

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Electrical Engineering and Electronics
(AME - 08, A-08 (R))

Full Marks : 100

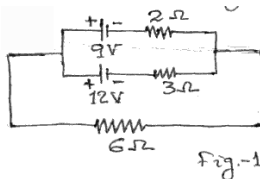
Time : 3 Hours

Pass Marks : 40

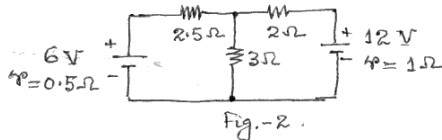
PART - A

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

1. a. State and explain Kirchoff's voltage law. 2+3
 b. By applying superposition theorem find the current through 6Ω resistor as shown in Fig-1. 5



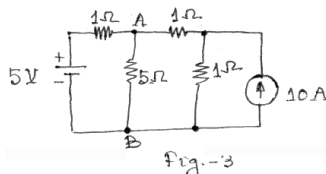
2. a. A delta connection contains three equal resistances R .
 Find the resistances of the equivalent star connection. 5
 b) Calculate the current through 3Ω resistor by Maxwell's loop current method of the Fig.2 shown below. 5



PART - B

Answer any Three questions

3. a. State and explain Norton's theorem. 3+4
 b. Find using Thevenin's Theorem, the current in the 5Ω resistor connected across AB in the network shown in Fig.3 below. 8



- | | | |
|-------|---|-----|
| 4. a. | Explain B-H curve of a magnetic material | 7 |
| b. | An Iron ring of mean circumference 50cm, has an air gap of 0.1 cm and a winding of 300 turns. If the permeability of iron is 400 when a current of 1 amp, flows through the coil, find the flux density in the air gap. | 8 |
| 5. a. | What is the difference between impedance triangle and power triangle ? Explain with diagram. | 7 |
| b. | Two alternating voltages represented by the equations $v_1=7 \sin \omega t$ and $v_2=10 \sin (\omega t+\pi/3)$ are connected in series. Find the equation for the resultant voltage. | 8 |
| 6. a. | discuss the condition of resonance in a series RLC circuit | 7 |
| b. | Three impedences $(4-j6)\Omega$, $(6-j8)\Omega$ and $(5-j3)\Omega$ are connected in parallel. Calculate current in each branch when total supply current is 20A. | 8 |
| 7. a. | State the advantages of three phase system over single phase system. | 5 |
| b. | Deduce the relationship between phase voltage and line voltage and phase current and line currents in a three phase star connected circuit. Draw phase diagram to establish it. | 7+3 |

PART - C

Answer any three question

- | | | |
|--------|--|-----|
| 8. a. | Derive the e.m.f. equation of an ideal single phase transformer | 6 |
| b. | A 75 KVA transformer has 500 turns in the primary and 100 turns in the secondary. The primary and secondary resistances are 0.4Ω and 0.02Ω respectively and corresponding leakage reactances are 1.5Ω and 0.045Ω respectively. The supply voltage is 6600 volt. Calculate (i) equivalent impedance referred to primary and (ii) the voltage regulation at power factor of 0.8 lagging. | 6+3 |
| 9. a. | Briefly describe the construction of d.c. motor. How do you classify such motors ? | 6+3 |
| b. | Derive a general expression for the gross armature torque developed by a d.c. motor. | 6 |
| 10. a. | Define a capacitor start induction run single phase induction motor. Also, describe the construction and working of such a motor. | 8 |

- b. Classify of the single phase induction motor and draw the diagram with one application in each case. 7
- 11. a. Describe the 7
 - i) Construction
 - ii) Operations and
 - iii) Deflecting torque of a moving iron attraction type instrument.
- b. Explain the construction and working of a dynamometer wattmeter. 8
- 12. a. Explain semiconductors and insulators with energy band diagram. 7
- b. Explain forward bias with schematic diagram of p-n junction 9
- 13. Write short notes (any five) 6
 - a. Opto-electronic devices
 - b. LCD 3x5
 - c. LDR
 - d. Transistor as an amplifier
 - e. Operational amplifier as an integrator.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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) State the nature of images produced in a convex lens when the object is placed (i) within focus and (ii) beyond focus. 3
b) What is meant by spherical aberration ? Show diagrammatically how it affects image in a convex lens. 3
c) Show how combination of lens is used to eliminate speherical aberration. 4
2. a) Define (i) lateral and (ii) longitudinal chromatic aberration. 3
b) How achromatic doublet is designed to remove chromatic aberration. State the condition thereof. 3
c) An achromatic doublet of focal length 30cm is designed with two lenses. If dispersive power of one lens is double that of the other determine focal lengths of the two lenses used. 4
3. a) What should be the properties of coherent sources ? State different methods to produce coherent sources. 3
b) Find the ratio of maximum to minimum intensities of interference fringes when light of equal amplitude from two coherent sources superpose. 4
c) Separation of the virtual images formed by a biprism placed 5cm away from the slit illuminated by Na-light of wavelength 5890A is 0.5 cm. Determine the fringe width of the interference pattern produced on a screen 75cm from the biprism. 3
4. a) Draw the Newton's ring experimental set up and show how coherent sources are produced there. State why the interference fringes produced in Newton's ring set up are circular in shape. 3+1
b) It is observed that as a unknown liquid is introduced in a Newton's ring experimental set up diameter of 10th bright fringe is reduced from 2.4 mm to 2.0 mm. Calculate the refractive index of the liquid. 4

- c) State the observational difference between diffraction and interference fringes. 2
5. a) Write down the conditions for Fresnel and Fraunhofer class of diffraction. 2
- b) Calculate the highest order diffraction fringe that may be observed in a plane transmission grating having 5000 lines/cm when it is illuminated by light of wavelength 500 Å. 3
- c) Define resolving power of grating. Two spectral lines of wavelength around 6000Å are resolved in second order by a grating having 500 lines/cm. If width of the grating is 2cm determine wavelength difference of the spectral lines. 2+3
6. a) Describe the phenomena of double refraction in uniaxial crystal. Determine its thickness to introduce a path difference of $\lambda / 2$ between e-ray and o-ray. Given λ -5890Å and $\mu_e = 1.5442, \mu_o = 1.5533$. 2+3
- b) Define optical activity. In a half shade polarimeter, 20cm long tube is filled with sugar solution of concentration 0.15 gm/cc. If the plane of polarization is found to rotate by 20° determine specific rotation of sugar. 2+3
7. a) State Snell's laws of refraction and prove it from Huygens' wave theory of light. 2+3
- b) Yellow light of wave length 5890Å is incident on a glass plate from air. Determine wavelength, velocity and frequency of refracted light. Given refractive index of glass w.r.t. air is 1.5. 3
- c) Determine the above parameters if the glass plate is immersed in water of refractive index 1.33. 2
8. a) Define Einstein's A and B coefficients in the context of spontaneous and stimulated emission. Find a relation between them. 2+5
- b) Discuss the conditions for lasing those can be inferred from Einstein's relation. 3
9. a) Discuss different damping conditions from the expression of damped vibration and show them diagrammatically. 3+2
- b) In underdamped condition calculate average energy dissipation in a period. 3
- c) Define log decrement and its implication. 2
10. a) Define reverberation and state acoustic requirements of a good auditorium. 2+2

- b) An auditorium has dimension $25 \times 15 \times 10$ m. Its reverberation time is 1.3 sec when empty. Find reverberation time when 300 persons are present in the auditorium. Given sound absorption by each person is 4.5 Sabine. 4
- c) How does sound wave spread in a medium? 2
11. a) Define magnetic induction vector and state its unit. How does its value change in presence of magnetic material? 2+1
- b) If 15A current is passed through a long straight wire, calculate the force on a unit magnetic pole placed 0.15m away from the wire. If the wire is bent to form a circular loop calculate the radius of the loop to produce same force on unit magnetic pole placed at the centre of the loop. Hence determine the length of the wire. 5
- c) State function of inductor in an electrical circuit. 2
12. a) In India, household electric supply is $E = 220 \sin(100\pi t)$ volt. Calculate mean and r.m.s. value of the supply. Also state the supply frequency. 3
- b) If this supply is passed through a C-R circuit, find an expression for current. Given $C = 20\pi F$ and $R = 100\Omega$. 3
- c) Draw the phasor diagram corresponding to the above circuit and determine power factor. 2+2
13. a) Find the analogy between a mechanical vibrator with an electrical a.c. circuit. 3
- b) Write down the differential equation of a series L-C-R circuit subjected to an a.c. supply. Solve it and determine the resonant condition and the resonant frequent. 2+5
14. Write short notes on the following topics: - 5+5
- a) Optical fibres and its application
- b) Semiconductor lasers and its applications.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Elementary Mathematics (AME - 01, A-(01)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) Let D, E, F be the midpoints of sides AB, BC, CA respectively of triangle ABC. If P be any point, show that
 $\overrightarrow{PA} + \overrightarrow{PB} + \overrightarrow{PC} = \overrightarrow{PD} + \overrightarrow{PE} + \overrightarrow{PF}$ 10
- b) Using vector methods, prove that line joining the mid points of two sides of a triangle is parallel to the third side and is half of the length of the third side. 10
2. a) Show that 10
$$\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$$
- b) Using Cramer's rule, solve the following system of equation. 10
$$\begin{aligned} 2x + y + z &= 5 \\ x - y &= 0 \\ 2x + y - z &= 1 \end{aligned}$$
3. a) Given $W^{100} = 1, W \neq 1$, find the value of $\sum_{K=0}^{99} W^K$. 8
- b) Find the square roots of each of the following
i) i, ii) -i, iii) $1+i$, iv) $1-i$, v) $-1+i$, vi) $-1-i$ 6
- c) What locus is represented by Z if $\overline{ZZ} = 1$? 6
4. a) Differentiate $\cosh^{-1}x$ with respect to $\tan^{-1}x$ and find the value of the derivative at $x = \sqrt{2}$. 10
- b) Given $a+b+c=0$, using Rolle's theorem prove that the equation $4ax^2 + 3bx + 2c = 0$ has a root in $0 < x < 1$ 10
5. a) Using Lagrange's mean value theorem prove that $1 - \frac{1}{x} < \ln x < x-1$. 10
- b) If $x = 5 \cos \theta, y = 4 \sin \theta$ find the derivatives $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ in terms of θ 10

6. a) Find Mclaurin's expansion of e^x with Lagrange's form of remainder. 10
- b) Evaluate $\int_0^1 \frac{\ln(1+x)}{1+x^2} dx$ 10
7. a) State the fundamental theorem of integral calculus. 2
- b) Prove that $\int_0^a f(x) dx = \int_0^a f(a-x) dx$ 5
- c) Using this properly, show that $\int_0^{\pi/2} \log \tan x dx = 0$ 7
- d) Find the area of the region bounded by $y = x^3$ and $y^2 = x$. 6
8. a) Evaluate $\int e^{2x} \sin 3x dx$ 10
- b) A plane surface is bounded by the x-axis, the curve $y^2 = 25x$ and the line $x = 10$. Find the coordinates of its centroid. 10

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

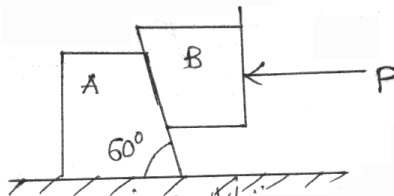
Time : 3 Hours

Pass Marks : 40

Answer any five questions

Parts of a question should be answered at one place

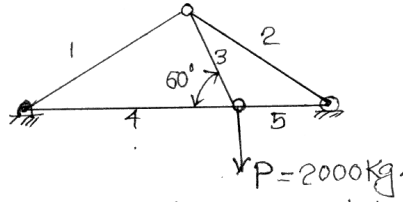
1. a) State and Prove Lami's Theorem. 5
- b) State D'Alembert's Principle and its application. 1+1=2
- c) Energy is consumed for a Mechanical system - Prove by starting an example. 5
- d) Prove that range of a Projectile is maximum when it is projected with an angle 45° to horizontal 3
- e) Prove angle of friction is equal to angle of repose 3
- f) Friction is sometimes beneficial to Mankind - Explain. 2
2. a) Relate the moment of Inertia of a rectangle w.r.t. base and with respect to centroid. 5
- b) Prove that centroid of a triangle lies on $\frac{1}{3}$ of height from its base 5
- c) State parallel axis theorem and perpendicular axis theorem and Explain. 2+2=4
- d) State and prove Varignon's theorem related to moments. 6
3. a) Why banking of roads are done ? 2
- b) Define impulse force and impulse of a force. 3
- c) A particle starts from rest and accelerating 2 rad/S^2 . The particle is at D_0 when $t = 0$. After 5 seconds particle is projected along the tangent of a circle of radius 100 cm. Find the maximum height it attains from centre of the circle and the horizontal distance covered at the level of circle centre. 8
- d)



Two blocks are in equilibrium with the action a force P. If all surface has friction co-efficient $\mu=0.3$ and Mass of the blocks A and B are 100 Kg respective. Find the force. P.

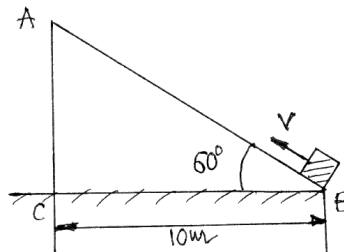
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4. a) A particle moves in a straight line obeying $S = t^3 - 3t^2 + 5t + 6$. The particle starts from rest. Find the distance moved, velocity and acceleration of the particle after 3 seconds. 2+2+2
=6
- b) What are superposition and transmissibility of force - explain with an example. 4
- c) 10



Find the axial force in each bar.

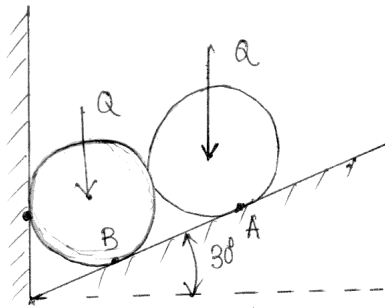
5. a) 10



A block of mass 10 Kg is required to slide in a plane AB. The block and plane AB has friction co-efficient $\mu = 0.4$ Find the initial velocity of block such that it comes to rest after reaching A.

- b) What the condition of equilibrium for three dimensional case. 1+1=2
- c) A balloon of gross weight W is falling vertically downward with constant acceleration a . What amount of ballast Q must be thrown out in order to give an equal upward acceleration? Air resistance should be neglected. 8
6. a) The maximum range of a projectile is 2000m. At what angle α will the range be 1500m if initial velocity remains unchanged? 3
- b) The rain falling vertically with a speed of 2m/s. A cyclists is moving toward last with a speed of 15 km/hr. Find the speed and angle of rain to the cyclist.
- c) What are the differences between centroid and centre of gravity. 2
- d) A thread is wrapped over a drum intended to raise a weight of 40 Kg. The drum has diameter 0.5 m and friction co-efficient 0.4. find the tension to be applied on other side of rope to pull the load. 7

7. a) State and Prove parallelograms Law of forces to find the resultant of two forces. 2+5
- b) How resultant of several forces are find out. 3
- c) 10



Two identical cylinders are kept side by side in between one inclined plane and vertical plane. The cylinders have weight of 1000 KgP. Find the reactions at support A, B and C.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Engineering Mathematics (AME - 12, B-12(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) Solve the system of equations
 $x_1 + x_2 = 4$
 $x_2 - x_3 = 1$
 $2x_1 + x_2 + 4x_3 = 7$ 10
- b) Find the matrices A and B if
 $2A + 3B = I_2$ and $A + B = 2A^t$. 10
2. a) If $A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{pmatrix}$ = show that $A^2 - 4A - 5I_3 = 0$.
Hence obtain a matrix B such that $BA = I_3$ 10
- b) Find all non-null real matrices $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$
such that $A^2 = 0$ 10
3. a) Find the maxima and minima of the function
 $x^3 + y^3 - 3x - 12y + 20$. find also the saddle points existing.
- b) If $x = u - v$, $y = u^2 - v^2$ find the Jacobian
 $\frac{\partial(x, y)}{\partial(u, v)}$ 10
4. a) Test the series for convergence
 $1 + \frac{x}{2} + \frac{x^2}{5} + \frac{x^3}{10} + \dots$ 10
- b) Discuss the convergence of the series
 $1 + \frac{2^p}{2!} + \frac{3^p}{3!} + \frac{4^p}{4!} + \dots$ ($P > 0$) 10
5. a) Solve the linear differential equation
 $(x+y+1)\frac{dy}{dx} = 1$ 10
- b) Solve : $\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = x$ 10

6. a) Solve the equation $\frac{\partial^3 u}{\partial x^2} = 4 \frac{\partial^2 u}{\partial x^2}$
 given $u(0, t) = u(5, t) = 0$, $u(x, 0) = 0$
 and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 5 \sin \pi x$ 10
- b) Prove that $B(x, y) = \int_0^{\infty} \frac{t^{x-1}}{(1+t)^{x+y}} dt$, $x, y > 0$ 10
7. a) Obtain the Fourier series corresponding to $f(x) = x$ on $[-\pi, \pi]$
 and hence deduce that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}$ 10
- b) Prove that the even function $f(x) = |x|$ on $-\pi < x < \pi$ has a cosine series in Fourier's form as
 $|x| \sim \frac{\pi}{2} - \frac{4}{\pi} \left\{ \cos x + \frac{\cos 3x}{3^2} + \frac{\cos 5x}{5^2} + \dots \right\}$
 Also show that $1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}$. 10
8. a) Prove that $\iint \{2a^2 - 2a(x+y) - (x^2 + y^2)\} dx dy = 8\pi a^4$, the region of integration being the circle $x^2 + y^2 + 2a(x+y) = 2a^2$. 10
- b) Show that $\int_0^{\infty} \frac{\cos x}{\sqrt{1+x^3}}$ converges
 absolutely by μ -test 10

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

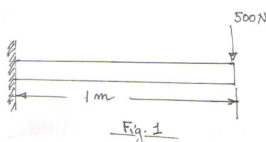
Time : 3 Hours

Pass Marks : 40

Answer any five questions

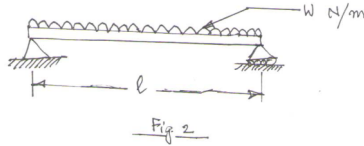
Parts of a question should be answered at one place

1. a) Draw and label stress strain diagram for a ductile and a brittle material. 2x6=12
b) What are resilience, toughness, hardness and proof stress ? 8
2. a) State the significance of factor of safety in designing, explaining the meaning of factor of safety. 5
b) Give reasons why sharp corners or discontinuity within a material is avoided in a component. 4
c) What is meant by stress concentration. 2
d) Differentiate between a statically determinate and statically indeterminate problem. How can a statically indeterminate problem be solved. 5
e) State the meaning of engineering stress and strain, and true stress and strain. Which are used in practice and why ? 4
3. a) Derive the expression relating bulk modulus of elasticity K with elastic modulus E and Poisson's ratio ν i.e., $E=3K(1-2\nu)$ 5
b) State the importance of Poisson's ratio. 3
c) What is modulus of rigidity ? 2
d) Draw a typical Mohr's circle and show the principal stress and maximum shear stress points on it. 5
e) If at a plane within a body, $\sigma_x = \sigma_y = 100 \text{ Mpa}$ and $\tau_{xy} = 100 \text{ Mpa}$ find out the principal stresses. 5
4. a) What is neutral axis of a beam ? Give a sketch. Show the variation of bending stress along the cross section of a beam. 6
b) 8



Draw the shear force and bending moment diagram of the loaded cantilever beam as shown.

- c) Draw the elastic curve of the simply supported beam as shown. 6



5. a) Differentiate between a short column and a long column. How are compressive stress calculated in both of these columns? 5
- b) A 2m long standard cylindrical steel rod of 20mm diameter is a pin ended column. Calculate critical load of this column. Given E steel = 210 Gpa. 6

- c) For a cantiliver beam shown in Fig.3, derive the equation to define the deflection curve, and prove that deflection at the 9

free end, $\sigma = \frac{Pl^3}{3EI}$

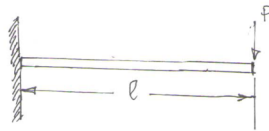


Fig 3

6. a) Determine diameter of a solid shaft to transmit 200 KW power at 100 RPM if working shear stress is 50 Mpa. 5
- b) What is shear stress and shear strain ? Show a sketch of them 6
- c) i) Derive the expression for shear strain energy, or ii) Modulus of resilience. 4
- d) Calculate the wall thickness of spherical pressure vessel of 5m diameter subjected to an internal pressure 10 kPa. Given safe membrane stress of the pressure vessel material = 60 Mpa. 4

7. Write short notes on (Any five) : 5x4=20

- i) Pure shear, ii) Pure bending
- iii) UTS, iv) Necking, v) Plane stress and plane strain conditions
- vi) Shear stress distribution in a I section.
- vii) Section modulus and moment
- viii) Use of flexural equation.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Q. no. 1 is compulsory.

Answer any four from the rest of the questions

Q.2 . - Q.8 Parts of a question should be answered at one place

1. A) Choose the correct answer (any five) 1x5
- a) The acetylene gas is generated by the chemical reaction of water with i) CaC_2 or ii) CaCO_3 ?
 - b) In arc welding processes the depth of penetration increases by i) increase in welding speed or ii) decreasing the welding speed.
 - c) Amount of voltage required to generate the arc under no load condition is called i) open circuit voltage ii) Arc voltage
 - d) The voltage current characteristics in arc welding must be i) rising or ii) drooping.
 - e) Arrange the following processes in order of increasing arc temperature i) TIG welding ii) SMAW iii) MIG
 - f) Constant current power sources (cc) are preferred for i) GMAW/FCAW or ii) SMAW/GTAW.
 - g) Which type of oxyacetylene flame is most suitable for welding of high carbon steels : i) carburizing ii) oxidizing
1. B) Write true or false (any five) 1x5
- a) A coated electrode burns faster when it is connected to the negative terminal than when it is connected to the positive.
 - b) In fusion welding penetration is the ratio of depth of weld to its width.
 - c) The inner core of oxyacetylene flame has the highest temperature.
 - d) Pinch effect in welding is the result of electrical resistance.
 - e) CO_2 shielding gas cannot be used in AC power supply.
 - f) In arc welding arc initiation voltage is of the order of 100 - 140 volts.
 - g) High frequency starter units are used for initiating the arc in TIG welding.

1. C) Answer any five 2x5
- a) Which type of polarity is used to weld reactive metals such as aluminium ? Why ?
 - b) Why CO₂ is not used as a shielding gas in GTAW process ?
 - c) Explain the effect of arc blow in welding.
 - d) What is coating factor in SMAW ?
 - e) What are the modes of metal transfer commonly observed in GMAW process.
 - f) How can welding power sources be classified ?
 - g) What are flash back arrestors ? Where is it used ?
2. a) What is the role of coating on SMAW electrodes ? Write common constituents used in coating of electrodes along with their role. 10
- b) Describe the following characteristics of welding power sources along with their signification in welding i) Dynamic characteristics ii) Static characteristics. 10
3. What are the various modes of metal transfer in GMAW process ? 2+3+
Which mode of metal transfer generates maximum spatter and why ? Which mode of metal transfer is most suitable for all position welding and why ? What is pulse-spray mode of metal transfer ? How is it achieved ? List down the advantages of pulsed mode of transfer over spray transfer. Explain with the help of a neat sketch the Dip Transfer cycle. 3+2+2+
4+4
- 4a) What is the role of welding parameters namely welding current, arc voltage and welding speed on development of sound weld joint by GTAW ? Describe different types of electrodes used in GTAW process. Explain the effect of electrode tip angle on shape and power density distribution for GTAW process. 4+4+2
- b) Why is CO₂ used as a shielding gas in welding even after being an active gas ? What are the advantages of using Gas mixtures for shielding in welding ? What will be the molten pool characteristics when pure Argon is used in GMAW process ? How do shielding gases effect the mode of metal transfer in GMAW process ? 2+3
2+3
- 5a) How are welding power sources different from conventional domestic supply power sources ? What is operating point in arc characteristic curve for given power source ? How is operating point affected by arc length ? What is self regulating arc and how can it be achieved in SAW/GMAW processes ? 2+4
2+2

- b. What is welding arc ? How is it generated ? How is heat produced in the arc ? How is the temperature distributed in on arc ? Explain the term thermionic emission ? 2+2+2
+2+2
- 6a. What is the difference between transformer and rectifier type of arc welding power sources ? What is a Bridge rectifier ? Explain the operation of single phase and three phase bridge rectifiers. 2+2+6
- b. What are inverter type of arc welding power sources ? How do they work ? What are its advantages over Transformer / Rectifier type of arc welding power sources ? 3+3+4
- 7a. What are low hydrogen electrodes ? Where are they used ? Differentiate between cellulosic and rutile coated electrodes. 3+3+4
- b. How are MIG wires specified as per AWS A5.18 standard ? What is the difference between ER 705-6 and ER 70 S-3 type MIG wires. Explain the designation of commonly used stainless steel MIG wires as per AWS. 4+4+2
8. Write short notes on any four the following : 4x5
- What is slag ? Explain their role in welding. Name the processes in which slag is formed.
 - Types of joints and types of welds.
 - Safety precautions in GMAW process
 - Difference between sine wave and square wave AC power sources.
 - Heat input in arc welding.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer question no. 1 compulsory and
any 5 (five) from the rest
Parts of a question should be answered at one place**

1. Answer all questions 6x5=30
 - a) Write the differences between single user OS and multiuser OS with example.
 - b) Write the similarities and differences between high level and low level languages.
 - c) How is an assembly program different from a machine language program ?
 - d) How to execute a C program in a PC ?
 - e) What is multidimensional array ? Give example
 - f) How to give the output of a C program into a file ?
2. Write the different elements of computer organisation with block diagram. 14
3.
 - a) What is a logic gate. Give example ? 5
 - b) Write a C program to find the prime numbers between 1 to 100. 9
4.
 - a) Convert the following 3x3=9
 - i) $(6A)_{16}$ to Octal
 - ii) $(55)_8$ to decimal
 - iii) $(68)_{10}$ to binary
 - b) Explain in detail the use of ASCII and EASCII. 5
5.
 - a) Write a C program to find the value of $1^2+2^2+3^2+ \dots +50^2$. 8
 - b) Write a C program to multiply two given numbers. 6
6.
 - a) Write a C program to demonstrate the use of do-while loop. 7
 - b) Write a C program to concatenate two strings. 7
7.
 - a) Write aq C program to find the factorial of a number 7
 - b) Write a C program to find the Filbonacii series. 7

- | | | |
|---|---|----|
| 8 | a) Write the differences between getch () and getc () in C language. Give examples. | 7 |
| | b) What is command line argument ? Why it is used ? | 5 |
| | c) What is switch statement ? | 2 |
| 9 | Write short notes on any four from the following | 14 |
| | a) Pointer in C | |
| | b) Logical Operator | |
| | c) Windows | |
| | d) Union in C | |
| | e) C keywords | |

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer any five question

Parts of a question should be answered at one place

- 1a) Schematically draw the
- i) engineering stress vs engineering strain, and ii) true stress vs true strain curves of a low carbon steel. Explain why the differences between the two curves over. 10
 - b) Explain the significance of the area under the curve. 10
- 2a) What information can be obtained from the longitudinal, transverse and side bend tests of a butt joint? 10
- b) Discuss the role of bend tests in i) welding procedure qualification, and ii) welder qualification. 10
- 3a) Explain, with neat sketches, the Charpy V-notch test. 8
- b) What property is determined by the test? 2
 - c) Explain how the Charpy impact test can be used to determine the ductile to brittle transition temperature. 10
- 4a) Explain how the S-N curve of a metallic material can be obtained by laboratory tests. 8
- b) What is the stress ratio you would recommend for carrying out the tests? 2
 - c) What property or properties of the material is found in the above tests? 5
 - d) Draw typical S-N curves of a low carbon steel, austenitic stainless steel and aluminium. 5
5. Explain the causes, method(s) of detection and remedial action to be taken to prevent or lessen the severity of any three of the following weld defects in a low carbon weldment of section thickness less than 20 mm in GMAW and SMAW. 20
- a) sub surface cracks
 - b) blow holes
 - c) liquation cracks
 - d) leakage in pressure vessels.

- 6a) Explain the factors to be considered before arriving at a decision as to whether X-ray, gamma ray or ultrasonic inspection is to be carried out on a weldment if not specified in the code. 10
- b) Describe the relative merits of NDT methods available to detect surface cracks or discontinuities in plain carbon steel weldment. 10
- 7a) Distinguish between inspection by measurement and inspection by attributes by citing an example of each. 8
- b) Distinguish between single, double and sequential sampling. 6
- c) Explain the following : probability of detection, producer's risk, consumer's risk. 6
8. Write short notes on any four of the following 5x4=20
- a) nil ductility temperature.
 - b) hydrogen assisted cracking
 - c) tension shear test of resistance spot welded joints.
 - d) determination of pitting corrosion resistance.
 - e) creep rupture
 - f) acoustic emission testing.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Welding Equipment and Consumables AME-23

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer any five questions choosing at least two (02)
Questions from group A and B.**

Parts of a question should be answered at one place

Group A : Welding Equipment

- | | | |
|---|--|----|
| 1 | a) Describe the volt ampere characteristics of modern, solid state assisted power sources for arc welding. | 10 |
| | b) Bring out the effect of V-A characteristics on modes of metal transfer, weld quality, electrical efficiency and suitability for mechanised and automatic welding. | 10 |
| 2 | a) Explain the principle of operation of plasma arc welding (PAW). | 8 |
| | b) Explain the effects of the level of vacuum used on the process characteristics of PAW. | 6 |
| | c) What is the basic principle of plasma cutting as opposed to plasma arc welding ? | 6 |
| 3 | a) Describe the process of Resistance spot welding of lap joints bringing out the characteristics of the process, equipment, electrodes and volt ampere relations on high strength steel sheets. | 12 |
| | b) Describe the tension shear test of spot welded lap joints and discuss the various modes of failure. | 8 |
| 4 | Write short notes on any three of the following : | 20 |
| | a) Oxy-acetylene flame cutting | |
| | b) Equipment for gas Tungsten Arc welding | |
| | c) Continuous wave laser beam welding. | |
| | d) Positioners for automatic welding. | |

Group B : welding Consumables

- | | | |
|---|--|---|
| 5 | a) Describe the different types of electrode coatings used in Shielded Metal Arc Welding and bring out their advantages and disadvantages. | 8 |
| | b) What types of electrodes are recommended for prevention of hydrogen induced cracking ? | 4 |

- | | | |
|------|---|----|
| c) | Describe the precautions to be taken for their storage and pre-heating before use. | 8 |
| 6 a) | Describe the different types of submerged arc welding (SAW) fluxes and their classification. | 8 |
| | b) Name the different types of shielding gases and gas mixtures in gas metal arc welding (GMAW). Bring out their relative merits and point out area of use of each. | 12 |
| 7 a) | Explain the sources of hydrogen in steel and aluminium welding. | 6 |
| | b) Explain the precautions to be taken in each of the above to counteract the sources. | 6 |
| | c) Describe the various consumables used in arc welding of aluminium and its alloys. | 8 |
| 8 | Write short notes on any three of the following. | 20 |
| | a) Flux cored arc welding wires. | |
| | b) Hard facing electrodes | |
| | c) Electrode type and shielding gas (or gas mixture) combination in GMAW. | |
| | d) Brazing alloys. | |

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer any five questions

Parts of a question should be answered at one place

Group A : Welding Equipment

- 1 a) Explain various ferrous and non ferrous alloys used in industries in brief. What is the difference between structural and high strength steels ? 10
- b) Discuss various types of stainless steels with their designation, composition and application. 10
- 2 a) During welding explain the mechanism of absorption of gases such as Oxygen, Hydrogen and Nitrogen. What will be effect on quality of weld if high amount of gases are absorbed in weld. 10
- b) Describe various types of coating on the electrode. What is the function of coating ? Explain the characteristics of shielding gases. 10
- 3 a) Define residual stress in the weld. Explain various types of residual stress. Describe transverse, longitudinal and angular distortion with suitable examples. 10
- b) How one can control the distortions of welded joints. 4x5
- 4 Write short notes (Any Four) 4x5
 - a) Weldability of Cr-Mo steels
 - b) Weldability of stainless steels
 - c) Bend test
 - d) Radiography
 - e) Pitting corrosion
- 5 Describe the mechanism of following : 4x5
 - a) Cold cracking
 - b) Hot cracking
 - c) Liquation cracking
 - d) Reheat cracking

- 6 a) Explain various processes of cladding. How the clad steels are welded? 10
- b) Describe the mechanism of weld decay in stainless steels. How it can be prevented? 10
- 7 a) Explain the Schaffeler diagram. How it is useful during welding of stainless steels. 10
- b) Define delta ferrite. Explain the effect of delta ferrite in stainless steel welds. 10
- 8 a) Describe the mechanism of stress corrosion cracking in stainless steel welds. Give remedies to control the stress corrosion cracking. 10
- b) Explain the difference between anodic and cathodic protection. 10

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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 term Sociology. | 2 |
| | b. Discuss the relation between sociology and (i) Economics
(ii) History (iii) Social anthropology | 6+6+6=18 |
| 2. | What is meant by Culture? Analyse the different elements of culture. | 2+18=20 |
| 3. | a. Define the term Urbanization. | 4 |
| | b. Discuss in details the socio-economic features of urbanization in Indian Society | 16 |
| 4. | a. Define the terms Science and Technology | 3 |
| | b. Analyse the impact of science and technology on civilization. | 17 |
| 5. | a. Define the term Industrial Sociology | 3 |
| | b. Explain the socio-economic features of Industrial sociology in Indian perspective. | 17 |
| 6. | a. What is meant by the term Modernization? | 2 |
| | b. Explain the economic, cultural and social ingredients of Modernization. | 18 |
| 7. | a. Define the term Technology transfer? | 2 |
| | b. Analyse the advantage and disadvantages of Technology transfer in India. | 18 |
| 8. | a. What do you mean by the term Environment? | 3 |
| | b. Explain in your view the sociological perspective of Environment. | 17 |

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : General English (AME-4, 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. Adequate investment in science and innovation an urgent need of the day
 - b. "Save Daughter, Educate Daughter"
 - c. Global refugee problem

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

The Indian population is now aging and non-communicable disease -basically life-style diseases - such as diabetes, high lipids and hypertension are prevalent. While those suffering from such diseases are usually correctly diagnosed, the disease itself is often inadequately controlled. Sometimes, patients skip medication during fasting (for religious events) ,or else they 'forget' or there is a few days delay in replenishing the exhausted stock of pills. life style modifications (diet and exercise) are ignored or inadequate. this means that the sugars, the blood pressure and the lipid levels can go up and down. This causes fatal events such as a stroke.

In developed countries, strokes- a clot or bleeding in the brain - occur around the age of 65 but in India they occur around 15 years earlier. Also earlier it was thought that only men were at risk but now more and more women are suffering strokes. Major risk factors include diabetes, hypertension, alcoholism and tobacco use. Fast food and diet drinks have added to the risk.

A stroke occurs when blood supply to a part of the brain is compromised or completely cut off. Blood supplies oxygen to the brain without which brain cells die. The symptoms of a stroke depend on the area of the brain affected, the extent of the damage and whether the blood supply is partially or completely affected.

Partial symptoms may occur intermittently for days or weeks.

At that time, if the symptoms are recognized as TIA (Transient Ischaemic Attacks) it is possible to treat the damaging factor and prevent its progress to a full blown stroke. Unfortunately, TIA's are not taken seriously as they pass off spontaneously and recovery is complete.

Blood supply may be affected because blood vessels in the brain have become narrow or blocked by fat deposits or a clot produced somewhere in the body has travelled to the brain via blood. It can also be due to a bleed into the brain. This may be due to congenital malformations in the blood vessels of the brain leading it to sudden bursting. Damage may also occur because of trauma to the head, when blood collects in the space around the brain.

- a) What do you mean by 'life style diseases' Give examples.
 - b) What are the factors that lead people fall victims to such diseases?
 - c) What is a stroke?
 - d) When does a stroke occur?
 - e) What is TIA? What should be done when TIA is recognized?
 - f) How is blood supply to the brain affected?
 - g) How can we reduce the number of stroke victims in India?
3. Make a Precis of 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
(12+3)
4. Write a report on any one of the following topics in about 200 words. 20
- a. Welding and associated activities related to it have some occupational hazards. The Manager of your unit has asked you to prepare a list of such hazards and measures to be undertaken to minimize the risk of such hazards.
 - b. The Human Resource Department of your organization has asked you (as unit head) to submit a report regarding recreational facilities that may be introduced in your unit for the benefit of the workforce. Submit the report.
 - c) Your unit is in urgent need of some young welders. You as unit manager prepare a report regarding the urgency of the situation, essential minimum qualifications (general and technical), age and experience of new recruits. The report has to be submitted to the head of H.R.D.

5. Fill in the blanks of the passage with appropriate articles (a, an or the). In case no article is required put a cross (x). 5
- a. Medical researchers have for _____ first time established _____ link between _____ high blood pressure and _____ heart valve disorder that had hitherto been viewed as _____ age-old condition
6. Rewrite the following sentences according to the instructions given in brackets (any ten) 1x10=10
- a. No other food is as nourishing as milk (Change it into a superlative sentence)
- b. John is one of the most industrious boys (Make it a positive sentence)
- c. Late comers will not be allowed to enter the conference hall (Change it into a complex sentence)
- d. Mother rebuked me that I was not sincere (Change it into the direct form of speech)
- e. It is very costly. I can not buy it. (Join the two sentences using too)
- f. It is a lame excuse (Change it into an exclamatory sentence) 1x10=10
- g. No sooner did the thief see the policeman, he ran away (Change the negative into an assertive sentence)
- h. If you speak any more I'll punish you (Change it into a compound sentence)
- i. The police are _____ the person who was present at the scene (Select the correct phrase - looking at / looking forward to, looking out for)
- j. Rashid goes to bed by 10 o'clock (Change it into a question with 'when')
- k. Football is the most popular game,.....? (Complete it using the appropriate question tag)
- l. Yesterday Navina had returned home late (Correct the sentence)
- m. Father asked me, "Where are you going" (Change it into the indirect form of speech)
7. Edit the following paragraph that contains a number of words that are either misspelt or wrongly used. 5

- a. Rajnish is upset with the news. Today he has his taste in English. But the message is very disturbing. He feels uncomfortable. what should he do now? Rajnish loses his piece of mind.
8. Change the voice of the following Sentences. (any five) 1x5=5
- a. I have submitted my project report on time.
 - b. The GST has been introduced.
 - c. Anyone found cheating will be expelled.
 - d. Angry mob broke the glass panes of several buses.
 - e. We hope we will regain our lost glory.
 - f. We will send our children to school.
 - g. A knowledge-rich country always makes rapid progress.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

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

1. a. What are the three primary bonds in materials? Which is the strongest? why? 5x4=20
b. Insert gases has completely filled outer cell yet the boiling point of these increases with the atomic number. Explain why it is so.
c. Sketch an unit cell and show the following planes (a) (112) (b) (101) (c) ($\bar{1}11$) (d) (123)
d. Show the atomic arrangements in (111) plane of face center cubic structure and show the following directions [$\bar{1}10$], [$10\bar{1}$], [$01\bar{1}$], [$21\bar{1}$], [$12\bar{1}$]
e. What is the stacking sequence of FCC and HCP crystals?
2. a. Find the planar of density {111} planes and linear density of directions in FCC system. 5x4=20
b. What is miller index? How is it obtained?
c. Show that packing efficiency of FCC is 74% and that of BCC is 68%.
d. What is coordination number (CN)? Show that CN for FCC and HCP structure is 12 while it is 8 for BCC.
e. What is unit cell? what is lattice parameter?
3. a. What is the importance of binary phase diagram? Explain one example of binary phase diagram in isomorphous system. 2+4=6
b. In what condition dendrite structure can be form in metal system? Give an example of application of dendritic growth in directional solidification. 1+1=2
c. Define the Lever rule. Give a derivation of the Lever rule for two phase region. 4
d. Describe peritectic, eutectoid and peritectoid reaction. 6
e. What are the difference between alloys and intermetallic compound? 2

4. a. Define the plastic deformation of materials. If the deformation is elastic then what will be the relationship between stress and strain? What is anelasticity? 1+2+1=4
- b. What is creep? How can be measured the creep rate of material from the creep curve? 1+5=6
- c. What are the difference between slip and twining in crystals ? Why during deformation of BCC materials wavy nature of slip observed? How many slip system is/ systems are required to deform a single crystal? 3+3+4=10
5. a. Differentiate between ductile and brittle fracture. Explain the theory of the ductile to brittle transition. 4+4=8
- b. What is fracture toughness ? How fracture toughness can be measured ? 1+3=4
- c. Explain the Griffith's theory of brittle fracture. What are the different stages of fatigue failure process? 5+3=8
6. a. Write down the classification of polymer with suitable examples. 8
- b. What is polymerization ? What is the different reaction of polymerization ? 5
- c. What is the degree of polymerization ? Define the polymer crystallinity. 1+2=3
- d. What are the difference between addition and condensation polymerization? 4
7. a. What are the classification of composite materials? 8
- b. Explain Dispersion and particulate strengthened composite materials. 3+3=6
- c. Explain the effect of fiber length and effect of fiber orientation and concentration on composite materials. 3+3=6
8. a. The structure of silica and silicates. Explain the mechanism of fracture in glass. 4+4=8
- b. What are the electrical properties of ceramic phases? 4
- c. What is polymorphism? Give one example. What are the types of polymorphism? 2+4=6
- d. Define the refractory materials. Write one application of refractory materials. 2

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Production Engineering (AME - 10, B-10(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. Draw and explain Merchant's Circle Diagram, stating clearly the assumptions made. Also explain the possible modifications if flank friction is considered. 6
- b. Explain graphically the variation of tool life with velocity. Derive the Zorev formula to find out the point of inflexion. 8
- c. Explain different mechanism of wear of cutting tools. Out of the two types of cutting tool wear, which one is more significant and why? 6
2. a. Explain with a neat sketch the constructional and operational features of horizontal milling machine. 5
- b. Explain the geometry of a milling cutter. 5
- c. What are the different operations that can be performed on a drilling machine? 5
- d. Explain the mechanism of chip formation in grinding. 5
3. a. Differentiate between a pattern and a casting. 3
- b. Write a brief note on "Riser Design" 5
- c. Explain with suitable sketches the process of shell moulding. 7
- d. Draw a neat sketch of a cupola and explain its features. 5
4. a. Differentiate between hot working and cold working. 4
- b. Explain with suitable sketches the different manual forging processes. 6
- c. Explain the relative advantages and disadvantages of indirect extrusion over direct extrusion. 4
- d. Explain the mechanism of Rolling. Also sketch the different Rolling Stand Arrangements. 6

- | | | |
|-------|--|--------|
| 5. a. | State the differences between activity oriented and event oriented network. Also state the significance of dummy activity. | 6 |
| b. | What are the limitations of Gantt Chart? Explain with a suitable example. | 5 |
| c. | What is the significance of EOQ? | 3 |
| d. | Explain the salient features of time study, method study and work study. | 6 |
| 6. a. | Explain the basic differences between welding and cladding. What are the specific applications of cladding? | 7 |
| b. | State the features and applications of carburizing, cyaniding and nitriding processes | 8 |
| c. | Differentiate between PVD and CVD | 5 |
| 7. a. | Clearly differentiate between tolerance and allowance. | 4 |
| b. | Explain how surface flatness is measured in laboratory | 7 |
| c. | What is the difference between roughness and waviness. | 4 |
| d. | State the properties of mechanical and optical comparators. | 5 |
| 8. | Write short notes on <u>any four</u> of the following: | 4x5=20 |
| a. | Hot chamber die casting. | |
| b. | Hydrostatic extrusion process. | |
| c. | Centreless grinding. | |
| d. | Gating design. | |
| e. | Embossing and coining. | |
| f. | Spring back. | |

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Answer all questions

All question carry equal marks

Parts of any question should be answered at one place

1. a. What are the main factors that cause crack in welds? 10x2=20
- b. List four welding processes used for pipe joining.
- c. What is hot spot stress?
- d. Differentiate flaw and defect.
- e. Penetrameter is used in which NDT technique?
- f. Differentiate between semi automatic & automatic FCAW in pipe welding.
- g. Explain 'P' Number & 'F' number as per ASME Sec IX?
- h. What is OSHA?
- i. Define the term weldability
- j. What is the validity of a PQR?

GROUP - B

Answer any Four questions

2. Write short notes on any Four the following 4x5=20
 - a. Stress Concentration
 - b. Welding Repair procedure specification.
 - c. Welder's Duty cycle.
 - d. Welding processes for pipe joining.
 - e. Cladding of Pressure vessel.
3. a. Explain with sketches, the various techniques involved in pipe welding mentioning advantages and disadvantages of each. 10
- b. Explain with sketches different types of pressure vessels 5

- . c. Explain the term fitness for purpose. 5
4. a. Explain the term Engineering critical assessment of a welded structure with suitable example. 7
- b. Which are the welding processes generally deployed for Pressure Vessel welding. 5
- c. Explain in detail the welding procedure / technique involved in welding a 100mm thick Low alloy steel plate with Submerged Arc welding. 8
5. a. Explain the detail the various steps involved in preparing a PQR for weld repair. 5
- b. What are the various stages / steps involved in carrying out weld repair of a high thickness pressure vessel fabricated from Stainless Steel? 7
- c. Which are the defects generally encountered in high thickness pressure vessel welding and which are the NDT's generally performed to assess the quality of weld? Explain in detail the merits and demerits of each NDT deployed. 8
6. a. What are the various costs involved in welding. List down various methods of reducing cost in Welding? 8
- b. For the given data calculate the following 12
- 1) Labor Cost 2) filler metal Cost

Data

Weld Joint type	T-joint
Number of passes	Single
Type of Weld	Fillet
Weld leg length	6mm
Total length of weld	1 meter
Material	Carbon Steel
Welding Process	GMAW
Wire diameter	1.2mm
Deposition efficiency	95%
deposition rate	3.6kg/Hour
Density of steel	7850 kg/m ³
Cost of filler material	Rs.50/kg
Labor rate (including overhead)	Rs.250/Hr
Operator factor	60%

- | | | |
|-------|--|----|
| 7. a. | Which are the possible hazards associated with welding & allied processes? | 5 |
| b. | State the role of PPE in welding and cutting. Explain in detail with suitable example against each possible Hazards. | 10 |
| c. | What are the safety precautions to be taken during Gas cutting of a 100mm thick Low Alloy Steel plate? | 5 |

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

Total number of question 23 nos. answer any 20 questions

All question carry equal marks: 20x5=100

Parts of any question should be answered at one place

1. Define critical cooling rate, draw the complete CCT diagram of eutectoid iron carbon alloy and name the different phase's formation under CCT condition.
2. Define TTT and explain the pearlitic and bainitic phase transformation with reference to TTT diagram.
3. Define phase diagram. Explain the utility of diagram. Prove the lever rule.
4. Recrystallization is proceeding more rapidly in pure metals than alloys? Explain
5. Increase in % CW increases the rate recrystallization? Explain
6. Define heat treatment and explain the recovery, recrystallisation and grain growth.
7. Draw the detail iron-iron carbide phase diagram and explain reactions.
8. Define martensite & temper martensite, explain the effect of tempering heat treatment variables on mechanical.
9. Explain the fundamentals differences between Fe-Fe₃C, TTT and CCT diagrams.
10. Explain the microstructures and mechanical properties of various Fe-C alloys mainly micro-constituents, phases present, arrangement of phases, relative mechanical properties.
11. Fine pearlite is harder & stronger than coarse pearlite and coarse pearlite is more ductile than fine pearlite? Justify..
12. Define the term heat treatment explain role of quenching medium characteristics on cooling of sample.

13. Define hardenability. Explain the effect of the quenching medium and specimen size on hardenability test.
14. Explain the fundamental difference between steel, Alloy steel and stainless steel; name the various steel grades and its applications.
15. Fine grain structure is stronger and harder in comparison with coarse grain structure? Explain..
16. Pure metals are always softer and weaker than alloy composed of the same base metal? Explain..
17. Define work hardening, out of following data which is difficult to deform? Why (a) 0% CW (b) 4% CW (c) 24% CW.
18. Define weldability and explain the carbon equivalent and its relevance.
19. Define heat input and effect of input on cooling rate.
20. Explain relevance of following terms (a) pre heat, (b) Interpass temperature (c) Post heating.
21. Explain various defects in steels.
22. What do mean by crystal defects? Explain types Grain boundary.
23. Explain LD process of steel making.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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

Full Marks : 100

Time : 3 Hours

Pass Marks : 40

**Answer question No.1(Compulsory) and
any four question from the rest**

Parts of a questions should be answered at one place

1. Point out the correct alternative answer and blanks (any ten) 2x10
- (i) Current Assets have..... degree of liquidity. (higher/lower)
 - (ii) have no voting rights. (share holder/debenture holder)
 - (iii) Depreciation is aagainst current years profit. (charge/provision)
 - (iv) Market price and normal pricesame. (are/are not)
 - (v) In short period the supply is(elastic/inelastic)
 - (vi) In perfect competition the seller is(price taker/price maker)
 - (vii) Breakeven point is also called.....(maximum profit point/no profit no loss point)
 - (viii) There isrelationship between cost and profit. (direct/inverse)
 - (ix) Technical Economics are part of.....Economics. (internal /external)
 - (x) Output is a variables. (dependable/independable)
 - (xi) In the long period all factors are (fixed/variable)
 - (xii) In case of products demand forecasting is easier. (new/established)

2. a. Define Managerial Economics. Describe its important features. 10
- b. Explain the Law of Demand and also describe the exception to the Law of Demand. 10
3. a. Define Elasticity of Demand. Explain different types of Price Elasticity of Demand. 10
- b. Price of goods raises from Rs.10 to Rs.12 per unit as a result Demand for it falls from 120 units to 100 units. Calculate price elasticity of Demand for the Commodity. 10
4. a. What are the different methods of Demand Forecasting? Describe the factors affecting Demand Forecasting. 10
- b. What do you mean by Returns to Scale? In what respect it is different from Returns to Factor? 10
5. a. Write short notes on any four of the following: $2^{1/2} \times 4$
- (i) Sunk Cost
- (ii) Replacement Cost
- (iii) Incremental Cost
- (iv) Accounting Cost
- (v) Economic Cost
- (vi) Marginal Cost
- b. Consider the following data and suggest the optimum product mix when plant capacity is of 15000 hours. 10
- | <u>Particulars</u> | <u>Product X</u> | <u>Product Y</u> |
|------------------------|------------------|------------------|
| Market Demand | 1,600 units | 2,500 units |
| Selling price per unit | Rs.400.00 | Rs.500.00 |
| Variable Cost per unit | Rs.250.00 | Rs.300.00 |
| Production Time/Hours | 4 hours | 5 hours |
- 6.a. Define Breakeven point with the help of diagram. Describe its applicability in the industry including the limitation if there would be any? 10
- b. Describe the important features of the market. Describe the factor which governs the market structure? 10
7. a. Explain the meaning of Business Capital. Ennumerate any five methods of raising Long term Finance by a Corporate Body. 10
- b. What is pay back technique of Capital Budgeting? What are 10

8. a. What is fixed Capital? Describe in details about Fixed Capital and working Capital. 10
- b. Write short Notes on: (any four) $2^{1/2} \times 4$
- (i) Current Liability
 - (ii) Depreciation
 - (iii) Capital Budgeting
 - (iv) Equity Share
 - (v) Overdraft
 - (vi) Preferential Share

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

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 Newton's Law of Viscosity. 5+5+10=20
b. Describe variation of viscosity with temperature.
c. A vertical gap 2.2cm wide of infinite extent contains a fluid of viscosity 2 ns/m^2 and specific gravity 0.9. A metallic plate $1.2\text{m} \times 1.2\text{m} \times 1.2\text{cm}$ 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 40N.
2. a. Explain laminar boundary layer phenomenon inside a pipe with neat sketch. 8+12=20
b. Explain (i) Surface tension (ii) Reynold's No. (iii) Froud No. (iv) Metacentre.
3. a. State and prove Pascal's Law. 5+5+10=20
b. Explain briefly working principle of a differential manometer.
c. An inverted differential manometer containing an oil of specific gravity 0.9 is connected to find the difference of pressure at two points of a pipe containing water. If the manometer reading is 40cm, find the difference of pressures.
4. a. A pipe line which is 4m in diameter contains a gate valve. The pressure at the center of the pipe is 19.6N/cm^2 . If the pipe is filled with oil of specific gravity 0.87, find the force exerted by the oil upon the gate and position of center of pressure. 10+10=20
b. A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is $2\text{m} \times 1\text{m} \times 0.8\text{m}$

5. a. Derive the expression for differential continuity equation in cartesian coordinate system for an incompressible flow. 8+12=20
- b. Find the convective acceleration at the middle of a pipe which converges uniformly from 0.6m diameter to 0.3m diameter over 3m length. The rate of flow is 40lit/s. If the rate of flow changes uniformly from 40lit/s to 80lit/s in 40 seconds, find the total accelerations at the middle of the pipe at 20th second.
6. a. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200mm diameter at a position A to 500mm diameter at a position B, which is 4m at a higher level. If the pressure at A and B are 9.81N/cm^2 and 5.89N/cm^2 respectively and the discharge is 200lit/s, determine the loss of head and direction of flow. 10+10=20
- b. Derive the expression for actual discharge from a venturi meter.
7. a. State and explain Buellingham π theorem by giving appropriate example. 10+10=20
- b. Find the discharge through a trapezoidal channel of width 8m and side slope of 1 horizontal to 3 vertical. The depth of flow of water is 2.4m and value of Chezy's constant, $C=50$, The slope of the bed of the channel is given 1 in 4000.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Weldment Design and 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. Below are given Ten joint designations. Draw neat Sketches and the corresponding symbols of the joints as designated: 10x(1+1)=20
 - a. Butt weld between plates with raised edges.
 - b. Single Vee Butt Weld
 - c. Single Bevel Butt Weld
 - d. Single Bevel Butt Weld with Broad root Face
 - e. Single Vee Weld with Broad Root Face
 - f. Single U Butt Weld (parallel or sloping sides)
 - g. Backing Run: Back or Backing Weld
 - h. Fillet Weld in a T joint
 - i. Fillet Weld in a Lap Joint
 - j. Plug Weld: Plug or Slot Weld

2. Weld Symbols are shown in a Drawing as per Standard Practice. 10x2=20

Draw the Standard Reference Line with Tails and Arrow Line for Weld Symbols and indicate the following on the line (a) Finish Symbol. (b) Contour Symbol. (c) Size of Weld (d) Reference Line (e) Basic weld Symbol. (f) Length of weld (g) Unwelded Length (h) Field Weld Symbol (i)Weld all around Symbol (j) Arrow Connecting the Reference Line.

3. Before any structural fabrication is taken up in the shop floor WPS and WPQR are established. 4+6+10=20
 - a. Explain the scopes, differences and applications of WPS and WPQR.
 - b. State the Essential and Non-essential Variables to be included in the Procedure.
 - c. Prepare a WPS for butt welding pipes of 304L material of 80mm O.D,6mm thick wall. You may choose process and filler metal for a leak proof radiographic weld.

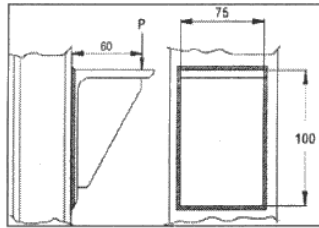
4. Fill up the blanks in the following table of Standards and Codes :

20x1=20

No.	Codes/Standards	Description
1	ASME BPVC Section II	
2		Nondestructive Examination
3		Welding and Brazing Qualifications
4	ASME B16.25	
5		Butt Welding ends
6	AWS A03.0	
7		Specification for carbon steel electrodes for shielded metal arc welding
8	AWS A05.18	
9		Specification for Welding Procedure and Performance Qualification
10	AWS D01.2	
11		Structural welding (strengthening and repair)
12	AWS D08.1	
13	BS 2633	
14		Structural welding(stainless steel)
15		Specification for welding of steel pipelines on land and offshore. Duplex stainless steel pipelines
16	PD 6705-2	
17		Welded, brazed and soldered joints-symbolic representation on drawings (1992)
18	ISO 2560	
19		Covered electrodes for manual arc welding of creep-resisting steels- Code of symbols for identification
20	ISO 3834	

5. In the picture below one plate is welded over the I-beam and a vertically downward load P of 10KN is acting on the plate. Design stress of the filler material is 220N/mm^2 . Calculate the fillet size of the weld.

20



6. a. Explain with sketches the different types of distortion faced during fabrication by welding. 5+5+5+5=20
- b. State the major factors causing such distortions.
- c. What is residual Stress? What are its effects on the fabricated product?
- d. State in brief the methods to remove residual stress.
7. a. State the problems faced at workplaces for repair of defective weldments and the steps to be taken for proper quality of welds to be made on repair. 8
- b. A crack is visibly detected in a Block of Cast Iron fixed to a Machine and can not be dismantled for repair. State and explain a step by step repair procedure with special reference to consumables to be used. 12
- 8 Write short notes on **Any Four** : 5x4=20
- a. Cladding
- b. ISO 3834
- c. EN 15085
- d. Shear stress in a weld
- e. Effects of Imperfections in a weld.

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Welding and 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 (8) 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 answers 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.
 - i. Explain with the help of sketches/block diagram the essential functional parts of the GMAW welding set up. 4
 - ii. Explain why there is only ONE Knob called either Current or Wire Feed. 4
 - iii. How Dynamic Current Transfer from Contact tube to Wire takes place? 2
 - iv. In GMAW, MAG requires one equipment more than MIG-What is it? 2
 - v. What is Cast and Helix as applicable to GMAW consumables? 3
 - vi. Why Carbon Steel wires are essentially only Copper coated? 3
 - vii. Name the Metal Transfer Modes in GMAW process. 2
2.
 - i. Give specific reason Why the sub-Arc Welding process was inveted? 2
 - ii. What is the highest deposition rate achievable in surfacing process? 2
 - iii. Name the SAW Welded mass-produced Product India is exporting. 2
 - iv. Explain with sketches the mechanism of ESSC process. 7
 - v. What techniques are used in SAW to get higher deposition rates? 5
 - vi. Almost every household uses a Sub-Arc Welded product daily - Which? 2
3.
 - i. What type of metallurgical joint is generated by FW and 2

	FSW processes and why?	
ii.	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
iii.	Name the industries where these two processes are used and describe two products each which are made by these two processes.	8
4. i.	Explain with sketch(es) the essential features of 'Gas Cutting' equipment	3
ii.	Give the list of three consumables in the Oxy-Acetylene Gas Cutting Processes and explain how they react and do the 'cutting' operation.	3
iii.	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
iv.	Explain the sequence of operation during flame generation (getting torch on) and the putting it off (torch off) and reasons to do so.	3
v.	Though not practice it is said that "Once the cutting processes starts oxyacetylene flame can be switched off." Why?	2
vi.	Can Stainless steel plates be cut by gas cutting? - Yes or No? Why?	2
vii.	Which cutting process is applicable to a variety of materials? Why?	2
viii.	Which cutting process gives a metallurgically cleanest cut? Why?	2
ix.	What thickness can be cut by Oxy-Acetylene Cutting Process?	1
5. i.	What is the main difference between welding Brazing & Soldering?	3
ii.	Is the use of flux essential in Brazing and Soldering? Why?	2
iii.	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 joins?	4
iv.	What is Braze-Welding? Where is it used?	3
v.	Name a more than 100yrs old common product of daily use manufactured using Dip-Brazing process.	2
vi.	Describe with sketches three different brazed product you know.	6

6. i. Explain with sketches the basic difference between two Resistance Projection processes - Embossed Sheet Projection and Solid Projection
 Projection > natural one like cross wire or machined like ring projection. 4
- ii. Explain the sketches the difference between Seam Welding and Roll-Spot welding using the same machine set up. 4
- iii. Explain why and for which application(s) and/or materials the Roll Spot welding process is required and used? 3
- iv. Briefly describe with sketches the three seam welding methods: a) Mash Seam welding; b) Foil Butt Seam Welding; c) Narrow Track Seam Welding 9
7. i. What is Squeeze Time in RW and why it is important for Welding? 2
- ii. Explain with sketches the resistance Spot welding process. 6
- iii. To reduce the unwanted heat generation in the electrodes, Pure Copper should be used, but instead Copper Alloys are used. why? 2
- iv. Explain briefly with sketch the Flash Butt Welding process and the mechanism of joint formation. What type of weld it is metallurgically? 8
- v. A flash butt welded product forms an economic life line of the nations world wide. Name the product. 2
8. 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=20
- i. Electric Arc Spray surfacing process
- ii. Electron Beam welding
- iii. Thermit Welding
- iv. Drawn Arc Stud Welding
- v. Laser Processing of materials
- vi. Explosive welding

THE INDIAN INSTITUTE OF WELDING

Associate Membership Examination

Winter Session, December 2017

Sub : Advanced Welding Technology (AME - 24, C-24(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. | Describe with sketch the plasma spraying process. | 10 |
| b. | What is the amount of porosity present in coatings produced by various thermal-spraying processes? | 3 |
| c. | How is the bond strength of a thermally sprayed coating tested? | 4 |
| d. | What is the general structure of sprayed deposit? What are the changes expected in the properties of particles when these are deposited by thermal spray method? | 3 |
| 2. a. | Discuss the procedure of welding stainless steel-clad thick carbon steel plate. Give complete details of joint preparation, filler selection etc. | 10 |
| b. | Describe strip-cladding process using submerged arc welding. How is dilution defined? What is the significance of dilution during cladding carbon steel plate with stainless steel? | 10 |
| 3. a. | Discuss use of automation in welding. What are the welding processes suitable for automation? Explain. | 10 |
| b. | What are the various applications of computers and computerized analysis in welding? | 10 |
| 4. a. | Discuss the mechanism of joint formation in diffusion bonding and show how does it differ from the mechanism in case of friction and explosive welding. | 6 |
| b. | Give some applications of diffusion bonding in aerospace industry. | 6 |
| c. | Explain the equipment used for diffusion bonding. What are the parameters, which control the process? Discuss interdependence of these parameters. | 8 |

5. What are maraging steels? Discuss the various considerations taken during welding of these steels. Discuss also the suitability of various welding processes for welding of these steels. 20
6. a.. Describe the process of friction stir welding. explain the advantages of this process. Discuss the type of tools used? 10
- b. Explain the problems encountered during joining copper to aluminium. Highlight the relative merits and demerits of the techniques like brazing, friction welding and friction stir welding used for this purpose. 10
7. a. What are the various techniques of joining ceramics? Explain 10
- b. Describe the various methods used for joining polymer matrix composites. 10

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Associate Membership Examination

Winter Session, December 2017

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. Derive an expression of temperature distribution in a plane slab with heat generation at the mid-plane. Consider steady state conduction. 10
b. The following data pertains to a hollow cylinder and a hollow sphere made of the same material and having the same temperature drop over the wall thickness :
Inside radius = 0.1m and Outside surface area = 1m^2
If the outside radius is same for both the geometries, calculate the ratio of heat flow in the cylinder to that in the sphere. 10
2. a. Derive an expression of critical radius of insulation wrapped around a cylindrical pipe. 10
b. A steel rod ($\kappa = 30\text{w/mK}$), 1cm in diameter and 5cm long protrudes from a wall which is maintained at 100°C . The rod is insulated at its tip and is exposed to an environment with $h = 50\text{w/m}^2\text{k}$ and temperature of surroundings = 30°C . Calculate the fin efficiency, temperature at the tip of the fin and the rate of heat dissipation. 10
3. a. What do you understand by " Lumped system analysis?" What are the underlying assumptions? What is the criterion to apply lumped system analysis? 3+2+1
b. Explain the importance and physical significance of Biot number and Fourier number, in transient heat conduction. 4
c. During a heat treatment process, alloy steel spherical balls of 6mm radius are initially heated to 800°C in a furnace. Subsequently, these are cooled to 100°C by keeping them immersed in an oil bath at 35°C with convection coefficient $20\text{w/m}^2\text{C}$. Determine the time required for the cooling process.
The thermophysical properties of steel balls are :
Density= 7750 kg/m^3 ; Specific heat= 520 J/kgk ; Conductivity = $50\text{w/m}^\circ\text{C}$. 10

4. a. Comment on the hydrodynamic and thermal entry lengths for laminar and turbulent flows for an oil inside a circular pipe. How would they compare for a liquid metal? Draw neat sketches to explain. 7+3
- b. Air at 35°C flows across a cylinder of 5cm 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 : $\rho = 1 \text{ kg/m}^3$; $\mu = 20 \times 10^{-6} \text{ kg/(ms)}$; $\kappa = 0.0312 \text{ w/mk}$, $C_p = 1 \text{ kj/kg K}$.
Use the relation : $Nu_D = 0.027(Re_D)^{0.805} (Pr)^{0.33}$ 10
5. a. With the help of dimensional analysis show that in case of forced convection the Nussett number is a function of the Reynolds number and the Prandtt number. 10
- b. A spherical heater of 10cm radius and at 60°C is immersed in a tank of water at 20°C . Determine the value of covective heat transfer coefficient. Properties of water at mean temperature of 40°C are : $\rho = 992.2 \text{ kg/m}^3$; $\nu = 0.66 \times 10^{-6} \text{ m}^2/\text{s}$ $Pr = 4.34$; $\kappa = 0.633 \text{ w/mk}$ and $\beta = 0.41 \times 10^{-3}/\text{k}$. Use the relation : $Nu_D = 2+0.43 (Gr_D Pr)^{0.25}$ 10
6. a. Derive an expression of effectiveness of a parallel flow heat exchanger, in terms of NTU and capacity ratio. 10
- b. Consider a counter-flow heat exchanger for cooling oil which enters at 180°C, and cooling water enters at 25°C. Mass flow rates of oil and water are 2.5 and 1.2 kg/s, respectively. Area for heat transfer = 16m². Specific heat data for oil and water and overall heat transfer coefficient are given : $C_{p \text{ oil}} = 1900 \text{ J/kgk}$; $C_{p \text{ water}} = 4186\text{J/kgk}$ and $U = 285 \text{ w/m}^2\text{k}$.
Calculate the output temperature of oil and water. 10
7. a. State Planck's law of monochromatic radiation . What is its significance? 3+2
- b. Incident radiation ($G = 1577 \text{ w/m}^2$) strikes an object. The amount of energy absorbed is 472 w/m² and the amount of energy transmitted is 78.8 w/m². Find the value of reflectivity. 7
- c. Calculate the net radiation exchange per m² for two large parallel plates maintained at 800°C and 300°C. The emissivities of two plates are 0.3 and 0.6, respectively. 8

8. Write short notes on (any Four)

5x4=20

- a. Composite slab
- b. Fully developed flow in a pipe
- c. Heisler Charts
- d. LMTD method of heat exchanger analysis
- e. Response time of a thermocouple