



Syllabus for PhD Coursework

2022

**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL
SCIENCES & TECHNOLOGY**

**(An Institute of National Importance,
Department of Science and Technology, Govt. of India)**

Thiruvananthapuram

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) is an Institute of National Importance under the Department of Science and Technology, Govt. of India.

The joint culture of medicine and technology pioneered by its founders more than four decades ago, has come of age and gained unprecedented acceptance in India. The institute has the status of a university and offers excellent research and training facilities. The Institute has three wings;

- **Tertiary Referral Super Specialty Hospital**
- **The Biomedical Technology Wing**
- **The Achutha Menon Centre for Health Science Studies**

The present document is the Syllabus for PhD Coursework, prepared based on the guidelines of University Grant Commission, New Delhi. The syllabus is divided in to two parts. The first part is the mandatory ‘Core course’ with eight credits. The second part is the ‘Elective Course’ having two credits. The minimum required credit for the PhD coursework is ten. Each credit is having fifteen hours of class room teaching. The details of the syllabus, modules and name of faculties are addressed in the following pages.

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COURSE MODULE

PART - I. CORE COURSE (8 CREDITS)

- MODULE – 1** : **Research Methodology**
(2 credits, 30h teaching)
- MODULE –II** : **Scientific conduct and practices**
(1 credit, 15h teaching)
- MODULE – III** : **Ethics in Research and Publication**
(1 credit, 15h teaching)
- MODULE - IV** : **Quality Practices and Intellectual property**
(1 credit, 15h teaching)
- MODULE – V** : **Biostatistics**
(1 credit, 15h teaching)
- MODULE – VI** : **Use of Laboratory Animals in Research**
(1 credit, 15h teaching)
- MODULE – VII** : **Computer Applications**
(1 credit, 15h teaching)

PART - II. ELECTIVE COURSES (2 CREDITS)

A. BIOLOGICAL SCIENCES

- MODULE – I : Basics of Cell Biology
(1 credit, 15h teaching)**
- MODULE – II : Neurobiology
(1 credit, 15h teaching)**
- MODULE – III : Bone Biology:
(1 credit, 15h teaching)**
- MODULE – IV : Experimental Pathology:
(1 credits, 15h teaching)**
- MODULE – V : Microbiology
(1 credit, 15h teaching)**
- MODULE – VI : Stem Cells & Regenerative Medicine
(1 credits, 15h teaching)**
- MODULE –VII : Immunology of Medical devices
(1 credit, 15h teaching)**
- MODULE –VIII : Neurophysiology
(1 credit, 15h teaching)**
- MODULE –IX : Cell Material Interactions
(1 credit, 15h teaching)**

B. INTER-DISCIPLINARY SCIENCES

- MODULE – I** : **Biomaterials & Biocompatibility**
(1 credits, 15h teaching)
- MODULE – II** : **Toxicology**
(1 credits, 15h teaching)
- MODULE – III** : ***In Vivo* models**
(1 credit, 15h teaching)
- MODULE – IV** : **Biomaterial Scaffolds in tissue engineering**
(1 credits, 15h teaching)
- MODULE- V** : **Entrepreneurship & Startups in Biosciences**
(1 credits, 15h teaching)
- MODULE- VI** : **Essentials of R and Bioconductor**
(1 Credit, 15h teaching)
- MODULE- VII** : **Data Analysis using Reproducible methods**
(1 Credit, 15h teaching)
- MODULE- VIII** : **Data Science for Researchers (1 Credit, 15h teaching)**
- MODULE- IX** : **Technology Development and Translations**
(1 Credit, 15h teaching)

C. MATERIAL SCIENCES

- MODULE – I : Ceramic and Metallic Materials
(1 credits, 15h teaching)**
- MODULE – II : Polymeric Biomaterials
(2 credits, 30h teaching)**
- MODULE – III : Dental Materials
(1 credit, 15h teaching)**
- MODULE – IV : Biomaterials and Nanomaterials in drug delivery and gene
therapy, Biomedical sensors
(1 credits, 15h teaching)**
- MODULE – V : Biophotonics and Imaging (1 credit, 15h teaching)**
- MODULE – VI : Applied Electron Microscopy (1 credits, 15h teaching)**
- MODULE – VII : Solid Freeform Fabrication (SSF) of Biomaterials
(1 credits, 15h teaching)**
- MODULE – VIII : Mucoadhesive Polymers in Dental Applications
(1 credits, 15h teaching)**

D. MEDICAL DEVICE ENGINEERING

MODULE – I : Medical Device Technology (2 credits, 30h teaching)

E. MEDICAL SCIENCES: Cardiac Sciences

- MODULE – I : Cardiac Anatomy and Physiology (1 credit, 15h teaching)**
- MODULE – II : Molecular and Cellular Cardiology (1 credit, 15h teaching)**
- MODULE – III : Overview of Diagnosis, Medical and Surgical treatments (1 credit, 15h teaching)**

E. MEDICAL SCIENCES: Neurosciences

- MODULE – I : Neuroanatomy and Neuroimaging (1 credit, 15h teaching)**
- MODULE – II : Neurobiology (1 credit, 15h teaching)**
- MODULE – III : Neurophysiology (1 credit, 15h teaching)**
- MODULE – IV : Clinical Neurosciences (1 credit, 15h teaching)**
- MODULE – V : Neurosurgery (1 credit, 15h teaching)**
- MODULE – VI : Advanced Monitoring in Neuroscience (1 credit, 15h teaching)**

E. MEDICAL SCIENCES: Pathology

- MODULE – 1 : Cardiovascular pathology & Neuropathology (1 credit, 15h teaching)**

E. MEDICAL SCIENCES

- MODULE – 1 : Biochemistry & Molecular Genetics (1 credit, 15h teaching)**
- MODULE – II : Clinical Epidemiology (1 credit, 15h teaching)**

LIST OF FACULTY

PART - I. CORE COURSE (8 CREDITS)

Dr. Manoj Komath Dr. Anilkumar PR	:	MODULE - 1 Research Methodology (2 credits, 30h teaching)
Dr. Anilkumar PR Dr. Manoj Komath Dr. Mohanan PV	:	MODULE –II Scientific conduct and practices (1 credit, 15h teaching)
Dr. Anoopkumar T Dr. Ravi Prasad Varma P	:	MODULE – III Ethics in Research and Publication (1 credit, 15h teaching)
Er. Nagesh DS Dr. Mohanan PV Dr. Ramesh P Er. Balram S Er. Rajkrishna Rajan	:	MODULE – IV Quality Practices and Intellectual property (1 credit, 15h teaching)
Dr. Sankara Sarma P Dr. Jissa VT	:	MODULE – V Biostatistics (1 credit, 15h teaching)
Dr. Harikrishnan V.S Dr. Anilkumar TV	:	MODULE – VI Use of Laboratory Animals in Research (1 credit, 15h teaching)
Dr. Arun Anirudhan V Er. Muraleedharan CV	:	MODULE – VII Computer Applications (1 credit, 15h teaching)

LIST OF FACULTY

PART -I I. ELECTIVE COURSE (2 CREDITS)

A. BIOLOGICAL SCIENCES

- Dr. Anugya Bhatt**
Dr. Renjith P Nair : **MODULE – I**
Basics of Cell Biology (1 credit, 15h teaching)
- Dr. Anoopkumar T**
Dr. Arun Anirudhan V : **MODULE – II**
Neuro Biology (1 credit, 15h teaching)
- Dr. Francis B Fernandez** : **MODULE – III**
Bone Biology: (1 credit, 15h teaching)
- Dr. Anilkumar T.V** : **MODULE – IV**
Experimental Pathology: (1 credits, 15h teaching)
- Dr. A Maya Nandkumar** : **MODULE – V**
Microbiology (1 credit, 15h teaching)
- Dr. Anil Kumar PR**
Dr. Naresh Kasoju : **MODULE – VI**
Stem Cells & Regenerative Medicine
(1 credits, 15h teaching)
- Dr. P.R. Umashankar** : **MODULE –VII**
Immunology of Medical devices
(1 credit, 15h teaching)
- Dr. Kamalesh K Gulia** : **MODULE –VIII**
Neurophysiology (1 credit, 15h teaching)
- Dr. Naresh Kasoju** : **MODULE –IX**
Cell Material Interactions (1 credit, 15h teaching)

**LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)**

B. INTER-DISCIPLINARY SCIENCES

Dr. Sabareeswaran A	:	MODULE – I Biomaterials & Biocompatibility (1 credits, 15h teaching)
Dr. Mohanan P.V Dr. Remya NS	:	MODULE – II Toxicology (1 credits, 15h teaching)
Dr. Sachin J Shenoy	:	MODULE – III <i>In Vivo</i> models (1 credit, 15h teaching)
Dr. Lynda V Thomas	:	MODULE – IV Biomaterial Scaffolds in tissue engineering (1 credits, 15h teaching)
Er. S. Balram	:	MODULE- V Entrepreneurship & Startups in Biosciences (1 credits, 15h teaching)
Dr. Srikant A	:	MODULE- VI Essentials of R and Bioconductor (1 Credit, 15h teaching)
Dr. Biju Soman	:	MODULE- VII Data analysis using reproducible methods (1 Credit, 15h teaching)
Dr. Biju Soman	:	MODULE- VIII Data Science for Researchers (1 Credit, 15h teaching)
Dr. Manoj G Er. Subhash NN Dr. Easwer HV	:	MODULE- IX Technology development and Translations (1 Credit, 15h teaching)

LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)

C. MATERIAL SCIENCES

- Dr. H.K.Varma**
Dr Manoj Komath
Dr. Francis B Fernandez : **MODULE – I**
Ceramic and Metallic Materials
(1 credits, 15h teaching)
- Dr. Ramesh P**
Dr. Shiny Velayudhan
Dr. Manju S
Dr. Gijo Raj : **MODULE – II**
Polymeric Biomaterials (2 credits, 30h teaching)
- Dr. Lizymol P.P** : **MODULE – III**
Dental Materials (1 credit, 15h teaching)
- Dr. Rekha MR**
Dr. Jayasree RS : **MODULE – IV**
Biomaterials and Nanomaterials in drug delivery
and gene therapy, Biomedical sensors
(1 credits, 15h teaching)
- Dr. Jayasree RS** : **MODULE – V**
Biophotonics and Imaging (1 credit, 15h teaching)
- Dr. Varma HK**
Dr. Manoj Komath
Dr. Francis B F : **MODULE - VI: Applied Electron Microscopy**
(1 credits, 15h teaching)
- Dr. Shiny Velayudhan**
Dr. Anil Kumar PR : **MODULE - VII: Solid Freeform Fabrication (SSF)**
of Biomaterials (1 credits, 15h teaching)
- Dr. Manju S** : **MODULE - VIII: Mucoadhesive Polymers in Dental**
Applications (1 credits, 15h teaching)

LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)

D. MEDICAL DEVICE ENGINEERING

Er. Muraleedharan C.V

Dr. Sujesh S

:

MODULE – I

Medical Device Technology

(2 credits, 30h teaching)

LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)

E. MEDICAL SCIENCES: Cardiac Sciences

- Dr. Harikrishnan S**
Dr. Abhilash SP
Dr. Deepa S Kumar : **MODULE – I**
Cardiac Anatomy and Physiology
(1 credit, 15h teaching)
- Dr. Neethu Mohan** : **MODULE – II**
Molecular and Cellular Cardiology
(1 credit, 15h teaching)
- Dr. Narayanan Namboodiri**
Dr. Arun Gopalakrishnan
Dr. Harikrishnan S : **MODULE – III**
Overview of Diagnosis, Medical and Surgical
treatments (1 credit, 15h teaching)

LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)

E. MEDICAL SCIENCES: Neurosciences

Dr. Kesavadas C
Dr. Bejoy Thomas
Dr. Jayadevan
Dr. Santhosh

: **MODULE – I**
Neuroanatomy and Neuroimaging
(1 credit, 15h teaching)

Dr. Anoopkumar T

: **MODULE – II: Neurobiology**
(1 credit, 15h teaching)

Dr. Kamalesh K Gulia

: **MODULE – III: Neurophysiology**
(1 credit, 15h teaching)

Dr. Sylaja PN
Dr. Ashalatha R
Dr. Syam K
Dr. Divya KP
Dr. Sruthi S Nair
Dr. Soumya S
Dr. Sajith S
Dr. Sapna Erat
Dr. Ramshekhar Menon
Dr. Ajith Cherian
Mr. Manju Mohan

: **MODULE – IV: Clinical Neurosciences**
(1 credit, 15h teaching)

Dr. Jayanand Sudhir

: **MODULE – V: Neurosurgery**
(1 credit, 15h teaching)

Dr. S Manikandan
Dr. Ajayprasad Hrishi

: **MODULE – VI: Advanced Monitoring in**
Neuroscience (1 credit, 15h teaching)

LIST OF FACULTY
PART -I I. ELECTIVE COURSE (2 CREDITS)

E. MEDICAL SCIENCES: Pathology

Dr. Deepti AN
Dr. Rajalakshmi P : **MODULE – I: Cardiovascular Pathology & Neuropathology**
(1 credit, 15h teaching)

E. MEDICAL SCIENCES

Dr. Cibin TR
Dr. Jyothi EK
Dr. Madhusoodanan UK
Dr. Divya MS : **MODULE – I: Biochemistry & Molecular Genetics (1 credit, 15h teaching)**

Dr. Ravi Prasad Varma P : **Module – II: Clinical Epidemiology (1 credit, 15h teaching)**

QUALIFICATION AND EXPERIENCE OF FACULTY
(ALL FACULTIES MORE THAN 10 YEARS OF EXPERIENCE)

No	Name of Faculty	Qualification
1.	Abhilash SP (Dr)	DM
2.	Ajayprasad Hrishi (Dr)	DM
3.	Ajith Cherian (Dr)	DM
4.	Anil Kumar PR (Dr)	PhD
5.	Anilkumar T.V. (Dr)	PhD
6.	Anoopkumar T (Dr)	PhD
7.	Anugya Bhatt (Dr)	PhD
8.	Arun Anirudhan V (Dr)	PhD
9.	Arun Gopalakrishnan (Dr)	PhD
10.	Ashalatha R (Dr)	DM
11.	Balram S (Er)	MTech
12.	Bejoy Thomas (Dr)	DM
13.	Biju Soman (Dr)	MD
14.	Cibin TR (Dr)	PhD
15.	Deepa S Kumar (Dr)	DM
16.	Deepti AN (Dr)	MD, PhD
17.	Divya KP (Dr)	DM
18.	Divya MS (Dr)	PhD
19.	Easwer HV	MCh
20.	Francis B Fernandez (Dr)	PhD
21.	Gijo Raj (Dr)	PhD
22.	Harikrishna Varma (Dr)	PhD
23.	Harikrishnan S (Dr)	DM
24.	Harikrishnan V.S (Dr)	BVSc&AH, MLAS
25.	Jayadevan ER (Dr)	DM
26.	Jayasree RS (Dr)	PhD
27.	Jayanand Sudhir (Dr)	MCh
28.	Jissa VT (Dr)	PhD
29.	Jyothi EK(Dr)	PhD
30.	Kamalesh K Gulia (Dr)	PhD
31.	Kesavadas C (Dr)	DM
32.	Lizymol P.P (Dr)	PhD
33.	Lynda V Thomas (Dr)	PhD
34.	M.R. Rekha (Dr)	PhD
35.	Madhusoodanan UK (Dr)	PhD
36.	Manikandan S (Dr)	DM
37.	Manju Mohan (Mr)	
38.	Manju S (Dr)	PhD
39.	Manoj G (Dr)	PhD
40.	Manoj Komath (Dr)	PhD
41.	Maya Nandkumar A (Dr)	PhD
42.	Mohanan PV (Dr)	PhD
43.	Muraleedharan CV (Er)	MTech
44.	Nagesh DS (Er)	MTech
45.	Narayanan Namboodiri (Dr)	DM

46.	Naresh Kasoju (Dr)	PhD
47.	Neethu Mohan(Dr)	PhD
48.	Rajalakshmi P (Dr)	MD
49.	Rajkrishna Rajan (Mr)	MBA
50.	Ramesh P (Dr)	PhD
51.	Ramshekhhar Menon (Dr)	DM
52.	Rekha MR (Dr)	PhD
53.	Remya NS (Dr)	PhD
54.	Renjith P Nair (Dr)	PhD
55.	Ravi Prasad Varma P (Dr)	MD
56.	Sabareeswaran A (Dr)	PhD
57.	Sachin J Shenoy (Dr)	MVSc
58.	Sajith S (Dr)	DM
59.	Sankara Sarma P (Dr)	PhD
60.	Sapna Erat (Dr)	DM
61.	Santhosh Kumar K(Dr)	DM
62.	Shiny Velayudhan (Dr)	PhD
63.	Soumya S (Dr)	DM
64.	Srikant A (Dr)	PhD
65.	Sruthi S Nair (Dr)	DM
66.	Subhash NN (Er)	MTech
67.	Syam K (Dr)	DM
68.	Sylaja PN (Dr)	DM
69.	Umashankar PR (Dr)	PhD

Syllabus for PhD Coursework

CORE COURSE CREDITS

PART - I. CORE COURSE (8 CREDITS)

MODULE - 1 Research Methodology (2 credits, 30h teaching)

Faculty: Dr. Manoj Komath, Dr. Anilkumar PR

1. Course outline

- **Introduction**

- History of science,
- Evolution of the Scientific Method,
- The Scientific Temper,
- Roles and responsibilities of a researcher.

- **Research process**

- Selecting topic,
- Literature survey,
- Defining and Formulating the Research Questions,
- Formulation and sources of Hypothesis

- **Experimental design**

- Experimental approaches and methodology,
- Finalization of experimental design.

- **Academic skills in research - Part 1:**

- Developing a research proposal
- Writing research article
- Making presentations

- **Assignment**

- Writing Research proposal
- Seminar: Presentation skills-present the proposal.

Total 100 marks (Written exam - 60 marks, Assignment and Seminar - 40 marks)

MODULE -II: Scientific conduct and practices (1 credit, 15h teaching)

Faculty: Dr. Anilkumar PR, Dr. Manoj Komath, Dr. Mohanan PV

1. Course Outline

• Tools and techniques of experiments

- Study design, Introduction, Planning and Designing a Research Study,
- Steps in Planning a Research Experiment, Research Design – Components, Experimental group, Variable, Control,
- Types of Research Designs and Approaches: Groups in research design, Group Equivalence, Importance of group equivalence, General Approaches for Controlling Artifact and Bias, Data Collection
- Assessment Methods and Measurement Strategies, Validity, Data Preparation, Analyses, Recording observations and documentation
- The significance and interpretation of the data

• Scientific Conducts

- Intellectual honesty and research integrity
- Scientific misconducts- Embezzlement of ideas, Plagiarism, Falsification, Fabrication, Fraud, Non-compliance of Regulatory Guidelines, Inappropriate Authorship, withholding data from validation, Selective reporting and misrepresentation of data, Problems that lead to unethical behavior
- Peer review, Authorship, Allegations of misconduct

• Research communications

- Preparation of proposals and manuscripts: Types of manuscripts, Best practices / standards setting initiatives and guidelines, Peer review, Authorship, Intellectual property, Conflict of interest, Impact factor, H index, i10 index, citation
- Publication misconduct: Definition, Concept, Violation of publication ethics, Predatory publishers and journals, Disputes in authorship and contributor ship, Identification of publication misconduct, complaints and appeals
- Redundant publications - Duplicate and overlapping publications
- Tools in research publication: Word processor, Reference Manager, Graphics editor, Image analysis software,
- Paraphrasing, predatory publishers and journals.
- Impact factor, H index, i10 index, citation

• Academic skills in research

- Workplace Etiquette, Difference Between Skills and Behavior, Identifying skill area, Typesetting, Image processing for research applications
- Using databases and research metrics

2. Assignment/ Seminar

Total 100 marks (Written exam - 60 marks, Assignment and Seminar - 40 marks)

MODULE - III: Ethics in Research and Publication (1 credit, 15h teaching)
Faculty: Dr. Anoopkumar T, Dr. Ravi Prasad Varma P

1. Course outline

• Ethics in Research

- 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
- Case studies, interactive small group discussions
- Role-playing simulations.
- Best practices / standards setting initiatives and guidelines
- Conflicts of interest

2. Assignment/ Seminar

Total 100 marks (Written exam - 60 marks, Assignment and Seminar - 40 marks)

MODULE - IV : Quality Practices and Intellectual property (1 credit, 15h teaching)
Faculty: Er. Nagesh DS, Dr. PV. Mohanan, Dr. P. Ramesh, Er. S. Balram,
Mr. Rajkrishna Rajan

1. Course Outline

- Overall Quality Management system
- ISO standards and guidelines
- Good Laboratory Practice
- IPR & its significance
- Patent Law & Practice in India
- International Patent Regimes

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks.

MODULE - V: Biostatistics (1 credit, 15h teaching)

Faculty: Dr. P Sankara Sarma, Dr. Jissa VT

1. Course Outline

- Relevance of statistics as a scientific discipline that provide tools for empirical research.
- The emphasis of this course is on the application of statistical methods commonly employed in biomedical research and the interpretation of their results.
- Topics that will be covered include: Descriptive statistics, Probability, Principles of statistical inference, Estimation and Hypothesis testing, Parametric vs. Non-parametric tests, Statistical vs. scientific/clinical significance and sample size for adequate power.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks.

MODULE – VI: Use of Laboratory Animals in Research (1 credit, 15h teaching)

Faculty: Dr. Harikrishnan V.S, Dr. Anilkumar TV

1. Course Outline

- Duties of the research team and the governmental organizations involved in regulating biomedical research, basic considerations of experimental design.
- Laws that govern biomedical research; Role of CPCSEA in India
- Function of the institutional animal ethics 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.
- 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, signs of good health and illness in common species.
- Methods of euthanasia of the following animals: rats, mice, guinea pigs, rabbits.
- The course will include teaching and demonstration of proper techniques used in handling of small laboratory animals .

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE – VII: Computer Applications (1 credit, 15h teaching)
Faculty: Dr. Arun Anirudhan V, Er. Muraleedharan CV

1. Course Outline

- Basics of Excel (Referencing, Formula etc)
- Sorting and Filter in Excel
- Measures of Central tendency and Measures of dispersion
- Data cleaning and charts
- Tests of Hypothesis and P-value in excel
- Normal Distribution
- T-test
- Application of p-value in biological experiments

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

Syllabus for PhD Coursework

ELECTIVE COURSES CREDITS

PART –I I. ELECTIVE COURSE (2 CREDITS)

A. BIOLOGICAL SCIENCES

MODULE – I: Basics of Cell Biology (1 credit, 15h teaching)

Faculty: Dr. Anugya Bhatt, Dr. Renjith P Nair

3. Course Outline

- Introduction to cell biology, cell-cell interaction, cell-ECM interaction.
- Cytokines and growth factors in cell regulation, cell cycle, cell signaling, cell proliferation
- Nucleic acids, DNA replication, Transcription and Translation
- Introduction to Stem cells and Cancer Biology.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE – II: Neuro Biology (1 credit, 15h teaching)
Faculty Dr. Anoopkumar T & Dr. Arun Anirudhan V

1. Course Outline

- Introduction to neuroscience.
- Brain structure and its origins
- Brain and cognition
- Neuronal basis of learning and memory
- Cellular neurobiology -Neurological diseases

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - III: Bone Biology: (1 credit, 15h teaching)

Faculty: Dr. Francis B Fernandez

1. Course Outline

- Structure and development of bone
- 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
- Metabolic bone diseases

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - IV: Experimental Pathology: (1 credits, 15h teaching)
Faculty: Dr. Anilkumar T.V.

1. Course Outline

- Introduction to pathology: definitions and basic terminology
- Reversible cell injury; Irreversible cell injury
- Chronic cell-injury and cell adaptation
- Disorders of cell metabolism: intracellular and extra-cellular accumulations
- Tissue response to injury-1: Acute inflammation
- Tissue response to injury-2: Chronic inflammation
- Vascular response to injury
- Pathology of cell proliferation (tumour pathology)
- Experimental pathology for biomaterial specialists

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - V: Microbiology (1 credit, 15h teaching)

Faculty: Dr. A Maya Nandkumar

1. Course Outline

- 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.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - VI: Stem Cells & Regenerative Medicine (1 credits, 15h teaching)
Faculty: Dr. Anil Kumar PR, Dr. Naresh K

1. Course Outline

- 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.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE -VII: Immunology of Medical devices (1 credit, 15h teaching)

Faculty: Dr. P.R. Umashankar

1. Course Outline

- Innate and acquired immune response : an overview
- Hypersensitivity reactions
- Transplant rejection
- Immune response to medical devices: Eg Tissue based medical devices
- Concepts in Immuno-compatibility/ immune toxicity assessment
- Induction of tolerance

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE -VIII: Neurophysiology (1 credit, 15h teaching)

Faculty: Dr. Kamalesh K Gulia

1. Course Outline

- Introduction to the Neurophysiological approach to understand brain function
- Resting membrane potential: Electrical principles of neuronal function
- Action potential
- Skeletal muscle and neuromuscular contraction
- Functional organization of nervous system
- Somatic sensations
- Special senses – Lecture 1 (vision and hearing)
- Special senses – Lecture 2 (olfaction and taste)
- Motor functions of spinal cord and reflexes
- Control of motor movements by cortex and basal ganglia
- Control of motor movement by cerebellum and brainstem
- Limbic system including hypothalamus
- Sleep and wakefulness
- Autonomic nervous system
- Intellectual functions of the brain, learning and memory
- Plasticity in the nervous system

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE -IX: Cell Material Interactions (1 credit, 15h teaching)

Faculty: Dr. Naresh Kasoju

1. Course Outline

- Introduction to matrix biology and extracellular composition
- Insights into extracellular matrix remodeling and tissue homeostasis
- Basics on various materials in medicine and their characteristics
- Effect of morpho-topological properties of materials on cell response
- Effect of physico-chemical properties of materials on cell response
- Effect of mechano-properties of materials on cell response
- Effect of bio-functional properties of materials on cell response
- Practical aspects of cell – material interactions analysis

2. Assignment/ seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

B. INTER-DISCIPLINARY SCIENCE

MODULE - I: Biomaterials & Biocompatibility (1 credit, 15h teaching)

Faculty: Dr. Sabareeswaran A

1. Course Outline

- 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 be 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

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE – II: Toxicology (1 credits, 15h teaching)

Faculty: Dr. Mohanan P.V, Dr. Remya NS

1. Course Outline

- 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-toxicity
- Genotoxicity
- Selected agents and classes of agents are examined in detail
- Material toxicity
- Methods in toxicity evaluation
- Nanotoxicity
- Alternatives to Animal experimentation

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE – III: *In- Vivo* Models (1 credit, 15h teaching)

Faculty: Dr. Sachin J Shenoy

1. Course Outline

- Introduction to Animal Models
- Preclinical testing for safety and efficacy medical implantable
- 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.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - IV: Biomaterial Scaffolds in tissue engineering (1 credit, 15h teaching)
Faculty: Dr. Lynda V Thomas

1. Course Outline

- Introduction to tissue engineering and regenerative medicine
- Introduction to the basic concepts of scaffolds in tissue engineering
- The criteria for using different scaffolds in a variety of application areas
- Micro and macro encapsulation of cells
- Scaffold materials-Natural and Synthetic biopolymers or combinations
- Decellularized scaffolds in tissue engineering
- Hydrogel technology
- Surface modification and delivery of bioactive molecules
- Fabrication technology of scaffolds: Traditional techniques, Nanotechnology and Solid free-form fabrication techniques
- Characterisation of scaffolds for tissue engineering- Material characterization and biological characterization; biomechanics
- Tissue microenvironment and bioreactors in tissue engineering
- Ethical and regulatory issues
- Case Study

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE- V: Entrepreneurship & Startups in Biosciences (1 credits, 15h teaching)
Faculty: Er. S. Balram

1. Course Outline

- This course will provide an awareness and kindle interest in science led entrepreneurship among research scholars
- This course will cover the emerging opportunities for startups in biosciences and highlight the risks and challenges for entrepreneurs
- The startup scenario, the incubation support & funding schemes available to science led entrepreneurship activities will be covered
- Identifying the innovation and startup potential in the research projects and making a business plan out of research will be discussed

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE- VI: Essentials of R and Bioconductor (1 Credit, 15h teaching)

Faculty: Dr. Srikant A

1. Course Outline

- **Essentials of R**

Introduction to R & Getting assistance in R, Useful functions in R, Communicating with other software, Summarizing data, Plotting- using Base R and ggplot, producing publication quality figures using ggplot, Building statistical models in R

- **Packages in Biocoductor**

Introduction to Bioconductor, Examples and use of analysis software packages, annotation packages, experiment data packages and workflow packages

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE- VII: Data analysis using reproducible methods (1 Credit, 15h teaching)
Faculty: Dr. Biju Soman

1. Course Outline

- Introduction to reproducible research and introduction to R software
- Database management in R – reading, writing, importing, and exporting databases
- Use of visualization tools and Graphics in R
- Use of inferential statistics in R
- Creation of print-ready tables and charts in R
- Storage and reuse of the reproducible algorithm

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE- VIII: Data Science for Researchers (1 Credit, 15h teaching)

Faculty: Dr. Biju Soman

1. Course Outline

- The basic concepts in data science
- Primary data: skill development for customized data entry and creation of databases
- Secondary data: skill acquisition for data cleaning, simple analysis and in the use of scripts for analysis
- Learning to use specialized databases like bibliographies

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE- IX: Technology Development and Translations (1 Credit, 15h teaching)
Faculty: Dr. Manoj G, Er. Subhash NN, Dr. Easwer HV

1. Course Outline

- Overview of product development
- Valley of death in technology translation
- Technology assimilation and product engineering
- Importance of clinical trial/studies
- Post Marketing studies

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

C. MATERIAL SCIENCES

MODULE - I: Ceramic and Metallic Materials (1 credits, 15h teaching)

Faculty: Dr. H.K.Varma, Dr Manoj Komath, Dr. Francis B Fernandez

1. Course Outline

- 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 behaviour, 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;
- 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
- Examples of biomaterials applications - heart valve prostheses, artificial hip joints, intraocular lenses and left ventricular assist devices.
- Ceramics & Tissue Engineering: A bench to bedside journey in ceramic materials.
- Development of need based ceramic systems, identification of problem areas, generation of suitable remedies based on in – house experiences.
- Assessment data for pre - clinical and clinical guidance and need based modifications.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE – II: Polymeric Biomaterials (2 credits, 30h teaching)

Faculty: Dr. Ramesh P, Dr. Shiny Velayudhan, Dr. Manju S., Dr. Gijo Raj

1. Course Outline

- 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
- Chemistry of Polymerization- Chain polymerization: Free radical polymerization, Ionic polymerization (Anionic and cationic polymerization), Co-ordination polymerization (Ziegler-Natta catalysts, metallocene catalysts) Step polymerization: Polycondensation, Ring opening polymerization, Modern techniques of polymerization
- Polymer synthesis-bulk, solution, suspension and emulsion, melt polycondensation, solution polycondensation, interfacial condensation, solid and gas phase polymerization
- Characterization of polymers - molecular weight, tacticity, crystallinity, viscoelasticity, mechanical properties, thermal properties, dynamic mechanical properties, surface properties
- Structure property relationships: Focus on connecting bonding and polymer structure (i.e. molecular weight, tacticity, crystallinity as it regards spherulites) to mechanical (yield phenomena and fracture) and thermomechanical (viscoelasticity) behavior.
- Composites, Classification of composites, Evaluation of composites, Composites in Biomedical applications
- 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
- Polymeric medical devices and implants - gloves, catheters, blood bags
- Compounding and processing of polymeric biomaterials: Polymer additives and compounding, vulcanization process; processing such as compression moulding, injection moulding, extrusion, film blowing, calendaring, electrospinning, Additive Manufacturing Techniques, 3D printing, 3D Bioprinting: Concept of Bioink, Various Bioprinting Modalities, Application of 3D printing and Bioprinting.
- Storage stability; Sterilization and packaging.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - III: Dental Materials (1 credit, 15h teaching)

Faculty: Dr. Lizymol P.P.

1. Course Outline

- 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, *in vitro* and *in vivo* 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.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

**MODULE - IV: Biomaterials and Nanomaterials in drug delivery and gene therapy,
Biomedical sensors (1 credits, 15h teaching)**

Faculty: Dr. Rekha MR, Dr. Jayasree RS

1. Course Outline

- The course is designed to provide an overall understanding on polymers and nanomaterials as drug carriers
- Nanoparticles based oral peptide delivery systems: hurdles in oral protein delivery, overcoming the gastro-intestinal barriers, nanoparticle based approaches, case study
- Physico-chemical and biological characterization
- 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.
- Preparation and characterization of metallic nanoparticles and functionalized nanoparticles for sensing of clinically relevant molecules.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - V: Biophotonics and Imaging (1 credit, 15h teaching)

Faculty: Dr. Jayasree RS

• **Course Outline**

- Medical Lasers-Laser illumination, surgical lasers, laser for dermatology, cosmetic lasers, dental lasers, wound care lasers, laser for low level laser therapy(LLLT)
- Interaction between biological system and light
- Physics underlying biophotonics based therapeutic and diagnostic techniques
- Light to image, detect and manipulate biological materials
- Biophotonic approaches towards diagnosis
- Biophotonic approaches towards cancer therapy-PDT,PTT and LLLT
- Nano-biophotonics for molecular imaging and diagnosis -Contrast agents and molecular probes for biomedical imaging
- Advanced biophotonic imaging and spectroscopy techniques-Bioluminescence, Fluorescence, Fluorescence life time, Optical Coherence tomography, Infrared, Raman and SERS.

• **Assignment/ Seminar**

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - VI: Applied Electron Microscopy (1 credits, 15h teaching)

Faculty: Dr. Varma HK, Dr. Manoj Komath, Dr. Francis B F

1. Course Outline

- Theory and practice of operation of the transmission electron microscope (TEM) and supporting equipment (e.g. ultramicrotome and knife maker),
- The scanning electron microscope (SEM) and supporting equipment (critical point dryer and sputter coater) and allied equipment.
- The theory of scanning transmission electron microscopy and analytical electron microscopy including energy and wavelength dispersive X-ray microanalysis and electron energy loss spectroscopy will also be outlined in the lectures.
- This will integrate lab module where demonstration of protocols and instrument handling will be carried out.

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - VII: Solid Freeform Fabrication (SSF) of Biomaterials (1 credits, 15h teaching)

Faculty: Dr. Shiny Velayudhan, Dr. Anil Kumar PR

1. Course Outline

- Introduction to SSF; Classification of SSF
- Design guidelines for SSF; Basics of Computer Aided Designing
- Three dimensional Printing (3DP), Principles – Process - Additive Manufacturing Technologies, Types of prototyping - Continuous mode and Drop on Demand mode
- Digital Light Processing (DLP) - Photo Polymerization
- Photoinitiators, Photo crosslinkable materials; Selective Laser Sintering (SLS)
- Fused deposition Modeling (FDM) - Working Principles, Process
- Materials and Biomedical Applications, Advantages -Limitations – Applications Case studies.

2. Assignment/ Seminar

Total marks: 100; Written exam - 60 marks, Assignment and Seminar - 40 marks

MODULE - XIII: Mucoadhesive Polymers in Dental Applications (1 credits, 15h teaching)

Faculty: Dr. Manju S

1. Course Outline

- Introduction to mucoadhesion
- Application of mucoadhesive polymers in dentistry
- Theories of mucoadhesion: wetting theory, Electrostatic theory, diffusion theory, adsorption theory, and fracture theory of mucoadhesion
- Overview of oral mucosa, factors affecting mucoadhesion
- Chemical structures of mucoadhesive polymers
- Different strategies to enhance the mucoadhesive properties of natural/synthetic polymers
- Techniques for the determination of mucoadhesion
- Mucoadhesive polymer formulations: spray, tablets, films, patches, gels, ointments, wafers, etc.
- Challenges and opportunities for mucoadhesive formulations

2. Assignment/Seminar

Total 100 marks. Written exam-60 marks, Assignment and Seminar-40 marks

D. MEDICAL DEVICE ENGINEERING

MODULE - I: Medical Device Technology (3 credits, 27h teaching)

Faculty: Er. Muraleedharan C.V, Dr. Sujesh S

1. Course Outline

- Medical Device Classification
- Medical Device Design
- Product Reliability
- In vitro Evaluation
- Pre Clinical Animal Evaluation
- Good Manufacturing Practices
- Product Cleaning, Packaging and Sterilization
- Quality System Practices
- Clinical Evaluation of Medical Devices
- Medical Device Regulatory Mechanisms

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

E. MEDICAL SCIENCES: Cardiac Science

MODULE – I: Cardiac Anatomy and Physiology (1 credit, 15h teaching)

Faculty: Dr. Harikrishnan S, Dr. Abhilash SP, Dr. Deepa S Kumar

1. Course Outline

- Objectives of the training in cardiology
- Introduction to heart diseases.
- Cardiac Anatomy: Anatomy of Heart- Surface anatomy
- Gross anatomy, cardiac chambers, valves, Blood vessels. Arteries, Veins, Lymphatics, Coronary circulation and coronary venous drainage, Conduction System of Heart
- Cardiac Physiology: Normal Cardiac Cycle, Cardiac Cycle, Circulation,
- Tissue Perfusion- Unified Concept Circulation in Health and Disease
- Cardiac Output, Blood Pressure, Heart Rate/Pulse.
- Blood pressure-Measurement of Blood Pressure Technique: Sphygmomanometer Heart Sounds, Murmurs, Stethoscope, phonocardiography.
- Oxygen Saturations: Physiology of Oxygen Transport Blood Gases – Technique and Various Parameters
- Cardiac Pathophysiology: Valvular Heart Disease including Rheumatic Heart Disease,
- Congenital Heart Disease: Acyanotic and cyanotic, Shunts, R-L,L-R
- Pathophysiology of Heart Disease in General: Myocardial Failure, Pump Failure, Circulatory Failure, Impact on other organ systems- Eg. Kidney

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – II: Molecular and Cellular Cardiology (1 credit, 15h teaching)

Faculty: Dr. Neethu Mohan

1. Course Outline

- Major cell types in heart, Molecular Basis of myocyte contraction,
- Extra cellular matrix of heart, Molecular mechanisms of hypertrophy/ heart failure, Cell death and wound healing in the heart,
- Myocardial regeneration, Cardiac fibroblasts, Matrix remodelling in physiological and pathological condition, cardiac fibrosis,
- Molecular techniques to understand cardiac cell function,
- Recent developments in cardiac regeneration and cardiac tissue engineering

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – III: Overview of Diagnosis, Medical and Surgical treatments (1 credit, 15h teaching)

Faculty: Dr. Narayanan Namboodiri, Dr. Arun Gopalakrishnan, Dr. Harikrishnan S

1. Course Outline

- Diagnosis of Heart Diseases: Electrocardiography
- Echocardiography
- Cathlabs – Angiography
- Exercise testing
- CT, MRI, Electrophysiology studies
- Monitoring Patients with Heart Disease: Clinical Monitoring gadgets Invasive Monitoring- CVP, Intra Arterial BP, PA Wedge Pressure, Cardiac Output
- Treatment of Heart diseases: Coronary heart disease
- Congenital heart disease
- Treatment of electrical disorders – Radiofrequency ablation,
- Pacemakers Cardiac Arrest and cardiac Resuscitation
- Cardiac Surgery: Introduction Cardiopulmonary bypass surgery
- Surgical treatment of common heart diseases
- Congenital Heart Diseases Coronary Heart Disease – CABG
- Preventive Cardiology: Primary Prevention
- Secondary prevention

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

E. MEDICAL SCIENCES: Neurosciences

MODULE – I: Neuroanatomy and Neuroimaging (1 credit, 15h teaching)

**Faculty: Dr. Kesavadas C, Dr. Bejoy Thomas, Dr. Jayadevan ER,
Dr. Santhosh Kumar K**

1. Course Outline

- Neuroanatomy: Gross anatomy, Lobar anatomy, Gyri in Brain,
- Deep grey nuclei, Structural organisation-cortex and Fiber tracts
- Gross functional areas in brain and spinal cord
- Brain stem, Cerebellum, Spinal cord, Autonomic system, Peripheral nerves, sensors and effectors
- Neuroimaging: Introduction to Ultrasound,
- Doppler, Computed Tomography,
- Magnetic Resonance Imaging, P
- ositron Emission tomography (PET),
- Single Photon Emission Computed Tomography (SPECT),
- Nuclear Infrared Spectroscopy (NIRS),
- Magnetoencephalography (MEG),
- Magnetic Resonance Spectroscopy (MRS)
- Radiation and MRI safety (Group discussion with visit to department)
- Advanced neuroimaging methods: Diffusion Tensor Imaging (DTI),
- Fiber Tractography, BOLD fMRI, Combined fMRI-EEG/MEG data,
- Perfusion imaging, Arterial Spin Labelling (ASL).

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – II: Neurobiology (1 credit, 15h teaching)

Faculty: Dr. Anoopkumar T

1. Course Outline

- Brain structure and its origins,
- Brain and cognition,
- Neurological basis of learning and memory,
- Cellular Neurobiology,
- Basics of Neurodegeneration

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – III: Neurophysiology (1 credit, 15h teaching)

Faculty: Dr. Kamallesh K Gulia

1. Course Outline

- Introduction to the Neurophysiological approach to understand brain function
- Resting membrane potential: electrical principles of neuronal function
- Action potential
- Skeletal muscle and neuromuscular contraction
- Functional organisation of nervous system
- Somatic sensations
- Special senses – Vision and hearing
- Special senses – olfaction and taste
- Motor functions of spinal cord and reflexes
- Control of motor movements by cortex and basal ganglia
- Control of motor movements by cerebellum and brainstem
- Limbic system including hypothalamus
- Sleep and wakefulness
- Autonomic nervous system
- Intellectual functions of the brain, learning and memory
- Plasticity in the nervous system
- Student seminars: Each student one seminar
- Practical/Demonstration sessions: Exposure to the neuropsychological techniques

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – IV: Clinical Neurosciences (1 credit, 15h teaching)

Faculty: Dr. Sylaja PN, Dr. Ashalatha R, Dr. Syam K, Dr. Divya KP, Dr. Sruthi S Nair, Dr. Soumya S, Dr. Sajith S, Dr. Sapna Erat, Mr. Manju Mohan, Dr. Ramshekhar Menon, Dr. Ajith Cherian

1. Course Outline

- Introduction to Neurology, Movement disorders, TMS, DBS
- Neuromuscular disorders & ENMG, Evoked potentials
- Paediatric Neurology
- Critical care Neurology
- Stroke
- Audiology and speech therapy
- Cognitive Neuroscience, Clinical Evaluation of Cognitive Functions, Neuropsychological evaluation and cognitive retraining
- Sleep Medicine
- Epilepsy, EEG
- Video telemetry, intra and extra-operative monitoring, VNS (RMNCEC)

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – V: Neurosurgery (1 credit, 15h teaching)

Faculty: Dr. Jayanand Sudhir

1. Course Outline

- Vascular anatomy of brain and spinal cord, Cerebral blood circulation
- CSF circulation, Blood brain barrier, Intracranial pressure
- Cerebrovascular diseases: Aneurysms, Arteriovenous malformations, neurovascular conflicts
- Physics of blood flow, Physiology and Physics of blood flow in aneurysms and cerebrovascular disorders
- Cerebral bypass surgery, Moyamoya disease and surgery for stroke
- Surgical treatment of neurological diseases [*Including visit to Neurosurgery Operation Theatre*]
- Neurosurgical instruments
- Additional topics will be covered under course-sharing basis with IIT Madras

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

MODULE – VI: Advanced Monitoring in Neuroscience (1 credit, 15h teaching)

Faculty: Dr. S Manikandan and Dr. Ajayprasad Hrishi

1. Course Outline

- Cerebral physiology, metabolism, regulation of homeostasis
- Brain –organ interactions
- Spinal cord physiology and monitoring
- Monitoring of brain for Neuro interventions
 - Transcranial doppler
 - ICP
 - Cerebral micro dialysis
 - NIRS
 - Intraoperative advanced electrophysiological monitoring
 - Ultrasound in brain monitoring
- Pharmacological interventions in brain injury
- Ischemic preconditioning
- Ischemic post conditioning
- Prehabilitaion

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

E. MEDICAL SCIENCES: Pathology

MODULE – I: Cardiovascular Pathology & Neuropathology (1 credit, 15h teaching)

Faculty: Dr. Deepti AN, Dr. Rajalakshmi P

1. Course Outline

A. Cardiovascular Pathology

- Normal Cardiac Gross Anatomy and Histology
- Histopathology of Valvular heart disease
- Atherosclerosis and Aneurysms
- Tumors
- Congenital heart diseases

B. Neuropathology

- Normal gross anatomy and histology of brain and spinal cord
- Neuro-oncology
- Neuromuscular diseases
- Neuroinfections
- Epilepsy pathology
- Diagnostic Neuroimmunology

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

E. MEDICAL SCIENCES

MODULE – I: Biochemistry & Molecular Genetics (1 credit, 15h teaching)

Faculty: Dr. Cibin TR, Dr. Jyothi EK, Dr. Madhusoodanan UK, Dr. Divya MS

1. Course Outline

- Methods in Biochemistry: Principle & application of chromatography,
- HPLC, Electrophoresis (agarose and page),
- Blotting techniques,
- Ultracentrifugation (Velocity and buoyant density)
- Analysis of biomolecules using UV/visible, fluorescence, ELISA, HPLC
 - Basics of cell culture, microscopy and cell imaging, Cellular energetics and its assessment
 - Methods in Molecular Biology: Nucleic acids, chromosome, isolation and quantification of nucleic acids,
 - Principles of PCR, RT-PCR, Primer design,
 - Types of PCR, proof reading enzymes; microbial species identification.
 - Nucleic acid sequence databases; sequence alignment, data mining methods for sequence analysis, web-based tools for sequence searches
 - Molecular diagnostics in infectious diseases
 - Molecular Genetics: Principles of DNA damage and Repair,
 - Chromosomal aberrations, copy number variation (CNV),
 - Genomic instability
 - Genetic basis of inherited disorders, application of genetic testing in cardiovascular and neurodegenerative disorders,
 - Neurogenetics, GWAS.
 - Sequencing Methodology: Sanger sequencing,
 - Advanced sequencing technologies -Next Generation Sequencing (NGS)
 - Gene editing: Gene silencing technologies, transfection, cloning, screening of clones
 - Advanced genome editing techniques and its applications, Genome editing by CRISPR-Cas (*in vivo* and *in vitro*)
 - Ethical issues of CRISPR technology and genome engineering

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment/Seminar - 40 marks

E. MEDICAL SCIENCES

MODULE – I: Clinical Epidemiology (1 credit, 15h teaching)

Faculty: Dr. Ravi Prasad Varma P

1. Course Outline

- Overview of clinical audit and clinical research– information generation, outcome measurement in clinical research
- Concept of patient reported outcome measures – generic, disease specific
- Introduction to epidemiological designs – case series, cross-sectional studies, case control studies, cohort studies
- Introduction to randomized controlled trials
- Systematic reviews and meta-analysis – the topics will be addressed to enable candidates to appraise clinical research literature and to choose and implement appropriate design for various research questions
- Review of basic concepts of reliability and validity in clinical research – reliability of measurement
- Sources of imprecision, validity of measurements, processes, internal and external validity
- Introduction to causal reasoning

2. Assignment/ Seminar

Total 100 marks. Written exam - 60 marks, Assignment and Seminar - 40 marks

Notes on Teaching and Examination

- For each credit of course work, 15h will be allotted for teaching and discussion on assignments.
- The student has to attend the classes and secure 85% attendance for appearing for the written examination.
- Student seminar is included in each course schedule.
- The student has to give seminars/assignments in each course.
- The performance in class tests, assignments and seminars will be accounted for the evaluation for internal marks 40.
- There will be final written examination for 60 marks at the end of each course, which will be conducted by the Division of Academic Affairs
- The student has to appear for the written examination at the end of the each course as per the schedule.

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- Lodish, Harvey. Molecular Cell Biology. W H Freeman & Co
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- Fundamentals of Toxicology, Essential concepts and Applications PK Gupta Academic Press 2016
- Nano toxicology:Materials, Methodologies, and Assessments edited by Nelson Durán Silvia S. GuterresOswaldo L. Alves. Springer Publications 2013
- Regulatory Toxicology Third Edition Shayne.C. Gad Published by CRC Press 2018
- In vitro Toxicology Edited by Shayne C Gad 2nd Edition published by CRC press 2000

3. Materials Sciences

- An Introduction to Materials in Medicine, by William Wagner (Editor), Shelly Sakiyama-Elbert (Editor), Guigen Zhang (Editor), Michael Yaszemski (Editor), Academic Press Inc; 4th edition edition (4 March 2020)
- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, Biomaterials Science, An introduction to Materials Science, 2nd Edn, Elsevier Academic Press, London, 2004.
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