With effect from the academic year 2016-2017

SCHEME OF INSTRUCTION & EXAMINATION
(BIO-MEDICAL ENGINEERING)

B.E - SEMESTER-III

S. No	Course Code	Course Title	Scheme of Examination		L	T	P	Hrs/ Wk	Credits
			CIE	SEE					
1.	PC301BM	Anatomy	30	70	3	1	0	4	3
2.	PC302BM	Physiology	30	70	3	1	0	4	3
3.	PC303BM	Biochemistry	30	70	3	1	0	4	3
4.	ES304BM	Hospital Electrical Systems	30	70	3	0	0	3	3
5.	ES324EC	Electronic Circuits	30	70	3	0	0	3	3
6.	ES325EC	Circuit Analysis	30	70	3	1	0	4	3
Practicals									
7.	PC351BM	Anatomy Lab	25	50	0	0	2	2	1
8.	PC352BM	Physiology Lab	25	50	0	0	2	2	1
9.	PC353BM	Biochemistry Lab	25	50	0	0	2	2	1
10	ES344EC	Electronic Circuits Lab	25	50	0	0	3	3	1
Total			**280**	**620**	**18**	**04**	**09**	**31**	**22**

PC301BM

ANATOMY

Credits: 3

Instruction: 4 Periods per week — *Duration of SEE: 3 hours*
CIE: 30 marks — *SEE: 70 marks*

Objectives:

- To study systemic anatomy i.e., the structure and position of the systems in the human body.
- To study the respiratory, circulatory, digestive, urinary, reproductive, endocrine and nervous systems.

Outcomes:

- Able to understand the Musculo-Skeletal and Nervous System
- Understand the system of Respiratory System and Digestive system.
- Able to locate various glands of the body

UNIT-I

Musculo-Skeletal System: Anatomical Positions. Planes of Body. Anatomical terms. Skeletal system. Bones: Types with examples. Joints: Types with examples. Structure and Classification of synovial joint with examples.
Muscular system. Types and locations. Structure of a skeletal muscle. Important muscle of limbs-location. Actions.

UNIT-II

Nervous System: Classification into Central Nervous System (CNS), Peripheral Nervous System (PNS), Autonomic Nervous System (ANS).
Brain &Spinal Cord: Meninges covering with emphasis on subarchnoid space. Spinal cord. Subdivisions of brain. Base of brain with cranial nerve attachments. Brain stem, Cerebellum, Cerebrum, Diencephalon, Ventricular System, Peripheral Nervous System, Autonomic Nervous System, Special Senses.

UNIT-III

Circulatory System: Heart. General plan of Circulatory System-Arterial System, Venous System, Lymphatic System. Important Blood Vessels of different parts of body.
Respiratory system: Various parts of Respiratory System-Trachea, Bronchial tree, Lungs.

UNIT-IV

Digestive System: Parts of Digestive System. Important parts of Gastro Intestinal Tract (GIT) and associated glands.
Urinary system: Parts of Urinary System. Kidneys, Urater, Urinary Bladder and Urethra. Male Reproductive System. Female Reproductive System.

UNIT-V

Endocrine Glands: Location, Descriptions and functions-Thyroid, Pituitary, Pancreas, Supra renal, Parathyroid-Important relations, Secretions.

Suggested Readings:

1. Gibson J, *Modern Physiology & Anatomy for Nurses*, Blackwell Scientific Publishers, 1981
2. Charles E.Tobin, *Basic Human Anatomy*, McGraw Hill, 1980.

PC302BM

PHYSIOLOGY

Credits: 3

Instruction: 4 Periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Objectives:

- This course is designed such that the student is exposed to various mechanisms involved in the normal functioning of human body underlining the basic working principles of different biological processes with Engineering tools. It deals with the overall functional orientation of a living organism which has undergone a variably rapid change all through its process of evolution.
- Casting a systematic array of different systems such as respiratory, circulatory, neuro-muscular mechanisms, stimuli propagation etc, emphasizing on the clinical importance of the same.

Outcomes:

- Understand various mechanisms involved in the normal functioning of human body.
- Ability to learn basic working principles of different biological processes with engineering tools.

UNIT-I

General Physiology: Evolutionary aspects of biological systems, homeostasis, Organelles, Integration of Organelles, Cells, Membrane Physiology, Transport across cell membrane, genesis of membrane potentials, Nernest equation, Resting membrane potential, Goldmann-Hodgkin-Katz equation, Cable properties(Local signaling-Analog Potentials(Digital mode),Hodgkin-Huxley model, Differential equations of action potentials, Voltage-Clamp and Patch-clamp methods, Signal Processing-Synapse, signal Transduction, Neuro transmitters, Biological amplification and filtration, Signal Integration(Input-sensory),Centers of Integration-Spinal Cord, Brain Stem, Cerebral Cortex, Motor System(Output)-Organization-Cortical, Sub cortical and spinal, Reflex process, NMJ, Smooth muscle, Cardiac Muscle, Skeletal muscle, Excitation-Contraction coupling, Sarcomere-Contractile Unit, Motor Unit, Frequency and Intensity related summation(temporal and Multi motor unit Summation),Tetanus, Load, Fatigue, EMG.

UNIT-II

Cardiovascular System: Conducting system of the Heart, ECG, Blood as Non-Newtonian fluid, Dynamics of peripheral circulation, Resistance and Impedance, Streamline and Turbulent flow, Raynold's Number, Poisulle equation, Bernoulli equation, B.P., Control systems- Neurohumoral regulation, applied aspects.

UNIT-III

Respiratory System: Biophysics of Transport Across Respiratory Membrane, Perfusion and Diffusion limited process, Ventilation, Alveolar, Shunt and Dead space equations, Ventilation-perfusion inequalities, Physiological and anatomical shunts and dead spaces, Biophysics of transport of gasses in the blood, hemoglobin-oxygen association and dissociation curve, Haldane and Bohr effect, Applied aspects, Ventilators.

UNIT-IV

Renal System: Regulation of volume and composition of Body fluids, Clearance equations, Biophysics of Filtration, Re-absorption and secretion, Counter current Multiplication and Exchange, Acid-Base Balance, regulation of Body Temperature-Physical and Physiological process, applied aspects, Dialysis. Endocrine System and Reproductive System, Hormonal regulation of Body functions, Overview of Reproductive Physiology.

UNIT-V

Nervous System: Higher functions of Brain (Perception, Rule of special senses, Learning and memory), Cybernetics of living systems, Neuro-Endocrine Control System, Servo mechanism, Posture and equilibrium, Motor skills, Neural Network related to the cognitive functions of the brain, near field (EEG) and Far Field Potentials(Evoked Potentials).

Suggested Readings:

1. Mount Castle, *Textbook of Medical Physiology.*
2. Best and Taylor, *Physiological basis of Medical Practice.*
3. Boron F, *Medical Physical*
4. John.Herbert Green, *An Introduction to physiology*, Oxford University Press, 1976
   Gillain pocock, Christopher D.Richards, *Human Physiology, The Basis of Medicine*, Oxford University Press, 2004

PC303BM

BIOCHEMISTRY

Credits: 3

Instruction: 4 Periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Objectives:

- To study the basic chemical reactions occurring inside the cell which are responsible for the physiological activity of the body are studied under this disciplinary course.
- To study the pathology clinically through different techniques of analysis like the analysis of blood, urine, cerebro spinal fluid etc. This study also enlightens the students with the basic course of reactions occurring with the DNA and RNA which determine the characteristic features of the human.

Outcomes:

- Understand basic chemical reactions occurring inside the cell which are responsible for the physiological activity of the body
- To determine the characteristic features and reactions occurring with the DNA and RNA

UNIT-I

Biochemistry of living cell. Sub-cellular fractionation using the Differential Centrifugation method. Functions of each organelle. Redox potential. Oxidative phosphorylation. Transport of substances across biological membranes.

UNIT-II

Broad chemical nature of enzymes-Isolation and study of the properties of enzymes. Study of enzyme kinetics by spectrophotometry. Diagnostic and Therapeutic uses of enzymes.

UNIT-III

Nucleic Acid chemistry. Protein synthesis. Transcription and Translation. Replication, Polymerase Chain reaction (PCR) Techniques, Recombinant DNA Technology.
Immunological Techniques or Immunoassay-Radio Immuno Assay (RIA), Enzyme-Linked Immunosorbent Assay (ELISA), Chemiluminiscence.

UNIT-IV

Chemical composition of blood-Separation of serum proteins and lipoproteins by electrophoresis and ultracentrifugation. Acid-Base balance and biochemical measurements of acid-base and electrolyte status of the patients. Urine Analysis.

UNIT-V

General methods of biochemical analysis carried out in the estimation of blood constituents, such as glucose etc. Principles and different methods of chromatography-fluorometry, flame photometry, Applications of isotopes in biochemistry.

Suggested Readings:

1. Martin D.W.,Mayes P.A. & Rodwell V.W.,*Harper's Review of Biochemistry*, Lange Medical publications,Meruzen Asia,1980.
2. Lalit srivastava M., Nibhriti Das & Subrata Sinha, *Essentials of Practical biochemistry*, CBS Publishers, 1st Edition, 2002

ES304BM

HOSPITAL ELECTRICAL SYSTEMS

Credits: 3

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Objectives:

- To acquire knowledge in principle of operation of basic electrical machines.
- To know about the Power distribution systems
- To learn about the Electrical safety measures in Hospitals.
- To know the principle of operation and working of Transformers and UPS.

Outcomes:

- Students will know the basics of Electrical Engineering with good knowledge on underlying principles of operation.
- Students can relate these basics with daily experiences.
- Students will understand the Electrical safety measures in hospitals.

Unit-I:

3-Phase Balanced Circuits: Basics, Star & Delta connections, Measurement of 3-phase power by two-wattmeter method.

Single-Phase Transformer: Principle of operation, Constructional details, Transformer on no-load and on load, OC & SC tests, Losses, Efficiency, Regulation, Isolation Transformer.

Unit-II:

DC Motor: Principle of operation, Types of motors, Torque equation, 3-point starter, Characteristics of DC motors, Speed control of DC shunt motor, Losses & efficiency, Applications, Stepper motor, BLDC motors, applications.

Unit-III:

Three-phase Induction Motor: Production of rotating field, Constructional details. Types of motors, Torque-slip characteristics, Star-delta starter, Auto-transformer starter, Losses & efficiency, applications.

Single-phase Induction Motors: Principle of operation, Capacitor run & Capacitor start motor, applications.

Unit-IV:

Hospital Power Distribution: Three Phase Systems, Voltage stabilisation. Proper location of Air Conditioners, Elevators, Transformers, other electrical machinery. Electrical Shielding techniques to prevent 50Hz power supply interference in sensitive Medical equipment.

Unit-V:

Power Factor: Disadvantage of low P.F., Causes of low P.F., Improvement of P.F. by using Static Capacitors. Electrical Safety Measures: Earthing and its Importance, Safety practices, Basic ideas of Fuse, Types of Fuses, Circuit Breaker, and Leakage current relay.

UPS: Relay switch, Transformer Working, Basic principle and UPS Block Diagram, types of UPS – Off-line On-line, Line Interactive, their comparison. Various stages. Cold Start, Static Switch.

Suggested Reading

1. J.B.Gupta, *Fundamentals of Electrical Engineering and Electronics,* S.K.Kataria & Sons Publications, 2002.
2. B.L Thereja, *Electrical Technology,* S.Chand & comp limited, 2008.
3. S.L.Goel, *Hospital preventive and promotive services*, First edition, 2004.
4. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, *Basic Electrical Engineering*, Tata McGraw Hill, Publications, 2009.

ES324EC

ELECTRONIC CIRCUITS

Credits: 3

Instruction: 3 Periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Objectives:

- The course facilitates the students to study the principle and operation of Op-Amps.
- Exposure towards the applications of the Op-Amps.
- To know about the linear wave shaping circuits.
- The students also learn about Voltage regulators and SMPS.

Outcomes:

- Ability to analyze and design basic electronic circuits, particularly with application to diodes, BJTs, MOSFETs, Operational amplifiers.
- Ability to understand Operational amplifiers and their internal devices, including BJT and MOSFET transistors.
- Able to design linear wave shaping circuits and higher order filters.
- Understand the basic concept of Power supply and SMPS.

UNIT – 1:

Sinusoidal Oscillators: Condition for oscillations – LC Oscillators – Hartley, Colpitts, Frequency and amplitude stability of oscillators – Crystal Oscillators – RC Oscillators – RC phase shift and Wien bridge oscillators.

UNIT – 2:

Operational Amplifiers: Concept of Direct Coupled Amplifiers. Differential Amplifier- Calculation of common mode Rejection ratio, Differential Amplifier supplied with a constant current source, Normalized Transfer Characteristics of a differential Amplifier. Ideal Characteristics of an operational Amplifier, and Parameters of an Op-Amp.

UNIT – 3:

Applications of Operational Amplifier: Inverting and Non-inverting Amplifiers, Summing, scaling and Averaging amplifiers, Integrators, Differentiators, Logarithmic Amplifiers, Instrumentation Amplifiers, Rail-to-Rail op-amps, Voltage to Current and Current to Voltage Converters, Precision Rectifiers, Peak Detectors. Comparators, Schmitt trigger, Multivibrators, Sinewave oscillators (phase-shift and wein bridge), Waveform generators (triangular and saw tooth), 555 Timers.

UNIT – 4:

Linear wave shaping circuits & Filters: Clipping circuits for single level and two level, Clamping circuit and applications
Butterworth Filters: Active low pass Filter, High pass filter, Band pass filter, Band elimination filter & Notch filter. Higher order Filters and their Comparison. Design of second, fourth and sixth order filters using op-amps. Switched Capacitance Filters.

UNIT – 5:

Voltage Regulators & SMPS: Linear power supply (voltage regulators); Basic Transistorized regulators, Three pin regulators, switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode.
Working principle of SMPS, Block Diagram of SMPS, Design criteria for SMPS, comparison of linear & switching power supply.

Suggested Reading:

1. Ramakanth A Gayakwad, *Op-Amps and Linear ICs*, 4th Edition, PHI, EE Edition, 2013.
2. R.F Coughlin and F.F Driscoll, *Op-Amps and Linear Integrated Circuits*, PHI, EE Edition, 4th Edition.2001.
3. JB Gupta, Electronic Devices and Circuits, S.K Kataria & sons, 5th Edition, 2012.

ES325EC

CIRCUIT ANALYSIS

(Common to ECE and BME)

Credits: 3

Instruction: (3L+1T) Periods per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

Objectives:

- Students are exposed to analysis of physical circuits through the use of Kirchhoff's laws and ideal circuit element models. Strong emphasis is placed on the formulation of nodal equations for linear circuits as a foundation Transient analysis of second order circuits with unit step inputs and switched dc sources is emphasized to promote understanding of time-domain linear circuit response. Finally, students will master concepts of coupled inductors and transformers.

Course Outcomes:

- To learn how to develop and employ circuit models for elementary electronic components and to adapt using various methods of circuit analysis, including simplified methods such as Series-Parallel reductions, voltage and current dividers, and the node method.
- To appreciate the consequences of linearity, in particular the principle of superposition and Thevenin-Norton equivalent circuits etc.
- Able to analyze small RLC circuits by hand. Analyze the frequency response of circuits containing inductors and capacitors. Apply the Laplace transform to linear circuits and systems.

UNIT-I

Circuit elements, Dependent and independent sources, passive elements, R,L and C, Energy stored in L and C, Kirchoff's laws, integro-differential equations, RMS and average value of periodic signals, Network theorems: Superposition, Thevenin's, Norton's, Millman's and Maximum transfer theorem.

UNIT-II

Response of RC,RL and RLC circuits first order and second order differential equations, initial conditions, step response, in pulse response zero state and zero-input response, steady state and transient response**.**

UNIT-III

Response of RLC networks to exponential excitation, quality factor, damping ratio, Bandwidth of resonant circuits, sinusoidal excitation, steady state response, impedance and admittance functions, responses related to S-Plane location of roots.

UNIT-IV

Circuit analysis using Laplace Transforms, basic theorems of Laplace transforms, Laplace transform of periodic signals, unit, step, ramp and impulse functions, initial and final value theorems, solutions using Laplace transforms.

UNIT-V

Network Topology, Graph, tree, Tie set and cut set matrix, impedance matrix formulation of node and loop equations using Tie set and cut set.

Suggested Reading:

1. Valkenberg M.E Van, *Network Analysis*, PHI, New Delhi, 1996
2. Hayt W H, Kemerly J E and Durbin, *Engineering Circuit Analysis*, Tata McGraw-Hill-2006
3. Choudary Roy D, *Network and Systems*, New Age India, 1999

PC351BM

ANATOMY LABORATORY

Credits: 1

Instruction: 2 Periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*

1. Histology-Slides of primary tissues of body

2. Study of Gross anatomy of the human body

3. Study of dissected Upper Limb

4. Study of dissected Lower Limb

5. Study of dissected Brain

6 Study of dissected Thorax-Heart

7. Study of dissected Thorax-Major Blood Vessels

8. Study of dissected Thorax-Various parts of respiratory system-Trachea, Lungs.

9. Study of dissected abdomen-Digestive organs.

10. Study of dissected abdomen-Other abdominal organs.

PC352BM

PHYSIOLOGY LABORATORY

Credits: 1

Instruction: 2 Periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*

1. Recording of B.P. and effects of Physical exertion and posture on this parameter.
2. Recording of mechanical response of the muscle on application of induced electric signal.
3. Study of load, length and force relationship of muscle.
4. Study of rate of conduction of nerve impulse.
5. Spirometry-recording tidal volume, inspiratory reserve volume, expiratory reserve volume, vital capacity and index and effect of posture on vital capacity.
6. Isolated heart perfusion by Legendraff Technique (demonstration).
7. Isolated frog's heart perfusion and effects of ions (Mg, ca, K) using slow micro-injector demonstration).
8. Test of hearing using Tuning Fork.
9. Test of vision:
   a) Acuity of vision b) Colour vision
   c) Ophthalmoscopy d)Error of refraction
10. Recording of EMG, ECG and EEG by polygraph (Demonstration).
11. Examination of sensory system.
12. Examination of motor system.
13. Recording of action potential and its display on oscilloscope (Demonstration).

PC353BM

BIOCHEMISTRY LABORATORY

Credits: 1

Instruction: 2 Periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*

1. Study of Plasma protein electrophoresis.

2. Study of Chromatography of amino acids.

3. Study of Colorimetry.

4. Study of Spectrophotometry.

5. Study of pH meter.

6. Study of Flame photometry-Analysis of Na and K in an unknown sample.

7. Quantitative estimation of glucose.

8. Quantitative estimation of Urea.

9. Quantitative estimation of Creatinine.

10. Quantitative estimation of Serum proteins, A/G Ratio.

11. CSF Analysis.

12. Clearane Tests-Demonstration.

ES344EC

ELECTRONIC CIRCUITS LAB

Credits: 1

Instruction: 2 Periods per week *Duration of SEE: 3 hours*
CIE: 25 marks *SEE: 50 marks*

1. RC Coupled Amplifiers (Frequency response of BJT & FET)
2. Oscillators:
   a) Wein Bridge Oscillator
   b) RC Phase Shift Oscillator
   c) Hartley Oscillator
   d) Colpitts Oscillator
3. Op-Amps based Filters
   a) Active Low Pass Filters
   b) Active High Pass Filters
   c) Band Pass Filters
   d) Notch Filters
4. Wave Shaping Circuits using operational amplifiers:
   a) Differentiator
   b) Integrator
   c) Clipper
   d) Clamper
5. Differential amplifier
6. Instrumentation amplifier (INA112 & 3op-amp)
7. 555 Timer Applications:
   a) Astable Multivibrator
   b) Monostable Multivibrator
   c) Bistable Multivibrator
8. Current Sources
   a) Precision DC Current sources
   b) Voltage to Current Converters (ac & dc)
   c) High Frequency Current sources