

**Aim**

It is a foundation course and aims to familiarize students with various aspects of biomaterials and its applications

**Course outcomes**

| <b>Module</b> | <b>Learning outcomes</b>   |
|---------------|--|
| <b>1</b>      | <b>Students will understand the basics, properties and various design concepts in Biomaterial field.</b>                 |
| <b>2</b>      | <b>Students will learn cell structure of biomaterial components</b>  |
| <b>3</b>      | <b>Students will gain knowledge by testing and assessing the different biomaterial components.</b>                       |
| <b>4</b>      | <b>Students will analyze different classification of Biomaterial components, metal types and bio composite coatings.</b> |
| <b>5</b>      | <b>Students will learn about different application of Biomaterial components.</b>  |

**Mode of transaction - Lecture sessions, Assignments, Presentations**

**Course outline****Module 1 - Introduction to the basic concepts of Biomaterials Science**

Introduction, Salient properties of important material classes; overview of body environment. Properties (Mechanical and Physico-chemical), Mechanical properties, Material characterization - Analytical instruments, Understanding Design Concepts of Bio-implants, Dental-implants, Orthopaedic-implant, Experiments-surface modification-Demonstration, Cardiovascular and ocular biomaterials, Sterilisation/Device failure

**Module 2 - Concepts of Biomaterials**

Biocompatibility, Resorbability, biodegradation, host response, structure-property of biological cell, Structure and properties of cells, protein and cellular adaptation process. Biofilm, Cell Migration and Cell Division and cell death, Cell Apoptosis, Structure and properties of Protein; cell - material interaction

**Module 3 - Assessment of Biomaterials**

Biocompatibility of biomaterials, biological testing (hemocompatibility, tribological testing), Structure and properties of bone as well as in vivo testing and histocompatibility assessment. Animal trials, Design Concepts of Bio-implants, Dental-implants, Orthopaedic-implant, Experiments-surface modification-Demonstration, Cardiovascular and ocular biomaterials, Sterilisation/Device failure

**Module 4 - Classification of Biomaterials**

Metals-types, classifications, applications, Important bio metallic alloys, Ti Alloy, Co-Cr-Mo alloys, Polymer blends, Biopolymers- proteins/ hydrogels, Electrostatic Spraying of UHMWPE-HA-CNT composites, Thin Films and Coatings, thermal Spray Coatings, Biocompatibility of plasma sprayed CNT reinforced Hydroxyapatite bio composite coatings

### **Module 5 - Application of Biomaterial**

Ceramics, Bioceramics, Processing of Bioceramics, Bioceramics and Glasses, Sintering and mechanical properties of ceramics, Fracture and toughening of ceramic composites, Development of based bioceramic composites for hard tissue replacement, Alternative phosphate materials, based composites with bactericidal property and glass ceramics for dental restoration, Biodegradable polymers (Importance, Types), Mechanisms of Bioerosion, External field and material interaction, Tissue Engineering and wound healing, Understanding Biocompatibility of Alumina and CNT reinforced Hydroxyapatite, Glass-ceramics for dental restoration applications, Structure and properties of polymers

### **Reference**

1. BIOMATERIALS: Multidisciplinary approaches and their related applications By Amir N. Saud Al-Humairi, Hasan Sh. Majdi, Safaa N. Saud Al-Humairi, Mohammed Al-Maamori · 2020
2. Vasif Hasirci, Fundamentals Of Biomaterials by Hasirci, Springer, ISBN - 9781493988549, January 2019.
3. Dr. Birkamjit Basu, Dr. Kantesh Balani 'Introduction to Biomaterials, IIT Kanpur, nptel, 2012.
4. Advanced Ceramics, Bikramjit Basu and Kantesh Balani, Wiley, New Jersey, ISBN: 978-1-118-03729-4, 2011.
5. Biological Performance of Materials: Fundamentals of Biocompatibility, Jonathan Black, Marcel Dekker, Inc., New York and Basel, 1981.