

9. (a) Explain the dye-penetration test in detail with suitable sketches.
- (b) What are the advantages of non-destructive testing over destructive testing? What are the advantages of radiographic inspection of welded product?

6 + (2 + 4) = 12

**ADVANCED WELDING TECHNOLOGY
(MECH 4141)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: 10 × 1 = 10
- (i) Non-consumable electrode is used in
 (a) Gas metal arc welding (b) Plasma arc welding
 (c) Flux cored arc welding (d) None of these.
- (ii) Electrode used in resistance welding is made of
 (a) Al base alloys (b) Cu base alloys
 (c) Stainless steel base (d) M.S. base.
- (iii) Preheating before welding is done to
 (a) prevent plate distortion
 (b) make the plate softer
 (c) burn away oil, greases etc. from the plate surface
 (d) prevent cold cracks.
- (iv) A Granular fusible flux is used for shielding the arc in
 (a) TIG welding (b) MIG welding
 (c) Submerged Arc Welding (d) Flux Cored Arc welding.
- (v) Electron Beam Welding is carried out in
 (a) Shielding gas environment (b) Vacuum
 (c) a pressurised inert gas chamber (d) Open air.
- (vi) In Ultrasonic welding the frequency range is generally
 (a) 100 to 400 Hz (b) 500 to 5000 Hz
 (c) 6000 to 20000 Hz (d) 20000 to 50000 Hz.

- (vii) The residual stress generated due to welding can be removed by
 (a) preheating
 (b) post weld heat treatment
 (c) using inert gas during welding
 (d) keeping a slow welding speed.
- (viii) The width of HAZ of plain carbon steel increases during fusion welding if
 (a) welding speed increases (b) welding speed decreases
 (c) arc current decreases (d) both (a) and (c).
- (ix) Toughness can be measured by
 (a) visual inspection (b) destructive test
 (c) non destructive test (d) torsion test.
- (x) The PWHT is required to
 (a) reduce residual stress
 (b) reduce HAZ
 (c) remove the cracks developed
 (d) increase the tensile strength.

Group - B

2. (a) Briefly explain the Flux-cored arc welding (FCAW) process mentioning its advantages.
 (b) What are the applications of Submerged arc welding (SAW) and how is it different from the inert gas shielded metal-arc welding process? Explain how a tube can be manufactured from sheet by a suitable welding process.
6 + (4 + 2) = 12
3. (a) The voltage-length characteristic of a dc arc is given by $E = (20 + 4l)V$, where l = length of the arc in mm. During a welding operation, it is expected that the arc length will vary between 4 mm and 6 mm. It is desired that the welding current be limited to the range 450 – 550A. Assuming a linear power source characteristic, determine the open circuit voltage and the short circuit current of the power source.
 (b) Explain the process of diffusion welding .
6 + 6 = 12

Group - C

4. (a) Describe the Electron Beam Welding process with a schematic diagram.
 (b) Explain various types of lasers used in the Laser Beam Welding (LBW) process. What are the applications of LBW?
6 + (4 + 2) = 12
5. (a) Explain the process of Friction Stir Welding (FSW) process with a schematic diagram. What are the process parameters of FSW?
 (b) What are the advantages of FSW process? Is it possible to use a vertical milling machine for FSW? Justify your answer.
(4 + 2) + (3 + 1 + 2) = 12

Group - D

6. (a) Write down the three zones of fusion welding. Briefly describe the metallurgical and mechanical properties of HAZ during the fusion welding of plain carbon steel.
 (b) What is post weld heat treatment? What are the reasons for doing heat treatment after welding?
(1+7) + (2+2) = 12
7. (a) What is weldability? Discuss briefly about the weldability of stainless steel.
 (b) Write a short note on welding automation.
 (c) When is pre heating done in low carbon steel?
(1 + 5) + 4 + 2 = 12

Group - E

8. (a) Discuss briefly the sources of welding defects.
 (b) Write down the causes and effects of 'lack of fusion' as a defect of welding process
 (c) Write down the names of different types of inspection processes associated with welding.
6 + 4 + 2 = 12