                                                                                                                                                                             | 7 |
| b.    | A coil is connected in series with a pure capacitor. The combination is fed from a 10 V supply of 10,000 Hz. It was observed that the maximum current of 2 Amp flows in the circuit when the capacitor is of value 1 microfarad. Find the parameters (R and L) of the coil.                                                                                                                                                | 8 |

**PART - C**

**Answer any three question**

- |       |                                                                                          |   |
|-------|------------------------------------------------------------------------------------------|---|
| 8. a. | Derive the e.m.f. equation of an ideal single phase Transformer.                         | 7 |
| b.    | A 25-kVA transformer has 500 turns on the primary and 50 turns on the secondary winding. | 8 |

The primary is connected to 3000v, 50 Hz supply. Find the full load primary and secondary currents, secondary e.m.f. and maximum flux in the core.

- |        |                                                                                                                               |     |
|--------|-------------------------------------------------------------------------------------------------------------------------------|-----|
| 9. a.  | Draw the equivalent circuit of self excited, shunt excited and series excited DC generator and write the necessary equations. | 15  |
| 10. a. | Explain the operation principle of single phase induction motor.                                                              | 7   |
| b.     | Explain the use of capacitor in the single phase induction motor.                                                             | 8   |
| 11.    | Explain the different modes of operation of BJT with circuit diagram.                                                         | 15  |
| 12.    | Write short notes on                                                                                                          | 3x5 |
| a)     | LED                                                                                                                           |     |
| b)     | Push-pull Amplifier                                                                                                           |     |
| c)     | Logic Gates                                                                                                                   |     |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Material Science (AME - 09, B-09 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any Five question, Answer must be brief and to the point**

**Parts of a question (a, b, c etc..)**

**Parts of a questions should be answered at one place**

1. a) Explain the Heisenberg uncertainty principle. 2
- b) What is quantum state ? Explain the characterization of the quantum number. 1+8
- c) What is Pauli Exclusion Principle ? Explain the electron density effect as a function of distance from nucleus. 1+4
- d) Give the electronic configuration of a neutral iron atom, a ferrous ion, and ferric ion. Compare their sizes. 4
2. a) Explain the variation in bonding character and properties of a material. 6
- b) Explain why covalent and ionic solids have melting and boiling point ? 2
- c) Define space lattice. Give one example. 2
- d) What is bravais lattice ? Explain, different crystal systems in Bravais lattices ? 1+7
- e) How the Miller indices of a crystal plane can be determining ? 2
3. a) Draw a (110) and  $(\bar{1} \bar{1} 1)$  planes inside a cubic unit cell. determine the Miller indices of the direction that is common to both these planes, 4
- b) Explain the different form of crystal structure of carbon. 6
- c) Except diamond which element has the diamond cubic (DC) structure ? Give application of these elements. 2
- d) What are the differences between edge and screw dislocation ? 4
- e) Explain the structure of silica and silicate. 4
4. Write short notes on : 5x4
  - a) Thermoplasts
  - b) Thermosets
  - c) Three types of long chain polymer
  - d) Degree of polymerization
  - e) Crystallinity of polymers

- |       |                                                                                                                                                                                              |       |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5. a) | What is a binary phase diagram ? Elaborate a binary phase diagram of an important alloy system.                                                                                              | 1+5   |
| b)    | What are the different invariant reactions in binary phase diagrams ? Explain all invariant reactions briefly.                                                                               | 2+6   |
| c)    | Describe Lever rule with a suitable example                                                                                                                                                  | 4     |
| d)    | What are the classifications of solid solution ?                                                                                                                                             | 2     |
| 6. a) | What are the differences between elastic and anelastic deformation ?                                                                                                                         | 2     |
| b)    | At what condition the plastic deformation can occur ? Explain the true stress strain curve and load elongation curve for a ductile material.                                                 | 1+4   |
| c)    | Describe the basic modes of plastic deformation ?                                                                                                                                            | 4     |
| d)    | Under what conditions a material exhibits superplasticity ? Define work hardening and UTS of a material. Write the power relationship equation as a function of true stress and true strain. | 1+2+1 |
| e)    | Describe the three stages of mechanism of creep. What are the applications of creep resistance materials ?                                                                                   | 3x2   |
| 7. a) | Real crystals are weak but perfect crystals are very strong. Explain. Describe the solid solution strengthening and precipitation strengthening.                                             | 1+4   |
| b)    | Describe the recovery, recrystallization and grain growth in a material.                                                                                                                     | 4     |
| c)    | What are the differences between ductile and brittle fracture of a material ?                                                                                                                | 2     |
| d)    | Illustrate the Griffith's criterion for propagation of a pre existing crack in a brittle material.                                                                                           | 3     |
| e)    | How a ductile material can be transform into a brittle material? What is the variation in the impact energy for steel of different carbon content as a function of temperature ?             | 4+2   |
| 8. a) | What are the electrical properties of ceramic phases and glasses ? Define refractory materials. Give applications of refractory materials .                                                  | 2+2   |
| b)    | Briefly explain the effect of the fiber length, orientation and concentration on the mechanical properties of fiber reinforced composites.                                                   | 6     |
| c)    | What are the classifications of particle reinforced composites?                                                                                                                              | 4     |
| d)    | How the crystallinity of polymers can be promoted ? What factors can promotes the noncrystallinity of polymers ?                                                                             | 3+3   |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Production Engineering (AME - 10, B-10 (R))

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 between repeatability, reproducibility and interchangeability.                         | 5  |
| b)    | Differentiate between precision and accuracy with suitable examples.                               | 4  |
| c)    | State the advantages of electrical and electronic comparator.                                      | 4  |
| d)    | Explain with a neat sketch the working of Talysurf instrument for surface finish measurement       | 7  |
| 2. a) | What are Grantt charts ? Explain their types. How are they contributed ?                           | 12 |
| b)    | State the four basic methods in time study.                                                        | 3  |
| c)    | Define method study and state the three different levels in method study.                          | 5  |
| 3. a) | Explain the surface hardening methods used for alloy steel and stainless steel.                    | 7  |
| b)    | State the different PVD processes and discuss the sputter coating technique.                       | 7  |
| c)    | Differentiate between : i) cyaniding and carborizing, ii) flame hardening and induction hardening. | 6  |
| 4. a) | Distinguish between piercing and blanking with the aid of a neat sketch of the die-set up.         | 6  |
| b)    | Explain with sketches the mechanism and applications of drawing and deep drawing.                  | 6  |
| c)    | Explain and compare between drop forging, press forging and upset forging.                         | 8  |

- |       |                                                                                                                                               |        |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 5. a) | Discuss the 'Tool Nomenclature' and the effect of different tool angles on machinability and the tool performance in any machining operation. | 8      |
| b)    | Discuss the 'Merchants' circle Diagram' and its importance in machining.                                                                      | 6      |
| c)    | Explain different types of chip formation during machining, along with the mechanisms involved.                                               | 6      |
| 6. a) | Discuss the mechanism of grinding in detail. Also describe the cutting action of the grit and the effect of grit force on wheel wear.         | 8      |
| b)    | Explain with diagram any one of the gear manufacturing methods.                                                                               | 6      |
| c)    | Discuss the different types of wear that can take place in cutting tool. Explain three of them along with the mechanism involved.             | 6      |
| 7. a) | What are the different stages of shrinkage of a casting ? Distinguish between liquid shrinkage and solid shrinkage of castings.               | 8      |
| b)    | What is a riser and why is it used ? Sketch and explain different types of risers.                                                            | 6      |
| c)    | Explain with neat sketches "Centrifugal Casting".                                                                                             | 6      |
| 8.    | Write short notes on any four of the following :                                                                                              | 4x5=20 |
| a)    | EOQ                                                                                                                                           |        |
| b)    | Elements of gating system                                                                                                                     |        |
| c)    | Indirect Extrusion                                                                                                                            |        |
| d)    | Super finishing                                                                                                                               |        |
| e)    | Time standards                                                                                                                                |        |
| f)    | Cladding                                                                                                                                      |        |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Engineering Mathematics (AME - 12, B-12 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer any five questions

Parts of a questions should be answered at one place

1. a. Solve the system of equations 10  
 $x+2y+z = 1$   
 $3x+y+2z=3$   
 $x+7y+2z=1$
- b. Find the matrix A if  $\text{adj } A = \begin{pmatrix} 2 & 2 & 0 \\ 2 & 5 & 1 \\ 0 & 1 & 1 \end{pmatrix}$  10  
and  $\det A = 2$
2. a. If  $A = \begin{pmatrix} 4 & 2 & 2 \\ 2 & 4 & 2 \\ 2 & 2 & 4 \end{pmatrix}$ , show that  $A^2 - 10A + 16I_3 = 0$  10  
Hence obtain  $A^{-1}$ .
- b. If  $A = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$  prove that  $A^n = \begin{pmatrix} 1 & n & \frac{n(n+1)}{2} \\ 0 & 1 & n \\ 0 & 0 & 1 \end{pmatrix}$  10  
10
3. a. Find the maxima and minima of the function  $x^3+y^3-3x-12y+20$ . Find also the saddle points if exists. 10
- b. If  $H = \cos^{-1} \left\{ \frac{x+y}{\sqrt{x}+\sqrt{y}} \right\}$ , then prove that 10  
$$x \frac{\partial H}{\partial x} + y \frac{\partial H}{\partial y} = -\frac{1}{2} \cot H$$
4. a. Solve the linear equation 10  
$$\frac{\partial y}{\partial x} - \frac{3}{x+2} y = (x+2)^3$$
- b. Solve  $x^2 \frac{\partial^2 y}{\partial x^2} - 3x \frac{\partial y}{\partial x} + 4y = 2x^2$  10

- 5 a. Prove that  $B(m, n) = \int_0^{\infty} \frac{x^{m-1}}{(1+x)^{m+n}} dx$  (10)  
 ( $m > 0, n > 0$ ).
- b. Solve:  $\frac{\partial^3 z}{\partial x^3} - 2 \frac{\partial^3 z}{\partial x^2 \partial y} = 2e^{2x}$  (10)
6. a. Discuss the convergence of the series (10)  
 $1 + \frac{1}{2^p} + \frac{1}{3^p} + \frac{1}{4^p} + \dots$  ( $p > 0$ )
- b. Determine the radius of convergence of the (10)  
 power series  $\sum_{n=0}^{\infty} a_n x_n$  where
- i)  $a_n = 3^n + 4^n, n \in \mathbb{N}, a_0 = 0$
- ii)  $a_n = n!, n \in \mathbb{N}, a_0 = 1$
7. a. Prove that the even function  $f(x) = |x|$  on  $[-\pi, \pi]$  has a cosine (10)  
 series in Fourier's form as
- $$\frac{\pi}{2} - \frac{4}{\pi} \left\{ \cos x + \frac{\cos 3x}{3^2} + \frac{\cos 5x}{5^2} + \dots \right\}$$
- (10)
- Show that the series converges to  $|x|$  in  $[-\pi, \pi]$  and
- $$1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots = \frac{\pi^2}{8}$$
- b) Evaluate  $\iint (x^2 + y^2) dx dy$  over the region (10)  
 E bounded by  $xy = 1, y = 0, y = x, x = 2$ .
8. a. Find the Fourier series of  $f(x)$  where (10)  
 $f(x) = \begin{cases} x - \pi & \text{if } -\pi < x < 0, \\ \pi - x & \text{if } 0 \leq x \leq \pi \end{cases}$
- b. Examine the convergence of the improper integral (10)  
 $\int_0^1 \frac{\log x}{\sqrt{1-x}} dx$

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding Metallurgy - I (AME - 13, B-16 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Total number of questions are 13 and answer any 10 questions**

**All questions carry equal marks : 10 x 10 = 100**

**Parts of a questions should be answered at one place**

**Each part in a single question has equal mark**

1. a. How chemical composition and cold work influences rate of recrystallisation ?  
b. What is abnormal grain growth ? Explain it ?  
c. Using a diagram, explain recovery, recrystallisation and grain growth. In the same diagram, plot hardness variations and explain in conjunction of microstructure evolution.
2. a. What is the difference between annealing and normalizing ? How they are useful to metal processing ?  
b. Which element has more pronounce effect on hardness in carbon steels and why ?
3. a. How many invariant points are present in Fe - C diagram and name them ? Why martensite phase is not shown in Fe-C phase diagram ?  
b. What is the difference between hypo and hyper eutectoid steel ? Explain using phase diagram and schematic microstructure.
4. a. Why the solubility of carbon in bcc and fcc iron are different ? Explain with diagram ?  
b. Why phase transformation does not occur at the same temperature during isothermal and isothronal heat treatment in steel ?
5. a. Define weldability, carbon equivalent and heat input  
b. How carbon equivalent is used to define preheat ?  
c. What is single pass and multi pass welding ?  
d. What is auto tempering and in which types of steel it is employed ? What is the benefit of this process ?

6.
  - a. What is the relation between carbon equivalent and thickness of a job to be welded ?
  - b. What is preheat and post heat temperature ?
  - c. How and why preheat and post heat temperature is determined ?
  - d. What should be the maximum preheating temperature for a martensitic steel ?
7.
  - a. Why preheat is not necessary but post heat is necessary for austenitic stainless steel during welding ?
  - b. What is the difference between sensitization and Knife line attack ?
  - c. How to overcome this problem in steels ?
8.
  - a. What is the difference between bainitic and martensitic transformation ? Explain with diagram.
  - b. What is the difference between tempering and precipitation hardening ? Explain with example.
9.
  - a. Which types of microstructure is suitable for welding of precipitation hardened alloy and why ?
  - b. What is the difference between tempering of martensitic steel and aging of precipitation hardened Al alloy ?
10.
  - a. Define heat affected zone ?
  - b. Classify different heat affected zones in steel with schematic diagram.
  - c. What is the influence of heat affected zone on mechanical properties of steel ?
11.
  - a. Hardness variations in the heat affected zone of a martensitic steel and in a austenitic stainless steel are different - Justify ?
  - b. Why microalloyed steel is not considered as alloy steel ?
  - c. Write the name of different categories of microalloyed steel.
12.
  - a. What are different types of welding defects ?
  - b. Why they originates ?
  - c. What is hydrogen assisted cracking ?
  - d. This cracking is seen in ferritic/martensitic steel but not well reported in austenitic stainless steels - why ?
13.
  - a. Draw engineering stress - strain diagram of carbon and austenitic stainless steel. Explain all points in the diagram.
  - b. What is Hume-Rothery rules ? Why ductility of fcc material is higher than bcc material ?
  - c. What is packing density ? Why packing density of fcc and bcc is different ?

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Heat and Mass Transfer (AME - 14, B-14 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

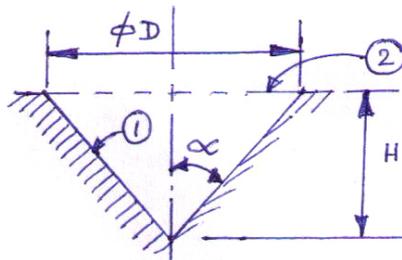
**Parts of a questions should be answered at one place**

1. a. With a neat diagram derive the three dimensional steady state heat conduction equation in cartesian coordinate. 10
- b. The composite wall of an over consists of three materials, two of them are of known thermal conductivity ,  $K_A = 20$  w/mk and  $K_C = 50$  w/mk and known thickness  $L_A = 0.3$  m and  $L_C = 0.15$  m. The third material B, which is sandwiched between material A and C is of known thickness,  $L_B = 0.15$  m, but of unknown thermal conductivity  $K_B$ . 10
- Under steady state operating conditions, the measurement reveals an outer surface temperature of C as  $20^\circ\text{C}$  and inner surface temperature of A is  $800^\circ\text{C}$ . The inside convection coefficient is  $25$  W/m<sup>2</sup> K. What is the value of  $K_B$  ?
2. a. Determine the expression of the rate of heat transfer and temperature distribution for a rectangular fin of uniform cross section with convection heat loss from its tip. 10
- b. A copper pipe carrying the refrigerant at  $-20^\circ\text{C}$  is 10 mm in outer diameter and is exposed to ambient at  $25^\circ\text{C}$  with convection coefficient of  $50$  w/m<sup>2</sup>K. It is proposed to apply the insulation of material having thermal conductivity of  $0.5$  w/mk. Determine the thickness beyond which the heat gain will be reduced. Calculate the heat losses for 2.5 mm thick layer of insulation, over 1m length. 10
3. a. Briefly discuss the role of "Characteristics length" in Lumped Parameter Analysis. 3
- b. Define time constant and write down its physical significance. 3
- c. Define for efficiency. 3
- Show that for a fin with uniform cross-section and an insulated tip, fin efficiency is given by 3+3

$$\eta = \frac{\tanh(mL)}{mL}$$

- d. A copper cylinder, 10cm diameter and 20 cm long, is removed from liquid nitrogen bath at  $-196^{\circ}\text{C}$  and exposed to air at  $25^{\circ}\text{C}$  with convection coefficient of  $20 \text{ W/m}^2\text{K}$ . Determine the time required by the cylinder to attain the temperature of  $-110^{\circ}\text{C}$ . Take thermophysical properties as :  $C = 380 \text{ J/KgK}$ ;  $\rho = 8800 \text{ Kg/m}^3$  and  $k = 360 \text{ W/mK}$ . 9
4. a. With neat sketches briefly explain the formation of velocity boundary layer and thermal boundary layer over a flat plate. 10
- b. Water at  $50^{\circ}\text{C}$  enters 75 mm radius and 3m long tube with a velocity of 1.5 m/s. The tube wall is maintained at  $100^{\circ}\text{C}$ . Calculate the heat transfer coefficient and total amount of heat transferred if the exit temperature is  $70^{\circ}\text{C}$ . Properties of water at  $60^{\circ}\text{C}$  :  
 $\rho = 990 \text{ kg/m}^3$ ;  $\nu = 0.517 \times 10^{-6} \text{ m}^2/\text{s}$ ;  $C_p = 4186 \text{ J / Kgk}$ ;  
 $k_f = 0.65 \text{ W/mk}$  and  $\text{Pr} = 3.15$ . 10
- You may use the Diffuse - Boelter equation, for heating of water :  
 You may use the Dittus - Boelter equation, for heating of water :
- $$\text{Nu}_D = 0.023 (\text{Re}_D)^{0.8} (\text{Pr})^{0.4}$$
5. a. With the help of dimensional analysis show that in case of free convection the Nusselt number is a function of the Grashof number and the Prandtt number. 10
- b. A rectangular duct 30 cm x 20 cm in cross-section carries cold air. The temperature of the outer surface of the duct is  $5^{\circ}\text{C}$  and surrounding air temperature is  $25^{\circ}\text{C}$ . Find the heat gain by the duct assuming that one metre duct is exposed to the air in vertical position. 10
- Properties of air at  $15^{\circ}\text{C}$  :  
 $\rho = 1.2 \text{ kg/m}^3$ ;  $\mu = 18.17 \times 10^{-6} \text{ kg/m-s}$ ;  $\nu = 14.61 \times 10^{-6} \text{ m}^2/\text{s}$ ;  
 $C_p = 1006 \text{ J/kgK}$  and  $k = 0.0256 \text{ W/mk}$ .  
 You may use the relation :  
 $\text{Nu} = 0.13 (\text{GrPr})^{0.33}$
- 6 a. With a neat diagram derive an expression of Logarithmic Mean Temperature Difference (LMTD) of a counterflow heat exchanger and, hence, express the rate of heat transfer in terms of LMTD. 10

- b. In a parallel flow heat exchanger, the hot water at  $80^{\circ}\text{C}$  is cooled to  $65^{\circ}$  by cold water entering the heat exchanger at  $20^{\circ}\text{C}$  and leaving at  $35^{\circ}\text{C}$ . What would be the exit temperatures if the flow rates of water are doubled. ? 10
7. a. Define total and monochromatic emissive power. Hence state and explain Wien's displacement law. 2+2
- b. Two parallel, infinite gray surface are maintained at temperatures of  $127^{\circ}\text{C}$  and  $227^{\circ}\text{C}$ . If the temperature of the hot surface is increased to  $327^{\circ}\text{C}$ , by what factor is the net radiation exchange per unit area increased ? 10  
Assume emissivities of colder and hotter surfaces to be 0.9 and 0.7, respectively.
- c.



6

Find the shape factor of a conical hole, as shown in the figure,  $F_{11}$ .

9. Write short notes on (any four) 5x4
- Fouling factor
  - Stefan-Boltzman law
  - Green house effect
  - Regenerative heat exchanger
  - Different types of boundary conditions.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding & Allied Processes-I (AME - 15, B-15(R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

**Parts of a questions should be answered at one place**

1. a) Which is the Oldest Welding Process, used before the gas and Arc welding era, and is still in use in villages ? How and why the weld is formed in it ? 2
- b) Name of two types of weld joints and explain the mechanism of joint formation. Name four welding processes for each, which generate those welds. 6
- c) Name the four (4) types of Energy sources used for welding and name two processes each which use them for weld formation. 8
- d) For Oxy-Acetylene flame used in welding operation, write the Chemical equations for heat generation and indicate the amount of heat generated. 4
2. a) Name the One World term often used for indicating the welding process capability ? 1
- b) Explain why that is that is the most important parameter in welding ? 4
- c) On which machine setting that capability depends in SMAW, SAW, GTAW & GMAW ? 2
- d) Why this capability is always range bound in SMAW but not so in SAW & GMAW. 5
- e) Who specifies that parameter and where it is indicated/ shown for SMAW electrodes. 2
- f) Explain what is the Polarity in Arc welding and its effects on welds. How many types are there ? 4
- g) For a steel grill / furniture maker, using a 1 ph transformer set, which polarity is better ? 2

3. a) Which electrical parameter is used for specifying the Arc welding power source ? 2
- b) Explain the difference between Rating and Capacity of Arc Welding Power sources 4
- c) Explain the concept of Duty Cycle of the Power Source and time base applicable to it. 5
- d) Explain the meaning and implications of kVA and Kw of the Power Source. 5
- e) Explain why a transformer is always there in the welding power source, even if it is an Inverter type or a Rectifier type generally giving DC current output. 4
4. Write Short Notes on any 4 of the following topics. 4x5=20
- a) Types of Oxy-Acetylene Flames used for welding and their applications.
- b) Hazards associated with Welding Power Sources.
- c) Function of coating on SMAW Electrodes.
- d) Need for High Frequency and DC Suppressor units in GTAW welding.
- e) Why waste existing material which is needed in final Butt joint, by making the Joint preparation like V, Dbl V. Dbl U,K. etc. ?
- f) Efficiency and the Power Factor of Welding power source.
5. a) Explain the difference between a Spark and an Arc, when both are essentially a discharge of electrical energy through an air gap. 2
- b) Explain which property of the Arc helps in detaching the molten metal droplet from consumable electrode in to the weld pool ? 2
- c) What is Plasma ? When Plasma is an essential part in all the Arcs irrespective the Arc Welding processes, why only one of them is called Plasma Arc Welding ? 4
- d) Comparing with other types, explain why the Inverter Power sources are superior in performance. 6
- e) Briefly explain the terms : OCV, Short circuit Current, Dynamic characteristics of power sources. 6

- |    |    |                                                                                                                                                                                               |   |
|----|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 6. | a) | The constituents of the SMAW Electrode coatings are supposed to carry out some essential functions during the Arc time. Name any three constituents and explain what they do in the Arc zone. | 6 |
|    | b) | Explain for what specific reason SAW process was made available as compared to when SMAW was meeting most of the requirements.                                                                | 4 |
|    | c) | Describe why and how to handle and store the SMAW electrodes and SAW fluxes.                                                                                                                  | 6 |
|    | d) | Explain the Arc Blow in Welding and how to prevent or minimize its effect.                                                                                                                    | 4 |
| 7. | a) | Explain as to what specific features - at least two - of the Oxy-Acetylene Welding.                                                                                                           | 4 |
|    | b) | Explain which Dynamic characteristic(s) of Power source is used in GTAW process ?                                                                                                             | 4 |
|    | c) | Which polarity in GTAW is needed to weld Aluminium Alloy parts and why ?                                                                                                                      | 4 |
|    | d) | Scratch Drawn Arc like in SMAW is not recommended for GTAW process : Why ?                                                                                                                    | 2 |
|    | e) | Explain how the Arc is initiated and maintained in GTAW and in the absence of flux and in presence of Inert gas : How that arc is then sustained ?                                            | 6 |
| 8. | a) | GMAW process is an optimized choice for two specific properties of the other welding processes - explain what are those and how that is achieved                                              | 6 |
|    | b) | Which properties are specifically incorporated in the welding wires to help the dynamic transfer of current from stationary contact tip to the moving wire through it ?                       | 6 |
|    | c) | Why the SAW & GMAW wires are Copper coated - the main purpose ?                                                                                                                               | 3 |
|    | d) | Explain why this choice of Copper, which is relatively an expensive material, is made over other methods like phosphating, electro-galvanizing, cadmium plating etc.                          | 5 |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Engineering Economics (AME - 16, C-17 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer questions no.1 & any four question from rest.  
Parts of a questions should be answered at one place**

1. Point out whether the following statements are true or false with brief reasons. (any ten) 2x10
  - a. The fall in the price of diesel will increase the demand for car.
  - b. Negative slope of demand curve and the downward trend of demand curve is the same thing.
  - c. Extension or Contraction of demand is related to change in price.
  - d. Average Cost is equal to Average Fixed Cost (AFC) + Average Variable Cost (AVC)
  - e. Marginal Cost changes faster than Average Cost.
  - f. Monopolist does not have control over the price of the commodity.
  - g. In very short period the supply can be adjusted to demand.
  - h. In imperfect competition market, new firm can easily enter.
  - i. In perfect competition is broader concept than pure competition.
  - j. Factors of production are stable in the long period.
  - k. Every debit may not have corresponding credit.
  - l. Trade discount is shown in the journal entry.
  - m. Cash account always shows credit balance
  - n. Assets and Liabilities are the two sides of cash books.
  - o. Cash account need not be prepared if cash book is maintained.
  
2.
  - a. Explain the principle of consumer's equilibrium and the consumer's preference theory with example. 10
  - b. Define the consumer's equilibrium under indifference curve analysis. 10

3. a. Describe the factors affecting demand or determinants of demand. 10
- b. Distinguish between; 10
- i) Extension of demand & Contraction of Demand
- ii) Increase in Demand & Decrease in Demand
4. How will the demand for goods changes if; 4x5
- i) Price of substitute falls.
- ii) Complementary goods become more expensive.
- iii) Consumer's Income increases.
- iv) Commodity becomes a fashion goods
- v) Certain increase in population.
5. The following information is extracted from XYZ Company Ltd. 5x4
- |                        |   |             |
|------------------------|---|-------------|
| Fixed cost             | = | ₹ 100,000/- |
| Selling Price per unit | = | ₹ 20/-      |
| Variable cost per unit | = | ₹ 12/-      |
- i) You are required to draw Break-even chart based on the following information.
- ii) Break even point in terms of unit.
- iii) Break even point in terms of value.
- iv) P.V. ratio.
6. a. What is opportunity cost ? Give some example of opportunity cost. How are these cost relevant for Managerial decision. 10
- b. Calculate required sales when; 10
- Selling price ₹ 40/- per unit
- Variable cost ₹ 30/- per unit & Fixed cost ₹ 40,000/-
- Required profit ₹ 10,000/-
7. Write short notes on (any five) 4x5
- i. Bilateral Monopoly
- ii. Sunk Cost
- iii. Implicit Cost
- iv. Working Capital
- v. Equity Share
- vi. Depreciation
- vii. Money Market
8. a. Describe the rules for Debit & Credit in Accounting system with example 10
- b. Explain the utility of; 10
- i) Cash Book & Journal Book.
- ii) Sundry Debtor & Sundry Creditor

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Computational Methods &  
Computer Programming (AME - 17, C-18 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer questions 1 and any Five from the rest  
Parts of a questions should be answered at one place**

1. a. Explain the characteristics of a computer 6x5=30
  - b. What are the different symbols used in a Flowchart ?
  - c. Write about binary addition and subtraction with examples.
  - d. Write in details about ASCII, EASCII, and BCD.
  - e. Discuss about identifiers and keywords of C programming language.
  - f. What is function and recursion in C language ? Give examples.
2. Describe model of a computer and its parts with a diagram. 14  
Explain different types of input devices.
3. a. What are universal gates ? Draw AND gate using NAND gate 9  
with truth table.
  - b. What are the differences between assembly language and 5  
high level languages ?
4. a. Convert the following : 3x3=9
  - i.  $(C2)_{16}$  to Binary
  - ii.  $(32)_8$  to Decimal
  - iii.  $(95)_{10}$  to Binary
  - b. What is a pointer ? Give example. 5
5. a. Write a C program to find the nth power of a given number. 7
  - b. Write a C program to demonstrate the use of multi- 7  
dimensional array.
6. a. Write a C program to swap two integers. 7
  - b. Write a c program to determine whether a given number is 7  
prime or not.

7. a. What is break in C language ? Give example code to demonstrate the use of break statement. 6
- b. Write a C program is add two 3x3 matrices. 8
8. a. Write a C program to find the value of  $1^2 + 3^2 + 5^2 + \dots + 101^2$  7
- b. What is call by value in a C function ? Give example to demonstrate the use. 7
10. Write short notes (on any four) from the following : 3.5x4=14
- a. DOS
  - b. NOR Gate
  - c. Union and Structure in C
  - d. Bitwise operator
  - e. C preprocessor
  - f. File input and output

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Weldment Design & Weld Procedure  
(AME - 18, C-23 (R))

Full Marks : 100

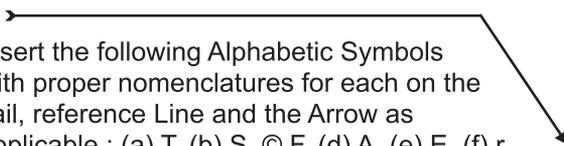
Time : 3 Hours

Pass Marks : 40

**Answer any five questions.**

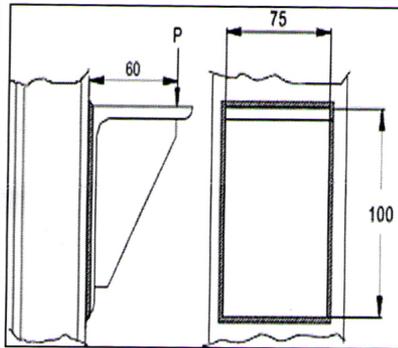
**All question carry equal marks**

**Parts of a questions should be answered at one place**

1. a. Draw neat sketches with dimensions of a Butt Joint of a 25 mm plate with a 20 mm plate to show : Root face, root Gap. groove Face. Bevel Angle. Groove Angle. Penetration. Fusion and HAZ. 7
- b. Draw neat sketches with dimensions of a fillet welded T-Joint of 20 mm thickness plates to show : Leg Length. Theoretical Throat. Effective throat. Actual Throat. Penetration. Fusion and HAZ 7
- c. Explain with sketches the functions of : Joint root. groove face. Root Face. Root Edge. root Opening. bevel. Angle. Groove radius. 6
2. Insert the following Alphabetic Symbols with proper nomenclatures for each on the Tail, reference Line and the Arrow as applicable : (a) T. (b) S. © F. (d) A. (e) E. (f) r. (g) L. (h) P. (I)N. Show the symbols for (I)Field weld and (ii) Weld All around. 20
- 
3. a. Define and explain : 5+5
- i) Distributed loading with shear and bending moment diagrams.
- ii) Concentrated Loaded beam with shear force and bending moment diagrams.
- b. Explain the use of Mohr's Circle with diagrams to find out the stresses and their relationship acting on a structural member. State the formula for the combined stress acting on a structural member. 10

- |       |                                                                                                                                                                                               |        |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 4. a. | Explain the differences between ANSI/AWS D1.1, D1.3, D1.4                                                                                                                                     | 6      |
| b.    | State what the following codes stand for :                                                                                                                                                    | 8      |
|       | i. BS EN ISO 15610:2003                                                                                                                                                                       |        |
|       | ii. BS EN 287-1:2011                                                                                                                                                                          |        |
|       | iii. BS EN ISO 9606-2:2004                                                                                                                                                                    |        |
|       | iv. ISO 9692-1.                                                                                                                                                                               |        |
|       | v. ISO 3834                                                                                                                                                                                   |        |
|       | vi. PD 6705-2                                                                                                                                                                                 |        |
|       | vii. API 1104                                                                                                                                                                                 |        |
|       | viii. ASME BPVC Section II.                                                                                                                                                                   |        |
| c.    | What are - ASME, Aws, ISO, BS. API and DN.                                                                                                                                                    | 6      |
| 5. a. | Define WPS as a Process and as a Document as per ASME Section IX and its purpose in manufacturing where welding is the main process.                                                          | 10     |
| b.    | State the Essential and non essential variables used in WPS.                                                                                                                                  | 5      |
| c.    | State and explain each of QW/QB 422, WQ 432 and QW 442 and the differences if any in these codings.                                                                                           | 5      |
| 6. a. | Explain with appropriate diagrams and sketches the development of Residual stresses in welded fabrication. What are the effects of residual Stress on the performance of a welded structure ? | 6      |
| b.    | State and draw sketches to explain different types of distortion. What are the major factors contributing to distortion in welded fabrication ?                                               | 7      |
| c.    | How can the distortion be minimized in welded fabrication - state the processes and the methodology to be adopted before, during and after welding.                                           | 7      |
| 7.    | Write short notes on any four                                                                                                                                                                 |        |
| a.    | Purpose and procedure for pre-heating of weldments                                                                                                                                            | 4x5=20 |
| b.    | Welding procedure qualification                                                                                                                                                               |        |
| c.    | NDT of weld repair                                                                                                                                                                            |        |
| d.    | Engineering Critical assessment of welded structure                                                                                                                                           |        |
| e.    | Controlling distortion in structural hollow section welding                                                                                                                                   |        |

8. In the loaded structure shown in the drawing  
 $p = 30,000$  Newtons.  $d = 100$  mm.  $b = 70$  mm.  $y = 50$  mm. Design stress =  $220 \text{ N/mm}^2$ . Calculate the size of the Fillet Weld.



# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Testing and Quality Control (AME - 19, C-19 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any Five questions.**

**Parts of a questions should be answered at one place**

1. a. Define Engineering stress, Engineering strain; True stress and true strain during material testing in universal testing machine. 8
- b. Draw a sketch to schematically explain 6
  - i) Engg. stress vs Engg. strain and
  - ii) True stress vs true strainfor a ductile material such as low carbon steel.
- c. Draw and explain the above type of diagrams for a brittle material like grey cast iron. 6
2. a. What are 'Welding Procedure Specification, 'Procedure Qualification' as mentioned in various codes ? 5
- b. What type of bend tests are usually required by codes for welding procedure qualification ? 5
- c. What information is obtained by various types of bend tests that justifies their use in the fabrication industry ? 5
- d. What is welder certification ? Which bend tests, if any, are normally required in welder certification ? 5
3. Explain the reasons for occurrence, methods of detection, and steps to be taken for prevention (or minimization of severity) of any three of the following defects in fusion welding of steel 20
  - a. Cold cracking
  - b. Hot cracking
  - c. Porosity
  - d. Base metal lamination or delamination
  - e. Residual stress

- |    |    |                                                                                                                           |     |
|----|----|---------------------------------------------------------------------------------------------------------------------------|-----|
| 4. | a. | Discuss the relative advantages and disadvantages of x-ray and gamma ray radiography.                                     | 10  |
|    | b. | Discuss the principal and mechanism of eddy current generation in the weldment and its utilisation in NDT.                | 10  |
| 5. | a. | Describe the principle and procedure of ultrasonic testing of a weld joint.                                               | 8   |
|    | b. | What are the principal limitations of the ultrasonic testing of weldments ?                                               | 8   |
|    | c. | How does use of angle probes enhance the effectiveness of flaw detection ?                                                | 4   |
| 6. | a. | Explain the differences and inter relationships among quality control, quality assurance and quality audit ?              | 10  |
|    | b. | Explain the utility of any two of the following control charts in the fabrication industry.<br>X-chart, P-chart, C-chart. | 5+5 |
| 7. |    | Write short notes on any four of the following.                                                                           | 5x4 |
|    | a. | S-N curves                                                                                                                |     |
|    | b. | Notch bend tests                                                                                                          |     |
|    | c. | Penetrant testing                                                                                                         |     |
|    | d. | Quality level                                                                                                             |     |
|    | e. | Double sampling                                                                                                           |     |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding Metallurgy - II (AME - 20, C-20 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any TEN questions.**  
**Answers of all parts of this same question**  
**must be at the same place.**

1. a. Joining of dissimilar metals is always challenging ? Explain in detail with examples. 5x2=10  
b. Define corrosion and its types explain the stress corrosion cracking and knife line attack
2. Define 'defects and discontinuity'. All defects are discontinuity but all discontinuities are not defects ? Explain, Name the different discontinuity and explain Porosity including their types, causes and remedies. 10
3. Define delta ferrite. Name the different methods for measurement of delta ferrite in the weld. What is the role of delta ferrite in an austenitic stainless steel weld deposits ? What is the role of Schaeffer and de Long diagram. 10
4. a. Explain the weldability issues of Cr-Mo Steels 5x2=10  
b. Explain the weldability issues of Ni base alloys
5. Define cladding. Name the different cladding methods. Explain submerge arc strip cladding in detail including its advantages, disadvantages & applications. 10
6. a. Explain the destructive testing of welded joints - Bend Testing 5x2=10  
b. Define residual stress in the weld. Explain various types of distortion.
7. Explain the following terms in detail 10
  - a. Liquation cracking
  - b. Lamellar tearing
  - c. Cold cracking
8. Explain following steels 10
  - a. Heat resisting steels
  - b. Cryogenic steels
  - c. Creep resistant steels

- |                                                                                                 |    |
|-------------------------------------------------------------------------------------------------|----|
| 9. Define weldability and its relevance. Explain Trans Varestraint test                         | 10 |
| 10. Explain the role of the thermal properties on welding of ferrous and non ferrous materials. | 10 |
| 11. Name the challenges posed to joining the coated steels.                                     | 10 |
| 12. Explain gas metal and slag metal reactions in welding.                                      | 10 |
| 13. Explain the important weldability issue of Titanium and it alloys.                          | 10 |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding Applications (AME - 21, C-21(R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer question No.1 and any 4 from the rest.**

**Parts of a question should be answered at one place**

1. a. Differentiate between a welding code, welding standard and a welding specification. 9
- b. Explain what is meant by 'fitness for purpose', with a suitable example. 6
- c. What is meant by a workmanship standard ? Give an example. 5
2. Recommend, starting reasons, the most suitable welding process, type of power source and choice of welding consumables for any three of the following welding tasks : 20
  - a. Low pressure boiler drum using 8 mm thick carbon steel plate.
  - b. Field welding of oil refinery pipes.
  - c. Welding of field rail lines.
  - d. Repair welding of overhead electric crane traction wheels.
3. a. Differentiate between a weld discontinuity, weld imperfection and welding defect. 6
- b. Explain the importance of a weld repair plan. Discuss in detail the various stages involved in carrying out an in service weld repair including the NDT requirements. 14
4. a. Explain any three of the following pipe welding techniques, pointing out their advantages and disadvantages 20
  - a. Uphill welding
  - b. Down hill welding
  - c. Roll welding
  - d. Dolly mesh technique
  - e. Orbital welding in cross country pipe lines
5. Determine the cost per metre of a fillet weld of throat thickness 7 mm made by Co<sub>2</sub> shielded MMAW process using an electrode wire of 1.5mm diameter. Given. 20

Operator duty Cycle : 60%

Yield of fillet metal : 90%

Electrode wire price : Rs.350 per Kg

Cost of CO<sub>2</sub> gas : Rs.145 per cubic meter welder pay rate :

Rs.150 per hour overhead cost : Rs.130 per hour

Travel speed : 50 cm/min

Gas flow rate : 24 litres per minute

Assume any other data required

6. a. Can a production qualified welder or a certified welder be used for repair welding ? Why is a separate welder or welding operator often required for repair welding and plant maintenance ? 10
- b. What information is to be collected or required before a repair procedure is written down for a damaged or broken machine component ? 10
7. Write short notes on any four of the following 20
- a. Estimating the remaining life of a welded structure.
  - b. Root pass, fill pass and cap pass
  - c. Quality level
  - d. Duty cycle of an arc welding machine
  - e. Overmatched filler materials in composition or mechanical properties.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding & Allied Processes - II  
(AME - 22, C-22(R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

**Parts of a questions should be answered at one place**

- |    |    |                                                                                                                                                         |     |
|----|----|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1. | a. | Explain with block diagram the principle and operation of SAW process.                                                                                  | 8   |
|    | b. | Describe the classification system for carbon steel electrode and fluxes used in SAW process.                                                           | 6   |
|    | c. | Write about single and multi wire techniques in SAW                                                                                                     | 6   |
| 2. | a. | Explain resistance spot welding techniques with the welding parameters                                                                                  | 8   |
|    | b. | Describe various shape of welding electrodes used in spot welding. Why copper electrodes are used ?                                                     | 4   |
|    | c. | Explain working operation of Projection welding with its application.                                                                                   | 8   |
| 3. |    | Write about following welding processes with their principles, equipment, accessories and applications                                                  | 4x5 |
|    | a. | Laser beam welding                                                                                                                                      |     |
|    | b. | Electron beam welding                                                                                                                                   |     |
|    | c. | Plasma arc welding                                                                                                                                      |     |
|    | d. | Explosive welding                                                                                                                                       |     |
| 4. | a. | Describe electro-slag welding process in detail about its principles, applications, merits and demerits. How this method is different compared to SAW . | 10  |
|    | b. | Differentiate between friction and friction stir welding with respect to principles, joint formation advantages and disadvantages                       | 10  |
| 5. | a. | Explain the difference among the welding, brazing and soldering                                                                                         | 6   |
|    | b. | Describe torch brazing, furnace brazing, induction brazing and dip brazing.                                                                             | 8   |
|    | c. | Explain different types of fluxes with their properties used in brazing and soldering.                                                                  | 6   |

6. Write short notes 4x5
- a. Flash butt welding
  - b. Thermit welding
  - c. Cold pressure welding process
  - d. Automation in welding processes
7. a. What is the purpose of thermal spray coating ? How it is carried out by flame spraying and arc spraying ? 10
- b. Explain in detail about plasma spray coating with its principles, merits and demerits. 10
8. a. Write in brief mechanical cutting methods with advantages and disadvantage 4x5=20
- b. Describe oxy-fuel gas cutting method with its principles.
  - c. Explain plasma cutting method with its merits and demerits
  - c. Explain water jet cutting method with merits and demerits

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Welding Equipment and Consumables (AME - 23)

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer any Five questions from each group.

Parts of a questions should be answered at one place

Group A : (Any five)

1. Describe the following types of welding Transformers used in small scale & medium scale industries. 10
  - Oil-cooled transformer
  - Natural cooled transformer
  - Forced Air cooled transformer
2. How many types of welding rectifier are used in fabrication industries ? Describe in details with diagrams. 10
3. Explain the selection criteria of an ideal welding power source with CC & CV characteristics in following processes. 10
  - a. SMAW
  - b. GMAW
  - c. GTAW
  - d. SAW
  - e. PAW
4. What are benefits of an inverter welding power source ? List them. Write down on Burn back control and Feed back mechanism in wire feed system available with MIG/MAG welding machine. 10
5. How welding current is regulated in Motor generator set ? What is the basic difference in the output of a rectified set and motor generator set ? Explain 10
6. Write short notes (any four) 2.5x4=10
  - a. Oxy-Acetyline cutting process & Equipment
  - b. Plasma cutting process & equipment
  - c. MIG Brazing equipment
  - d. Resistance spot welding
  - e. Plasma Arc welding (PAW)
  - f. Flux cored arc welding (FACW)

**Group B : (Any five)**

1. What is the difference in chemical composition of a Rutile Electrode & Basic coated electrode 10  
Write down the AWS classification of both the electrodes.
2. Why cellulosic type of electrodes are used in cross country pipe line ? What is the AWS classification of the same ? Why ER7056 electrode write in not used in root run of pipe welding ? 10
3. What are the shielding gas & gas mixtures in 10
  - a. GMAW of carbon steel
  - b. GMAW of stainless steel
  - c. GTAW of aluminium
  - d. GTAW of stainless steel
  - e. GMAW of duplex steelWhat are their benefits ?
4. Explain the sources of hydrogen in steel & aluminium 10  
What are precautions to be follow in each case to prevent the sources ? What is meant by HICC ?
5. Write short notes (any four) 2.5x4=10
  - a. Hard facing electrodes / wires
  - b. Consumables for welding of cast iron with carbon steel
  - c. Influence of O<sub>2</sub> in Argon - CO<sub>2</sub>-O<sub>2</sub> mixture of shielding gases.
  - d. Flux cored wire for ship building fabrication
  - e. Various types of non consumables electrode used in GTAW
  - f. Consumables for Aluminium in its alloys (Arc welding)
6. Explain in details various ingredients of AWS E8018 electrodes; 10  
their functions, significations of the digits 8018, etc, with example

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Advanced Welding Technology  
(AME - 24, C-24 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any FIVE questions.**

**Parts of a questions should be answered at one place**

- |       |                                                                                                                                                                                                                                                                                                         |    |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. a. | What is the purpose of cladding ? Describe various methods of producing clad steel with thin clad layer.                                                                                                                                                                                                | 15 |
| b.    | Compare clad surface with sprayed surface in terms of various features of these.                                                                                                                                                                                                                        | 5  |
| 2. a. | Explain flame spraying process.                                                                                                                                                                                                                                                                         | 10 |
| b.    | What are the gases / gas combination used for this purpose.                                                                                                                                                                                                                                             | 4  |
| c.    | Describe the pre and post treatment carried out for spray coated surface.                                                                                                                                                                                                                               | 6  |
| 3.    | Describe the complete unit including the construction of the electron gun along with its parts used for Electron-Beam welding.                                                                                                                                                                          | 20 |
| 4. a. | What are the welding processes used for welding of Ti-alloys? Give special precautions required during welding of Ti and Ti alloys.                                                                                                                                                                     | 10 |
| b.    | Describe inertia friction welding. What are the parameters controlling this process ?                                                                                                                                                                                                                   | 10 |
| 5.    | Describe any four methods used for joining thermo-plastics. Also discuss tools and equipments used in these methods.                                                                                                                                                                                    | 20 |
| 6. a. | What are the problems of welding 18.8 stainless steel to mild steel ? How will you tackle these ?                                                                                                                                                                                                       | 10 |
| b.    | Decide about the composition (Cr and Ni percentage) of stainless steel welding electrode, which will give desired (18:8 austenitic S.S.) weld metal composition for welding 18.8 stainless steel to mild steel. Assume that both m.s. and S.S. base plates contribute 20% metal each to the weld metal. | 10 |

7. a. Give the list of various methods of joining ceramics to ceramics/composites. 5
- b. Explain in details the i) Ultrasonic joining ii) Infiltration process. Also give the metals, ceramic and composites combination for which these two processes are found suitable. 15

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Summer Session, June 2018

Sub : Fluid Mechanics (B-13 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

**Parts of a questions should be answered at one place**

1. a. State and explain capillarity with neat sketch. 5+5+5+5=  
b. Calculate the capillary rise in a glass tube of 2.5 mm diameter 20  
when immersed vertically in mercury. Take surface tension  $\sigma$   
= 0.52 N/m for mercury in contact with air. The specific  
gravity for mercury is given as 13.6 and angle of contact  
=  $130^\circ$   
c. Two horizontal plates are placed 1.2 cm apart, the space  
between them being filled with oil of viscosity 14 poises.  
Calculate the shear stress in oil if upper plate is moved with a  
velocity of 2.5 m/s.  
d. State and explain Newton's Law of Viscosity
2. a. An inverted U-tube monometer is connected to two 10+10=  
horizontal pipes A and B through which water is flowing. The 20  
vertical distance between the axes of these pipes is 30 cm.  
When an oil of specific gravity 0.8 is used as a gauge fluid,  
the vertical heights of water columns in the two limbs of the  
inverted manometer are found to be same and equal to 35  
cm. Determine the difference of pressure between the pipes.  
b. Explain with neat sketch working principle of a micrometer  
type pressure gauge.
3. a. Each gate of a lock is 6m high and is supported by two hinges 10+10=  
placed on the top and bottom of the gate. When the gates are 20  
closed, they make an angle of  $120^\circ$ . The width of lock is 5m. If  
the water levels are 4m and 2m on the upstream and  
downstream sides respectively, determine the magnitudes of  
the forces on the hinges due to water pressure.

- b. A rectangular pontoon 8.0 m long, 7.0 m broad and 3.0 m deep weights 588.6 KN. It carries on its upper deck an empty boiler of 4.0m diameter weighing 392.4 KN. The centre of gravity of the boiler and the pontoon are at their respective centres along a vertical line. Find the metacentric height. Weight density of sea water is 10104 N/m<sup>3</sup> ?
4. a. Explain laminar boundary layer phenomenon over a flat plate with neat sketch. 8+12=20
- b. Explain with neat sketch experimental determination of metacentric height.
5. a. A fluid flow is given by — 10+10=20  
 $\vec{V} = x^2y\hat{i} + y^2z\hat{j} - (2xyz + yz^2)\hat{k}$   
 Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (5, 2, 4)
- b. In a water supply pipe line the change in diameter is gradual from 20 cm at A to 50 cm at B. Pressures at A and B are 7.848 N/cm<sup>2</sup> and 5.886 N/cm<sup>2</sup> respectively with the end B being 3m higher than A. If the flow in the pipe is 200 litre/s, find  
 i) direction of flow, ii) the head lost in friction between A and B.
6. a. State and explain model testing procedure of partially submerged boiler by giving suitable example. 8+12=20
- b. Explain i) Reynold's no., ii) Euler Na, iii) Dynamic viscosity, iv) Bulk modulus.
7. a. Explain briefly with neat sketch about turbulent flow phenomenon. 5+10+5=20
- b. Find the discharge through a trapezoidal channel of width 7m and side slope of 1 horizontal to 4 vertical. The depth of flow of water is 2.4 m and value of Chezy's constant, C = 55, the slope of the bed of the channel is given 1 in 4000.
- c. Describe different kinds of pipe losses.