GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Metallurgy
Subject Code : BE05021071
Subject Name: Composite Materials & Seminar

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	**Nil**
Rationale:	The course on Composite Materials is designed to equip metallurgical engineers with the knowledge required to meet the demands of modern engineering applications. Rapid technological advancements increasingly require materials that offer high strength, superior corrosion resistance, enhanced fatigue and creep performance, and high stiffness while maintaining low density—key attributes for sectors such as automotive, aerospace, space technology, and sports equipment manufacturing. This course provides comprehensive coverage of various classes of composite materials, including their constituent phases, manufacturing processes, properties, and testing methods, along with their practical applications across multiple industries. It also introduces state-of-the-art fabrication techniques and offers an overview of emerging materials such as hybrid composites, green composites, and nano-composites, which represent current research trends.

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Course Outcome:

After Completion of the Course, Student should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understanding of the classification, fabrication methods, and applications of various composite materials.	50
CO-2	Interpret strengthening and toughening mechanism of composite materials.	20
CO-3	Evaluate and select suitable composite materials for given applications based on performance requirements, service conditions, and material characteristics.	30

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	PBL* (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End Semester Examination, PA = Progressive Assessment

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*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Course Content:

Sr. No.	Content	No. of Hours	% of Weightage
1	**Introduction to Composites**: Matrices, Reinforcements, Classifications, Advantages, Properties and Applications, Design fabrication and economic consideration, General requirements.	**05**	11
2	**Classification**: Classification of composites, Major composite classes, Functions of matrices & reinforcement. Dispersion strengthened, particle strengthened and fiber-reinforced composites. Laminated composites. Particulates, Flakes, Whiskers, Fibers and resin materials.	**06**	13.33
3	**Strengthening**: Strengthening mechanisms, Aspect Ratio, Rule of Mixture, discontinuous and continuous fiber composites and their comparison, Critical Fiber Length, Short and Continuous Fibers, Fiber Orientation.	**06**	13.33
4	**Interfaces**: Role of interfaces in composites, Interfacial Bonding Mechanisms. Pull-out & Push-out Testing. Control of Bond Strength. Toughening mechanisms in PMCs, MMCs, and CMCs. Wettability.	**06**	13.33
5	**Fabrication**: Fabrication of PMC's :- Fabrication of Fibers, Plastic Fiber Forms, Prepregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, Vacuum Bag Assembly, etc.. Fabrication of CMC's: Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques. CVD & CVI, Sol-gel, etc. Fabrication of MMC'S : Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding & In Situ Technique, etc.	**16**	36
6	**Advanced composites:** Nanocomposites, hybrid composites, sandwich composites, in-situ composites, smart composites, carbon-carbon composites, surface composites.	**06**	13.33
	Total	**45**	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**40**	**30**	**15**	**05**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

The syllabus of Composite Materials & Seminar directly contributes to:

SDG 4	Quality Education
SDG 9	Industry, Innovation and Infrastructure
SDG 12	Responsible Consumption and Production
SDG 13	Climate Action

Reference Books:

1. K.K. Chawla, Composite Materials – Science & Engg., Springer- Veslag, New York, 2012.
2. Mel M. Schwartz, Composite Materials: Properties, Non-destructive testing and Repair, Prentice Hall, New Jersey
3. L.J. Broutman and R.M. Krock, Modern Composite Materials, Addison-Wesley, 1967. 4. David A Colling & Thomas Vasilos, Industrial Materials: Polymers, Ceramics and Composites, vol. 2, Prentice Hall, N. Jersey, 1995
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Laboratory sessions:

Laboratory sessions in Composite Materials & Seminar course will consist of a mini project that includes study (market, literature, etc.), review, group discussion and presentation of selected topics related to the subject content in general. Each group of students will be assigned a topic related to recent advancements in the area of Composite Materials by the concerned faculty. Students will do a literature survey; study and practice the minimum 03 presentation of his/her work in the batch during the semester. Students will write a report and present the same at the time of the final presentation in the group.

The exercises should be properly designed and implemented with an attempt to develop different types of cognitive and practical skills (Outcomes in cognitive, psychomotor and affective domain) so that students are able to acquire the competencies. However, if these exercises are completed appropriately, they would also lead to development of Program Outcomes/Course Outcomes in the effective domain for this program.

List of Open Source Software/learning website:

1. nptel.ac.in/courses/101104010/
2. www.doitpoms.com
3. composite.about.com
4. https://compositesuk.co.uk/composite-materials
5. www.asminternational.org/documents/10192/1849770/05287G_Sample_Chapter.pdf

List of suggested activities for Problem-based Learning (PBL):

Sr. No.	PBL Category	Name of the activity	No. of hours	Evaluation Criteria
1	Industry / Research Laboratory Visit	Industry / Research laboratory Visit	Visit = 5hrs, Report preparation = 5hrs Total = 10hrs	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2	Video Based Learning	Technical Video based learning related to the subject (MOOC/ NPTEL Video)	Duration of video = 5hrs Report preparation = 5hrs Total = 10hrs	Report /presentation based on the video learning outcomes.
		Self-learning on-line course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
		Annotated Video Explanation of Concept/Problem	10hrs (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
3	Assignment/ Technical Writing / Research Writing	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2hrs each. Total = 10hrs	Based on the assignment submitted.
		Blog or Technical Article Writing	10hrs (Research – 6hrs, Writing – 4hrs)	Based on originality, technical content, references cited, and clarity of communication.
4	Complex Problem-Solving targeting relevant SDGs. / Mini Project	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 15 hrs	Based on the depth of the solution submitted.
5	Research Paper Review / Analysis	Discussion on research paper based on relevant subject (Indexed Journal)	5 research paper = 20 hrs	Summarize research paper and evaluate critical parameters
6	Poster/ Chart/ Power point presentation	Poster/chart/power point preparation on technical topics	Duration = 6 hrs	Based on poster/chart preparation and presentation skills

7	Micro Project	Working/non-working model on technical topics	Working = 10 hrs Non-working = 10 hrs	Based on inter department/external evaluation
8	Group Discussion / Quiz / Simulation	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 hrs each	Based on performance in group discussion, technical depth, knowledge etc.
		Online Technical Quizzes/ MCQ test/ Simulations	Multiple quizzes summing up to 10hrs	Based on quiz score and reflection summary.
9	Case Study Analysis / Seminar	Real world case studies-based learning	Duration of data collection/study = 5hrs Report preparation = 5hrs Total = 10hrs	Based on in-depth study, technical depth, data collected, fact finding, etc.
10	Other	Patent Search and Innovation Gap Identification	10hrs (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

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Note:

1. In alignment with Outcome-Based Education (OBE) and NBA accreditation requirements, the subject Composite Materials & Seminar incorporates;

- Mini Project – 10 Marks
- Micro Project and – 5 Marks
- Seminar activities -– 10 Marks

These activities are incorporated as integral Project-Based Learning (PBL) components. These activities are designed to foster experiential learning, encourage innovation, and strengthen problem-solving skills by engaging students in practical applications of power converter design, simulation, and analysis. The inclusion of PBL ensures that learners develop higher-order cognitive abilities mapped to Bloom's taxonomy, while simultaneously enhancing teamwork, communication, and research competencies essential for professional engineering practice.

2. The hours allocated to specific activities should be proportionate to the total no. of PBL hours and marks.

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