Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: AUTOMOTIVE MATERIALS AND STRUCTURES [AAE 5101]

REVISED CREDIT SYSTEM
(20/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Briefly explain the Schmid factor and its orientation for the slip. **(03)**

1B. With a neat sketch explain the brittle and ductile fracture. **(03)**

1C. List the mechanism by which materials may be strengthened. **(02)**

1D. With neat sketch explain the modes of failures. **(02)**

2A. A material required for the visor safety helmet to provide maximum facial protection. Use the table 1. Apply the material selection strategy for the design requirement for helmet visor. **(06)**

Table 1 materials with fracture toughness

Materials	Avg. fracture toughness K1c MPa.$m^{1/2}$
Poly carbonate (PC)	3.4
Cellulose acetate (CA)	1.7
Polymethyl methacrylate (Acrylic, PMMA)	1.2
Polystyrene(PS)	0.9
Soda-Lime glass	0.6
Borosilicate glass	0.6

2B. With a sketch explain the cast-in-fit liner used with the cylinder dry liner. **(04)**

3A. With a microstructure and graph explain the shape memory effect. **(06)**

3B. List the advantages and disadvantages of piezo electric materials. **(02)**

3C. What is hydroforming process? **(02)**

4A. With a neat sketch explain the wet spinning process used for the manufacturing the fibers. **(05)**

4B. With a neat sketch explain the pultrusion process. **(05)**

5A. Find the longitudinal elastic modulus of a unidirectional glass/epoxy lamina with a 70% fiber volume fraction. Use the properties of glass and epoxy from Table 2 and Table 3, respectively. Also, calculate the ratio of load taken by fibers to that of the composite. **(05)**

Table 2 typical properties of Fiber

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 3 typical properties of Matrices

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

5B. Find the major and minor Poisson's ratio of a glass/epoxy lamina with a 70% fiber volume fraction. Use the properties of glass and epoxy from Table 2 and Table 3, respectively. **(05)**