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BAS-022

B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

00996

June, 2015

BAS-022 : COMPOSITE MATERIALS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) What is the degree of polymerisation ? If a particular type of polyethylene has a molecular mass of 1,40,000 g/mol, what is its degree of polymerisation ? *5*

(b) Distinguish between the structure and the properties of thermosetting and thermoplastic resins. *5*

2. (a) What are some of the advantages of glass-fiber reinforced plastics ? *5*

(b) What are the differences in the compositions of E- and S glasses ? Which is the strongest and the most costly ? *5*

3. (a) What type of chemical bonding takes place within the aramid fibers ? What type of chemical bonding takes place between the aramid fibers ? 5

(b) What are two of the most important matrix plastics for fiber-reinforced plastics ? What are some advantages of each type ? 5

4. (a) Give examples of metal-matrix composites, and identify their advantages over polymer-matrix composites. 5

(b) Explain in brief the benefits from Non-Destructive Testing (NDT). Discuss X-Ray NDT. 5

5. (a) Define a composite material with respect to a material system. Give some suitable examples. 5

(b) What are the three main types of synthetic fibers used to produce fiber-reinforced plastic composite materials ? Describe in brief each of them. 5

6. (a) What are the processing steps for the production of carbon fibers from polycrylonitrile ? What reaction takes place at each step ? 5

(b) Describe the spray-up process for producing a fiber glass-reinforced part. What are some advantages and disadvantages of this method ? 5

7. (a) Distinguish between addition and condensation polymerisation and state which of these are applied for processing polyethylene and polycarbonates. 5

(b) A metal-matrix composite is made with 75 percent by volume of aluminum alloy 2124-T6 and 25 percent by volume of SiC whiskers. The density of the 2124-T6 alloy is 2·75 g/cm^3 and that of the whiskers is 3·12 g/cm^3. Calculate the average density of the composite material. 5

8. (a) It is generally true that fibers are stronger (in the length direction) than the bulk material from which they are made. Explain. 5

(b) Describe in brief Ultrasonic NDT. 5

9. (a) Describe the injection moulding process for plastics. How is it different from other thermoplastic forming techniques ? 5

(b) A unidirectional carbon-fiber-epoxy-resin composite contains 68 percent by volume of carbon fiber and 32 percent epoxy resin. The density of the carbon fiber is 1·79 g/cm^3 and the average density of the composite material is 1·60 g/cm^3. Determine

(i) the density of the epoxy resin,

(ii) the weight percentage of carbon fibers and epoxy resin in the composite. 5

10. Calculate the tensile modulus of elasticity of a laminate composite consisting of 62 percent by volume of unidirectional Kevlar 49 fibers and an epoxy matrix stressed under isostress conditions. The tensile modulus of elasticity of the Kevlar 49 fibers is 170 GPa and that of the epoxy is $3{\cdot}70 \times 10^3$ MPa. *10*
