**First Semester:**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Contact Hours/Week</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BM-5101</td>
<td>Physiology</td>
<td>3</td>
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<tr>
<td></td>
<td>Elective-I*</td>
<td>3</td>
<td>3</td>
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<tr>
<td></td>
<td>Elective-II*</td>
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<td>3</td>
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<tr>
<td></td>
<td>Elective-III*</td>
<td>3</td>
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<tr>
<td></td>
<td>Elective-IV*</td>
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<tr>
<td>BM-5301</td>
<td>Practical</td>
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<td><strong>Total of First Semester</strong></td>
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*Elective-I, Elective-II*, Elective-III*, & Elective-IV*

Any four of the following

- BM-5102: Biomaterials
- BM-5103: Bioinstrumentation
- BM-5104: Biomechanics-I
- BM-5105: Computer Application in Biomedical Engineering
- BM-5106: Biological System Analysis and Control
- BM-5107: Mathematical Methods in Biomedical Engineering

**Second Semester:**

<table>
<thead>
<tr>
<th>SUBJECT CODE</th>
<th>SUBJECT</th>
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<th>CREDIT</th>
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<tr>
<td>Open Elective*</td>
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<td>Elective-I**</td>
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<tr>
<td>BM-5401</td>
<td>Practical/Project</td>
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<tr>
<td>BM-5402</td>
<td>Seminar</td>
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<td><strong>Total of Second Semester</strong></td>
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*From other Departments/ School (Approved by the Head of the Department)

**Elective-I, Elective-II*, Elective-III*, & Elective-IV*
Any four of the following

- BM- 5201: Biotransport Process
- BM- 5202: Electrophysiological Signal Analysis
- BM- 5203: Biomechanics-II
- BM- 5204: Composite Materials
- BM- 5205: Biomedical Signal and Image Processing
- BM- 5206: Effects of Radiation and Biomedical Applications of Radiation
- BM- 5207: Bioceramics

**Third Semester:**

<table>
<thead>
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<th>SUBJECT</th>
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<th>CREDIT</th>
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<tr>
<td>BM- 6301</td>
<td>Seminar on Dissertation</td>
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<td>BM- 6302</td>
<td>Dissertation - Interim Evaluation</td>
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**Total of Third Semester** 10

**Fourth Semester:**

<table>
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<th>CONTACT HOURS/WEEK</th>
<th>CREDIT</th>
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<tbody>
<tr>
<td>BM- 6401</td>
<td>Dissertation (Open Defence)</td>
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<tr>
<td>BM- 6402</td>
<td>Dissertation Evaluation</td>
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**Total of Fourth Semester** 15

**GRAND TOTAL** 62
BM –5101: Physiology
   Introduction to human physiology. Composition and function of blood. Structure and function of cardiovascular system, respiratory system, renal system, musculo-skeletal system, endocrine system and gastrointestinal system. The structure and function of nervous system.

BM-5102: Biomaterials
   Structure of cell, tissue and organ and properties of biological materials e.g., bone, teeth and connective tissue. Soft tissue and hard tissue replacement. Facial and dermal prosthesis in human body. Biocompatibility. Interaction between materials and body and testing of implants.

BM-5103: Bioinstrumentation

BM- 5104: Biomechanics-I
   Scalar and vector quantities. Different operations on vector. Forces and moments, system of forces, resultant of system of forces in 3D and 2D. Equilibrium equations. Applications with example on human body.
   Work-energy equations: Applications to Biomedical system. Stress-strain diagram.
BM-5105: Computer Applications in Biomedical Engineering

Use of computers in physiological data acquisition and analysis. Programming, storage and display of data with reference to bioelectric potentials. Applications of Microprocessor and Microcontroller in medicine.

Digital filters; FIR and IIR type and their application to biomedical signal filtering. Data reduction techniques. Spectrum analysis.

Intelligent computing systems in medicine; Introduction to Intelligence and Artificial Intelligence. Heuristic search method, knowledge Based system, ANN architecture and learning algorithms. Evolutionary computing and Genetic Algorithm (EC-GA) Fuzzy Logic and its application in decision making. Application of ANN, EC, GA, FL in Medical data analysis and diagnosis.

BM-5106: Biological System Analysis and Control

Control system: Introduction to linear control system, Mathematical Modeling, Transfer function, signal flow graph, feedback control its characteristics, advantages and state-space models. Time-domain and frequency domain analysis. Stability analysis; Routh Hurwitz criteria, Root locus plots, Bode plots, Nyquist plots and Nichols plots. Introduction to Digital control, Optimal, Adaptive and Non-linear control systems.

Physiological control systems: Introduction, mathematical modeling & control. Biological receptors, thermoregulatory system, human limb, semicircular canal, skeletal-muscle, respiratory system, pupil-control systems, neuromuscular reflex motion.

Applications of Control theory to physiological systems. Time-domain, frequency domain, stability analysis. Biological performance criteria and adaptive control systems.

Simulation implementation.

BM-5107: Mathematical Methods in Biomedical Engineering

Mathematical modeling and solution of biomedical problems namely respiratory rate, blood flow, cardiac output and impedance diffusion, ultra filtration etc.

Operational research applied to the description of physiological systems and signals processing by interfacing instrumentation, biomedical variability and probabilistic solution to medical decision making, population dynamics perturbation technique in dealing with the problems of thermodynamics. Stochastic process. Finite- Difference method.

BM-5201: Biotransport Processes

Introduction to fluid flow, heat transfer and mass transfer. Unified approach of momentum; Heat and Mass transfer: flow behaviors of Newtonian and non-Newtonian fluids; application of momentum; heat and mass transfer principles of biological system with particular emphasis on human beings; fluid mechanics of time dependent flows in
pulmonary and urinary systems; Engineering models and their utilization in describing in-vivo observations. Modeling of the body as compartment; Source and stream; heat exchange between human body and its environment; mass transfer in membrane; hemodialysis as related to artificial kidney; extra corporal oxygenerators.

**BM-5202: Electrophysiological Signal Analysis**


**BM-5203: Biomechanics-II**

Principle of continuum mechanics. Tensor treatment to explain elastic, viscoelasticity, electric and electromechanical properties of bones, teeth and connective tissues. Wave propagation in extended and partly bound media and its application in analyzing the structural micro textural symmetry in calcified tissues. Theoretical models for bone as a hierarchical composite.

Dental forces, implant-tissue biomechanics, Crack propagation in bones, dynamic models.


**BM-5204: Composite Materials**

Types of composites and their advantages.

Reinforcement: Glass, boron, carbon, organic and ceramic fibers, their structure, properties and processing.

Matrix materials: Polymers, metal and ceramic matrices, their structure, properties and processing. Wettability and interface bonding.

Polymer matrix composites: Lamina, laminate composites. Primary and Secondary manufacturing; Lay-up, Filament winding, pultrusion, compression moulding. Machining, drilling and routing, applications.

Metal matrix composites: processing techniques and applications. Ceramic Matrix composites; processing techniques and applications.

Introduction to Nanocomposites and applications

Micromechanic: Mechanical properties, thermal properties and load transfer.

Degradation of composites due to various environmental conditions, corrosion resistance of composite. Designing with composites

Biological application of composites.

BM- 5205: Biomedical Signal and Image Processing
Medical imaging systems; X-ray system, C.T. Scan, Ultrasound (A, B and M scans), MRI and Positron Emission Tomography


BM- 5206: Effects of Radiation and Biomedical Applications of Radiation
Basic concepts, types, sources and characteristics of electromagnetic radiations and its influence on living beings with particular emphasis on human beings. Biological effects and Biomedical applications of X- Rays, Gamma–rays, Microwaves, Ultrasound etc. Introduction to Radioisotopes and its Biomedical Applications.

Lasers, its classification, basic concept, types and their Biomedical Applications. Laser use in surgery, diagnosis and in promotion of healing. Safety with biomedical lasers.

BM- 5207: Bioceramics

Structure, properties and functional behaviour of bio-materials. Tissues response to implants (bio-compatibility, wound healing process), body response to implants, blood compatibility.