SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, TRIVANDRUM

COURSE WORK FOR PhD PROGRAM

(All the students admitted for the PhD programme are expected to take a minimum of 4 courses including the compulsory course on "Statistics and Research Methodology" offered either along with the M.Phil Degree program at the Biomedical Technology Wing or along with the MPH programme offered at the Achutha Menon Centre for Health Science Studies, as detailed below and as specified in the PhD Manual)

(A) M Phil Course Modules Selected for PhD Course Work (offered at the BMT Wing)

PhD students' core course on "Statistics and Research Methodology" consists of 4 course modules of M.Phil. Programme titled (1) Statistics -1 credit (2)Development of Work Culture Development – 1 credit (3) Ethics in Research – 1 credit (4) Use of Laboratory Animals in Biomedical Research -1 credit.

1. STATISTICS (Compulsory Course – 1 credit)

Outline: This is planned as an introduction to the principles of statistics as it applies to the understanding and interpretation of the biomedical literature. The emphasis of this course is on the application of statistical methods commonly employed in biomedical research and the interpretation of their results. The following topics will be covered: probability, principles of inference, hypothesis testing, parametric and non-parametric tests, principles of epidemiology, statistical vs. clinical significance, and quasi-statistical methods (e.g., meta-analysis, decision analysis).

2. DEVELOPMENT OF WORK CULTURE DEVELOPMENT AND COMMUNICATION SKILLS (1 credit)

Outline: The course covers study design, preparation of proposals and manuscripts, peer review, authorship, allegations of misconduct, and intellectual property. Also discussed are mentoring relationships, inter-personal relationship in working atmosphere, conflict of interest, and work culture and career options.

3. ETHICS IN RESEARCH (1 credit)

Outline: This course explores techniques for recognizing, analyzing, and resolving ethical dilemmas facing healthcare professionals and biomedical researchers in today's highly regulated environment. Use of humans and animals in research, data acquisition and management, protection of human subjects/animals involved in research programs. Guest

lectures by practicing clinicians, technologists, researchers, and regulators will include case studies, interactive small group discussions, and role-playing simulations.

4. USE OF LABORATORY ANIMALS IN BIOMEDICAL RESEARCH (1 credit)

Outline: This course will discuss the duties of the research team and the governmental organizations involved in regulating biomedical research, basic considerations of experimental design, laws that govern biomedical research, the function of the institutional animal care and use committee, principles of the "three R's" of biomedical research, benefits of biomedical research, understanding research environment including: facilities, cages, feeding and watering devices, animal sources, and administrative responsibilities. Other areas to be covered are: identify and describe anatomic and physiologic characteristics, breeding systems used, behavior aspects, procedures for husbandry, housing, and nutrition, restraint and handling procedures, medication administration and blood collection, common diseases, and methods of euthanasia of the following animals: rats, mice, guinea pigs, rabbits.

5. BASICS OF CELL BIOLOGY (2 credits)

This course deals with introduction to cell biology, cell-cell interaction, cell-ECM interaction, cytokines and growth factors in cell regulation, cell cycle, cell signaling, cell proliferation/migration, apoptosis, molecular biology, nucleic acid, protein synthesis-translation and transcription, current concepts in immunology stem cell biology and cancer biology.

6. PATHOLOGY (2 credits)

This course provides a comprehensive overview of human/animal pathology with emphasis on biomedical pathology. General pathology: Introduction, terms used in pathology, General pathology, pathology of major systems and organs. Molecular Pathology: Cellular mechanisms of disease. Immunology/ immunopathology: Cells and tissues of the immune system, lymphocyte development, the structure and function of antigen receptors, the cell biology of antigen processing and presentation, cytokines, complements and the pathogenesis of immunologically mediated diseases.

7. NEUROSCIENCE & BONE BIOLOGY (2credits)

Introduction to neuroscience: Brain structure and its origins; Brain and cognation: Neuronal basis of learning and memory; Cellular neurobiology; Neurological diseases; Structure and development of bone; the Osteoblast and Osteoclast lineage and signal transduction; Biomechanics of Bone; Cytokines, Proteins and Growth factors in bone; Estrogen and thyroid hormones in bone development and homeostasis; Joints; and Metabolic bone diseases**.**

8. MICROBIOLOGY (1 credit)

This course involves analysis of fundamental problems in bacteria, bacteriophage, viruses, and yeast; Detection of microbial contamination; Cellular responses to stress and production of shock proteins, Material surface-bacterial interactions and role of structure-function aspects of proteins; Issues involved in infection control; Microbiology tests for

testing biomedical products; Viral transmission of diseases from bio therapeutics; Bacterial contamination of therapeutics and medical devices and methods of prevention and testing**.**

9. STEM CELLS & REGENERATIVE MEDICINE (2 credits)

Introduction to Regenerative Medicine; Biology of Regeneration; Strategies of Regenerative Medicine; Current and Future Perspectives of Regenerative Medicine; Basis of Regenerative Medicine; Cells and Tissue Development; Stem Cells as source in regeneration of tissues; Therapeutic Applications: Tissue Therapy, Research Issues in Regenerative Medicine, Bioethical Issues and Challenges**.**

10. INTRODUCTION TO BIOMATERIALS - BULK & SURFACE PROPERTIES OF MATERIALS AND MATERIALS PROCESSING (2 credits)

An introduction to materials used in medicine - Metals, ceramics, glasses and polymers; Bulk properties of materials; Microstructure; Bonding in materials - ionic, covalent, metallic and other weak interactions; Introduction to atomic structure; Mechanical properties of materials - elastic and plastic behavior, stress and strain, tension and compression, shear, elastic constants, isotropy, elasticity, brittle fracture, plastic deformation, creep and viscous flow, fatigue and toughness; Mechanical testing – techniques in general; Fabrication techniques – a general introduction; Examples of biomaterials applications - heart valve prostheses, artificial hip joints, intraocular lenses and left ventricular assist devices

11. POLYMERIC BIOMATERIALS (4 credits)

An introduction to polymer science and technology with relevance to biomaterials science is taught in this course. The topic covers introduction to polymers – natural and synthetic polymers, copolymers; Polymer synthesis – bulk, solution, emulsion, Zeiglar-Natta catalysts, metallocene catalysts, modern techniques of polymerization; Characterization of polymers - molecular weight, tacticity, crystallinity, viscoelasticity, mechanical properties, thermal properties, dynamic mechanical properties, surface properties; Structure property relationships; Composites; Hydrogels; Smart or intelligent polymers; Bioresorbable and bioerodible polymers - process of biodegradation, currently available degradable polymers, application of synthetic degradable polymers as biomaterials, process of bioerosion, mechanism of chemical degradation, factors that affect the rate of bioerosion; Storage stability; Sterilization and packaging; Disposable polymeric medical devices and implants - gloves, catheters; Fabrication and processing of polymeric biomaterials.

12. INTRODUCTION TO METALLIC AND CERAMIC MATERIALS (1 credit)

Introduction to metals and ceramics, steps in fabrication of metallic implants, microstructure and properties, stainless steels, cobalt based alloys, titanium based alloys, characteristics and processing of bioceramics, nearly inert crystalline ceramics, porous ceramics, bioactive glasses and glass ceramics, calcium phosphate ceramics, calcium phosphate coatings, resorbable calcium phosphates, clinical applications of hydroxyapatite; pyrolytic carbon

13. DENTAL MATERIALS (1 credit)

The course will comprise of basic concepts of dental materials, current status of dental research, Indian scenario, introduction to dental materials, applications of dental materials, physico-chemical, mechanical, toxicological and in vitro clinical performance of dental materials, dental implants, polymers, metals and ceramics in dentistry, chemistry of synthetic resins, guided tissue regeneration and various aspects of technology transfer of dental materials**.**

14. BIOMATERIALS AND NANOMATERIALS IN DRUG DELIVERY AND GENE THERAPY BIOMEDICAL SENSORS (2 credits)

The course is designed to provide an overall understanding on polymers and nanomaterials as drug carriers, nano-particles based oral peptide delivery systems, physico-chemical and biological characterisation, conjugates and gene delivery systems, passive or active targeting, targeting tumor cells, polymer-protein conjugates, polymer drug-conjugates, compounds in clinical stage, combination of polymer therapeutics. Introduction to biomedical sensors. Emphasis will be given to polymers in the design of sensors along with analytical tools used for quantification of the analytes. The course materials also include the preparation and characterization of metallic nano-particles and functionalized nano-particles for sensing of clinically relevant molecules**.**

15. BIOMATERIAL SCAFFOLDS IN TISSUE ENGINEERING (2 credits)

This course is an introduction to the basic concepts of scaffolds in tissue engineering. The criteria for using different scaffolds in a variety of application areas will be discussed. These include micro and macro encapsulation of cells, in situ polymerizing and injectable gels, micro and macro porous scaffolds, and the delivery of bioactive molecules. The course will also cover some scaffold materials – natural and synthetic or combinations and processing techniques such as solvent casting and particulate leaching, fiber bonding, compression molding, extrusion, freeze drying, phase separation, gas foaming, solid freeform fabrication, self-assembled materials etc and the characterization of processed scaffolds.

16. BIOMATERIALS & BIOCOMPATIBILITY (2 credits)

This course is an introduction to the principles of biomaterials (Synthetic and Natural) and cell biology with reference to the design of medical implants and matrices for tissue engineering. Topics include methods for biomaterials characterization and changes in the biological milieu both from biomaterial and biological perspective (case studies may presented). It also covers mechanisms of underlying wound healing and remodeling following implantation in various organs. Other areas include design of implants and prosthesis based on control of biomaterial- tissue interaction, comparative analysis of degrading and non-degrading implants. Exposure to various standard methods of testing for evaluation of biocompatibility

17. TOXICOLOGY (2 credits)

Topics covered include: mechanisms of drug action, dose-response relations, pharmacokinetics, drug delivery systems, drug metabolism, toxicity of pharmacological agents, drug interaction and substance abuse. Immuno-toxcity, genotoxicity. Selected agents

and classes of agents are examined in detail, Material toxicity, methods in toxicity evaluation**.**

18. IN VIVO MODELS (2credits)

This course is on preclinical testing for safety and efficacy medical implantable. This course covers basic concepts in design, conduct and interpretation of large animal studies for assessing medical device safety and performance. Identification of device failure modes for different devices and selection of suitable animal models for demonstrating these will be discussed**.**

(B) MPH Course Modules Selected for PhD Course Work (offered at AMCHSS)

Course 1: BASIC BIOSTATISTICS (Compulsory course – 4 credits)

Course 2: INTRODUCTION TO EPIDEMIOLOGY (3 credits)

Course 3: HEALTH AND DEVELOPMENT (3 credits)

Course 4: HEALTH AND ENVIRONMENT (3 credits)

Course 5: BASIC HEALTH ECONOMICS (2 credits)

Course 6: GENDER ISSUES IN HEALTH (2 credits)

Course 7: ETHICS IN PUBLIC HEALTH (2 credits)

Course 8: HEALTH POLICY ANALYSIS 1 (2 credits)

Course 9: HEALTH CARE SYSTEM IN INDIA (2 credits)

Course 10: HEALTH MANAGEMENT (4 credits)

Course 11: QUANTITATIVE RESEARCH METHODS (2 credits)

Course 12: ANTHROPOLOGICAL PERSPECTIVES IN HEALTH (1 credit)

For details of MPH Course Modules, visit website – http://www.sctimst.ac.in /amchss/

(C) ADDITIONAL INSTRUCTIONS

(1) PhD researchers based on experimental work (BMT Wing & Medical Complex) are recommended to take the Statistics and Research Methodology Course offered at BMT Wing as the course is designed suitable for their purpose.

(2) PhD researchers based on public health are recommended to take the Basic Biostatistics Course offered at AMCHSS.

(3) PhD Course Work will be offered at the BMT Wing and at AMCHSS during different periods. At BMT Wing between August to December and in AMCHSS between January to November every year.

(4) Regular class participation and securing at least a minimum pass is in the final examination is a mandatory requirement.

May 19, 2010 **DIRECTOR**