

**AE-681 Composite Materials**  
**Assignment No. 3**

**Q. 1** For plane stress constitute equations in principal material directions we have the relations  $Q_{ij} = C_{ij} - \frac{C_{i3} C_{3j}}{C_{33}}$  for  $i, j = 1, 2, 6$ . Using these relations and  $C_{ij}$  in terms of engineering constants, show that:

$$Q_{11} = \frac{E_1}{1 - \nu_{12} \nu_{21}}, \quad Q_{12} = \frac{\nu_{21} E_1}{1 - \nu_{12} \nu_{21}} = \frac{\nu_{12} E_2}{1 - \nu_{12} \nu_{21}},$$
$$Q_{22} = \frac{E_2}{1 - \nu_{12} \nu_{21}}, \quad Q_{66} = G_{12}$$

**Q. 2** For material id that you have got in Assignment No. 2, plot the  $\bar{Q}_{ij}$  against fibre orientation from  $-90^\circ$  to  $+90^\circ$ .

Plot 1:  $\bar{Q}_{11}$ ,  $\bar{Q}_{22}$  and  $\bar{Q}_{66}$

Plot 2:  $\bar{Q}_{12}$ ,  $\bar{Q}_{16}$  and  $\bar{Q}_{26}$