SARDAR PATEL UNIVERSITY
Programme & Subject: M.Sc (Biomedical Science)
Semester: III
Syllabus with Effect from: June - 2014

Paper Code: PT03CBMC02	**Total Credit: 4**
Title of Paper: Biomaterials and Bionanotechnology	

Unit	Description in Detail	Weightage (%)
I	Biomaterials: Introduction-definition of biomaterials, applications of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.	25%
II	**Types of implant materials:** Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking, corrosion behavior and the importance of passive films for tissue adhesion. Polymeric implant materials: types, general classification; some commonly used polymers: Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. (Classification according to thermosets, thermoplastics and elastomers). Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications. Ceramic implant materials: Definition of bioceramics. Common types of bioceramics: Aluminium oxides, Glass ceramics, Carbons. Bioresorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: different reinforcement materials, Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Mechanics of improvement of properties by incorporating different elements.	25%
III	Testing of biomaterials: biocompatibility and toxicological screening of biomaterials: Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests. Testing of biomaterials/Implants: In vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness; physiochemical testing: swelling, hydrophilicity, Molecular weight determination, degradation study.In-vivo testing (animals): biological performance of implants. Ex-vivo testing: in vitro	25%

	testing simulating the in vivo conditions. Standards of implant materials; Sterilisation techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties.	
IV	Nanobiotechnology: Types of nanomaterials, Properties, methods of synthesis and characterization of nanomaterials, Nanomaterials and biosystem interaction; Biomedical nanotechnology (Diagnostics, delivery and therapeutics), Nanotoxicology, Applications of Nano-Materials in Biosystems: Proteins - Lipids - RNA and DNA; Protein Targeting - Small Molecule/Nanomaterial - Protein Interactions; Nanomaterial-Cell interactions- Manifestations of Surface Modification (Polyvalency). Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles), carbon nanotubes, polymeric nanofibers, Implications in neuroscience, tissue engineering and cancer therapy. Lipid Nanoparticles and inorganic nanoparticles for drug delivery.	25%

Basic Text & Reference Books:-

- J B Park, Biomaterials - Science and Engineering, Plenum Press.
- Sujata V. Bhat, Biomaterials, Narosa Publishing House
- Jonathan Black, Biological Performance of materials, Marcel Decker
- C.P.Sharma and M.Szycher, Blood compatible materials and devices, Technomic Publishing Co. Ltd.
- Piskin and A S Hoffmann, Polymeric Biomaterials (Eds), Martinus Nijhoff Publishers. (Dordrecht. 1986)
- Eugene D. Goldbera , Biomedical Ploymers, Akio Nakajima.