- Kakani S.L., Kakani A., (2006) Material Science, New Age International.
- Yao J., Zhou Z., Zhou H., (2019) Highway Engineering Composite Material and its Application, Springer.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE-11)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
SMART MATERIALS	4	3	0	1	Class 12th with Physics, Chemistry	---

Learning objectives

- Overview of smart materials, Piezoelectric Ceramics, Piezo-polymers, Magnetostrictive Materials, Electroactive Polymers, Shape Memory polymers.
- To learn the fundamentals of electro and magneto rheological fluids, thermally responsive polymers, modelling of smart materials, introduction to composite smart materials and smart hydrogels.

Learning outcomes

After studying this paper, students will be able to

- Explain polymer based smart materials
- Demonstrate applications of smart materials.

SYLLABUS OF DSE-11

THEORY COMPONENT-

UNIT 1: (15 Hours)

INTRODUCTION

Smart materials and structures: components and classification of smart structures, single crystals vs polycrystalline systems, common smart materials and associated stimulus-response, application areas of smart systems, piezoelectric materials- piezoelectric effect, parameter definitions, piezoceramics, piezopolymers, piezoelectric materials as sensors, actuators and bimorphs.

UNIT 2: (15 Hours)

SMART POLYMERS

Thermally responsive polymers, electroactive polymers microgels (synthesis, properties and applications), protein-based smart polymers, ph-responsive and photo-responsive polymers, self-assembly, molecular imprinting using smart polymers, approaches to molecular imprinting, drug delivery using smart polymers

UNIT 3: (15 Hours)

SMART HYDROGELS

Synthesis, fast responsive hydrogels, molecular recognition, smart hydrogels as actuators, controlled drug release, artificial muscles, hydrogels in microfluidics. smart systems for space applications: elastic memory composites, smart corrosion protection coatings, self-healing materials, sensors, actuators, transducers, deployment devices, molecular machines.

PRACTICAL COMPONENT (30 Hours)

- To determine the elastic properties of polymers.
- To determine % swelling of a hydrogel.
- To determine the sensing power of a sensor.
- To prepare corrosion resistance coatings.
- To test the corrosion inhibition of materials.
- To prepare electroactive microgel.
- To prepare polymer for artificial muscles and study its behaviour with pH change.
- To determine the flexural strength of epoxy/ polyester composite.
- To synthesise and test water absorption behaviour of hydrogel.
- To prepare a polymer based photo sensor.

ESSENTIAL/RECOMMENDED READINGS

- Leo D.J., (2007) Engineering Analysis of Smart Material Systems, Wiley.
- Addington M., Schodek D.L., (2005) Smart Materials and New Technologies in Architecture, Elsevier.
- Otsuka K., Wayman (Eds.) C.M., (1998) Shape Memory Materials, Cambridge University Press.
- Gandhi, M.V., Thompson B. S., (1992) Smart Materials and Structures, Chapman & Hall.
- Schwartz, M., (2006) New Materials, Processes, and Methods Technology, CRC Press.

SUGGESTIVE READINGS

- Ball, P., (1997) Made to Measure: Materials for the 21st Century, Princeton University Press.
- Galaev, I., Mattiasson, B., (Eds.), (2008) Smart Polymers: Applications in Biotechnology and Biomedicine, 2nd ed, CRC Press.
- Yui, N., Mrsny, R. J., Park, hK., (Eds.), (2004) Reflexive Polymers and Hydrogels: Understanding and Designing Fast Responsive Polymeric Systems, CRC Press.

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DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE-12)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
AUTOMOBILE APPLICATIONS OF POLYMERS	**4**	**3**	**0**	**1**	**Class 12th with Physics, Chemistry**	**---**

Learning objectives

- To know various sources of materials used in automobiles.