Semester 7th Semester MME (JUT)
Composite Materials

(Marks-100/3 hours) (Answer any 5 questions)

1	It is desired to fabricate a continuous and aligned glass fiber reinforced polyester having a tensile strength of 1400 MPa in the longitudinal direction. The maximum possible specific gravity is 1.65. Determine if such composite is possible, using the following data. Specific gravity and tensile strength of glass fiber is 2.50 and 3500 MPa, Specific gravity and tensile strength of polyester is 1.35 and 50 MPa. Assume a value of 15 MPa for the stress on the matrix at fiber failure.
2	A continuous and aligned fiber-reinforced composite is to be produced consisting of 30 vol% aramid fibers and 70 vol% of a polycarbonate matrix; mechanical characteristics of these two materials are as follows: Modulus of elasticity E and ensile strength of Aramid fiber and polycarbonate are 131 GPa and 3.600 GPa, and 2.4 GPa and 65 MPa, respectively. Also, the stress on the polycarbonate matrix when the aramid fibers fail is 45 MPa. For this composite, compute a) longitudinal ensile strength, (b) longitudinal modulus of elasticity.
3	Also, in this composite, has a cross-sectional area of 320 mm^2 and is subjected to a longitudinal load of 44.500 KN, **(a)** Calculate the fiber–matrix load ratio. **(b)** Calculate the actual loads carried by both fiber and matrix phases. **(c)** Compute the magnitude of the stress on each of the fiber and matrix phases. **(d)** What strain is experienced by the composite?
4	A large-particle composite consisting of tungsten particles within a copper matrix is to be prepared. If the volume fractions of tungsten and copper are 0.60 and 0.40, respectively, estimate the upper limit for the specific stiffness of this composite given the data below: Copper: Specific gravity 8.9; Modulus of elasticity 110 GPa Tungsten: Specific gravity 19.3; Modulus of elasticity 407 GPa
5	Is it possible to produce a continuous and oriented aramid fiber-epoxy matrix composite having longitudinal and transverse moduli of elasticity of 57.1 GPa and 4.12 GPa, respectively? Why or why not? Assume that the modulus of elasticity of the epoxy is 2.4 GPa.

6	For a continuous and oriented fiber-reinforced composite, the moduli of elasticity in the longitudinal and transverse directions are 19.7 and 3.66 GPa, respectively. If the volume fraction of fibers is 0.25, determine the moduli of elasticity of fiber and matrix phases.
7	Compute the longitudinal strength of an aligned carbon fiber-epoxy matrix composite having a 0.25 volume fraction of fibers, assuming the following: (1) an average fiber diameter of 10×10^{-3} mm, (2) an average fiber length of 5 mm, (3) a fiber fracture strength of 2.5 GPa, (4) a fiber-matrix bond strength of 80 MPa, (5) a matrix stress at fiber failure of 10.0 MPa an, (6) a matrix tensile strength of 75 MPa
8	Compute the longitudinal tensile strength of an aligned glass fiber-epoxy matrix composite in which the average fiber diameter and length are 0.010 mm (4 ▯ 10 4 in.) and 2.5 mm (0.10 in.), respectively, and the volume fraction of fibers is 0.40. Assume that (1) the fiber-matrix bond strength is 75 MP, (2) the fracture strength of the fibers is 3500 MPa an, (3) the matrix stress at fiber failure is 8.0 MPa.