ME 512 Welding and Additive Manufacturing (3-0-0-6)

Introduction to welding processes; Classification of joining processes; Type of welds and weld joints; Welding symbols and codes; Arc welding processes; Laser welding; Electron beam welding; Resistance spot welding; Friction welding; friction stir welding; Types of power sources, Current-voltage and arc power – arc length characteristics; Synergic and pulsed welding; Forces on molten droplet, Mode of metal transfer in arc welding; Cold metal transfer. Analysis of heat flow, Cooling rates; Models for welding heat sources, Analytical solution of temperature distribution; Chemical reactions in welding; Solidification in welding and solidification cracking; Phase transformation in welded structure; Weld microstructure; Heat treatment of weld joint; Types of welding defects, their cause and remedies; Distortion and residual stress and their measurement; Weld testing methods: destructive and non-destructive; Analysis of welded structure for fatigue loading; Additive manufacturing: Introduction; Classification; Principle, Welding technology based metal 3D printing; Solid state additive manufacturing, Additive vs. subtractive manufacturing.

Text/References

1. A. O'Brien, Welding Handbook: Welding Processes, Part 1, Vol. 2, 9th Ed., American Welding Society, 2007
2. J. F. Lancaster, The Physics of welding, Pergamon, 1986
3. R. W. Messler, Principles of Welding, John Wiley and Sons, 1999
4. S. Kou, Welding Metallurgy, 2nd Ed., Wiley Interscience, 2003
5. V. M. Radhakrishnan, Welding technology and design, New Age International Private Ltd., 2nd Ed., 2005
6. R. S. Parmar, Welding Processes and Technology, Khanna Publishers, 3rd Ed., 2015
7. J. A. Goldak, Computational Welding Mechanics, Springer, 2005
8. W Steen, Laser Material Processing, Springer-Verlag, 1991.
9. I Gibson, D. W. Rosen, B. Stucker, Additive Manufacturing Technologies, Springer, 2010.