Note: Answer five questions, each branch 10 marks

Q1/A - Calculate the heat affected zone (HAZ) width $Y_z$ if the $T_p = 700^\circ C$

$E = 20V, I = 200A, V = 5mm/s, T_0 = 25^\circ C, T_m = 1510^\circ C$

$\rho c = 0.0044J/mm^3. ^\circ C, t = 5mm, f_1 = 0.9$

B - How to avoid the reheating cracking, explain its mechanism?

Q2/A - Calculate the strength of precipitation hardening $\sigma_{ppt}$ hard due to Ashby-Orowan equation, during welding of microalloyed normalized steel, which have the mean-plane-intercept path of precipitation of 200 nm($\bar{x}$) and volume fraction of $0.5(\nu_f)$

B - The additional stresses due to phase transformation by welding thermal cycles well interact with the quenching and shrinkage stresses, explain with sketches?

Q3/A - The combination of residual stresses and strains imposed at high temperature may result in distortion of welded parts, explain in sketches?

B - The elastic portion of the stress-strain curve is non-linear due to residual stresses in weld, explain why?

Q4/A - What are the Rosenthal assumption to estimate the heat-flow equations.

B - The particular path of the electrode to avoids cracks at the edges of plates which can constitute high risk cracking area, explain why with sketches?

Q5/A - A plate of 8% Ni steel is welded with an inconel welding wire of composition 85% Ni and 15% Cr, what will be the approximate composition of the final weld if there is 40% dilution?

B - Epitaxial growth in welding from the base metal is likely to occur initial by the development of planar growth front, explain the effect of growth angle ($\theta$) on planar growth?

Q6/A - For heat resistant steel of composition 0.4% C, 1.2% Mn and 0.5% Mo, calculate the preheating temperature for a plate of 100 mm thickness.

B - By dilution and even diffusion process alloying are obtained from metal deposition and air, explain that for welding in sketches?