B.E. (ME) Part-II 4th Semester Examination, 2010

Engineering Materials and Processes

(ME-403)

Time : 3 hours Full Marks : 70

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
The questions are of equal value.

FIRST HALF

1. a) A Resistance Spot Welding (RSW) machine is welding two sheets of steel having thickness of 2.0 mm using 12000 A current. At contacting surface, the electrodes are of diameter = 6 mm. Resistance is assumed to be 0.0001 ohm and the thickness of the weld nugget is 2.5 mm. The melting temperature of the steel is J487°C. Assuming that only 30% of heat is utilized for welding, calculate time required for one spot weld.

   b) Now suppose the above spot welding process is to be automated by using two separate rollers each of 140 mm diameter for feeding the sheets to the electrodes. Required gap between two spot welds = 50 mm. How the rollers are to be rotated and stopped to accomplish the above job? Draw a neat sketch of the set up. Assume that the length of the sheets to be welded = 1 m. You may assume any suitable data if needed.

2. a) Show with sketches, different edge preparation required for butt weld joint (at least 4 types)

   b) Show the required weld symbol for the following
   - A tee fillet joint having length of weld 120 mm on near-side and 100 mm on far-side.
   - J-type on near-side, Bevel-type on far-side
   - Weld all around

   Draw separate sketches for the above cases.

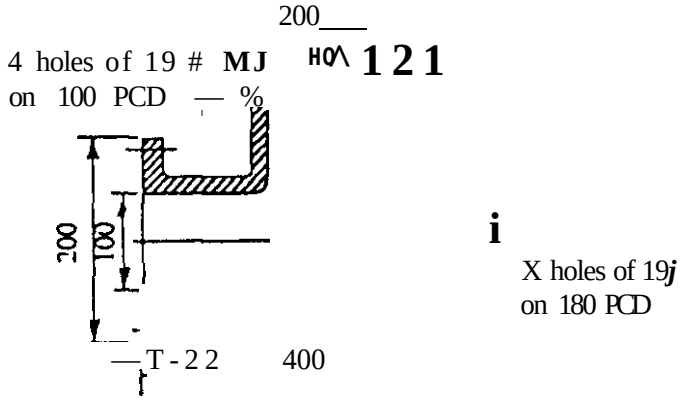
   c) Explain the main advantage of projection welding compared to seam welding.

3. a) Write the main applications of different types of flames in oxyfuel gas welding.

   b) What is 'duty cycle' for an arc welding machine?

c) An oxyacetylene torch supplies 0.3 m^3 of acetylene per hour and is completely burnt in oxygen for an welding operation. Heat liberated by acetylene during complete combustion is 55 x 10^6 J/m^3. Assuming that only 25% of the total heat generated by the torch is utilized for welding, calculate the rate of heat transferred to the weld surface. If the above heat is concentrated to an area of 9.0mm diameter circle, calculate the power density in W/mm^2.

4. a) Draw the neat sketches of the pattern(s) and core required for the product as shown in Fig-A. Also show the core-prints. (Holes not required, allowances need not be considered).



Approx mass = 25 kg

Fig-A

b) Write down, in brief steps, how a complete mould can be made for the above product.

c) What do you mean by 'hot-tear' defect in casting? How can it be avoided?

Write short notes on :-

a) Brazing,

b) Functions of the coating of the welding electrode,

c) Any one NDT of welding joint,

d) Hot chamber versus cold-chamber die casting process.

SECOND HALF

6. a) Prove that the true strain at the onset of necking is equal to the strain hardening exponent.

b) A cable is made of four different materials, all behaving according to the following equation : $a = ke^n$, where $n = 0.5$. The materials, strength coefficients and cross-sections are as follows:
Material X : k 500 MPa, A_0 7 mm^2
Material Y: k 850 MPa, A_0 2.5 mm^2
Material Y: k 430 MPa, A_0 3.5 mm^2,
Calculate the maximum tensile force that this cable can withstand prior to necking.

7. a) What useful information does a phase diagram provide?
Draw the Iron-Carbon equilibrium diagram showing important points.

b) Write the characteristics of the followings :
Eutectic, Eutectoid, Peritectic, Pearlite and Martensite steel and also draw the microstructures of steel at different phases.

8. a) How Iron-Carbon equilibrium diagram differs from TTT diagram. Write the characteristics of the TTT diagram. Explain in brief the isothermal transformation of austenite steel at sub critical temperature.

b) Discuss in brief with applications of the following heat treatment processes:
(i) Stress-relief annealing,
(ii) Hardening and Tempering,
(iii) Surface hardening.

9. a) What do you mean by 'Eutectic temperature*, 'Eutectic point' and 'Eutectic reaction' in a Eutectic system.

b) A cylindrical specimen is made of brittle material having 30 mm length and diameter of 30 mm, subjected to a compressive force along its axis. It is found that fracture takes place at an angle of 45° under a load of 4 tonne. Calculate the shear stress and the normal stress, respectively, acting on the fracture surface.

10. Write short notes in the followings:
a) Tool and Die material,
b) Lever rule,
c) Nitriding,
d) Composite and Ceramic material.