E5: Charpy Impact Test

1. **Objective:**
   (a) To study the impact resistance of metals using Impact testing machine of the Charpy type.
   (b) To determine the variation of impact strength of a material with change in temperature.
2. **Theory/Background (related to the experiments):**

   Impact strength is the resistance of materials to sudden loads or impacts. Impact testing is used to determine the energy absorbed by a specimen when broken by a hammer blow and can provide information about the material's brittleness. Temperature can also affect a material's impact strength. The toughness of a material can be determined by measuring the area under the stress-strain curve in a static tensile test. Impact testing can also be used to determine the transition temperature at which a material changes from ductile to brittle behavior.

   The impact load can be applied in various ways, such as allowing a standard mass to fall on a specimen from increasing heights until fracture occurs. In laboratory testing, Charpy and Izod impact tests are commonly used. In the Charpy test, the specimen is supported as a simply supported beam and a notch is cut across the middle of one face, and the mass hits the opposite face directly behind the notch. In the Izod test, the specimen is a cantilever, clamped upright in an anvil, with a V notch at the level of the top of the clamp. These notched specimens are fractured with a standard blow from a pendulum hammer and energy absorbed is measured. Other types of specimens such as tension, shear or torsion can be used with special testing machines. However, the distribution of stress throughout the impact test specimen is not known and the test results are mainly comparative and have some correlation with the fracture toughness.

   The appearance of the fracture surface changes as the temperature is reduced through the transition range. At higher temperatures, the fracture surface has a 'fibrous' or 'silky' appearance with significant distortion at the sides. As the temperature decreases, the fracture surface becomes completely crystalline in appearance with minimal distortion. There is a strong correlation between the energy absorbed and the proportion of the cross-section that deforms in fracture. The fracture surface is often described in terms of the percentage of its area that appears crystalline. As the temperature decreases, the amount of crystallinity on the fracture surface usually increases.
3. **Equipment Required:**
   (a) Impact testing machine and Scale
   (b) Standard charpy specimens
   (c) Furnace and thermocouple
   (d) Liquid nitrogen.
4. **Experimental Method:**
   (a) Note down the dimensions of the specimen and find the working area of the specimen at the place of notch.
   (b) With no specimen on the anvil, raise the pendulum to an initial reading R1 in the dial and release it.
   (c) Note the reading R2 of the dummy pointer on the dial. The difference is the energy loss due to friction.
   (d) Now place the specimen accurately in position on the anvil.
   (e) Raise the pendulum to the same initial height and release. The pendulum swings to the other side rupturing the specimen.
   (f) Note the reading R3 on the dummy pointer on the dial. Tabulate the reading
   (g) Repeat the procedure for change in temperature and examine the variation of impact strength.
5. **Expected outcomes:**
   (a) Find out the energy loss due to friction in joule.
   (b) Find out the energy of rupture in J for various specimens.
   (c) Find the impact strength, Energy absorbed / area, (J/m2)
   (d) Plot the variation of impact strength with the change in temperature.
   (e) Write your observations in a bulleted list based on the data you obtained and the results computed from that data.