With effect from the academic year 2019-2020

SCHEME OF INSTRUCTION

B.E. (Biomedical Engineering)

III - SEMESTER

With effect from the Academic year 2019-2020

S. No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Examination		Credits
			L	T	P		CIE	SEE	
1	ES 304 EC	Circuit Analysis	3	0	0	3	30	70	3
2	ES 307 EC	Electronic Circuits	3	0	0	3	30	70	3
3	PC 301BM	Anatomy	3	0	0	3	30	70	3
4	PC 302 BM	Physiology	3	0	0	3	30	70	3
5	PC 303 BM	Biochemistry	3	0	0	3	30	70	3
Practicals									
6	ES 353 EC	Electronic Circuits Lab	0	0	3	3	25	50	1.5
7	PC 351 BM	Anatomy Lab	0	0	2	2	25	50	1
8	PC 352 BM	Physiology Lab	0	0	2	2	25	50	1
9	PC 353 BM	Biochemistry Lab	0	0	2	2	25	50	1
Total			**15**	**0**	**9**	**24**	**250**	**550**	**19.5**

L : Lectures

T : Tutorials

P : Practical

CIE : Continuous Internal Evaluation

SEE : Semester End Examination

ES 304 EC

CIRCUIT ANALYSIS

Instruction	3 Periods per week
Duration of SEE:	3 Hours
SEE:	70 Marks
CIE:	30 Marks
Credits	3

Course 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:

1. To understand the circuit elements and estimation of circuit parameters by different theorems.
2. To analyze the RLC circuits for different types of inputs
3. To derive the circuit parameters of RLC networks for different types of excitations.
4. To estimate Laplace transforms and use it for circuit analysis
5. To convert the network into graph and analyse it by network topology

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

ES 307 EC

ELECTRONIC CIRCUITS

Instruction	3 Periods per week
Duration of SEE:	3 Hours
SEE:	70 Marks
CIE:	30 Marks
Credits	3

Course 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.

Course Outcomes:

1. Understand and design the concept of Oscillators.
2. Illustrate Operational amplifiers and their internal devices, including BJT and MOSFET transistors.
3. Examine different applications of OP-AMPs with design examples.
4. Design linear wave shaping circuits and higher order filters.
5. Outline the basic concept of Power supply and SMPS.

UNIT-I

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-II

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-III

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-IV

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-V

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.

With effect from the academic year 2019-2020

PC 301 BM

ANATOMY

Instruction	3 Periods per week
Duration of SEE:	3 Hours
SEE:	70 Marks
CIE:	30 Marks
Credits	3

Course Objectives:

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

Course Outcomes:

1. Able to classify the various systems of human body and identifying their functionality
2. Able to understand musculoskeletal skeletal system and different joints
3. able to understand nervous system and assess functionality of brain
4. understand circulatory and respiratory systems and their functions and relate their functions
5. understand the structure of organs involved in digestive system urinary system endocrine systems

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.

With effect from the academic year 2019-2020

PC 302 BM

PHYSIOLOGY

Instruction	3 Periods per week
Duration of SEE:	3 Hours
SEE:	70 Marks
CIE:	30 Marks
Credits	3

Course 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.

Course Outcomes:

1. understand various mechanisms involved in the normal functioning of human body
2. Able to evaluate CVS by BP and heart rate
3. able to perceive the importance of Respiratory System and identifying the need for ventilators
4. understanding the renal system and formulating the principles of homeostasis
5. understand the cognitive functions of brain

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), Differential equations of action potentials, Voltage-Clamp and Patch-clamp methods, Signal Processing-Synapse, signal Transduction, 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), 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, Oxygen Therapy.

UNIT-IV

Renal System: Regulation of volume and composition of Body fluids, Clearance equations, Biophysics of Filtration, Acid-Base Balance, regulation of Body Temperature-Physical and Physiological process, applied

aspects, Dialysis. Hormonal regulation of Body functions, Overview of Reproductive Physiology, Endocrine System.

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, 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
5. Gillain pocock, Christopher D.Richards, Human Physiology, The Basis of Medicine, Oxford University Press, 2004

PC303BM

BIOCHEMISTRY

Instruction	3 Periods per week
Duration of SEE:	3 Hours
SEE:	70 Marks
CIE:	30 Marks
Credits	3

Course 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. This also includes the clinical study of the pathology 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.

Course Outcomes:

1. Understand basic chemical reactions occurring inside the cell which are responsible for the physiological activity of the body
2. understand the nature and properties of enzymes and identify their Diagnostic and therapeutic uses
3. to determine the characteristic features and reactions occurring with the DNA and RNA
4. analyse the chemical composition of blood and urine in order to identify any non functionality
5. demonstrate various instrumentation techniques involved in biochemical analysis

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

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

ES353EC

ELECTRONIC CIRCUITS LABORATORY

Instruction	3 Periods per week
SEE:	50 Marks
CIE:	25 Marks
Credits	1.5

Course Objectives:

- The course facilitates the students to design the Oscillators.
- To study the 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.

Course Outcomes:

1. Build LC and RC Oscillators.
2. Illustrate different applications of Operational amplifiers.
3. Design the 3-Op-Amp Instrumentation amplifier.
4. Construct linear wave shaping circuits and higher order filters.
5. Demonstrate the Current sources.

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.

With effect from the academic year 2019-2020

PC351BM

ANATOMY LABORATORY

Instruction	2 Periods per week
SEE:	50 Marks
CIE:	25 Marks
Credits	1

Course Objectives:

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

Course Outcomes:

1. Understand the various human tissue structures.
2. Identify different organs of the body and their locations.
3. Able to identify the different lobes of the brain.
4. Able to perceive the importance of dissertation.
5. Able to identify different joints and their importance.

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.

With effect from the academic year 2019-2020

PC352BM

PHYSIOLOGY LABORATORY

Instruction	2 Periods per week
SEE:	50 Marks
CIE:	25 Marks
Credits	1

Course Objectives:

- This course deals with the overall functioning 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.

Course Outcomes:

1. Able to record BP.
2. To evaluate visual, auditory systems in human being.
3. Able to record various biopotentials.
4. Able to record and evaluate respiratory system.
5. To understand the muscular activity.

1. Recording of B.P. by different methods.
2. Effect of exercise on BP
3. Effect of posture on BP
4. Vital capacity by Spiro meter
5. Effect of posture on Vital capacity
6. Calculation of Vital Index
7. Tests of Hearing
8. Tests of Vision
    a. Visual Acuity & errors of Refraction
    b. Colour Vision
9. Recording of ECG
10. Examination of Sensory system
11. Examination of Motor System
12. Study of Rate of Conduction of Nerve impulse.

With effect from the academic year 2019-2020

PC353BM

BIOCHEMISTRY LABORATORY

Instruction	2 Periods per week
SEE:	50 Marks
CIE:	25 Marks
Credits	1

Course Objectives:

- To includes the clinical study of the pathology through different techniques of analysis like the analysis of blood, urine, cerebro spinal fluid etc.

Course Outcomes:

1. Understand the importance of electrophoresis and chromatograph in medical studies.
2. Able to use various instruments like colorimetry, pH meter, spectrophotometer etc.
3. To estimate glucose, urea in biological samples.
4. To estimate creatinine, serum protein etc. in biological samples.
5. To understand the basic principle of operation of various instruments.

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.