Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem 2019-20
Course Code: CHE 401
Course Name: COMPOSITE MATERIALS
Program & Sem: B.Tech (All Programs) & VII OE

Date: 30.09.2019
Time: 1.00 PM to 2.00 PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks **(3Qx4M=12M)**

1. List the four technological aspects for the selection of material

2. Match the following application with the material property

(a)	Biomedical	:	(i) Strength to weight ratio
(b)	Handle in Utensil	:	(ii) Toughness
(c)	Marine applications	:	(iii) High melting point
(d)	Aerospace and automotive	:	(iv) Corrosion resistant

3. Fill in the blanks

(a) Two or more chemically different constituents combined macroscopically to yield a useful material called _____

(b) Granite is an example of _____ composite

(c) Discontinuous fiber is also called as _____

(d) Raw material used to produce graphite fiber is called _____

(Q.1to3)(C.O.NO.1)[Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries six marks. (3Qx6M=18M)

4. Even though Matrices having inferior properties than that of reinforcements, its physical presence is must. Give reasons

(C.O.NO.1)[Comprehensive]

5. Glass Fibers has poor adhesion to specific polymer matrix materials and prone to environmental degradation. Suggest treatments to enhance adhesion and prevent from environmental effects

(C.NO.O1)[Comprehensive]

6 (a) Reinforcements plays an important role in composites. On its basis, how are they classified. [4M]

(C.O.NO.1)[Comprehensive]

(b) Name the fiber which has high resistant to abrasion and why it finds application in clutches and brakes [2M]

(C.O.NO.1)[Application]

Part C [Problem Solving Questions]

Answer the Question. The Question carries ten marks (1Qx10M=10M)

7. Graphite fiber is produced from PAN:

(a) Expand PAN [2M]

(C.O.NO.1) [Knowledge]

(b) Explain the steps involved in the production of graphite fiber [5M]

(C.O.NO.1)[Comprehensive]

(c) Graphite fibers have negative co-efficient of thermal expansion. Justify [3M]

(C.O.NO.1) [Application]

SCHOOL OF Engineering

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: VII

Course Code: CHE 401

Course Name: COMPOSITE MATERIALS

Date: 30 SEPTEMBER 2019

Time: 1 HOUR

Max Marks: 40

Weightage: 20

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1-3	1	MODULE I	12		BLOOMS LEVEL 1							
4,5,6 a	1	MODULE I				16		BLOOMS LEVEL 2				
6b	1	MODULE I							2	BLOOMS LEV		

										EL 3		
7a, 7b,7c	1	MODULE I	2		2	5		2	3	Lev el 3	2	
	Total Marks		14			21			5			40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Dr. Anu Sukhdev]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: VII

Course Code: CHE 401

Course Name:

Date: 30 SEPTEMBER 2019

Time: 1 HOUR

Max Marks: 40 M

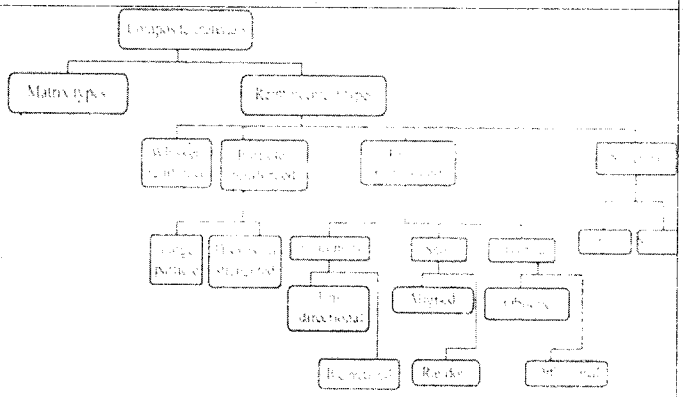
Weightage: 20

Part A (3Q x 4M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Mechanical, Physical, Chemical, manufacturing	1 Mark each	**2min**
2	(ii),(iii),(iv),(i)	1M each	**3min**
3	(a) Composite materials (b) Particulate composite (c)Staple (d) Precursor	1M each	**5min**

Part B (3Q x 6M = 18 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	• to give shape to the composite part • to keep the fibers in place • to transfer stresses to the fibers • to protect the reinforcement from the environment. such as chemicals & moisture • to protect the surface of the fibers from mechanical degradation	1M each	6min

	• to act as shielding from damage due to handling		
5	*sizes* are used to reduce degradation of fiber strength attributable to abrasion of fibers due to inter-fiber friction during fiber drawing process. They are also used to bind fibers for easy handling. They are made from starch-oils (starch, gelatin, polyvinyl alcohol, etc.). These sizes inhibit good resin-fiber adhesion. They also promote moisture absorption. fibers are coated with **coupling agents** (also known as finishes), which promote resin-fiber adhesion. These agents also inhibit deteriorating effects of humidity on the fiber-resin bond. Many of these agents are organo-functional silanes.	Sizes -3M Coupling - 3M	8min
6		Main classification -1M each Sub classification -2M each	6min

Part C (1Q x 10M = 10 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
7	(a) Polyacrylonitrile (b) 1. PAN material spun into coarse fiber form 2.Stabiliziation: Stretch the fiber by applying load 3. and simultaneously heating the fibre (200 -240 degree Celsius) for 24 hours	(a) 2M (b) 5M (1M each point) (c) 3M	15 min

	4. Pyrolysis:Heating to a temperature of 1500 degree Celsius (Carbonization – oxygen is completely removed 4. Graphitization: Heating to a temperature of 3000 degree Celsius where carbon is aligned in hexagonal planat form. (c) in the graphite plane bonds are covalent, whereas in between these planes there are weak vander waals bonds. When heat and temperature exists in these materials, the atoms vibrate mostly in the z direction (i.e. they go up and down). However, they also pull on the neighbouring atoms, bringing them closer to each other. This constricts the material in the x and y directions, making it appear shorter. (ie; when it is heated, it will shrink in length and it becomes fatter).		

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 | **Date**: 18.11.2019

Course Code: CHE 401 | **Time**: 1.00 PM to 2.00 PM

Course Name: COMPOSITE MATERIALS | **Max Marks**: 40

Program & Sem: B.Tech & VII (OE) | **Weightage**: 20%

Instructions:

(i) Read the question properly and answer accordingly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks. (3Qx4M=12M)

1. What are called Primitive composites?

2. Match the following matrix materials with the operating temperature

(a)	Polymers	:	(i) 260 – 750 °C
(b)	Metal	:	(ii) 750 -1150 °C
(c)	Glass	:	(iii) 1150 -1400 °C
(d)	Ceramics and Carbon	:	(iv) 260 °C

3. Fill in the blanks

(a) _____ is one method which helps us to produce good quality composites in a way that fibers do not dislodged from their original position

(b) _____ is a continuous composite fabrication process where continuous reinforcing fibers are impregnated with thermosetting matrix and are pulled through a heated die to form composite profiles

(c) Molten form of short fiber thermoplastic composite is injected through the passage. This process is known as _____

(d) Ceramic matrices are bonded to _____fiber which can withstand high temperature.

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries six marks. (3Qx6M=18M)

(C02)[Comprehensive]

4. Justify why metals are used as matrices in composites. List any two metal based matrices used in composites.

5. What are the considerations taken into account while choosing the matrix materials in composite.

6. Young's modulus of thermo and thermoset polymers changes with temperature. Justify

Part C [Problem Solving Questions]

Answer the Question. The Question carry ten marks (1Qx10M=10M)

(C03)[Application]

7. What is a good fabrication process? Describe the bag molding process for the fabrication of thermoset composites with a neat sketch

SCHOOL OF Engineering

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: VII

Course Code: CHE 401

Course Name:

Date: 18 NOVEMBER 2019

Time: 1 HOUR

Max Marks: 40

Weightage: 20

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1-3	2	MODULE 2	12		BLOOMS LEVEL 1							
4-6	2	MODULE 2					18	BLOOMS LEVEL 2				
7	2	MODULE 2								BLOOMS LEV	10	

										EL 3		
	Total Marks		12					18			10	40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines. [Dr. Anu Sukhdev]

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: VII

Course Code: CHE 401

Course Name:

Date: 18 NOVEMBER 2019

Time: 1 HOUR

Max Marks: 40 M

Weightage: 20

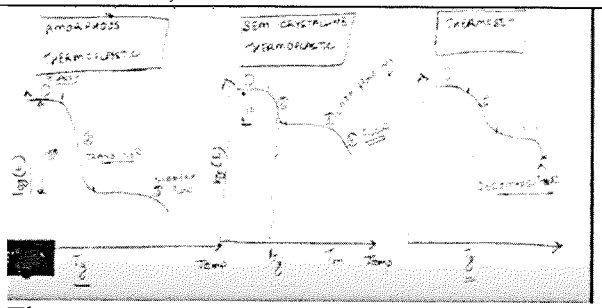
Part A (3Q x 4M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Primitive composites 1. Bulk material compound: it is a mixture of resin+fiber+additives (hardener/curing agent). This mixture is semicured to give BMC (dough)	1 Mark each	**5min**

	1. Sheet material compound: It is a mixture of resin and fiber (Fibers are arranged as sheet-continuous)and additives 2. Prepegs : resin + fabric (sheet form having fibers in both directions)-fibers are highly oriented. Don't require lot of additives All the above are semicured. They are stored at low temperatures during transportation (5 to 15 degree Celsius		
2	(iv),(i),(ii),(iii)	1M each	**3min**
3	(a) Resin transfer molding (b) Pultrusion (c)Injection molding (d) Silicon carbide/Boron tri nide	1M each	**5min**

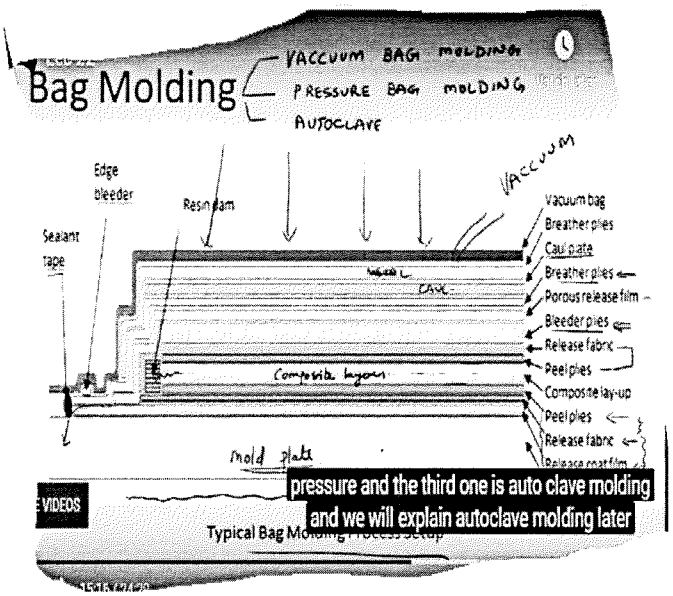
Part B (3Q x 6M = 18 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
4	Titanium and aluminium based metal matrices. Strength Stiffness Toughness (ability of material to absorb lot of energy) Impact strength Use temperature (go upto 1000 degree Celsius)	2+4	8

	Resistance to many environmental factors (UV radiation) –not 100 percent true statement		
5	Specific gravity Mechanical properties, Viscosity, melting temperature, curing temperature, reactivity with fibers, reactivity with ambient environment, cost	Any 6 considerations (1M each)	6M
6	 Thermosets: Before Tg, not much change but after Tg, significant change in material property, (material breaks down rapidly after Tg is crossed) We should not exceed glass transition temperature Amorphous thermo plastics: If T > Tg, Significant change in properties observed (polymer chain breaks , material starts flowing). No need to wait till Tm Maximum operating temperature should never exceed Tg Semicrystalline thermoplastics: If T< Tg, not much change in the material property If Temperature > Tg < Tm (some change in material property, still material can be used but if Temperature exceeds Tm, material melts and star flowing and becomes unusable. Maximum operating temperature of the material should be less than Tm can exceed Tg	2 M each	8 min

Part C (1Q x 10M = 10 Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
7	1.Matrix material is fully cured Properties will vary in the non cured position For curing heat is supplied	Diagram 4 M Explanation 4M Any two points 2M	

	May be uniform temperature is not received 2. Fibers maintain their shape and orientation 3. Good adhesion between fiber and matrix Sheet of composite 4. Air and porosity should be minimum 5. Residual forces should be manageable Bag molding process is suitable for long continuous fibers (Mats, tapes, reels, sheet mats with randomly oriented short fibers) • Prepregs (semi cured matrix and continuous fiber in mat form) • We have a mold and put fibers layer by layer, matrix between fiber • Entire thing put it into bag and part of the bag is connected to vacuum • All the air in the system is sucked out, porosity becomes less • Parallely, apply heat and vacuum (pressure) curing takes place at a faster rate and get higher density and consistent material • Entire set up is put under a plastic bag 		

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: CHE 401
Course Name: COMPOSITE MATERIALS
Program & Sem:: B.Tech (All Programs) & VII (OE-II)

Date: 26 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 4 marks. (6Qx4M=24M)

1. List the properties one can achieve by forming a composite material (C.O.No.1) [Knowledge]
2. Name the types of fibers used as reinforcements in composite (C.O.No.1) [Knowledge]
3. Glass fibers are widely used reinforcement material for commercial plastics. Why? (C.O.No.1) [Knowledge]
4. Define the following terms in fiber science: Staple fiber, Strand (C.O.No.2) [Knowledge]
5. What are the advantages and limitations of filament winding process of fabrication? (C.O.No.2) [Knowledge]
6. What are the parameters need to know to predict the failure in the unidirectional composite? (C.O.No.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 6 marks. (6Qx6M=36M)

7. Describe with a neat labelled diagram, the process of fabrication of composite which is used for the production of large components like swimming pool (C.O.No.2) [Comprehension]
8. Explain the roles of constituents in composite material (C.O.No.1) [Comprehension]
9. Compute mass fraction and volume fraction for composites (C.O.No.3) [Comprehension]
10. A continuous and aligned fiber-reinforced composite having a cross-sectional area of 1130 mm^2 is subjected to external tensile load. If the stresses sustained by the fiber and the matrix phases are 156 MPa and 2.75 MPa respectively, the force sustained by the fiber phase is 74,000 Newtons. Determine the force sustained by the matrix phase (C.O.No.3) [Comprehension]

11. Explain the steps involved in the production of glass fiber (C.O.No.1) [Comprehension]

12. Draw the stress-strain diagram for the failure mode of matrix and fiber materials

(C.O.No.3) [Comprehension]

Part C [Problem Solving Questions]

Answer any two Questions. Each Question carries 10 marks. (2Qx10M=20M)

13. Derive the mathematical expression to calculate the longitudinal modulus for unidirectional composite (C.O.No.3) [Application]

14.

a). Explain the pultrusion process of fabrication of composites.

b). How is it different from extrusion?

c). What are the factors that has to be taken into account during pultrusion. Name the components that can be produced by pultrusion. (C.O.No.2) [Application]

15. A polymer –matrix composite is unidirectionally reinforced with 65 Vol.% of E-glass fibers. The elastic moduli of the matrix and the fiber are 5.9 GPa and 70.4 GPa, respectively. Describe the elastic modulus of the composite parallel to the fiber direction in GPa. If a load of 100 Kg is applied on the composite parallel to the fiber direction, find the load carried by the fibers in Kg (C.O.No.3) [Application]

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	1	Module 1	12	12	-	24
2	2	Module 2	8	6	10	24
3	3	Module 3	4	18	10	32
4						
5						
6						
	Total Marks					

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: CHE 401
Course Name: Composite materials
Program & Sem: B Tech (VII Sem)

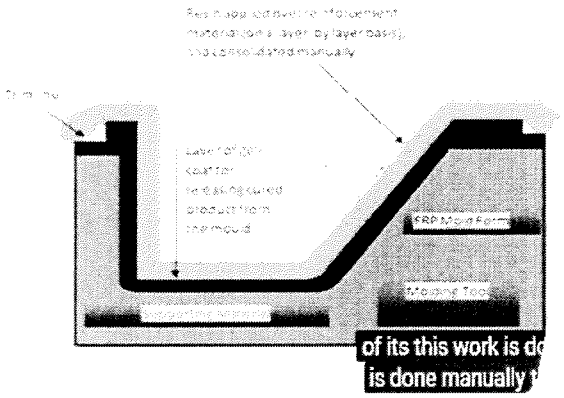
Date: 26.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

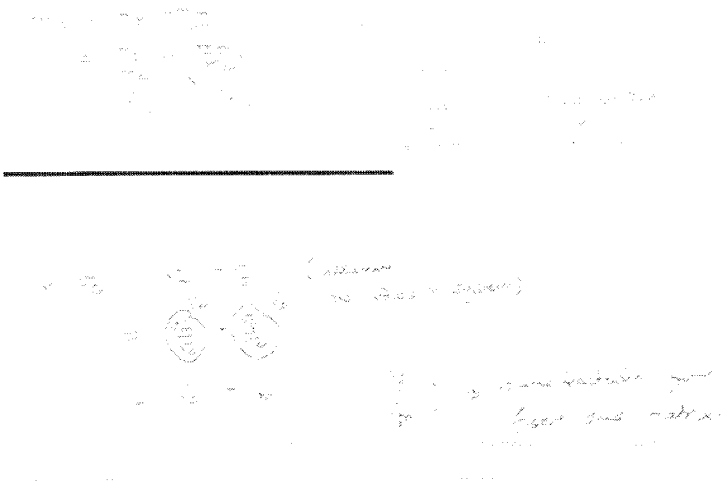
Part A (6Q x 4M = 24Marks)

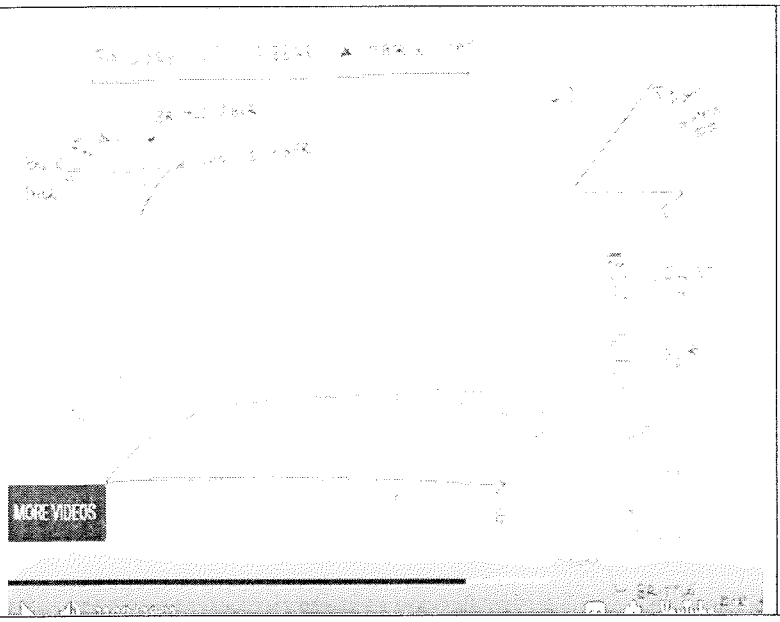
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	The following properties can be improved by forming a composite material: Strength (Stress at which a material fails) Stiffness (Resistance of a material to deformation) Wear & Corrosion resistance Fatigue life (long life due to repeated load) Thermal conductivity & Acoustical insulation Attractiveness and Weight reduction	**1M each (any 4 points)**	**8 min**
2	• Organic fibres – Carbon (graphite), nylon, aramid • Inorganic fibres-glass, graphite, Ceramics, Stainless steel fibre, wires of tungsten	**2M each**	**8 min**
3	• Exhibit low specific gravity, high strength and stiffness, good dimensional stability, resistance against heat,cold, moisture and corrosion • Available at relatively low cost	**1M each**	**8 min**
4	• Staple fiber : Represents discontinuous fiber • Strand : Represents a collection of untwisted fibers (filament) approximately 100 to 200 in numbers.	**2M each**	**8 min**
5	• Automate it easily • Product is high strength (fibers are in tension – tight) • Different sizes and shapes • Layer by layer control of fiber orientation • Limitation: • Reverse curvature parts are not easy to produce • Surface finish is not always great • Zero and 90 degree is difficult to achieve	**2M each (any two points each)**	**8 min**
6	• 1. Longitudinal tensile strength • 2. Longitudinal compressive strength • 3. Transverse tensile strength • 4. Longitudinal compressive strength	**1M each (any 4 points)**	**8 min**

	• 5. In plane shear strength (LT specifies the plane in which shear stress is applied)		

Part B (6Q x 6M = 36Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
7	 To make the shape, general procedures: MOLD FIBER LAY UP MATRIX PRESSURE AND HEAT FINISHING • As the name suggest, lot of manual labour is involved in the process • Placing the fibers is done manually • Oldest process • Less expensive • We use this process when we have to make small number of parts (5 parts of the same shape, we can use this process) but it is expensive if we have 50000 parts • Less capital (money use to produce tools, machinery) • Ducts, furniture, swimming pool, boats, shells, sheets	Diagram 3M Explanation 3M	12
8	**Role of Reinforcements:** Reinforcements give high strength, stiffness and other improved mechanical properties to the composites. Also their contribution to other properties such as the co-efficient of thermal expansion , conductivity etc is remarkable **(ii) Role of Matrices:** Even though having inferior properties than that of reinforcements, its physical presence is must; • to give shape to the composite part • to keep the fibers in place • to transfer stresses to the fibers • to protect the reinforcement from the environment, such as chemicals & moisture • to protect the surface of the fibers from mechanical degradation	3M each	12 min

	• to act as shielding from damage due to handling		
9		3M each	12 min
10	Vf = 0.4198 Vm= 0.5802 Force sustained by matrix phase = 1.803 N	2M each	12 min
11	Both, continuous and staple forms of glass fibers are produced by partiallysimilar method. • Process of producing continuous fibers: • – Raw materials (sand, limestone, alumina) are mixed and melted in a furnace at approximately 1260 C. • Molten glass then either flows directly into a fiber-drawing facility. This process is known as "directmelt" process. Most of fiber glass in the world is produced this way Or gets formed into marbles. These marbles are later fused, and drawn into fibers. For producing continuous fibers, molten glass passes through multiple holes to form fibers. These fibers are quenched through a light spray of water. Subsequently, fibers are coated with protective and lubricating agents • Next fibers are collected in bundles known as "strands". Each strand may have typically 204 individual fibers. • Next, strands wound on spools. Fibers in these spools are subsequently processed further to produce textiles. Note : Fibers in the spools (or) reels are converted into fabric/ yarn/tape Fabric may or not be unidirectional;	3M each	12 min

12		3M each	12 min

Part C (0Q x 0M = 0Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
13	$P_C = P_f + P_m$ Deduce in terms of cross section Deduce in terms of volume fraction Compute EL Compute E_L / E_m	2 M each	15min
14	• Short fiber composites and continuous fiber composites can be produced • Short fiber – thermo plastic • Continuous fiber –thermoset • Using pultrusion process how short fiber composites are produced? • Bars, tubes, pipes, rods • It is similar to extrusion (cross section of tool and final product will be same) Push the material and pull from the other end-typically used in metals • In pultrusion (rather than pushing we pull it) • factors that needed to be taken into account such as resin viscosity, fibre fraction, die temperature, resin polymerization and pulling speed.	4+2+2+2	15 min
15	Formula $E_C = E_f V_f + E_m (1-V_f)$ Calculate E_c Formula for ratio of load carried by fibers and that can be carried by composites Deducing in terms of volume fraction Calculate P_f	2 M each	15 min