



**COURSE OF STUDY AND SCHEME OF EXAMINATION OF  
B.TECH/B.ARCH/M.TECH/M.C.A.  
NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR**

**Branch- Biomedical Engineering  
Semester- III**

**Course- B.Tech.(NIT Scheme)**

S. No.	Board of Studies	Sub. Code	Subject Name	Periods/Week			Examination Scheme					Total Mark	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Prac. ESE		
1	Biomedical Engg.	BM203 11BM	Biochemistry	3	1	-	20	15	15	70	-	120	4
2	Mathematics	MA203 12BM	Mathematics-3	3	1	-	20	15	15	70	-	120	4
3	Biomedical Engg.	BM203 13BM	Biomedical Transducer and measurement	3	1	-	20	15	15	70	-	120	4
4	Biomedical Engg.	BM203 14BM	Anatomy and Physiology	3	1	-	20	15	15	70	-	120	4
5	Biomedical Engg.	BM203 15BM	Biomechanics	3	1	-	20	15	15	70	-	120	4
6	Biomedical Engg.	BM203 16BM	Network Analysis	4	1	-	20	15	15	70	-	120	5
7	Biomedical Engg.	BM203 21BM	Bio Chemistry Lab	-	-	3	30	-	-	-	20	50	2
8	Biomedical Engg.	BM203 22BM	Anatomy and Physiology lab	-	-	3	30	-	-	-	20	50	2
9	Information Tech.	IT2032 3BM	Computer Programming lab	-	-	3	30	-	-	-	20	50	2
10	Humanities	EN2032 4BM	Value Education	-	-	2	25	-	-	-	-	25	1
11			Discipline	-	-	-	25	-	-	-	-	25	1
			Total	19	6	11	260	90	90	420	60	920	33



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biochemistry	Subject code	BM20311BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4

### MODULE I – Chemistry of Biomolecules

Chemistry of carbohydrates, Amino acids, Proteins and Lipids, and Nucleotides

### MODULE II – Prostaglandins, Immunoglobulins, Enzymes & Nucleotides

Chemistry and functions; chemistry and functions; Chemistry of Enzymes, Enzymes and Iso-enzymes of clinical importance; Chemistry of Nucleotides.

### MODULE III - Metabolism of Biomolecules

Digestion and absorption of carbohydrates, Proteins and Lipids; Metabolism of carbohydrates; Proteins and Lipids

### MODULE IV - Molecular Biochemistry

Chemistry of Nucleic acids, Metabolism of Purines and pyrimidines, Hormones chemistry, mechanism of action and metabolic roles

### MODULE V - Clinical Biochemistry

Vitamins and Minerals, Biotransformation of xenobiotics, Biochemistry of cancer, radioactive isotopes in biochemistry, Diet and Nutrition.

### TEXT BOOKS

1. Textbook of Biochemistry Lehninger
2. Biochemistry Stryer

### REFERENCE BOOKS

1. Harper Biochemistry
2. Textbook of Medical Biochemistry – Chatterjee & Shinde
3. Bio Chemistry – Dvore, J.G. voet
4. Physical biochemistry – Dferfilder.



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Mathematics - III	Subject code	MA20312BM
Semester	Third	Board of Studies	Mathematics
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4

### MODULE I - Fourier Series and Fourier Transform

Expansion of function as Fourier series, Change of interval, Even and odd functions, Half-range Fourier series, Practical harmonic analysis, Fourier Sine and Cosine transforms, Properties of Fourier transform, Inverse Fourier transform, Fourier transform of derivatives.

### MODULE II - Laplace Transform

Laplace transform of elementary functions, properties of Laplace transform, Laplace transform of derivatives and integrals, multiplication by  $tn$  and division by  $t$ , Laplace transform of periodic functions, Inverse Laplace transform, Convolution theorem, Laplace transform of unit step function and Dirac delta function, Application of Laplace transform to solutions of ordinary differential equations.

### MODULE III - Group Theory

Definition and examples, Permutation group, cyclic group, subgroup, cosets, Lagrange's theorem, some theorems on subgroup, Homomorphism and Isomorphism of groups, Normal subgroup, Quotient group, Fundamental theorems of homomorphism on groups.

### MODULE IV - Partial Differential equation

Formation of partial differential equations, Lagrange's solution of first order linear partial differential equation, Homogeneous and Non-homogeneous linear partial differential: Non-linear partial differential of first order, Charpit's method and Jacobi's method, Solution of partial differential equations by the method of separation of variables.

### MODULE V – Z Transform

Sequence, Basic Operations on sequences, Definition, Properties, Initial value and Final Value theorems, Inverse Z transform, Convolution theorem, Inverse Z theorem by partial fraction, power series and residue methods. Applications to solution of difference equations.

### TEXT BOOKS

1. Higher engineering mathematics by Dr. B.S.Grewal- Khanna Publishers
2. Advanced Engg. Mathematics by Erwin Kreyszig- John Wiley and Hill Publishing
3. Higher Engg Mathematics by B V Ramana- Tata Mc Graw Hill Publishing
4. Elements of partial differential equations by I N Sneddan-Mc- Graw Hill International Editions



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biomedical Transducer and measurement	Subject code	BM20313BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4

### MODULE I - Static & Dynamic characteristics of Instrumentation System

General properties of input transducer, Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Loading effect, Input Impedance and Output Impedance. First and second order Characteristic, Time delay, Error free instrument, Transfer function, design criteria, generalized instrument specifications.

### MODULE 2: Displacement Pressure and Temperature Measurement

Potentiometers, strain Gauges, Bridge circuits, variable inductance and LVDT; Capacitive type; Piezoelectric transducers; Types of diaphragms, Bellows, bourdon tubes. Thermistors, Thermocouple, Resistive Temperature detector, Radiation Thermometry, Fiber Optic temperature sensor, Optical Measurement.

### MODULE III - Bipotential Electrodes

Electrode electrolyte interface, polarization, polarizable and non-polarizable electrodes, Electrode Behavior and, Circuit Models, Electrode-skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Internal Electrodes: Needle & wire electrodes, Electrode Arrays, Microelectrodes: Metal, supported metal, micropipette (metal filled glass and glass micropipette electrodes), microelectronic, properties of microelectrodes. Electrodes for Electric Stimulation of Tissue (i.e. for ECG, EMG & EEG)

### MODULE IV – Measurement of Flow & Volume of Blood

Indicator-dilution Method, Electromagnetic flowmeter, Ultrasonic flowmeter, Thermal-convection Velocity sensors, Chamber Plethysmography, Photoplethysmography.

### MODULE V- Chemical Biosensors

Blood gas and Acid-Base Physiology, Electrochemical sensors, reference electrode, pH, pO<sub>2</sub>, pCO<sub>2</sub> electrodes, Ion-Selective Field-Effect Transistor (ISFET), Noninvasive Blood-Gas Monitoring, Blood-Glucose Sensors. Transcutaneous arterial oxygen tension & carbon dioxide tension monitoring enzyme electrode.

### TEXT BOOKS:

1. Medical instrumentation, application and design by John G. Webster. ( Marcel Dekkar Pub)
2. Biomedical Transducers and Instruments by Tatsuo Togawa & Toshiyo Tamura. (CRC-Press)
3. Handbook of Biomedical Instrumentation by RS Khandpur. (TMH)
4. Biomedical Sensors - fundamentals and application –By Harry N. Norton (Plenum Press)
5. Biomedical Instrumentation and measurements – By Leslie Cromwell, Fred J. Weibell.



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Anatomy & Physiology	Subject code	BM20314BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4

### MODULE I – Introduction to Cell & Blood

Sub cellular structure and morphology, Transport across cell membranes and membrane potentials. Characteristics of blood, composition and function of blood, plasma proteins, Red blood cells, White Blood cells, Physiology of Blood Clotting.  
Elementary Knowledge of human skeletal system.

### MODULE II – Heart (Circulatory System)

Structure of Heart and circulation, Properties of Cardiac muscles, Cardiac Cycle, Cardiac output, Impulse generation and Transmission, Electrocardiogram, Heart sound, Regulation of Heart rate, its measurement, Regulation and Maintenance of Blood Pressure.

### MODULE III - Respiratory System & Muscle Tissue

Anatomy of respiratory system, Pulmonary Circulation, Physiology of respiration in the alveolar and tissues Capillaries, Mechanism of Respiration, Regulation of Respiration  
Structure & Function of muscles, Types of muscles, Physiology of muscles contraction. Generation of action potential.

### MODULE IV - Excretory System & Digestive System

Anatomy of urinary system and kidney, structure of kidney and urinary tracts, Nephron, Physiology of urine formation  
Anatomy of digestive system, digestion and absorption of carbohydrates, Proteins and fats, gastrointestinal tract, Role of pancreas and liver.

### MODULE V – Central Nervous System

Anatomy and function of different parts of brain, spinal cord, autonomic nervous system, Neuron, sense organ for sight and hearing.

### TEXT BOOKS

1. K. Sembulingam, J.P Brothers, Essentials of Medical Physiology.
2. A.C. Guyton, Text Book of Medical Physiology, Elsevier Saunders.
3. William F. Ganong: Review of Medical Physiology, Prentice Hall International Inc.
4. Gerard J. Tortora and Nicholas, P. Anagnostakos: Principle of Anatomy and Physiology, Harper and Row, New York
5. Keele and Neil: Samson Wright Applied Physiology.
6. A.J. Vander, J.H Sherman and D.C. Lucian: Human Physiology.



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biomechanics	Subject code	BM20315BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	-	4

### MODULE I - Biofluid Mechanics

Newton's law, stress, strain, elasticity, Hooke's law, viscosity, Newtonian fluid, Non-Newtonian fluid, viscoelastic fluids, Vascular tree. Relationship between diameters, Velocity and pressure of blood flow, Resistance against flow

### MODULE II - Cardiac Mechanics

Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. Prosthetic heart valves and replacements.

### MODULE III - Respiratory Mechanics

Alveoli mechanics, Interaction of blood and lung, P-V curve of lung. Breathing mechanism, Airway resistance, Physics of lung diseases.

### MODULE IV – Soft tissue Mechanics

Pseudoelasticity, non-linear stress-strain relationship, viscoelasticity. Structure function and mechanical properties of skin, ligaments and tendons.

### MODULE V - Orthopedic Mechanics

Mechanical properties of cartilage. Diffusion properties of articular cartilage. Mechanical properties of bone. Kinetics and Kinematics of joints. Lubrication of joints.

### TEXT BOOKS

1. Biomechanics: Y C Fung
2. Basic Biomechanics: Susan B. Hall, Tata McGraw Hill.
3. Fundamentals of Biomechanics: Duane Knudson, Springer.
4. Biomechanics: Principles & Applications, Donald R. Peterson & Joseph D. Bronzino, CRC Press.
5. Physics of Coronary Blood Flow: M. Zamir, Springer.



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Network Analysis	Subject code	BM20316BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	70	Minimum Marks	25
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	-	5

### MODULE I - Network Topology & Review of loop and mode

Graph of a network. Concept of tree and links. Incidence matrix, Tie set & cut set schedules, solution of network, and principles of duality & network transformation. Linearly independent KVL & KCL equation. Method of analysis of DC and AC networks. Network reduction using Y-A transformations. Coupled circuits. Locus Diagram.

### MODULE II- Networks theorems & Resonant circuits

Reciprocity, Thevenin's, Norton's Maximum power transformation, Tellegen's and Miller's theorem. Series and parallel resonance, Frequency - response of series and parallel circuits, Q-factor, Bandwidth.

### MODULE III - Transient Behavior and initial conditions in networks

Behavior of circuit element under switching condition and their representation. Evaluation of initial and final conditions in RL, RC & RLC circuits for AC & DC excitation

### MODULE IV - Transient Behavior and initial conditions in networks

L.T. for fourier transformation Definition & Properties of Laplace Transformation. Inverse Laplace transform. Partial fraction expansion, initial & final value theorem. Shifting theorem. Convolution Integral. Step, Ramp and Impulse functions. Delayed functions. Laplace transform of Periodic and non-periodic signals.

### MODULE V - One & two port network parameters

Driving point admittance & transfer function. Pole- zero concepts of the network function. Open circuit impedance parameters, Short circuit impedance parameters, Transmission parameters, H-parameters. Calculation of these parameters for two port networks.

### TEXT BOOKS:

1. Network Analysis, M.E. Van Valkenburg Pill.
2. Network Analysis and synthesis – Franklin F.Kuo.
3. Electric circuits: Joseph Edminister Schaum's series. Mc Graw Hill.
4. R.P. Punagin : Electrical circuit theory and Analysis.



## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biochemistry	Subject code	BM20321BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	30(TA) 20(ESE)	Minimum Marks	18(TA) 10(ESE)
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
Nil	Nil	3	2

- Experiment No. 1: Fehling's Test for Carbohydrates  
Experiment No. 2: Benedict's Test for Carbohydrates  
Experiment No. 3: Barfoed's Test for Carbohydrates  
Experiment No. 4: Osazone Test for Carbohydrates  
Experiment No. 5: Iodine Test for Carbohydrates  
Experiment No. 6: Molisch's Test for Carbohydrates  
Experiment No. 7: Bial's Test for Carbohydrates  
Experiment No. 8: Anthrone's Test for Carbohydrates  
Experiment No. 9: Methylamine test for Carbohydrates  
Experiment No. 10: Biuret Test for Proteins  
Experiment No. 11: Xanthoproteic Test for Proteins  
Experiment No. 12: Millon's Test for Proteins  
Experiment No. 13: Ninhydrin Reaction for Proteins  
Experiment No. 14: Lead Acetate Test for Proteins  
Experiment No. 15: Estimation of protein by Folin Lowry Method  
Experiment No. 16: Estimation of glucose by DNSA method  
Experiment No. 17: Estimation of RNA by orcinol method.  
Experiment No. 18: Test to determine Saponification of Oil.

### Recommended Books:

1. Biochemical Methods by Sadasivam and Manickam
2. Laboratory Manual in Biochemistry by Jayaraman
3. A Textbook of Practical Biochemistry by Rashmi A Joshi & Manju Saraswat

Refer Books mentioned in theory syllabus





## DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Anatomy & Physiology	Subject code	BM20322BM
Semester	Third	Board of Studies	Biomedical Engg.
Maximum Marks	30(TA) 20(ESE)	Minimum Marks	18(TA) 10(ESE)
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
Nil	Nil	3	2

EXPERIMENT 1. Determination of Bleeding time

EXPERIMENT 2. Determination of Clotting time

EXPERIMENT 3. Measurement of Blood Pressure

EXPERIMENT 4. R.B.C. Counting

EXPERIMENT 5. Total W.B.C. Counting

EXPERIMENT 6. Detection of Blood group

EXPERIMENT 7. Preparation of blood film & staining

EXPERIMENT 8. Detection of Hemoglobin

EXPERIMENT 9. Study of Bones