COURSE OF STUDIES

for

Master of Philosophy

in

Science of Dental Materials

UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

MPhil Science of Dental Materials is an applied basic science dealing with the physical, chemical and biological properties of the materials used in clinical dentistry and their interaction with other tissues. An understanding of these properties as well as their handling will equip the material scientist to critically develop and select novel and available dental materials in the field of dentistry.

Mission Statement:

The mission of program MPhil Science of Dental Materials is to Produce a competent dental biomaterial scientist with the appropriate skills and knowledge necessary to carry out in vitro & in vivo research on novel & available biomaterials for specific clinical applications.

Program Educational Objectives:

- To inculcate adequate knowledge of related subjects of Biomaterials sciences in order to have a broad-based concept of dental materials.
- To develop sound knowledge of specific biomaterial applications such as drug delivery, tissue engineering & regenerative medicine and regulatory affairs.
- To develop knowledge & skills to place special emphasis on materials-structure correlations in the context of both clinical and non-clinical applications.
- To develop understanding of research problems and be able to plan and carryout research independently.

Program Learning Outcomes:

At the end of the 2-year training program, the graduate will be able to develop both the scientific background and the practical skills to make the best use of novel and available materials for laboratory and clinical applications. The graduate will be able to design and conduct ethical & effective research on dental biomaterials.

1. Students will be able to relate basic knowledge of structure of matters and different properties of dental materials with clinical application and manipulations of available & novel dental biomaterials.
2. The student will be able to understand basic, advanced knowledge along with clinical handling of Resin based composites, Bonding & bonding agents, Dental cements &

Dental Amalgam.

3. The student will be able to understand basic knowledge along with clinical handling of Metals, Ceramic-based materials, Prosthetic polymers and resins & Dental implants.
4. The student will be able to understand basic knowledge along with clinical handling of Auxiliary materials; Casting investments& casting, soldering procedures, Digital technology in dentistry & Materials % prostheses for cutting, grinding, finishing& polishing.
5. The student will be able to understand knowledge & skills of advancements in: Polymers, Ceramics & Metals in dentistry, Compositional characteristics and hydration of Mineral trioxide aggregate, Fiber reinforced composites, Aging and stability of bonded interfaces in dentistry, Pit& fissure sealants, Nano technology in dentistry & Regenerative dentistry.
6. The student will be able to develop an understanding of biological processes at the cellular and molecular level. It will enable the student to use chemical knowledge & techniques to solve the biological problems.
7. The student will be able to understand basic concepts of research methodology & biostatistics. Identify and describe study designs that are commonly used in medical and health studies and accomplish scientific writing skills in the form of research synopsis, article writing and thesis.
8. It will provide a good level of understanding and appreciation of the principles and applications of biomaterials. Review of physical and chemical structural and mechanical properties of different materials used in biomaterial industry and their relation to medical application.
9. The student will be able to develop basics of teaching skills, learning & assessment; formative & summative.
10. The student will be able to develop basics of biosafety protocols and principles of ethics in biomedical research.

SCHEME OF STUDIES (2-Year)

MPhil Science of Dental Materials

Semester #	Course code	Course title	Credit hours		
			Theory	Practical	Total
1		Biostatistics and Research Methodology	2	0	2
	DMS 701	Fundamentals and Characterization of Dental Materials	2	1	8
	DMS 702	Auxiliary Dental Materials & Prosthetic Polymers.	2	1	
	DMS 703	Bio Ethics	2	0	
		Elective Course: Microbiology	2	0	2
2	DMS 704	Emerging Bio-Technologies & Advanced Dental Materials	2	1	10
	DMS 705	Direct & Indirect Restorative Dental Materials	2	1	
		Elective Course: Biomaterials and Tissue Engineering	2	0	
3	Research (thesis)		6		6
4	Professional & Teaching Skills Apprenticeship (PTSA)		2		2
(Total: 30)					

Biostatistics and Research Methodology

Contact Hours:	Credit Hours: 03
Theory =36	Theory = 02
Practical = 00	Practical = 00
Total = 36	Total = 02

Course Objective:

Students will able to:

- Explain what is meant by statistical observation, inference, biological variance
- Distinguish between populations and samples.
- Distinguish between population parameters and sample statistics.
- Compute a sample mean, sample variance, and sample standard deviation.
- Compute a population mean, population variance, and population standard deviation.

Learning Outcome: At the end of the course the students must be able to:

1. Define variables and their types:

   What are variables, different type of variables, classify variables into qualitative, quantitative, discrete and continuous variables, Define dependent and independent variables
2. Define the data types and the scales of measurements.

   Continuous and discrete data sets, Ordinal and nominal data sets.
3. Interpret a given data: Apply descriptive statistics for continuous variables in terms of:

   Measures of central tendency: Calculate the mean, median and mode and interpret them.

Measures of dispersion: variance, standard deviation, coefficient of variation

Measures of shapes: regarding the distribution of the data sets.

4. Define Probability, types of probability with examples.
5. Describe the common probability distributions especially Normal and Binomial distributions.
6. Describe Population and its relation to sample:
7. Define Sampling and its techniques:
8. Calculate the sampling errors; Calculate the standard error of a mean and a proportion and its interpretation.
9. Calculate and interpret confidence intervals for a parameter. Explain why it is necessary to calculate confidence interval in a data
10. Apply concepts of comparing data (Inferential statistics):
11. Apply various tests of significance: their rationale and use.
12. Calculate Confidence Intervals
13. Explain the meaning of 'p' in statistical terms and its interpretation.
14. Apply the steps of Hypothesis testing
15. Investigate the association between two continuous variables: using a scattergram.
16. Investigate the relationship of two continuous variables using regression, calculating linear regression of y on x and draw line of regression, interpreting and presenting regression.

Course Outline:

- Introduction to Biostatistics
- Types of statistical applications
- Variables

- Scales of measurements
- Descriptive Statistics
- Measures of central tendencies
- Measures of variability
- Probability
- Probability Distributions: Normal, Poisson, Binomial
- Sampling techniques, sampling errors/ Confidence Intervals
- Concepts of analytical statistics: Hypothesis testing:
- Alpha and Beta errors
- Tests of Significance: Normal test, t test, Chi square test etc.
- Correlation
- Regression
- Sampling and various sampling techniques
- Data presentation: Figures, graphs, tables

Practicals: Nil

Recommended Books:

- Quinn, G., 2002. *Experimental Design and Data Analysis for Biologists,* Cambridge University Press, U.S.A.
- Gerstman, B.B. 2014. *Basic Biostatistics: Statistics for Public Health Practice*. 2nd Edition. Jones and Bartlett learning publications. 5 wall street Burlington MA01803.
- Glover, T. and Mitchell, K., 2015. A*n Introduction to Biostatistics*, Third Edition 3rd Edition . Waveland Press, Inc. Long grove, IL,60047-9580.

Fundamentals & Characterization of Dental Materials

Contact Hours: Credit Hours: 03

Theory =	54	Theory = 02
Practical =	54	Practical = 01
Total =	108	Total = 03

Course Objective:

To develop an understanding of basic

- Structure of matter and principles of adhesion (surface properties of dental materials), Atomic building blocks.
- Standardization of dental materials
- Physical & chemical properties of dental materials
- Mechanical properties of dental materials
- Biocompatibility of dental materials
- Characterization tools for Dental Materials

Learning Outcomes:

By the end of this course the students will be able to

1. Understand and interpret various classes of Dental materials
2. Know the structure of matter, and principles of adhesion.
3. Understand Physical and chemical, Mechanical properties of materials and develop understanding of testing those properties.
4. Understand the basics of biocompatibility, and knowledge of measuring biocompatibility
5. Comprehend the basic chemistry, uses, and applications of all types of dental materials.
6. Understand and interpret material testing before utilizing for any purpose
7. Identify the International standards and apply it to clinical practice
8. Understand the basics of mechanical, thermal, chemical, optical, and electrical characterizations.
9. Knowledge about characterization techniques, equipment used for material

testing.

Course Outline:

General categories of Biomaterials, Applications and standards of Dental materials, International standards, Interatomic bonds, Adhesion and bonding to tooth structure, Rheology, Structural relaxation, Colour and optical effects, Thermal properties, Electrochemical properties, Magnetic materials, Mechanical properties, Stress and strain, Elastic and strength properties, Stress concentration effects, clenching, Metallic bonding, Classification of alloys, Properties of high Nobel, and Nobel metal alloys, Cast dental alloys, Solid solutions, Equilibrium phase diagrams, Eutectic and peritectic alloys, Solid state reactions in high Nobel, and Nobel alloy systems, Dental uses of polymeric materials and resins, Components and composition of resins, Performance criteria for Dental resins, Mechanical and physical properties of polymers, Chemistry of polymerization, Copolymerization, Acrylic Dental resins.

Anatomical and pathological aspects of oral tissues (The tooth, Bone, Periodontium, Gingiva, and Mucosa), Measuring biocompatibility (In vitro tests, Animal tests, Usage tests), Correlation among in vitro, animal, and usage tests, Using in vitro, animal, and usage tests together, Standards that regulate the measurement of biocompatibility, Biocompatibility of dental materials (Reaction of pulp, Reaction of Other oral soft tissues to restorative materials, Reaction of Bone and soft tissues to implant materials), Adverse effects from exposure to dental materials, Adverse effects data from national registries, Allergic reactions, Occupational hazards for dental personnel, Hydrofluoric acid, Clinical guidelines for selecting biocompatible materials.

Introduction and surface properties of different types of Dental materials.

Strengthening by heat treatments (Metals, Ceramics and glasses, Polymers and elastomers), Surface properties and adhesion, Electrical properties, Optical properties, X-ray absorption, Density and porosity, Acoustic and ultrasonic properties, Diffusion properties, ISO standards used in dentistry, Basics of UV spectroscopy, FTIR, Raman, UTM, SEM, XRD, AFM, Density kit, and electronic balance.

Practical:

- Practical Working and use of equipment used for material testing and characterization:
  Hardness, Compression, Tensile, shear and flexure tests using universal testing machine, Impact tester, Tests for Biocompatibility, Optical and scanning electron microscopes, FTIR spectroscopy.

Recommended Books:

- Applied Dental Materials by John F. McCabe & W.J. Walls 13th edition.
- Dental materials and their selection, by William J.O' Brien. Third or 4th edition. PublisherQuintessence, 2002.
- Craig's Restorative Dental Materials 14th Edition –February 6, 2018. Authors: Ronald Sakaguchi, Jack Ferracane, John Powers
- Phillips' Science of Dental Materials.13th Edition May13, 2021-Editors: Chiayi Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.
- Characterization of biomaterials. Integrated biomaterials science Lyman D. 2002 MA: Springer US.
- Biomaterials science : an introduction to materials in medicine by Buddy Ratner, Allan Hoffman, Frederick Schoen, Jack Lemons, 2nd Edition
- Biocompatibility of Dental Materials by Gottfride Schmalz & Dorthe.
- Handbook of Oral Biomaterials edited by Jukka P. Matinlinna,2015.

Auxiliary Dental Materials & Prosthetic Polymers

Contact Hours: Credit Hours: 02

Theory =	36	Theory = 02
Practical =	54	Practical = 01
Total =	90	Total = 03

Course Objective:

To understand chemistry, manipulation and clinical handling of materials used in as auxiliaries in dental laboratory as well as prosthetic polymers.

Learning Outcomes:

Upon completion, of course, the students should be able to:

1. Understand and interpret various impression materials
2. Know the basics of gypsum products and its use in dentistry
3. Comprehend knowledge about dental waxes, casting investments, and casting procedures
4. Have basic knowledge of materials and processes for cutting, grinding, finishing and polishing
5. Understand and interpret dental casting alloys, metal joining and wrought alloys
6. Understand prosthetic polymers, and resins

Course Outline:

Classification of impression materials, Elastomeric impression materials its making and properties, Hydrocolloids, Inelastic impression materials, Production of gypsum products, Setting of gypsum products, setting expansion and strength of set gypsum products, Types of gypsum products, Manipulation of gypsum products, Types of inlay waxes, Composition of dental waxes, Desirable properties of wax, Flow and thermal properties of dental wax, Manipulation of inlay wax, Wax distortion, Speciality waxes, Gypsum bonded investment, Phosphate bonded investment, Ethyl silicate bonded investment, Clinical evaluation of casting fit, Compensation for solidification shrinkage, Preparation of the master die, Variables and principles of optimal sprue design, Casting ring liner, Investing and casting procedure, Causes of defective castings,

Applications of abrasives in dentistry, Benefits of finishing and polishing restorative materials, Principles of cutting, grinding, finishing and polishing, Abrasion and erosion, Abrasive instrument design, Types of abrasives, Finishing and polishing procedures, Dentifrices.

Denture and denture base resins, Acrylic resins, Heat activated denture base resins, Light activated denture base resins, Chemically activated denture base resins, Physical properties of denture base resins, Miscellaneous resins and techniques, Resin teeth for prosthetic applications, flexible Dentures.

Practical:

Clinical Handling of Materials: Impression, waxes, Dental acrylic processing along with finishing and polishing.

Recommended Books:

- Phillips' Science of Dental Materials.13th Edition May13, 2021-Editors: Chiayi Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.
- Applied Dental Materials by John F. McCabe & W.J. Walls 13th edition.
- Dental materials and their selection, by William J.O' Brien. Third or 4th edition. PublisherQuintessence, 2002.
- Introduction to Dental Materials, by Richard Van Noort. 2nd or 3rd or 4th edition, Mosby
- Craig's Restorative Dental Materials 14th Edition –February 6, 2018. Authors: Ronald Sakaguchi, Jack Ferracane, John Powers

Course Title BioEthics

Contact Hours:	Credit Hours: 02
Theory = 36	Theory = 02
Practical = 00	Practical = 00
Total = 36	Total = 02

Course Objective:

To develop an understanding of medical ethics, their types, various ethical issues and ethicaldilemmas in healthcare setting along with the clinical practice of:

- Various ethical issues
- Identification and solution of various ethical dilemmas

Learning Outcomes:

At the end of course, the student will be able to develop an understanding of Medical ethics, their types, various ethical issues and ethical dilemmas in healthcare setting along with the clinical practice of:

- Basic ethical pillars
- Informed consent and Confidentiality
- How to find a solution for various ethical dilemmas

Course Outline:

- Introduction to medical ethics
- Different philosophical school of thoughts
- Principles of medical ethics and Hippocratic oath
- Ethical analysis in clinical work
- Duties and responsibilities of doctors
- Rights and responsibilities of patients
- Confidentiality
- Informed consent

- Risk Communication in Informed
- Consent
- Ethical dilemmas in a doctor's life
- Use of animals in medical research
- IRB's and ERC's

Practical:

- Ethical analysis in clinical work
- Confidentiality
- Informed consent
- Ethical dilemmas in a doctor's life
- IRB's and ERC's

Recommended Books:

- Johnston C, Bradbury P. 100 Cases in Clinical Ethics and Law. 2016;
- Jonsen, Albert R. (2000). A short history of medical ethics. New York: Oxford Universitypress.
- Beauchamp, T. L., Childress, J. F. (2001). Principles of Biomedical Ethics. Greece: Oxford University Press.
- Hope, T. (2004). Medical Ethics: A Very Short Introduction. United Kingdom: OUPOxford.

Microbiology

Contact Hours: Credit Hours: 03

Theory =	36	Theory = 02
Practical =	54	Practical = 01
Total =	90	Total = 03

Course Objective:

To develop understanding of basics of microbiology in order to understand microbiology of various diseases with special emphasis on dentistry

Learning Outcomes:

Upon completion, of course, the students should be able to:

Course Outline:

BACTERIOLOGY : General bacteriology; Difference b/w Eukaryotes & Prokaryotes, Structure of Bacteria, Physiology of Bacteria, Bacterial Genetics, Normal Flora, Bacterial Pathogenesis, Sterilization & disinfection, Lab diagnosis, Normal flora, Antibiotics action/ Resistance. Clinical bacteriology; Gram positive cocci (Staphylococcus, Streptococcus) , Gram postive rods; Clostridium, Corynebacterium diptheriae, Diptheroids. Gram negative rods; Related to enteric tract- Escherichi, Salonella, Shigella, Vibrio Campylobacter, Providencia, Klebsiella, Proteus Helicobacter, Enterobacter, Morgnella Serratia. Related to animal source- Brucella Fracisella Pasteurela Yersinia. Related to Respiratory tract- Pseudomonas Haemophilus Bordetella. Mycobacteria; Typical mycobacterium, Atypical mycobacterium.

Other bacteria important for oral diseases ;Fusobacterium, Lactobacillus Actinomyces and Nocardia

Spirochetes, Prevotella, Bacteriodes, Bifidobacterium, Eikenella.

VIROLOGY ;Basic virology ;Structure, Replication& Classification Pathogenesis& Lab Diagnosis,Collection And Transport ,Antiviral drugs Hostdefenses. Clinical virology;

Herpes viruses,

Hepatitis viruses, Measles, mumps, Rubella ,Rabies, HPV, HIV, Adenovirus, Pox virus, Human T cell

lymphotrophic virus, Chicken pox virus. Para-influenza virus, Influenza virus.

MYCOLOGY; Mucormycosis, Candida, Pneumocystis carinii, Cryptococcus, Cutaneous

and Subcutaneous mycosis, Aspergillous, Blastomycosis, Histomycosis, Coccidiomycosis.

PARASITOLOGY; Toxoplasmosis, Giardia, Blood and tissue protozoa, Cestodes, Trematodes, Nematodes.

Practical:

- Lab techniques of the course contents:
  Gram staining
  ZN staining
  Culture media
  Throat swab
  Biochemical tests (catalase, oxidase, coagulase)

Recommended Books:

- Medical Microbiology & Immunology by Warren Levinson & Earnest Jawetz

Emerging Bio-Technologies & Advanced Dental Materials

Contact Hours:		Credit Hours: 02
Theory =	18	Theory = 01
Practical =	18	Practical = 01
Total =	36	Total = 03

Course Objective:

To acquire knowledge and learn application of advanced technologies in dentistry.

Learning Outcomes:

Upon completion, of course, the students should be able to:

1. Understand the potential new areas of biomaterial research
2. Provide advance knowledge of dental materials that will give an in-depth

understanding of new developments in dental materials.

3. Address current clinical problems/shortcomings, and come up with a solution to address problem locally.
4. Understand the related areas/fields linked to biomaterial research, and apply them into practice.

Course Outline:

The course contents will include:

- Biomaterials, Biological materials, Instruments and processes, Environmental considerations, CAD-CAM, Biomimetics, Haptics, Chondrogenesis, Cytology, Nano-technology, Osteo-conductivity, Self-assembling materials, Stem cells, Smart materials, Voxel, Effect of exposure to biological fluids on biomaterials surface, Bone grafting materials, Self-healing materials, Re-mineralizing materials, Drug delivery systems, Regenerative dentistry, Diagnostics devices and techniques (Cone-beam computed tomography, Swept-source optical coherence tomography, Laser-induced fluorescence, Laser photo thermal radiometry, Ultrasound imaging, Salivary genetic testing), Computer-driven fabrication systems, three dimensional printing, Zirconia and Implant Dentistry, Bonding to Zirconia, Green dentistry, Digital Imaging ,Digital Impressions, Direct Digital Manufacturing, Dental Materials in digital age, Bioactive glasses.

Practical:

Understanding and practical implication of Digital Imaging and designing of prostheses, three-dimensional printing.

Recommended Books:

- Phillips' Science of Dental Materials.13th Edition May13, 2021-Editors: Chiayi Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.
- Phillips' Science of Dental Materials.12th Edition May13, 2021-Editors: Chiayi

Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.

- Handbook of Oral Biomaterials edited by Jukka P. Matinlinna,2015.
- Clinical applications of digital dental technology, 2nd Edition, Edited by Radi Masri, Carl F Driscoll.

Direct & In Direct Restorative Dental Materials

Contact Hours:		Credit Hours: 03
Theory =	36	Theory = 02
Practical =	54	Practical = 01
Total =	90	Total = 03

Course Objective:

To acquire knowledge and practical application of materials used as direct restorative. To understand the chemistry and handling of materials used as restoratives directly at the chair side.

Learning Outcomes:

Upon completion, of course, the students should be able to:

1) Understand the process of bonding and use of bonding agents
2) Comprehend the knowledge about resin-based composites
3) Comprehend the knowledge of indications, uses, properties, and clinical applications of dental cement.
4) Know the basics of dental amalgam, its uses, applications, and shortcomings

Course Outline:

Applications of bonding, Mechanisms of adhesion, Smear layer, Acid etch technique, Dentine bonding agents, Luting agents and resin cements, orthodontic bracket bonding resins, Root canal sealers, Glass ionomer restoratives, Amalgam bonding, Pit and fissure sealants, History, applications, and classification of resin based composite, Composition and function of composites, Properties of resin based composites,

Finishing and repair of composites, Acid etching, Use of composites for resin veneers, Selection criteria for posterior composites, Innovations in dental composites, Cement for luting, pulp protection, and restoratives, Zinc phosphate cement, Zinc polycarboxylate cement, Glass ionomer cement, Metal reinforced glass ionomer cement, High viscosity glass ionomer cement, Resin modified glass ionomer cement, calcium aluminate glass ionomer cements, Compomer, Resin cements, Zinc oxide eugenol cements, Mineral trioxide aggregate cements, root canal sealers, Calcium phosphate cements, Fluoride releasing materials, Direct filling gold ,Amalgam alloys, Amalgamation, Clinical manipulation of amalgam for restorations, Properties of amalgam, Clinical performance of amalgam restorations, Safety of amalgam fillings.

Practical:

Recommended Books:

- Phillips' Science of Dental Materials.13th Edition May13, 2021-Editors: Chiayi Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.
- Applied Dental Materials by John F. McCabe & W.J. Walls 13th edition.
- Dental materials and their selection, by William J.O' Brien. Third or 4th edition. PublisherQuintessence, 2002.
- Craig's Restorative Dental Materials 14th Edition –February 6, 2018. Authors: Ronald Sakaguchi, Jack Ferracane, John Powers.
- Dental Hard Tissue and bonding by George Eliades, David Watts, Theodore Eliades, springer, 2005.
- Dental Materials in vivo; aging and related phenomena by George Eliades Quintessence Publications,2003.

Indirect Restorative Dental Materials

Course Objective:

To understand chemistry and handling of metals and ceramics used to fabricate indirect dental prostheses.

Learning Outcomes:

Upon completion, of course, the students should be able to:

1. Know the basics of dental ceramics, and its application in dentistry
2. Comprehend the knowledge about dental implants and its interactions with human tissues
3. Comprehend the knowledge about dental Alloys for direct and indirect restorations

Course Outline:

Metals and Alloys: Cast and wrought alloys in dentistry, Classification of dental ceramics, Metal ceramic systems (Fabrication, Composition, Properties), Cast metal for metal ceramic prostheses, Technical aspects of metal ceramic products, Methods for strengthening ceramics, All ceramic systems, CAD-CAM processing of ceramics, Abrasiveness of dental ceramics, Clinical performance of all ceramic restorations, Porcelain denture teeth, Ceramic veneers, inlays, and onlays, Analysis of fractures, Principles governing the selection of dental ceramics, Ident Ceram system, Classification of implants, Implant components, Evaluation of clinical success, Implant biomaterials, Biocompatibility of implants, Biomechanics.

Practical:

Practical handling of materials used as indirect restoratives.

Recommended Books:

- Dental Materials: Foundations and Applications John M. Powers, John C. Wataha
- Phillips' Science of Dental Materials.13th Edition May13, 2021-Editors: Chiayi Shen, H. Ralph Rawls, Josephine Esquivel-Upshaw.
- Handbook of Oral Biomaterials edited by Jukka P. Matinlinna,2015.
- Dental Hard Tissue and bonding by George Eliades, David Watts, Theodore Eliades, springer, 2005.
- Dental Materials in vivo; aging and related phenomena by George Eliades Quintessence Publications,2003.

Course Title Biomaterials and Tissue Engineering

Contact Hours:	Credit Hours: 03
Theory = 54	Theory = 03
Practical = 00	Practical = 00
Total = 54	Total = 03

Course Objective:

It is designed to provide a good level of understanding and appreciation of the principles and applications of biomaterials. Review of physical and chemical structural and mechanical properties of different materials used in biomaterial industry and their relation to medical application.

Learning Outcomes:

Upon completion of the course, the student will be able to:

- Know basics of biomaterials and diversity in their applications.

- Understand properties of resorbable and non-resorbable materials
- Understand materials available to fabricate scaffolds and effective drug delivery in regenerative science.

Course Outline:

THE STRUCTURE OF SOLIDS; Atomic Bonding, Crystal Structure, Imperfections in Crystalline

Structures; Long-Chain Molecular Compounds (Polymers), Super cooled and Network Solids, Composite

Material Structure.

METALLIC IMPLANT MATERIALS; Stainless Steels, Co-Based Alloys, Ti and Ti-Based Alloys.

Dental Metals, Other Metals, Corrosion of Metallic Implants.

CERAMIC IMPLANT MATERIALS; Structure–Property Relationship of Ceramics, Aluminum Oxides

(Alumina), Zirconium Oxides (Zirconia), Calcium Phosphate, Glass-Ceramics, Other Ceramics, Carbons, Deterioration of Ceramics.

POLYMERIC IMPLANT MATERIALS. POLYMERIZATION AND PROPERTIES; Effect of Structural Modification and Temperature on Properties, Polymeric Implant Materials, High-Strength, Thermoplastics, Deterioration of Polymers. COMPOSITES AS BIOMATERIALS; Structure, Mechanics of Composites, Applications of Composite Biomaterials, Biocompatibility of Composite Biomaterials. STRUCTURE–PROPERTY RELATIONSHIPS OF BIOLOGICAL MATERIALS; Proteins, Polysaccharides, Structure–Property Relationship of Tissues.

TISSUE RESPONSE TO IMPLANTS; Normal Wound-Healing Process, Body Response to Implants, Blood Compatibility, Carcinogenicity.

SOFT TISSUE REPLACEMENT; sutures: Sutures, Surgical Tapes, and Adhesives. Skin: Per Cutaneous and skin Implants. Maxillofacial implants, Maxillofacial and Other Soft-Tissue Augmentation.

HARD TISSUE REPLACEMENT: Wires, Pins, and Screws, Fracture Plates, Intra medullary Devices, Acceleration of Bone Healing, Dental Restorations and Implants, Interface Problems in Orthopedic and Dental Implants.

TISSUE ENGINEERING MATERIALS AND REGENERATION: Substrate Scaffold Materials, Sterilization of Scaffolds, Regeneration Stimulated Electrically, Cellular Aspects, Viability, Stem Cells, Bone Regeneration.

Recommended Books:

- Biomaterials Principals and Applications Edited By Joon B. Park, Joseph D. Bronzino, 3rd edition.
- Biomaterials science : an introduction to materials in medicine by Buddy Ratner, Allan Hoffman, Frederick Schoen, Jack Lemons, 2nd Edition.