|  |  |  |  |
| --- | --- | --- | --- |
|  SUBJECT----- ADVANCE WELDING AND CASTING TECNOLOGY **- PhD student****Dr.shawnim R.jalal** |  |  |  |
|  |  |  |
| **Objective**1. To gain theoretical and practical knowledge in material casting processes and develop an understanding of the dependent and independent variables which control materials casting in a production setting. 2. Introduce students to good foundry practices and product design considerations. 3. Provide an overview of joining processes; discuss in detail the weld the welding process and the physics of welding. Introduce students to different welding processes weld testing and advanced processes to be able to appreciate the practical applications of welding.  |
| **Learning Outcomes:**

|  |
| --- |
| Ability to specify and select manufacturing processes involving material addition. To design simple patterns and pattern plates for the casting process. To specify and select foundry and welding equipment. To evaluate cause-effect relationship between processing variables and the final product. To identify and establish correcting measures to eliminate casting and welding defects. To select casting and welding processes. |

Frensessre-1. A Ghosh and A K Mallik, *Manufacturing Science*, Wiley Eastern, 1986. 2. P Rao, *Manufacturing Technology: Foundry, Forming And Welding*, Tata McGraw Hill, 2008. 3. M.P. Groover, *Introduction to manufacturing processes*, John Wiley & Sons, 2012 4. Prashant P Date, *Introduction to manufacturing technologies Principles and technologies*, Jaico publications, 2010 (new book)5-. J S Campbell, *Principles Of Manufacturing Materials And Processes*, Tata McGraw Hill, 1995.6. P C Pandey and C K Singh, *Production Engineering Sciences*, Standard Publishers Ltd., 2003.7. S Kalpakjian and S R Schmid, *Manufacturing Processes for Engineering Material*s, Pearson education, 2009.8-Modern welding technology by Howard.B.cary 2002.9-Welding metallurgy vol.1 by George E.lInnert,2004.10-Eng.metallurgy part1 by Higgins 2009. |

|  |
| --- |
|  |
|  |
| **COURSE DETAIL** |
|

|  |  |
| --- | --- |
| **Sl. No**  | **Topic** |
| 1. | **Introduction:** Evolution of welding; classification of welding processes; heat sources and shielding methods. |
| 2. | **Physics of Welding Arc** Welding arc; voltage distribution along the arc; thermionic and non-thermionic cathodes; theories of cathode and anode mechanism; arc characteristics and its relationship with power source; arc efficiency; heat generation; effect of type of shielding gas on arc; isotherms of arcs. |
| 3. | **Welding Power Sources** Conventional welding power sources; constructional features; static and dynamic characteristics; duty cycle; influence of inductance on arc and power source characteristics; internal and external regulation; specific power source requirements; special welding power sources. |
| 4. | **Arc Welding Processes** Consumable electrode welding processes. Manual metal arc (MMA) welding; Gas metal arc welding; pulsed MIG welding; Submerged arc welding, Significance of flux-metal combination; Electroslag welding: heat generation; principle; Gas tungsten arc welding; selection of polarity, Plasma arc welding; transferred and nontransferred plasma arc welding; selection of gases; welding parameters; keyhole technique. |
| 5. | **Heat flow in welding** Effect of welding parameter on heat distribution; calculation of peak temperatures; thermal cycles; cooling rate and solidification; Residual stresses and their distribution in welds; influence of residual stresses in static and dynamic loading, distortion |
| 6. | **Design of weld joints** Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading, Weld Calculations in lap, butt and fillet welds; design for fatigue loading, Introduction to Fatigue; nature of the fatigue process; fatigue strength; factors affecting fatigue life; improvement methods for fatigue strength; reliability analysis and safety factors applied to fatigue design. |
| 7. | **Testing and inspection of weld joints** Chemical tests; Metallographic tests; Hardness tests; Mechanical test for groove and fillet welds-full section, reduced section and all-weld- metal tensile tests, root, face and side bend tests, fillet weld break tests, creep & fatigue testing. Non-Destructive Testing of Weldments; Visual inspection; Dye-penetrant inspection; Magnetic particle inspection; Ultrasonic inspection-principle of ultrasonic testing, Radiographic inspection –principle of radiography, X-ray tubes, gamma-ray sources, defect discernibility; Eddy current inspection; Leak tests: N.D.T. Standard procedure for specification and qualification of welding procedure; WPS and PQR, WPQ |
| 8. | **Weldability of metals** Solidification of weld metal; heat affected zone (HAZ), factors affecting properties of HAZ; gas-metal, slag-metal and solid state reactions in welding and their influence on soundness of weld joint; lamellar tearing and hydrogen damage; weldability; definition, factor affecting the weldability of steel Carbon equivalent. weldablity of steel, cast iron and aluminium alloys of commercial importance, failure analysis of welded joints. |
| 9 | **Module: casting**Foundry technology: Introduction to the casting process Moulding processes: sand moulding, ceramic moulding, permanent moulding (die-casting, high and low-pressure die-casting, squeeze-casting)  |
| 10 |

|  |  |
| --- | --- |
| **Casting Processes**  |  |
| Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell Moulding, Co2 Moulding, continuous casting-squeeze casting, electro slag casting, Fettling and finishing, defects in Castings, Casting of non-ferrous materials  |
|  |  |
|  |  |
|  |

 |
| 11 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|

|  |  |
| --- | --- |
| **Melting, Pouring and Testing**  |  |
| Melting furnaces- -crucibles oil fired furnaces-electric furnaces-cupola, selection of furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques casting defects and Inspection of castings.  |

 |  |
|  |

 |
| 12 |

|  |  |
| --- | --- |
|  |  |
| **Casting defects**: classification and identification of casting defects; analysis of casting defects - possible causes and solutions to avoid themIntroduction to casting design; riser and gating design; numerical simulation of the casting process |

 |

 |
|  |   |
|  |  |
|  |  |