

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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 both analytically and graphically that total energy in SHM is conserved. 3+1  
b) Show that oscillation of simple pendulum is simple harmonic. 4+2  
Find its time period if the length of the pendulum is 10 cm.
2. a) Distinguish between velocity and amplitude resonance. 4  
b) Determine the resonant frequency and sharpness of resonance of an L-C-R series circuit with  $L = 10\text{mH}$ ,  $C=1\mu\text{F}$  and  $R=100\text{K}\Omega$ . 2+2  
c) Draw the resonance curve and show on what factors sharpness depends. 2
3. a) How do you distinguish between interference and diffraction fringes? 2  
b) Draw Lloyd's single mirror experimental set up to study interference and state the nature of the interfering source. 2+1  
c) Calculate the amount of fringe shift if a transparent glass plate of thickness  $5\mu\text{m}$  and refractive index 1.5 is introduced in one of the beam paths. the experiment is performed with Na-light of wavelength  $590\text{nm}$ . State what will happen to the fringes if Na-light is replaced by light from a common bulb. 3+2
4. a) Differentiate between single and double slit diffraction pattern by drawing their fringe systems. Find an expression for diffraction intensity in single slit pattern. 2+5  
b) Considering crystal lattice as equivalent to grating, determine the lattice spacing if 3rd order diffraction fringe is produced at an angle of  $60^\circ$  from the incident direction. Wave length of X-ray used in the experiment is  $1\text{\AA}$ . 3
5. a) How will you distinguish between linearly polarized and unpolarized light? If a mixture of these two is present how will you separate out them? 2+2  
b) Prove that linearly polarized light is a combination of left and right circularly polarized light. 3

- c) Calculate the angle of incidence for which light of wavelength 600A incident on a plane glass plate gets polarized. The refractive index of glass is 1.55. 3
6. a) Write down the basic conditions for lasing action to take place in a material illustrating their requirements. 3
- b) Derive Einstein's A and B coefficients and show from it that laser of visible can easily be produced but laser of X ray does not. 5+2
7. a) Compare a semiconductor laser with other lasers in regard to lasing mechanism and power output. 3
- b) Describe a Co<sub>2</sub> or He-Ne laser system. Draw its energy band diagram. State the scheme of population inversion and energy output. 2+2+3
8. a) Show diagrammatically and explain what is meant by longitudinal and lateral spherical aberration. 2+2
- b) State how applanatic doublet is used to minimize spherical aberration. 4
- c) What will be the equivalent focal length of such a combination? 2
9. a) Define magnetic flux density at any point in space and state its unit. 2
- b) Find an expression for the magnetic flux density at any point on the axis of a circular coil carrying current. 5
- c) Calculate the coefficient of self inductance of a coil having 1000 turns when current of 2.5 amp flowing through it produces magnetic flux = 0.5 mWb. 3
10. a) Find an expression for flux density in between the pole pieces of an electromagnet considering reluctance of pole pieces, of air gap, of core and of yoke. 4
- b) What kinds of material are preferred as the core and as yoke of electromagnet and why? 3
- c) A solenoid with soft iron core (permeability=780) is of length 0.5m and area 0.0005m<sup>2</sup> and have 500 turns. 4A current is flowing through it. Calculate MMF, reluctance and magnetic flux. 3
11. a) Draw the basic structure and describe the mechanism of light propagation in an optical fibre. 2+2
- b) Calculate the change in acceptance angle if an optical fibre having numerical aperture 0.2 in air is immersed in water of refractive index 1.33. 3
- c) Write down different applications of optical fibre. 3

12. a) An alternating emf  $e=10\sin 100\pi t$  volt is applied to a C-R circuit having  $C=1\mu\text{F}$  and  $R=10\text{K}\Omega$ . Calculate the expression for current in the circuit and its effective value. 4
- b) Also calculate the average power dissipation in the circuit. 3
- c) In this context define power factor and state its significance in regard to current transmission in the circuit. 3
13. a) Draw the phasor diagram of an L-C-R series circuit with  $L=10\text{mH}$ ,  $C=0.1\mu\text{F}$  and  $R = 10\text{k}\Omega$  and determine the phase angle when an alternating emf  $e=10\sin 100\pi t$  volt is applied to it. 3+1
- b) If the frequency of applied emf is tuned at what frequency resonance will take place ? What will be the phasor diagram at resonance ? 3+1
- c) State the significance of Q-factor corresponding to the resonant circuit. 2
14. a) State some methods to produce ultrasonic waves. State how it is used to measure depth of sea. 4+3
- b) A quartz crystal of thickness  $0.001\text{m}$  is producing ultrasonic. Calculate the fundamental frequency. Young's modulus  $Y=8\times 10^{10}\text{Nm}^{-2}$  and density  $\rho=2.65\times 10^3\text{Kg m}^{-3}$ . 3

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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. Effects of air pollution on human health
  - b. Narrate your visit to a well known tourist spot or/a place of interest.
  - c. Merits and demerits of unskilled labour in India
2. Read the passage below and answer the questions below. 20

Guppy, a freshwater fish that grows to little more than the size of your index fingers is Enemy no.1 of the Aedes acgypti mosquito that spreads the dengue virus. According to public health experts it is a cheap and effective weapon in the fight against dengue and malaria. (4x5)

The fish is named after the British born naturalist Robert John Lechmere Guppy who is credited with discovering the species in Trinidad in 1866. Its scientific name is Poecilia reticulata. Male guppies are 0.6 to 1.4 inches long while females vary between 1.2 and 2.4 inches. Their common habitat is small ponds and pools. They also live in brackish water. Some strains of the guppy are popular as aquarium fish because they are cheap, easy to keep and colourful. The average life span of guppies is about 5 years.

The guppy fish feeds on microbes and mosquito larvae. One fish can eat 25 to 50 larvae in 24 hours. For municipalities struggling for the destruction of breeding grounds of Aedes aegypti, voracious appetite of guppies for the larvae is a godsend. Another encouraging factor is that both the aedes aegypti mosquito and the guppy are fond of breeding in fresh water.

A trial study commissioned by Cambodia and the Lao people;s Democratic Republic and funded by the Asian Development Bank and the World Health Organisation has proved that the guppy fish



can help combat the spread of the mosquito. The ADB health specialist Gerard Servais says, "It offers a viable alternative to using chemicals and can reduce the scale of costly emergency response activities to contain epidemics".

The guppy can keep pace with the *Aedes aegypti* mosquito when it comes to breeding. A male guppy will be ready for breeding activity two months after birth while females can breed in three months. If a reservoir has 10 to 20 fishes, the population can shoot up to 2000 after a year.

- a. Describe the size, habitat and life cycle of guppy fishes.
  - b. What is the scientific name of the guppy fish ? What is the origin of its name ?
  - c. How can the fish control the spread of dengue ?
  - d. Who is Gerard Servais ? What is his suggestion ?
  - e. What is the finding of the trial study ? Who funded it ?
  - f. Select the words from the passage that are synonymous with the words given below (any four)
    - i) Practicable ii) Greedy iii) Salty iv) Enclosed area for water storage v) types / breeds, vi) natural home.
3. Make a precis based on the passage given above in about one third of its length and suggest a suitable title for it. Use your own language as far as possible. 15  
(13+=2)
4. Write a report on any one of the following topics in about 200 words. 20
- a. A fire broke out in your unit a fortnight ago causing considerable damage. As unit head prepare a report to the higher authority mentioning the cause / causes of the fire and the measures to be adopted to prevent such accidents in future.
  - b. As HR manager of a reputable organisation you have been asked to prepare a comprehensive programme to initiate social activities for the people in the neighborhood of the organisation. These social activities should suit the need of the population for eg. building / repairing roads, digging tubewells for drinking purposes, health check-up, primary ed etc.
  - c. Recently you have joined as Manager in the marketing section of a manufacturing company. The company has been running at a loss for the last two years. the Managing Director has asked you to prepare a plan of marketing strategies that can create a favourable market for the products of the company.

- 5 Complete the paragraph filling in the blanks with appropriate articles (a, an or the) where required. If no article is required put an X in the blank space. 1x5=5

Maureen Travis who worked as librarian for seven decades died recently at 1 age of 93. She was associated with 2 India House. Her passing is 3 big loss to her colleagues. For her exemplary dedication to work and unwavering commitment, she was made 4 institution during her service with 5 high commission.

6. Change the degree of comparison without change of meaning (any five) according to the direction. 1x5=5
- No other student is as industrious as Rajen (Superlative)
  - Niten is as intelligent as his friend (Comparative)
  - Mathematics is one of the easiest subjects to Paresh. (Positive)
  - Walking is better than many other exercises. (Superlative)
  - Jupiter is the biggest planet in the planetary system. (Comparative)
  - The Cow is more useful than most other animals (Positive)
  - Girls are as diligent as boys (Comparative)

- 7 The following passage needs proper editing, Edit the passage correcting the errors in spelling, rules of grammar and punctuation. There are five errors. 1x5=5

If you choose a trade or profession that appeals to you as the means of self expression and social service, you feel satisfied with your earning, however small, you may not earn like a lower or physician, but your work give you an outlet for your creative impulse. 'How I can earn the biggest salary' is the question of an unhappy selfish man'.

8. Rewrite the following sentences according to the instructions given in brackets (any ten) 1x10=10
- The teacher praised the boy for his honesty (Change with passive voice)
  - Before going home he completed his assignment. (Make it a compound sentence)
  - The poor man was hungry, so he ate everything given to him. (Make change it into a simple sentence)
  - However rich be may be, he is always dissatisfied. (Rewrite it using through)
  - Mother said to me "you are late again". (Change it into Indirect speech)

- f) The entire building collapsed. It happened suddenly.  
(Combine the two sentences into a simple sentence)
- g) No one cares for the poor in this world. (Change it into an interrogative sentence)
- h) This furniture is very costly. I cannot buy it.  
(Join the two sentence using 'too')
- i) The dog was run over by a car.  
(Change it into the Active voice)
- j) You wrote the answer, .....
- (Complete it using the question)
- k) The boy told his mother that he should not trouble her any more (Rewrite it into Direct Speech)
- l) Father told Raja to bring him a book.  
(Convert it into a complex sentence)
- m) Those who tear the pages of library books will be punished.  
(Rewrite it in a simple sentence)

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

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

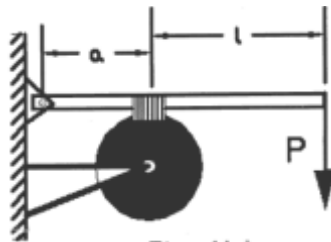
Figures in the right hand margin indicate marks

1. a. A set of three forces may keep a body in equilibrium - explain. 4
- b. Discuss on method of joints for finding out member forces in a given truss. 4
- c. Solve the given Truss (Fig. 1c) for its member forces by method of sections. 12



2. a. Distinguish between centroid and centre of gravity 4
  - b. State and explain the theorems for finding out area and volume. 6
  - c. An over hanged beam with 4.0 m simply supported span and 1.0 m over hanged span is subjected to uniformly distributed load (u.d.l) of intensity 3.5 kN/m over its entire simply supported span. A concentrated clock wise moment of 3.0 kNm is applied at the free end of the over hanged portion. In addition to this a point load of 2.5kN is applied at the mid point of simply supported span. Calculate support reactions for the beam. 10
3. a. Define moment of inertia of a given plane area. Also derive the analytical expressions used for finding M.I. of an area. 5
  - b. Illustrate on parallel and perpendicular axes theorem in connection with M.I. of plane areas. 5

- c. An economical T section has the dimensions as follows : Top flange (220mm X 11mm) and web (270mm X 14 mm). The section is symmetrical about its vertical axis. Determine moment of inertia of the a section about its centroidal axes (horizontal and vertical). Also calculate polar moment of inertia. 10
- 4 a. A heavy rotating drum of radius 20 cm is supported in bearings and is braked by the device as shown in the figure below. Calculate the braking moment with respect to the bearing if the coefficient of kinetic friction between drum and brake shoe is 0.20. Take  $a = 25$  cm,  $l = 65$  cm,  $P = 25$  kN. State the relevant equations with proper explanation. 8



- b. What do you mean by motion of projectile. Set up the expressions for maximum range, time of flight and maximum height. Use standard symbols in establishing these. 8
- c. Define F.B.D. Explain its importance in solving problem of mechanics. 4
5. a. A boy wishes to throw a stone over a flat roofed schoolhouse that stands 15m wide and 8.5 m high on level ground, determine how far from the wall he should take his stand in order to make the ball clear the roof with least effort. 6
- b. An open belt connects two pulleys of 210 and 620mm diameters with their centers 610 mm apart. the smaller pulley is driving and it rotates at 620 pm. If the coefficient of friction between the belt and the pulley is 0.25 and the maximum allowable tension in the belt is 810 N. Determine. 10
- i) the kW power that can be transmitted by the belt.
  - ii) the resultant force on the shaft of the driving pulley due to the belt tensions.
- c. Differentiate between rolling and kinetic friction 4

6. a. What do you by dynamic equilibrium. Explain its importance in dynamics. 5
- b. Define coefficient of restitution in case of elastic collision. Establish the important equations for direct central impact in case of partially elastic colision. 7
- c. A hammer weighing 8.5 kN falls from a height of 7.5 m on to a pile weighing 16.25 kN. If the average resistance of the ground is 4.25 kN find how much the pile will be driven in. 8
7. a. A flywheel weighing 20.5 kN and having a radius of gyration 0.45m increases in speed from 45 rpm to 130 rpm in one minute under a uniform torque. Find i) angular acceleration, ii) the torque applied, iii) the change in angular momentum, iv) change in K.E. 10
- b. A railway 4 wheeler wagon weighing 15.75 tonnes runs down a gradient of 1/120. Determine its speed when it has rolled down one km on a straight track. The axle friction is 40.,N per tonne. The weight of axis and wheels is 2.5 tonnes. the wheels have a radius of 30 cm and radius of gyration of 3.5 cm. 10
8. a. A solid block of mass M is placed at rest on a smooth horizontal surface. The block is then bombarded normally by a constant stream of bullets, each of mass m ( $m \ll M$ ) moving with constant initial velocity u along horizontal direction. Assuming the collisions to be perfectly elastic, find the velocity acquired by the block after the nth bullet has struck it. 10
- b. Explain the conservation principle of angular momentum. 5
- c. A sky laboratory of mass M has to be lifted from a circular orbit of radius 2.5R to another circular orbit of radius 3.25R. Determine the minimum energy required to do so. 5

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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. Define the term 'Culture'. Critically explain the elements of culture in Indian perspective. 2+18
2. What do you mean by the term 'Urbanization' ? Discuss the basic characteristics of urbanization of Indian Society. 3+17
3. Define the term 'Social Stratification'. Explain the functionalist approach to social stratification. 2+18
4. What is the meaning of 'Modernization' ? Mention and explain the various points of complexities in the process of modernization. 3+17
5. What is meant by 'Development' ? Explain the role of state and market in the process of development. 2+18
6. Define the term 'Technology transfer'. Discuss the advantages and disadvantages of technology transfer. 2+18
7. Explain the meaning of 'Child labour'. Elucidate the socio-economic factors for continuation of child labour. 3+17
8. What is meant by 'Trade Union' ? Explain the recent scenario of trade union movement in India. 2+18

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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. A load of 50 kN is suspended by a steel pipe of 50 mm external diameters. Find the thickness of the pipe given : 8  
 $E = 200 \text{ kN/mm}^2$ .  
Working stress allowable =  $125 \text{ N/mm}^2$
- b. Find the elongation of the above pipe over a length of 200 mm if stressed to the maximum permissible value. 6
- c. A load of 10 kN is to be lifted with the help of steel wire. Find the minimum diameter of the wire if permissible stress is limited to  $100 \times 10^6 \text{ N/m}^2$ . 6
2. a. Show that the volumetric strain of a rectangular block subjected to normal tensile stresses on three mutual perpendicular planes is 10  
$$\frac{1}{E} (f_x + f_y + f_z) \left(1 - \frac{2}{m}\right)$$
  
in the standard notation, where the poisson's ratio =  $1/m$ .
- b. A steel rail is 15 m long at  $30^\circ\text{C}$ . If there is no expansion gap between two rails, calculate the stress induced in the rails when the temperature is  $45^\circ\text{C}$ . Given 10  
 $\alpha = 12.5 \times 10^{-6} \text{ per } 0\text{C}$ .  
 $E = 2 \times 10^6 \text{ kg/cm}^2$ .
3. Find the forces in the members AB, BC and CA in Fig.3 20

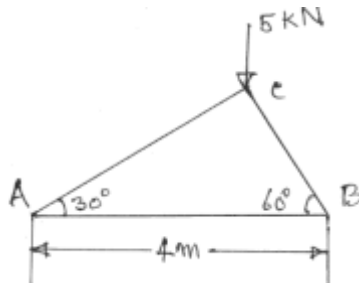


Fig.3



4. A simply supported beam of span 8m is carrying point loads of 3kN and 4 kN at distances 5m and 6m respectively from the left hand support. Calculate the values of shear force and bending moment of salient points, and draw the S.F. and B.M. diagrams. 6+6+8
5. a. Explain, with an example, what you understand by pure bending. 5
- b. Derive, using standard notation, the bending equation based on the theory of pure bending. 5
- c. A beam 250 mm wide and 300 mm deep is used to carry a uniformly distributed load of 1000 N/m. The beam has a span of 5m. Find the maximum bending stress in the beam. 10
6. a. Show that for a circular area of diameter D, the polar moment of inertia about its centroidal axis is  $\frac{\pi D^4}{32}$ . 10
- b. If a shaft rotates at N rpm and the mean torque applied on the shaft is T N.m., then show that the power transmitted through the shaft is
- $$\frac{\pi T N}{30,000} \text{ Kilowatts}$$
7. a. Define what is meant by a thin cylinder subject to internal pressure. 4
- b. In a thin cylindrical vessel subjected to internal pressure, derive formulae for
- Circumferential or hoop stress and
  - Longitudinal stress
- c. A pipe of diameter 1.2 m contains fluid at a pressure of 5N / mm<sup>2</sup>. If the allowable stress in the material is 120 N/mm<sup>2</sup>, find the thickness of pipe. 8
8. Write short notes on any three of the following 20
- Modulus of resilience.
  - Radius of gyration
  - Modulus of section or section modulus
  - Mohr's circle
  - Bending moment and moment of resistance.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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 ten question, each carrying 1 mark

1x10

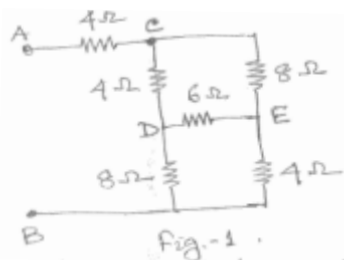
1. i. Electric current is the rate of flow of  
a) electrons, b) protons, c) Neutron, d) atom
- ii. The unit of resistivity of a material is  
a) ohm, b) ohm-mehe, c) ohm/m, d) siemens
- iii. Mass analysis is based on  
a) KCL, b) ohm's law, c) KVL,  
d) Law of conservation of energy
- iv) A capacitor in a series RC circuit is charged to 100 volts, when allowed to discharge for one time constant, the capacitor voltage would be  
a) 0 volt, b) 63 volt, c) 75 volt, d) 37 volt
- v) The unit of electric flux density D is  
a) C/m<sup>2</sup>, b) N/C c) F/m d) V/M
- vi) The time constant of RC series circuit is equal to  
a) R/C, b) RC, c) C/R d) 1/RC
- vii) The area of hysteresis loop is a measure of  
a) magnetic flux, b) m m of per cycle  
c) energy loss per cycle/m<sup>3</sup> d) permeance
- viii) The phase angle of an R-L-C series circuit is leading if  
a)  $X_e=0$ , b)  $R = 0$ , c)  $X_e < X_L$ , d)  $X_e > X_L$
- ix) Which of the following is not part of a d.c. machine ?  
a) damper winding b) field winding  
c) commutator d) armature
- x) When an induction motor is at stand still, its  
a) Stator current is zero b) rotor frequency equals to supply frequency, c) rotor frequency is zero, d) stator field is zero.

- xi) A 4 pole, 1200 rpm alternator generates e.m.f. at a frequency of
- a) 25 HZ,                      b) 50 HZ  
 c) 40 HZ                      d) 60 HZ
- xii) Transformer core is laminated to reduce
- a) improve coding              b) reduce weight of steel  
 c) reduce hysteresis loss      d) reduce eddy current loss

**PART - B**

**Answer any three question**

2. a. State and explain Norton's Theorem 4+4  
 b. Find the input resistance of the circuit between the points A and B of Fig.1 8



3. a. What is meant by the time constant of a series RC network? What is its significance? 5+3  
 b. A capacitor is charged from a d.c. source through a resistor of 0.5 megohm. If the p.d. across it reaches 75% of its initial value in half a second, find its capacitance. 7
4. a. Derive the condition for the maximum efficiency of a single phase transformer 8  
 b. A dc series motor is supplied at 110 V and the input current is 20 A. The armature resistance is  $0.35 \Omega$  and the field resistance is  $0.15 \Omega$ . The iron and friction losses amount is 200W. Allowing a total voltage drop at the brushes of 2V. Calculate the efficiency of the motor. 7
5. a. Briefly describe the construction of a d.c. motor. How do you classify such motors? 6+4  
 b. A 2200/200 V transformer draws a no-load primary current of 0.6A and absorbs 400 watts. Find the magnitude of magnetising and iron loss currents. 5

## PART - C

### Answer any three question

6. a. Define a capacitor start induction run motor. Also describe the construction and working of such a motor. 8
- b. Why in its elementary form, the single phase induction motor is not self starting ? Describe various methods of starting a single phase induction motor. 7
7. a. Describe the construction and operation of a moving iron attraction type instrument. Can such instruments be used both for ac and dc ? Justify your answer. 8+2
- b. A PMMC instrument has full scale deflection current of 50 mA and 2 ohm resistance. How the instrument can be converted to :
- i) 0-5A range ammeter ?
- ii) 0-100V range voltmeter ?
8. a. What is an ideal diode ? How it can be represented as a switch ? Draw its equivalent circuit and I-V characteristics. 2+2+2+2
- b. For a transistor as shown in Fig.2  $\alpha=0.95$ . The voltage drop across  $2K\Omega$  resistance which is connected in the collector is 3V. Find the base current.

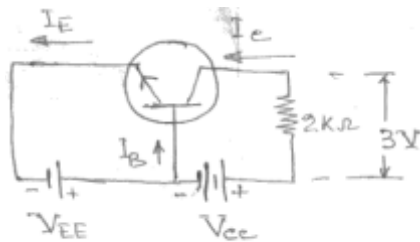


Fig - 2

9. Write short notes on any three 3x5=15
- a. Push Pull inverter circuits
- b. Boolean functions
- c. LDR
- d. The operational amplifier (TC)
- e. Star delta connections.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any Five question**

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

**Figures in the margin indicate marks**

1. a) How does the metallic bond differ from the ionic and covalent bonds ? 8+8+4  
b) What are the Miller indices of a plane that intersects the x-axis at 2 and Y axis at  $\frac{1}{2}$  and is parallel to the Z-axis ? The structure is cubic.  
c) Calculate the no. of atoms in the unit cell of a B.C.C. crystal.
2. a) Explain the difference between slipping and twinning. 6+6+8  
b) How does an annealing twin form in a F.C.C. crystal ?  
c) Explain with the help of a schematic diagrams the difference between edge and screw dislocations.
3. a) Define eutectic, peritectic and eutectoid reactions. 6+6+8  
b) Draw the phase diagram of a binary alloy of components A&B which are fully soluble in the liquid state but undergo an eutectic reaction during solidification. Also, the resultant phases show terminal solid solubility which decreases with decrease in temperature.
4. a) Briefly cite difference between recovery and recrystallisation processes. 10+10  
b) Explain the effect of cold working on the kinetics of isothermal recrystallisation.
5. a) Discuss the characteristics of ductile and brittle fractures. 6+6+8  
b) What do you mean by ductile to brittle transition ? How does it occur ?  
c) Write a brief note on Griffith theory of brittle fracture.
6. a) Differentiate between polymorphism and isomerism. 6+6+8  
b) Explain the difference between thermoplastic and thermosetting polymers.

- c) Cite the difference between addition and condensation polymerisation techniques.
7. a) What is the difference between glass transition temperature and melting temperature ? 10+10
- b) Explain with schematic sketches the structure of silica and silicates.
8. Write short notes on any four of the following : 4x5=20
- a) Fibre reinforced composites.
- b) Lever rule
- c) Stress strain diagram of mild steel
- d) Interstitial and substitutional solid solutions.
- e) Branched and cross linked polymers
- f) Fracture toughness

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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) Explain the purpose of using cores in casting. With the help of neat sketches explain different types of cores. 6
- (b) Make a neat sketch of a cupola and explain its relevant constructional features. 7
- (c) Explain with suitable figures how "Shell Molding" can be used to produce intricate shaped objects. 7
2. (a) State the differences between forward and backward extrusion processes. 5
- (b) Sketch different types of Rolling mills used in industries. 5
- (c) What do you mean by spring back ? How it is taken care of in sheet metal operations ? 5
- (d) Explain various manual forging operations. 5
3. (a) Explain Generalized Taylor's tool life equation. How the index 'n' of the equation can be determined experimentally. 6
- (b) Show with the help of a neat diagram the different types of wear occurring on a SPTT. 5
- (c) Explain the mechanism of action of cutting fluids in machining. 5
- (d) State the physical significance of "Chip reduction Coeff" 4
4. (a) What are the heat sources in machining and what are their effects ? 6
- (b) Explain the term "Machinability" 4
- (c) Explain the mechanism of chip formation in machining. 4
- (d) Explain with suitable sketches different taper turning methods performed in a Lathe. 6

- |        |  |        |
|--------|--|--------|
| 5. (a) | What do you mean by limit gauges. explain 'GO' gauge and 'NP GO' gauge.  | 4      |
| (b)    | Differentiate between 'tolerance' and 'allowance'.   | 3      |
| (c)    | Explain the difference between roughness and waviness of a surface. How surface roughness is measured in a laboratory. | 9      |
| (d)    | State the major features of optical comparator.  | 4      |
| 6. (a) | Explain the significance of Economic order quantity.   | 5      |
| (b)    | Explain why method study should precede time study.  | 5      |
| (c)    | What are the different costs involves in inventory ? Explain the term "Inventory Procurement Cost"                     | 6      |
| (d)    | Explain the role of dummy activity in a network.   | 4      |
| 7. (a) | Differentiate between welding, cladding and coating.   | 5      |
| (b)    | Explain how the process of case carburizing is accomplished.   | 7      |
| (c)    | State the differences between cyaniding and nitriding.   | 4      |
| (d)    | State some applications of PVD & CVD processes.  | 4      |
| 8.     | Write short notes on (any four)  | 4x5=20 |
| a)     | Gear hobbing   |        |
| b)     | Radial Drilling Machine  |        |
| c)     | Pattern allowances   |        |
| d)     | Riser design   |        |
| e)     | Punching and Blanking  |        |
| f)     | Gantt Chart  |        |



# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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. If  $A = \begin{pmatrix} 0 & 1 & 2 \\ 2 & 0 & 1 \\ 1 & 2 & 0 \end{pmatrix}$ , solve that  $A^3 - 6A - 9I_3 = 0$  10

Hence obtain  $\alpha$  matrix B such that  $BA = I_3$ .

b. Prove without expanding 5+5=10

i) 
$$\begin{vmatrix} b-c & c-a & a-b \\ c-a & a-b & b-c \\ a-b & b-c & c-a \end{vmatrix} = 0$$

ii) 
$$\begin{vmatrix} 1 & 1 & 1 & 1 \\ a & b & c & d \\ b & c & d & a \\ c+d & d+a & a+b & b+c \end{vmatrix} = 0$$

2. a. If  $u = \cos^{-1} \left\{ \frac{x+y}{\sqrt{x}+\sqrt{y}} \right\}$  then prove that 10

$$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + \frac{1}{2} \cot u = 0$$

b. Find the maxima and minima of the function  $x^3 + y^3 - 3x - 12y + 20$ . Find also the saddle points 10

3. a. Prove that 8+2=10

$$B(m, n) = 2 \int_0^{\pi/2} \sin^{2m-1} \theta \cos^{2n-1} \theta d\theta$$

Where  $m, n > 0$ . Hence obtain  $B\left(\frac{1}{2}, \frac{1}{2}\right) = \pi$

b. Verify Lagrange's mean value theorem for the following function : 10

$$f(x) = x(x-1)(x-2), 0 \leq x \leq \frac{1}{2}$$

4 a. Discuss the convergence of the series 10  
 $1 + \frac{2^p}{2!} + \frac{3^p}{3!} + \frac{4^p}{4!} + \dots$  ( $p > 0$ )

b. Determine the radius of convergence of the power series 10  
 $x + \frac{2^2 x^2}{2!} + \frac{3^3 x^3}{3!} + \dots$

5 a. Solve  $(1+x) \cos y \frac{dy}{dx} - \sin y = (1+x)^2 e^x$  10

b. Apply the method of variation of parameters to solve 10  
 $\frac{d^2 y}{dx^2} + y = \sec x$

6 a. Find the Fourier series expansion for  $f(x)$  where 10

$$f(x) = \begin{cases} -\Pi, & -\Pi < x < 0 \\ x, & 0 < x < \Pi \end{cases}$$

and hence deduce that

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \text{ to } \infty = \frac{\Pi^2}{8}$$

b.  $f(x) = \begin{cases} \frac{1}{4} - x, & 0 < x \leq \frac{1}{2} \\ x - \frac{3}{4}, & \frac{1}{2} < x < 1 \end{cases}$  10

Find half range Fourier sine series of  $f(x)$

7 a. Solve (by the method of separation of variables): 10

$$\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u, \text{ where } u(x, 0) = 6e^{-3x}$$

b. Solve the equation  $\frac{\partial^2 u}{\partial t^2} = 4 \frac{\partial^2 u}{\partial x^2}$  10

given  $u(0, t) = u(5, t) = 0, u(x, 0) = 0$  and

$$\left( \frac{\partial u}{\partial t} \right)_{t=0} = 5 \sin \Pi x$$

8 a. Evaluate  $\int_0^a \int_0^{\sqrt{a^2-y^2}} (x^2+y^2) dx dy$  changing to polar co-ordinates. 10

b. Examine the convergence of 5+5=10

i)  $\int_0^{\infty} \frac{\partial x}{x\sqrt{1+x^2}}$

ii)  $\int_0^1 \frac{\log x}{\sqrt{x}} dx$

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Welding Metallurgy - I (AME - 13, B-16 (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) Draw the sketches of the following showing the positions of atoms in each case : 6  
i) Body central cubic lattice    ii) Face central cubic lattice  
iii) Hexagonal close packed lattice
- b) What are substitutional and interstitial solid solutions ? Show the positions of solute and solvent atoms in each case through sketches. 6
- c) What is an isomorphous system ? Give one example of such a binary alloy system. 3
- d) Draw the phase diagram for cooper - nickel binary system. Mark the melting points and the various phase fields. 5
2. a) Explain the following heat treatment processes for a hypo-eutectoid steel 12  
i) Full annealing ii) Stress relief annealing  
iii) Re-crystallization annealing  
Draw only the relevant portion of the Fe-C diagram and mark the temperatures for the above mentioned heat treatments.
- b) What is the carbon content of the eutectoid steel ? Draw the schematic micro-structure of slowly cooled eutectoid steel and label the phases present. 4
- c) On which element does the hardness of martensite primarily depend ? Why usually a tempering heat treatment is given to martensitic structure. 4
3. a) Draw the Time - Temperature - Transformation diagram of eutectoid steel, clearly indicating the fields of coarse and fine pearlitic transformations, bainitic and martensitic transformations. Why quenching in water is required to obtain martensite in plain carbon steels ?” 12
- b) Write the expansion of HAZ. Draw the sketch of a cross section of welded plate showing the locations of the weld, HAZ and unaffected base metal. “Higher the heat input,

- greater will be the width of the HAZ” - is the statement true or false. The peak temperature in the HAZ will be high near the fusion line or away from it ?
- 4 a) What are eutectic, eutectoid and peritectic reactions in a binary alloy system ? Explain. 8
  - b) Draw the Fe - Fe<sub>3</sub>C diagram showing all the phase transformations. Identify the eutectic, eutectoid and peritectic reactions in this diagram mentioning the phase changes that occur in these reactions. 12
  - 5 a) Write the expansions of TTT and CCT diagrams. Which one relates to isothermal transformation ? What are the uses of these diagrams ? Which of the two diagrams is more relevant to predicting or explaining weldment microstructure. 8
  - b) Explain the phenomenon of work hardening. What are the three stages of annealing of a cold worked alloy ? Explain the effect of annealing on the microstructure and mechanical properties of a cold worked alloy. 12
  - 6 a) Show schematically the temperature fields around the moving arc in a single pass welding. 10
  - b) What do you understand by the term “heat in welding” ? Write the expression heat input in arc welding with units of each parameter. 5
  - c) Estimate the heat input for a weld made at a speed of 12cm/min with arc voltage of 12 volts and current of 120 amperes. 5
  - 7 Write short notes on the following : (any four) 4x5
    - a) Hardenability in steel.
    - b) Carbon equivalent and weldability.
    - c) Nucleation and growth of pearlite in steel.
    - d) Pre-heating in welding.
    - e) Precipitation hardening with example of any precipitation hardenable alloy.
    - f) Micro alloyed steels.
  - 8 a) What are killed, semi-killed and rimmed steels ? What is getting killed ? Explain the phenomenon of killing in steel making, mentioning the elements used to kill. 10
  - b) Show schematically through a neat sketch the grain structure of a large solidified ingot of square cross section. Explain the grain structure formed in different zones starting from the outer layer to the centre of the ingot. 10

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

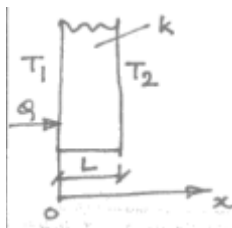
Time : 3 Hours

Pass Marks : 40

Answer any Five questions

Parts of a questions should be answered at one place

1. a. In the plane slab shown in the figure the thickness is  $L$ , temperatures at the two focus are constant and uniform, i.e.  $T=T_1$ , at  $x=0$  and  $T=T_2$  at  $X=L$ .



Determine the expression for temperature distribution within the shall and, also, fund the expression for heat flux.

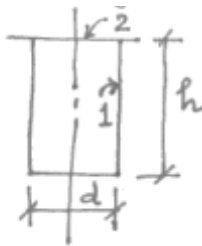
- b. Determine the steady state heat transfer through a double pane window, 0.8 m high, 1.5 m wide, consisting of two 4 mm thick glass layers ( $k=0.78 \text{ W/m}^2\text{C}$ ), separated by a 10 mm thick stagnant layer of air ( $k=0.026 \text{ W/m}^2\text{C}$ ). Inside temperature of room air is maintained at  $20^\circ\text{C}$  with a convective heat transfer coefficient of  $h_i = 10 \text{ W/m}^2\text{C}$ . Outside air temperature is  $-10^\circ\text{C}$  and the convective heat transfer coefficient on the outside is  $h_o = 40 \text{ W/m}^2\text{C}$ . Also determine the overall heat transfer coefficient.
- c. Write down the physical significance of thermal diffusivity.
2. a. Determine an expression of critical radius of insolutaion for a cylindrical system.
- b. Aluminium square fins (0.5 mm x 0.5 mm) of 1 cm length are provided at the surface of an electronic semiconductor device to carry 46 mW of energy generated by the electronic device and the temperature at the surface of the device should not exceed  $80^\circ\text{C}$ . The temperature of the surrounding medium is  $40^\circ\text{C}$ . Thermal conductivity of aluminium =  $190 \text{ W/m}^2\text{C}$  and the heat transfer coefficient  $h = 12.5 \text{ W/m}^2 \text{ }^\circ\text{C}$ / Find number of fins required to carry out the above duty. Neglect the heat loss from the end of the fin.

3. a. Define fin effectiveness 2+3  
 Find an expression of effectiveness for an infinitely long fin.
- b. A carbon steel (AISI 1010) shaft of 0.2 m diameter is heat treated in a gas fired furnace whose gases are at 1200 K and provide a convection coefficient of 80 W/m<sup>2</sup>C. If the shaft enters the furnace at 300K, how long must it remain in the furnace to achieve a centreline temperature of 900K ? Given thermophysical properties of AISI 1010 carbon steel :  $\rho = 7854 \text{ kg/m}^3$ ,  $k = 48.8 \text{ W/m}^\circ\text{C}$ ,  $C_p = 559 \text{ J/kgK}$ . 10
- c. Briefly discuss the physical significance of Biot number and Fourier number. 5
4. a. With neat sketches briefly explain the formation of velocity boundary layer and thermal boundary layer over a flat plate. 10
- b. Air at 35°C flows across a cylinder of 50 mm diameter at a velocity of 50 m/s. The cylinder surface is maintained at 145°C. Find the heat loss per unit length. Properties at mean temperature of 90°C are :  $\rho = 1 \text{ kg/m}^3$ ,  $\mu = 20 \times 10^{-6} \text{ kg/ms}$ ,  $k = 0.0312 \text{ W/m}^\circ\text{C}$ ,  $C_p = 1 \text{ kJ / kg}^\circ\text{C}$ . 10  
 Use the relation :  

$$\text{Nu}_D = 0.027 \text{ Re}_D$$
5. a. With the help of dimensional analysis show that in case of forced convection the Nusselt number is a function of the Reynolds number and the Prandtl number. 10
- b. A furnace door, 1.5m high and 1m wide, is insulated from inside and has an outer surface temperature of 70°C. If the surrounding ambient air is at 30°C, Calculate the steady state heat loss from the door. 10  
 Properties of air at 50°C :  
 $\rho = 1.093 \text{ kg / m}^3$ ,  $\nu = 17.95 \times 10^{-6} \text{ m}^2/\text{s}$ ,  $\text{Pr} = 0.698$ ,  $k = 0.028 \text{ W/m}^\circ\text{C}$  and  $C_p = 1.005 \text{ kJ / KgK}$ .  
 Use the relation :  

$$\text{Nu} = 0.13 \text{ R}^{0.33}$$
6. a. Derive an expression of effectiveness of a counterflow heat exchanger in terms of capacity ratio and NTU. 10

- b. A shell and tube counterflow heat exchanger uses copper tubes ( $k=380 \text{ W/m}^\circ\text{C}$ ), 20 mm ID and 23 mm OD. Inside and outside film coefficients are 5000 and 1500  $\text{N/m}^2 \text{ }^\circ\text{C}$ , respectively. Fouling factors in the inside and outside may be taken as 0.0004 and 0.001  $\text{m}^2\text{ }^\circ\text{C/W}$ , respectively. Calculate the overall heat transfer coefficient based on :  
i) Outside surface, and ii) Inside surface. 10
7. a. Briefly explain Kirchhoff's law of radiation. 3  
b. Define view factor. 2+2  
What do you mean by "reciprocity relation" between two surfaces ?  
c. For a cylindrical cavity of diameter 'd' and depth 'h'm, as shown in the figure, find the view factor of surface 1 with itself ( $F_{11}$ ) in terms of d and h. 10  
d. Define intensity of radiation for a black body. Write down the relation between emissive power and intensity of radiation for black surface. 2+1



8. Write short notes on (any Four) 5x4  
a. Heisler charts  
b. Response time of a thermocouple  
c. Planck's law of radiation  
d. Fully developed flow through a pipe  
e. Compactness of a heat exchanger

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Question No.1 is compulsory. Answer any four questions from the rest of the questions (Q2 - Q8).

All the question carry equal marks

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

1. Explain following processes : 4x5
  - a) Forge welding b) Soldering & Brazing
  - c) Adhesive bonding d) Weld surfacing
  - e) Submerged arc welding
  
2.
  - a) Explain when preheating is essential in the fusion welding of carbon steels. Give two suitable examples. 5
  - b) Explain why the presence of moisture in any form should be avoided when welding of low-alloy steels is done using SMAW. 5
  - c) Write the mechanisms through which free electrons are emitted during arc welding process 5
  - d) Give the principle, procedure and application of flux cored arc welding 5
  
3. Describe with the aid of sketches, what effect each of the following would have on the depth of root penetration and the quality of the deposited metal :
  - a) The use of too high current value 5
  - b) Incorrect slope angle of electrode 5
  - c) Too fast speed of travel 5
  - d) Incorrect arc length 5
  
4.
  - a) What is meant by : 5x2
    - i) Deep penetration coated electrode
    - ii) Non consumable electrode
  - b) Explain possible causes and remedies of each of the following, when MIG welding butt joint in mild steel. 5x2
    - i) Excessive penetration
    - ii) Incomplete penetration



- |    |    |   |     |
|----|----|---|-----|
| 5. | a) | What type of power supply unit may be used in TIG Welding ?   | 5   |
|    | b) | What is the use of H.F. unit in TIG welding process ?   | 5   |
|    | c) | What determines whether an air-cooled or water cooled torch is to be used with TIG welding ?  | 5   |
|    | d) | What is an inert gas ? List three inert gases and their applications.   | 5   |
| 6. | a) | What is meant by gas backing in TIG welding ?   | 5   |
|    | b) | Explain the principle of oxygen cutting.  | 5   |
|    | c) | In inert gas shielded arc welding would it be preferable to use A.C. or D.C. ?<br>Give reasons in support of your answer                      | 5   |
|    | d) | Explain briefly the various methods of welding high carbon steel.   | 5   |
| 7. |    | Describe briefly the principles of operation and give one suitable industrial application for all of the following welding processes.         | 4x5 |
|    | a) | Electroslag   |     |
|    | b) | Electric resistance flash butt  |     |
|    | c) | MIG   |     |
|    | d) | Arc stud  |     |
|    |    | Friction  |     |
| 8. | a) | State difficulties which may be encountered while welding dissimilar metals with manual metal arc welding                                     | 5   |
|    | b) | Explain stepwise procedure of D.C. Carbon arc welding.  | 5   |
|    | c) | What is arc blow ? Write causes of arc blow and suggest remedial measures.  | 5   |
|    | d) | Explain the term power density. Write effect of power density on Heat Input and explain the need of optimum power density of welding process. | 5   |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer questions no.1 compulsory and any four questions from the rest  
Parts of a questions should be answered at one place**

1. Fill in the blank with appropriate word from words given under bracket : (any ten) 2x10
  - a. In perfect competition the seller is \_\_\_\_\_ (price maker / price taker / price checker)
  - b. If there is single buyer it is called \_\_\_\_\_ (monopoly / monopsony / oligopoly)
  - c. In short period the supply is \_\_\_\_\_ (elastic / inelastic / non elastic)
  - d. Output is a \_\_\_\_\_ variable. (Dependent / independent / finished)
  - e. Shape of isoquant curve is \_\_\_\_\_ (convex from below / paved by axis / indifference)
  - f. Technical economics are a part of \_\_\_\_\_ economics. (internal / external / marginal)
  - g. All cost paid in terms of money are \_\_\_\_\_ cost. (Explicit / implicit / marginal)
  - h. A high p/v ratio indicates \_\_\_\_\_ of fixed expenses. (faster recovery / slower recovery / constant recovery)
  - i. There is \_\_\_\_\_ relationship between cost and profit. (direct / indirect / inverse)
  - j. Cash account always shows \_\_\_\_\_ balance. (debit / credit / nil)
  - k. Return inward books has \_\_\_\_\_ balance. (debit / credit / nil)
  - l. Payment of salary to an employee will \_\_\_\_\_ cash book. (debit / credit)
  
2.
  - a. Managerial Economics is a multi dimensional discipline, Explain. 10
  - b. State the general principle of consumer equilibrium and consumers preference theory. 10

3. a. Explain different types of elasticity with the help of suitable diagram. 10
- b. As a result of 5% fall in the price of a good its demand rises by 12%. Find out price elasticity of demand and say whether demand is elastic or inelastic and why? 10
4. a. Describe the factors determining the working capital. Differentiate between a Fixed capital and Working capital. 10
- b. What is payback period? Calculate payback period for a project, cost Rs.5 lacs and yields and annual cash inflow of Rs.1 lac for 9 years. 10
5. a. Describe briefly the factors affecting demand forecasting. 10
- b. Differentiate between returns to average factor and return to scale. 10
6. a. Define cost. Differentiate between fixed cost and variable cost. 6
- b. LED Engineering is operating at 70% capacity and present the following information : 14
- BEP = Rs.200 crore PV ratio = 40% Margin of safety = 50 crore  
 LED Management has decided to increase production to 90% capacity level with the following modification.
- i) The selling price will be reduced by 8%  
 ii) The fixed cost will increase by Rs.20 crore. What will be revised?  
 iii) PV ratio  
 iv) BEP
7. a. What is business finance? How many types of business finance are consumed by the Industries? 10
- b. Describe the use of fixed capital and working capital with suitable example. 10
8. Write short notes on (any ten) 2x10
- a) Current Liabilities                      b) Redeemable Preference share  
 c) Naked Debentures                      d) Floating Assets  
 e) Duopoly                                      f) Free entry and exit  
 g) Shut down cost                          g) Marginal cost  
 h) Isoquant                                      i) Average physical product  
 j) Price control and rationing by Govt. of India.

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Computational Methods &

Computer Programming (AME - 17, C-18 (R))

Full Marks : 100

Time : 3 Hours

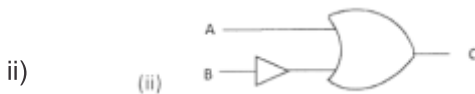
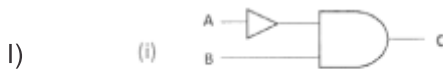
Pass Marks : 40

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

1. Answer all

6x5=30

- Find octal and hexadecimal equivalents of  $(153)_{10}$ ?
- Find the truth table for the following logic circuits ?



- Explain the memory hierarchy in computer system ?
  - Differentiate between compiler and assembler ? Give an example to each.
  - Find whether the following variables are valid or not ? Give reason if they are invalid.  
i) Row total ii) avg\_num iii) char iv) Price\$ v) int\_type
  - Differentiate between structure and union with an example.
2. a) Convert the following 10
- $(46687)_{10}$  to Hexadecimal
  - $(87.5)_{10}$  to Binary
  - $(2C6B.F06)_{16}$  to binary
  - $(127.4)_8$  to decimal
- b) Write short notes on ASCII. 4
3. a. Explain binary addition, subtraction, multiplication and division with an examples. 10
- b. Write a C program to reverse the given string. 4
4. a. Distinguish between DOS and WINDOWS operating system. 4
- b. Write a C program to multiply two matrices. 10

- 5. a. Distinguish between iteration and recursion ? 4
- b. Explain the differences between iterative structures for loop, while and do-while with simple example ? 10
- 6. a. Write a C program to arrange a set of integers in descending order using an array ? 7
- b. Write a C program to print Fibonacci series ? 7
- 7. a. Define 'function' in C ? Distinguish between 'function prototype' and 'function call'? 4
- b. Write a C program to swap two numbers that demonstrates both call by value and call by reference mechanism ? 10
- 8. a. What is the function of preprocessor and list various Preprocessor directives in C ? 4
- b. Write a c program that finds n! using the concept of recursion? 10
- 9. Write short notes on any four from the following :
  - a. Binary coded decimal system
  - b. NAND and NOR gates
  - c. UPS
  - d. UNIX operating system
  - e. Continue and brak statements in C
  - f) File I/O in C

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Weldment Design & Weld Procedure

(AME - 18, C-23 (R))

Full Marks : 100

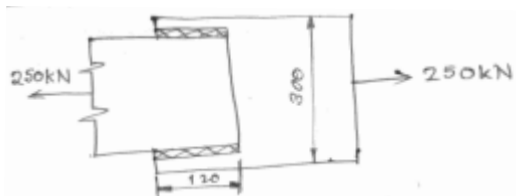
Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

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

1. a. Briefly discuss about the requirement of joint preparation during welded joint fabrication mentioning different joint preparation techniques. 3+8=11  
b. Give sketches of lap, T and edge joints. Also show standard symbols of them. 3x3=9
2. a. What do you mean by weldability ? 2  
b. Discuss about weldability of a medium carbon steel plate with a low carbon steel electrode. 4  
c. What is the significance of endurance limit in design ? 4+4  
Draw a sketch of stress number vs loading cycle relation ship to determine endurance limit.  
d. With a diagram, show 2G, 3G, and 6G positions. 6
3. a. Find out the maximum shear stress induced in the 8mm fillet weld of the lap joint shown in Fig.1. Plates are 10 mm thick. Length of weld is 120 mm on either side. Given that tension load is 250 kN. 10  
b. If stresses on two prependicular plane through a point in a body are 40MPa and - 40 Mpa and shear stress in 30MPa fund out principal stresses and maximum shear stress using a Mohr's circle 10



- |    |    |   |        |
|----|----|---|--------|
| 4. | a. | What is shrinkage ? How can it be controlled ?  | 5      |
|    | b. | Discuss about some cases where distortion can be eliminated by some means.  | 8      |
|    | c. | Planing is done to transform tensile residual stress to compressive residual stress - justify with reasons.         | 3      |
|    | d. | Write a short note on HAZ.  | 4      |
| 5. | a. | In WPS, explain the significance of essential and non-essential variables.  | 5      |
|    | b. | What are 'P', 'F' and 'A' numbers in WPS ? Give examples.   | 6      |
|    | c. | Compare WPS WPQ.  | 4      |
|    | d. | State the Welding Procedure for SAW Process briefly.  | 5      |
| 6. | a. | Discuss the difficulty of welding aluminum components. State the remedy possible.                                   | 8      |
|    | b. | Preheating may be used for flawless welding of stainless steel pieces - justify.                                    | 4      |
|    | c. | Why does arc welding of C.I. require some special electrode for an acceptable weld ?                                | 4      |
|    | d. | Comment on choice of current type during arc welding of different non-ferrous components.                           | 4      |
| 7. | a. | Discuss briefly about the standard qualification tests of welded joints of pressure vessels as per ASME Section IX. | 10     |
|    | b. | Outline salient points to assess quality of a welder for ASME Section IX.   | 6      |
|    | c. | List different weld cladding techniques.  | 4      |
| 8. | a. | Write short notes on any four the following.  | 4x5=20 |
|    |    | i) Hard facing  |        |
|    |    | ii) F and P numbers of ASME section IX  |        |
|    |    | iii) C.I. Welding   |        |
|    |    | iv) Wear Plate  |        |
|    |    | v) Creep  |        |
|    |    | vi) Choice of electrode in SMAW   |        |
|    |    | vii) Basicity of flux.  |        |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Total number of question 13 nos. answer any 10 questions

Parts of a question should be answered at one place.

1. Define heat input & types of heat sources available for welding. Explain the effect of cooling rate of LBW & SAW. Explain the reason for formation of pores in weld metal during LBW. 10
2. Define defects and discontinuity. All defects are discontinuity but all discontinuities are not defects ? Explain, name the different discontinuity and explain Cracks including their types, causes are remedies. 10
3. Explain the functional differences between Schaeffer and De Ionjg diagrams. What is relevance of these diagrams for welding of stainless steel ? 10
4. Define weldability and explain the weldability issues of cast iron. 10
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. tensile and bend Testing 5x2=10  
b. Explain the Effects of distortion and residual stresses introduced into a structure by and during welding.
7. a. Define shielding; explain its role, types of shielding & importance of pre flow and post flow in welding. 5x2=10  
b. Define corrosion and its types explain the preferential weld corrosion.
8. a. Define CE and explain the weldability issues of carbon steels. 5x2=10  
b. 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. ?
9. a. Explain the function of Electrodes coating and types associate with SMAW Process. 10  
b. Define weldability and types of weldability tests & its relevance. Explain Vareststraint test.



10. Explain the role of the thermal properties on welding of carbon steel, stainless steel, Aluminum and Copper material 10
11. Name the challenges posed to joining the dissimilar metals and alloys with relevant examples. 10
12. Explain the fundamental differences between welding, brazing and soldering process. 10
13. Explain the important weldability issue of non ferrous materials. 10

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any 5 question**

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

1. a. Explain with sketches vertical up and vertical down welding techniques used in pipe line welding mentioning the specific advantages and disadvantages of each. 6
- b. Draw a sketch to show the Joint preparation for Vertical Down Process and mention the current, voltage, bead type, number of passes, type of electrode and diameter, polarity to be used for a pipe wall thickness of 9.5 mm. 8
- c. Explain the techniques and precautions to be practiced especially in Root Pass Welding for the pipe of wall thickness 9.5 mm. 8
2. a. Draw neat sketches to show the following joints with 300 mm diameter pipes with edge preparation, dimensional details and sequence of welding operations. 8
  - i. Tee Joint
  - ii) V Joint
  - iii. X Joint and
  - iv) K Joint
- b. A Boiler Shell of 1200mm Diameter and 2000 mm length without Dished Ends has to be fabricated from 12 x 800 x 1200 mm plates. 12
  - i. State the cutting dimensions of plates, process of cutting, process for shell formation and joints configuration.
  - ii. Draw sketches to show the joint with dimensional details and process to prepare the weld edges.
  - iii. Calculate the volume of metal deposition required to weld the Shell.
3. a. Name and explain the Hazards associated with Welding Process and Operation. 6
- b. What is PPE ? Why are PPE used ? State the different PPE in use in welding and the hazards for which these are used ? 8
- c. State the different Shade Numbers of Coloured / Tinted Glasses in use in Welding and Gas cutting with specific uses of each. 6

4. a. Explain the term “Engineering Critical Assessment”. State its critical applications. What are the standards of ECA in API and British Standard ? What are the benefits of ECA ? 12
- b. What are weld imperfections ? Explain why every weld imperfection produced in a weld has to be treated as a threat to its function with specific reference to the term Fitness for purpose. 8
5. Answer briefly all the following questions “ 20
- a. What is the difference between a flaw and a defect ?
- b. What does an ultrasonic test of a weld reveal ?
- c. What is the purpose of a penetrometer ?
- d. List the three types of bend tests.
- e. List the three mechanical values of a weld determined by tensile tests
- f. Why should all rejected welds be thoroughly reviewed before attempting a repair ?
- g. List three conditions that require dimensional repair.
- h. What should be avoided when grinding out undercut defects?
- i. What type of defects located in the body of a weld are very hard to locate using grinding or routing ?
- j. What should be done when making a deep weld repair to confirm that new cracks have not formed ?
6. a. Calculate the volume of filler metal required to produce a fillet weld of 6 mm leg length for a 3m long weld, and then the number of 4 mm x 450 mm stick electrodes required for the job. Assume a stub length of 40 mm. 8
- b. Calculate the cost welding for a length of 3.0 m weld 1/8 in. (3.2 mm) fillet weld in low carbon mild steel-Mig short arc. 12
- Given :
- Labor rate - INR, 50.00/hr & overhead INR.100.000/hr
- Arc travel speed (0.045 in.wire) 27 inches per minute (68.58 cm/min),
- Operating duty cycle - 60%
- Pounds of weld metal required per foot - 03 lbs. (0.44 kg/m)
- Deposition efficiency - 95% -
- Wire price (INR>200.00/kg)
- C-25 gas flow rate - 35 cf/h (991 l/hr)
- C-25 gas cost per cubic foot - INR.55.00

7. Answer all the questions.

20

- a. Explain with neat sketches different types of Pressure vessels in use.
- b. Name different parts of a Pressure vessel and their functions.
- c. Explain with sketches different types of supports used in a Pressure vessel.
- d. Draw sketches to show different types of Heads used in Pressure Vessels.

8. Write short notes (any four)

4x5

- a. Cladding of Pressure Vessel.
- b. Hot Spot Stress.
- c. Return on Investment
- d. Weldability
- e. OSHA

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Welding & Allied Processes - II

(AME - 22, C-22(R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

## Answer any five questions in total from Eight given

First read the paper completely to decide the question you wish to attempt and then start answering. Choose what you know best.

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

Be brief and precise in your answer with reference to the marks  
Make use of sketches to explain the features instead of words.  
Irrelevant & lengthy answers will be given directly zero marks.

1. a. Write short notes with sketches to explain any four of following, focusing on specific features of process and their purpose/advantage for welding in their main field of application. 4x5
  - a. Ultrasonic Welding
  - b. Electron Beam Welding
  - c. Electrode Gas Welding
  - d. CD Stud Welding
  - e. Laser Welding
  - f. Explosive Welding
  
2. a. Explain with sketches the basic difference between two Resistance Projection processes - Embossed Sheet Projection Welding and Solid Projection Welding - natural like cross wire or machined like ring 4
- b. Explain with sketches the difference between Seam Welding and Roll spot welding using the same machine set up. 4
- c. Explain why and for which applications(s) and/or materials the Roill Spot welding process is required and used ? 3
- d. Briefly describe with sketches the three seam welding methods : a) Mash Seam Welding b) Foil Butt Seam Welding c) Narrow Track Seam Welding. 9
  
3. a. Explain with the help of sketches / block diagram the essential parts of the GMAW welding set up. 6
- b. Name the auxillary equipment used. Explain their function to show where actions are oriented. 4
- c. In GMAW, what part/unit of MIG & MAG set up is different ? Why ? 2
- d. What is Cast and Helix as applicable to GMAW consumables? 4
- e. What is the main reason the Carbon Steel Wires are essentially Copper coated. 4

- |    |    |  |   |
|----|----|--|---|
| 4. | a. | Where and Why the Sub-Arc Welding process is advantages?   | 2 |
|    | b. | Using modern Technology, Adoption and Techniques what is the highest deposition rate of surfacing possible ?   | 2 |
|    | c. | Explain with sketches the mechanism of ESSC process  | 8 |
|    | d. | What techniques are used in SAW to get higher deposition rates ?   | 6 |
|    | e. | Almost every household uses a Sub-Arc Welded product daily - Which ?   | 2 |
| 5. | a. | Explain with sketch(es) the essential features of 'Gas Cutting' equipment.   | 4 |
|    | b. | Give the list of three consumables in the Oxy-Acetylene Gas Cutting process and explain how they react and do the 'cutting' operation.                       | 3 |
|    | c. | Why Acetylene Gas is preferred for use in welding ? What are the substitute gases which can be used in lieu of Acetylene while cutting ?                     | 2 |
|    | d. | Explain the Sequence of operation during flame generation (getting torch on) and then putting it off (torch off) and reasons to do so.                       | 3 |
|    | e. | Though not practiced it is said that "Once the cutting process starts oxyacetylene flame can be switched of." Why ?  | 2 |
|    | f. | Can Stainless Steel plates be cut by gas cutting ? - Yes or No? Why ?  | 2 |
|    | g. | Which cutting process is applicable to a variety of materials ? Why ?  | 2 |
|    | h. | Which cutting process gives a metallurgically cleanest cut ? Why ?   | 2 |
| 6. | a. | What is the main difference between Welding Brazing & Soldering ?  | 3 |
|    | b. | Is the use of flux essential in Brazing and Soldering ? Why ?  | 2 |
|    | c. | Explain why and how the brazed joint exhibits higher load carrying capacity, when the filler metal is not as strong as the material of two parts it joints ? | 4 |
|    | d. | What is Braze-Welding ? Where it is used ?   | 3 |
|    | e. | Name a more than 100 yrs old common product of daily use manufactured using Dip-Brazing process.   | 2 |
|    | f. | Describe with sketches three different brazed product you know.  | 6 |

- |    |    |   |    |
|----|----|---|----|
| 7. | a. | What type of metallurgical joint is generated by FW and FSW processes and why ?   | 2  |
|    | b. | Explain with sketches the Friction and Friction Stir Welding processes and the mechanism of joint formation and show the difference between Friction Welding and Friction Stir Welding processes. | 10 |
|    | c. | Name the industries where these two processes are used and describe two products each which are made by these two processes.  | 8  |
| 8. | a. | What is Squeeze Time in R W and why it is important for Welding ?   | 2  |
|    | b. | Explain with sketches the resistance Spot Welding process.  | 6  |
|    | c. | To reduce the unwanted heat generation in the electrodes. Pure Copper should be use, but instead Copper Alloys are used. Why ?  | 2  |
|    | d. | Explain briefly with sketch the flash Butt Welding process and the mechanism of joint formation. What type of weld it is metallurgically ?  | 8  |
|    | e. | A Flash Butt Welded product forms an economic life line of the nations world wide. Name that product.   | 2  |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Welding Equipment and Consumables (AME - 23)

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

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

## Group A :

### Welding Equipment Consumables

1. Write a short notes to explain any two of the following welding processes essentially covering. 2+2=4
  - a. What is the unique feature of the process ?
  - b. Sketches / Block diagram of the essential parts of the set up required for welding >5 marks. 5+5=10
  - c. Brief cost benefit analysis & field of applications >3 marks. 3+3=6
    - i. Submerged Arc Welding
    - ii. Manual Metal Arc Welding
    - iii. Flux Cored Arc Welding
    - iv. Gas Metal Arc Welding
2. Explain with sketches (where required)
  - a. Principles of GTAW process 5
  - b. Equipment and accessories required for GTAW process. Name the current and polarity to be chosen. 5
  - c. Name the shielding gases used in GTAW process. mention the types of tungsten electrodes used and their colour codes. 10
3.
  - a. Name the basic principles of resistance welding. Describe the types of resistance welding. 8
  - b. Describe the applications of spot welding in industries. 6
  - c. Mention the types of wear in industries. Describe the alloys that resist frictional wear 6
4. Write short notes with sketches where required on any four : 4x5=20
  - a. Why cleaning is needed after brazing ?
  - b. Name the inert and active gases being used for shielding of weld pool in GMAW process.



- c. What is brazing ? How it differs from soldering ? What is MIG brazing.
- d. Explain the safety to be adopted in oxy-fuel. How it can be prevented ?
- e. Why stainless steel and aluminium cannot be cut by oxy-fuel cutting ? Name the alternative method by which they can be cut.
- f. What are cold cracks ? How does it occur and how you can prevent it ?

**Group B :**

**Welding Consumables**

- |    |   |        |
|----|---|--------|
| 1. | Write short notes - any four  | 4x5=20 |
|    | a. Where tubular wires are used ? What are the flux constituents of above tubular wire ?  |        |
|    | b. What is lamellar tearing ? Where do they occur ?   |        |
|    | c. What is weldability ? give the empirical formula for weldability in carbon steel.  |        |
|    | d. What do you mean by diffusible hydrogen ? Mention different permissible diffusible hydrogen levels during welding of carbon steel materials. |        |
|    | e. In carbon steel materials when and under what conditions stress relieving is required ? Describe the cycle of stress relieving.              |        |
|    | f. What is AWS classification of carbon steel MIG Wires. Describe in details.   |        |
| 2. | a. What is the difference between surfacing and hard facing ?   | 6      |
|    | b. What are rutile coated electrodes in MMAW process ? Are they baked before welding ? Give AWS classification for these electrodes.            | 3      |
|    | c. Name the welding positions where they are used.  | 3      |
|    | d. Mention the merits of these electrodes.  | 4      |
|    | e. Give the application of these electrodes in industries.  | 4      |
| 3. | a. Describe how aluminium and aluminium alloys are welded. Name the Power Source and inert gas being used.                                      | 5      |
|    | b. What difficulties are faced during aluminium welding ? How they are overcome ?   | 5      |
|    | c. Mention the properties of aluminium. How they affect welding ?   | 5      |
|    | d. For welding of carbon steel to low alloy steel materials which type of matching covered electrodes are preferred ?                           | 5      |

4. Decode in details as per AWS code of following classifications  $4 \times 5 = 20$  indicating type of consumables (e.g., electrode, wire / flux combination etc) and intended application areas (any four)
- a) E 80 18
  - b) E R70S-2
  - c) E 309-Mo
  - d) ER CuAl-A2
  - e) E304-L
  - f) F43A3-EM13K
  - g) ER-1100

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

Sub : Advanced Welding Technology

(AME - 24, C-24 (R))

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**All question carry equal marks**

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

- |    |    |  |    |
|----|----|--|----|
| 1. | a. | Differentiate between the mechanism of melting of powder based and wire based spraying processes. thus compare the two on the basis of quality and integrity of the sprayed surface coating. | 6  |
|    | b. | Explain various steps in surface preparation for spraying  | 7  |
|    | c. | Explain, with sketch, the plasma spraying process.   | 7  |
| 2. | a. | Differentiate between conventional friction welding and friction stir welding. Which of these is suitable for dissimilar metal joining and why ?   | 6  |
|    | b. | Name any other four solid phase welding processes and write 2-3 lines explaining the characteristics of these processes.   | 6  |
|    | c. | Explain the inertia friction welding process giving complete details of the process cycle.   | 8  |
| 3. | a. | What are the processes used for welding of titanium ? Give the special considerations during welding of Titanium and explain the precautions necessary.                                      | 10 |
|    | b. | Explain the different methods of joining ceramics to ceramic/metal.  | 10 |
| 4. | a. | What are the considerations to be taken during welding of stainless steel to mild steel. Discuss the problems encountered and explain how to choose suitable electrodes for welding.         | 10 |
|    | b. | Discuss the problems of joining Aluminium to Copper and explain the appropriate methods of joining this metal combination.   | 10 |
| 5. | a. | Which of the polymers are more adaptable to welding ? Give names of the main processes of welding plastics.  | 10 |
|    | b. | Explain extrusion-welding process for plastics. Show the set up with a sketch.   | 10 |

- |    |    |   |    |
|----|----|---|----|
| 6. | a. | Name different types of lasers used in welding. Also give the areas of application of these.  | 5  |
|    | b. | Give different methods of cladding. What are the areas of application of these methods ?  | 5  |
|    | c. | Explain, with sketch, the principle of explosive welding process.   | 5  |
|    | d. | Differentiate between transferred and non-transferred arc in case of plasma arc welding.  | 5  |
| 7. | a. | Which of the conventional welding processes are suitable for robotic welding ?<br>Explain why ? Give the areas of application of robotic welding. | 10 |
|    | b. | Give some application examples of automated welding where robots are not used. How is weld quality ensured in these processes ?                   | 10 |

# THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2016

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

Full Marks : 100

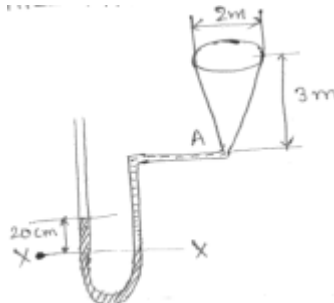
Time : 3 Hours

Pass Marks : 40

**Answer any five questions**

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

1. a. Explain variation of viscosity with temperature for liquids and gases. 5+5+10  
=20  
b. State and explain Newton's Law of viscosity.  
c. A vertical gap 2.2 cm wide of infinite extent contains a fluid of viscosity 2 Ns/m<sup>2</sup> and specific gravity 0.9. A metallic plate 1.2 m x 1.2 m x 0.2 cm is to be lifted up with a constant velocity of 0.15 m/s, through the gap. If the plate is in the middle of the gap, find the force required. The weight of the plate is 40 N.
2. a. Explain working principle of micromanometer by giving neat sketch. 10+10  
=20  
b. Calculate the capillary effect in millimeters in a glass tube of 4mm diameter, when immersed in i) Water, ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero and that for mercury 1.30°. Take density of water at 20°C is 998 kg/m<sup>3</sup>.
3. a. The following figure shows a conical vessel having its outlet at A to which a U – tube manometer is connected. The reading of the manometer given in the figure shows when the vessel is empty. Find the reading of the manometer when the vessel is completely filled with water. 12+8  
=20



- b. Explain with neat sketch how fluid velocity can be measured with the help of pitot tube.
4. a. Explain boundary layer phenomenon inside a pipe flow with neat sketch. 8+12  
=20
- b. State and explain Buckingham  $\pi$  theorem by giving example.
5. a. A caisson for closing the entrance to a dry dock is of trapezoidal form 16 m wide at the top and 10 m wide at the bottom and 6m deep. Find the total pressure and centre of pressure on the caisson if the water on the outside is just level with top and dock is empty. 10+10  
=20
- b. Explain analytical method to determine metacentric height with neat sketch.
6. a. Write down the expression and prove Euler's equation of motion. 10+10  
=20
- b. A 3 dimensional velocity field is given by -  
 $v(x,y,z) = 5x + 10y + \mu_0$   
 $V(x,y,z) = 5y + v_0$   
 $w(x,y,z) = -10z + w_0$  where  $u_0, v_0, w_0$  are constants.  
 Find the components of i) Rotational velocity, ii) Vorticity for the above flow field.
7. a. Explain i) Reynold's No. ii) Capilarity, iii) Surface tension iv) Vapour pressure. 12+8=20
- b. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200 mm at a position A to 500 mm at a position B, which is 4 m at a higher level. If the pressures at A and B are  $9.81 \text{ N/cm}^2$  and  $5.886 \text{ N/cm}^2$  respectively and the discharge is 200 litres/s determine loss of head and direction fo flow.