

MECHANICAL ENGINEERING DEPARTMENT

MCL 133 – Near Net Shape Manufacturing
Major, 10th May 2018, Duration 2 hr (8.00 pm-10.00 am), LHC-416

MAX MARKS 40

- Q1. For a 30° graphite epoxy lamina having $E_1 = 181$ GPa, $E_2 = 11$ GPa, $G_{12} = 9$ GPa, and $\nu_{12} = 0.3$;
- a) Find the transformed compliance and stiffness matrix (5)
- b) Find the strains in the x-y coordinate system, if the applied stresses are $\sigma_x = 12$ MPa, $\sigma_y = -5$ MPa, $\tau_{xy} = 2$ MPa (5)
- c) Find the maximum value of $S > 0$, if a stress of $\sigma_x = 4S$, $\sigma_y = 3S$ and $\tau_{xy} = -2S$ is applied to above lamina. Use Tsai-Hill failure criterion and compare the results with Max Stress failure criterion. The strengths of the lamina are given below:
 $X_t = 1500$ MPa; $X_c = 1500$ MPa; $Y_t = 40$ MPa; $Y_c = 246$ MPa; $S = 68$ MPa (5)
- Q2. a) An aligned short glass fiber composite tensile specimen consists of 30 vol % of fibers of length 1.5 mm and diameter 10 μ m in a polycarbonate matrix. The tensile strength of the fibers and the shear strength of the fiber matrix interface are 3 GPa and 15 MPa respectively. Calculate the critical fiber length, l_c and then estimate the longitudinal tensile strength of the composite specimen given that the stress on the matrix at the failure strain of the fibers is 30 MPa. (5)
- b) A motorcycle helmet shell is made of chopped glass fiber reinforced polyester with a fiber volume fraction of 25% by compression molding process. The chopped fiber length is 11 mm in the final product and the fiber diameter is 12 micron. Calculate the Elastic modulus, Shear modulus and Poisson's ratio of the helmet shell, when $E_m = 3.0$ GPa for polyester and $E_f = 72$ GPa for Glass fiber. The Poisson's ratio for polyester is 0.20 and for glass fiber it is 0.33. (5)
- Q3. a) If no gate mark is allowed on the outside surface of a bottle cap having internal threads and no weld line is permitted on the threaded portion, can you visualize and draw the schematic layout of the multi cavity injection mold for this near net shape product with core, cavity and ejection system for mass production (10)
- b) Write brief (to the point) notes on the following; (5)
- Advantages Vs Disadvantages of:
- Discontinuous vs continuous reinforcements in a lamina or any NNS product
 - Filament winding vs Braiding
 - Mold flow analysis in RTM vs Injection molding
 - Push-pull injection molding vs Vibratory Injection molding
 - Vacuum Bag molding vs Compression Molding