

I SEMESTER M.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, FEBRUARY 2021

SUBJECT: AUTOMOTIVE MATERIALS AND STRUCTURES [AAE 5172]

REVISED CREDIT SYSTEM (22/02/2021)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.

1A.	With a neat sketch explain the Griffiths criterion.	(04)
1B.	Explain the crack growth stages. How the striations are formed on the surface of the fractured surface.	(03)
1C.	Explain the concept of slip plane formation.	(03)
2A.	List the material selection process from all materials selection to final materials of choice. With an example explain the material section process.	(05)
2B.	Explain the manufacturing process of cast-in-fit for a dry liner for cylinder block.	(03)
2C.	With a neat sketch explain the three modes of fracture failures.	(02)
3A.	What is the purpose of forming limit diagram? With a strain graph explain the	(04)
3B.	Explain the shape memory effect with the stress-strain-temperature graph.	(04)
3C.	Explain the procedure to determine the gel time for the resin.	(02)

- **4A.** Derive the equation for longitudinal strength for fiber-reinforced composite **(06)** lamina.
- **4B.** With a neat sketch explain the steps involved in the diffusion bonding. **(04)**
- **5A.** Find the in-plane shear modulus of a glass/epoxy lamina with a 70% fiber **(06)** volume fraction using the strength of material approach and Halpin-Tsai relationship. Use properties of glass and epoxy from Table1 and Table 2, respectively.
- 5B. Find the major and minor Poisson's ratio of a glass/epoxy lamina with a 70% (04) fiber volume fraction. Use the properties of glass and epoxy from Table 1 and Table 2, respectively.

Property	Units	Graphite	Glass	Aramid
Axial modulus	GPa	230	85	124
Transverse modulus	GPa	22	85	8
Axial Poisson's ratio	_	0.30	0.20	0.36
Transverse Poisson's ratio	_	0.35	0.20	0.37
Axial shear modulus	GPa	22	35.42	3
Axial coefficient of thermal expansion	µm/m/°C	-1.3	5	-5.0
Transverse coefficient of thermal expansion	µm/m/°C	7.0	5	4.1
Axial tensile strength	MPa	2067	1550	1379
Axial compressive strength	MPa	1999	1550	276
Transverse tensile strength	MPa	77	1550	7
Transverse compressive strength	MPa	42	1550	7
Shear strength	MPa	36	35	21
Specific gravity	_	1.8	2.5	1.4

Table 1 Typical Properties of Fibers (SI System of Units)

Property	Units	Epoxy	Aluminum	Polyamide
Axial modulus	GPa	3.4	71	3.5
Transverse modulus	GPa	3.4	71	3.5
Axial Poisson's ratio	_	0.30	0.30	0.35
Transverse Poisson's ratio	_	0.30	0.30	0.35
Axial shear modulus	GPa	1.308	27	1.3
Coefficient of thermal expansion	µm/m/°C	63	23	90
Coefficient of moisture expansion	m/m/kg/kg	0.33	0.00	0.33
Axial tensile strength	MPa	72	276	54
Axial compressive strength	MPa	102	276	108
Transverse tensile strength	MPa	72	276	54
Transverse compressive strength	MPa	102	276	108
Shear strength	MPa	34	138	54
Specific gravity	_	1.2	2.7	1.2

Table 2. Typical Properties of Matrices (SI System of Units)