CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Mechanical Engineering)

Semester: VI

Course Code: 202020621

Course Title: Smart Materials

Course Group: Open Elective Course - II

Course Objectives: Smart materials are new generation materials surpassing the conventional structural and functional materials. Smart materials possess adaptive capabilities to external stimuli, such as loads or environment (pressure, temperature, electric and magnetic fields, chemicals or nuclear radiation), with inherent intelligence. This course offers an exposure to fundamental concepts/principles governing the properties of smart materials and their applications.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	0	3	50/18	50/17	NA	NA	100/35

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction:** Smart materials-Types and features; Smart systems and components; Smart materials and associated stimulus response; Direct and reverse effects; Need for smart materials and associated problems; Biocompatible eco-friendly smart materials for sustainable future.	06
2	**Ferroelectric Materials:** Ferroelectric materials: Piezoelectric materials-piezoelectric effect, Direct and converse, parameter definitions, Piezoceramics, Piezopolymers, Piezoelectric materials as sensors, Actuators and bimorphs	10
3	**Shape memory materials:** Shape memory alloys (SMAs), Shape memory effect, Martensitic transformation, One way and two-way SME, binary and ternary alloy systems, Functional properties of SMAs	06
4	**Smart Polymers:** Introduction and Classification; Active and Electroactive smart polymers; Ionic polymer matrix composites (IPMCs)- Properties and applications with illustration; Introduction to Protein-based smart polymers- pH-responsive and photo-responsive polymers; Approaches to molecular imprinting, drug delivery smart polymers.	08

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5	**Smart Hydrogels:** Introduction; Synthesis; Fast responsive hydrogels; Smart hydrogels as actuators, controlled drug release, artificial muscles; Hydrogels in microfluidics.	**06**
6	**Smart Materials for Space Applications:** Elastic memory composites, Smart corrosion protection coatings, Self-healing materials and their applications.	**06**

Reference Books:

1	D. J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, 2007.
2	M. V. Gandhi, B. S. Thompson, Smart Materials and Structures, Chapman& Hall, 1992.
3	Mohsen Shahinpoor, Fundamentals of Smart Materials, Royal Society of Chemistry, 2020
4	P. Ball, Made to Measure: Materials for the 21st Century, Princeton University, 1997.
5	Vijay K. Vardan, K. J. Vinoy , S. Gopalakrishnan, Smart Material systems and MEMS: Design and Development Methodologies, Wiley
6	I.Galaev, B. Mattiasson, Smart Polymers: Applications in Biotechnology and Biomedicine, CRC press, 2008

Supplementary learning Material:

1	Video lectures and modules available on the websites NPTEL
2	CDs available with some reference books.
3	Use of subject relevant software modules available from internet sources.

Pedagogy: Following one or more points can be incorporated as relevant pedagogy methods.

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying;**N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
25%	30%	25%	15%	5%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To understand the requirements of smart materials and differentiate them from other materials.	**15**
CO-2	To be able to explain the need for smart materials in today's space technology era.	**20**
CO-3	To be able to explain various functional properties and identify different smart materials based on their stimulus response	**30**
CO-4	To be able to choose a particular smart material for specific applications based on the requirements.	**20**
CO-5	To identify associated problems of using smart materials and the need for developing eco-friendly smart materials for sustainable future.	**15**

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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