

**Q.1** Consider the following  $V - I$  and  $V - l$  characteristics for AW where  $V$  in volt,  $l$  in mm and  $I$  in Amp

Case-A: Flat where  $V = 20 + 3.5l$

Case-B: Elliptic drooping where  $V = 24 + 4l$

Case-C: Parabolic drooping where  $V = 25 + 3.5l$

FIND:

- I. Optimum arc length for maximum power for case-A if OCV= 80 V and SSC=1000 A
- II. Optimum arc length for maximum power for case-B if OCV= 100 V and SSC=200 A
- III. Change in current if arc length changes 2 mm to 3.5 mm for the case-A with OCV= 80 V and SSC=600 A
- IV. OCV and the SSC if arc length changes from 3 mm to 5 mm and current in the range of 475-575 A for case-C

**Q.2** SMAW having voltage-length characteristics  $V=20+40S$  where  $S$  is the length of the arc in cm is used for welding T joint. The power source characteristic is approximated by a straight line with an open circuit voltage of 80 V and a short circuit current of 1000 A. The melting temperature and density of electrode metal is 1760 °K and 8 g/cm<sup>3</sup>, respectively. The latent heat and specific heat of electrode metal is 300 kJ/kg and 500 J/kg °C, respectively. The right angle triangular weld bead hypotenuse is 6 mm length making 30° with one of the base metal. The thermal efficiency is 0.63 and ambient temperature is 30 °C. Find the following at optimum arc length: (I) Welding power in kW (II) Welding speed in mm/s

**Q.3** GMAW with DC power source generating 3.75 kW power is supplied for making continuous fillet weld of 25 mm<sup>2</sup> X-sectional area in steel workpiece having melting temperature 1760 °K. If heat transfer factor is 0.75 and melting factor is 0.65 then find (I) the required welding speed for the joint (II) Rate of heat generation required at the welding source for welding speed of 5 mm/s assuming weld bead shape as right isosceles triangle with a leg length of 5 mm

**Q.4** GMAW is applied for but joint of two pieces of steel (melting temperature 1427 °C), 150 mm long, 50 mm wide and 10 mm thick along the longer side keeping 3 mm wide gap. The power supply is rated at 200 A with a 20 % duty cycle. The welding electrode has 3 mm diameter and the welding conditions are 220 A and 20 V with melting efficiency of 0.65 and heat transfer efficiency of 0.90. The volume rate of metal welded is 14000 mm<sup>3</sup>/min. Find (I) Welding speed and Welding time (II) Rate of heat generation for the welding

**Q.5** GTAW is performed for butt joint of 5 mm width and 3 mm depth on steel plates (melting temperature 1700 °C) at 20 V and 150 A current. Filler metal wire of 5 mm diameter is used in the operation which produces final weld bead consisting of 65% filler and 35% steel. If the heat transfer factor is 0.85 and melting factor is 0.65 then find (I) welding speed (II) feed rate of the filler wire

**Q.6** Two aluminium alloy plates (unit melt energy  $10 \text{ J/mm}^3$ ) each 10 mm thick and 1m long are butt welded by multi pass GTAW at 15 V and 180 A current. The joint configuration is V-type with  $60^\circ$  angle and root gap is maintained at 5 mm. If electrode of 5mm diameter and 500 mm length is used for welding then find (I) welding time considering 70% thermal efficiency (II) Number of electrodes required

**Q.7** A round steel tube of diameter 175 cm is welded around the circumference by slowly rotating the tube using AW process with voltage and current as 20 V and 350 A, respectively. The weld bead is 8 mm wide and 7 mm depth around the periphery. If the melting temperature of steel is  $1950 \text{ }^\circ\text{K}$ , heat transfer factor is 0.95 and melting factor is 0.75 then find (I) the rotational speed of tube and (II) the time required to complete the weld

**Q.8** RSW is used for joining two metallic sheets (melting temperature  $1793 \text{ }^\circ\text{C}$ ) each of 2.0 mm thickness using 10 mm diameter welding electrode, 10 kA current for 0.05 s with interface resistance of  $200 \mu \Omega$ . The density of spot welded nugget is  $8000 \text{ kg/m}^3$ , Latent heat of fusion=  $300 \text{ kJ/kg}$ , specific heat=  $500 \text{ J/kg }^\circ\text{C}$  and ambient temperature=  $293 \text{ }^\circ\text{K}$ . Find (I) Percentage of total energy utilized for cylindrical weld nugget considering diameter of nugget same as electrode diameter and minimum surface area (II) Welding time if current is reduced by 50% (III) Welding time if nugget is assumed spherical extending up to full thickness of each sheet with 70% thermal efficiency

**Q.9** OAW is applied for but joint of two pieces of steel with weld cross-sectional area of  $75 \text{ mm}^2$  at a welding speed of 5 mm/s. The specific energy of melting of steel workpiece is  $10.5 \text{ J/mm}^3$ . It has been found that heat utilization efficiency is 60% and melting efficiency is 40%. The flame is concentrated at workpiece through a welding torch of diameter 9 mm. If the heat energy generation capacity by combustion of acetylene gas is  $55 \text{ MJ/m}^3$  then find (I) Flow rate of acetylene required (II) Percentage change of acetylene flow rate if welding speed is doubled

**Q.10** Two pipes of inner diameter 100 mm and out diameter 110 mm each are joined by resistance but welding using 30 V power supply, At the interface, 1 mm material melts from each pipe which has resistance of 45 ohm. If unit melt energy is  $65.5 \text{ J/cm}^3$ . Find the time of welding.