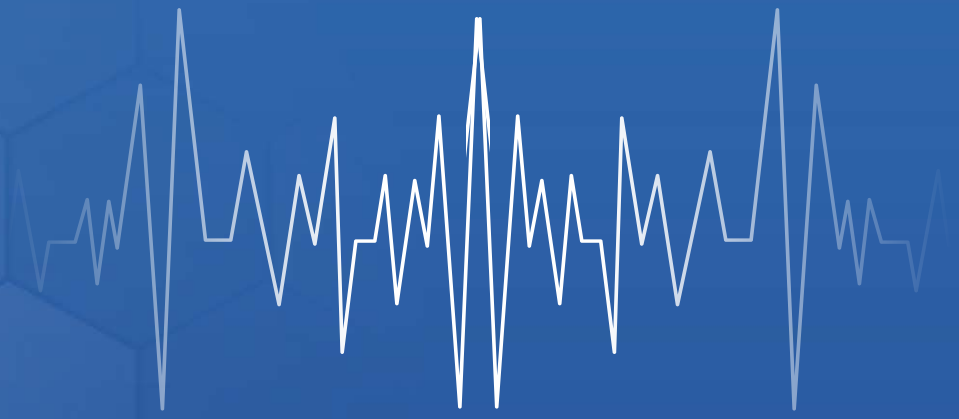
CURRICULUM & REGULATIONS

FOR

B. Sc. (H) PARAMEDICAL COURSES

(Operation Theatre & Anaesthesia Technology, Medical Laboratory Technology, Medical Technology in Radiography, Medical Technology in Radiotherapy, Perfusion Technology, Neuro Technology and Endoscopy Technology)



ALL INDIA INSTITUTE OF MEDICAL SCIENCES

BHUBANESWAR

PREAMBLE

All India Institute of Medical Sciences, Bhubaneswar is one of the apex healthcare Institutes established by the Ministry of Health & Family Welfare, Government of India under the Pradhan Mantri Swasthya Suraksha Yojna (PMSSY).

Mission & Vision Statement:

To establish a center of excellence in medical education, training, health care and research imbued with scientific culture, compassion for the sick and commitment to serve the underserved.

Objectives of the Institute

- To establish center of excellence in healthcare & research, training and medical education imbued
- with scientific culture, compassion for the sick and commitment to serve the undeserved
- To develop patterns of teaching in undergraduate and postgraduate medical education in all its branches so as to demonstrate a high standard of medical education to all medical colleges and other allied institutions in India;
- To bring together in one place educational facilities of the highest order for the training of personnel in all important branches of health activity; and

Functions of the Institute

- Provide for undergraduate and postgraduate teaching in the science of modern medicine and other allied sciences, including physical and biological sciences.
- Provide facilities for research in the various branches of such sciences.
- Provide for the teaching of humanities in the undergraduate courses.
- Conduct experiments in new methods of medical education, both undergraduate and postgraduate, in order to arrive at satisfactory standards of such education.
- Prescribe courses and curricula for both undergraduate and postgraduate studies.
- Train teachers for the different medical colleges in India.
- Establish and maintain a dental college.
- Establish and maintain a nursing college.
- Establish and maintain rural and urban health organizations which will form centers for the field training of the medical, dental and nursing students of the Institute as well as for research into community health problems.
- Establish and maintain other Institutions for the training of different types of health workers, such as physiotherapists, occupational therapists and medical technicians of various kinds.

The AIIMS, Bhubaneswar imparts graduate degrees in major specialties of Paramedical Sciences i.e.

1. B Sc (H) Operation Theatre & Anaesthesia Technology (OTAT)
2. B Sc (H) Medical Laboratory Technology (MLT)

3. B Sc (H) Medical Technology in Radiography (MTR)
4. B.Sc (H) Medical Technology in Radiotherapy (MTRT)
5. B.Sc. (H) Perfusion Technology (PT)
6. B.Sc. (H) Neuro Technology
7. B.Sc. (H) Endoscopy Technology

The courses are managed by faculty of the concerned departments and further scrutinized by the Academic Section under the supervision of the Dean.

ACADEMIC AFFAIRS

Concerned Officials

Prof. (Dr.) Ashutosh Biswas –Executive Director

Prof. (Dr.) Prasanta Raghab Mohapatra – Dean (Academics)

Prof. (Dr.) Soubhagya Kumar Jena – Dean (Examination)

Dr. Debapriya Bandyopadhyay- Associate Dean (Academics)

Dr. Gaurav Chhabra- Faculty I/C (Paramedical)

Dr. Sudipta Ranjan Singh- Registrar

CONTENTS

CURRICULUM FOR

B. Sc. (Hons.)

Operation Theatre & Anaesthesia Technology (OTAT)

INTRODUCTION

AIMS AND OBJECTIVES

BSc (OT & A Technology) will be a bachelor course in which students will be trained with a wide spectrum of knowledge in anesthetic and surgical procedures. The students, after successful completion of the course would be able to acquire comprehensive knowledge about the nuances involved in administration of anesthesia for a variety of surgical procedures and should also be able to perform multiple allied requirements in operating rooms like handling surgical equipments (electrocautery, laparoscopes, carry out packing and sterilization, maintain and trouble shoot equipments as well as receive and transfer patients, etc). In addition, the students, after training, should be able to assist the anesthesiologists in remote locations such as MRI, CT unit, Cath lab, ECT and other procedure rooms as well as in the critical care Unit apart from operating theatres.

Keeping in mind the above aims, the **broad objectives of the course will be**:

1. Should be able to assist anaesthesiologists during induction, maintenance and recovery of anesthesia
2. Should be able to handle all basic and advanced anesthesia equipments including workstations, ventilators, airway equipments, monitors, defibrillators, body warmers, medical gas pipeline systems and cylinders (oxygen and nitrous oxide), etc
3. Should be able to identify, prepare and handle all anesthesia drugs required for local, regional, centro-neuroaxial and general anesthesia; antibiotics; iv fluids; blood and other component therapy; anti-epileptics; anti-hypertensives; fibrinolytics and anti-fibrinolytics and other drugs as and when may be required (for e.g., resuscitation drugs, inotropes etc)
4. Should be able to help in emergency situations like difficult airway, cardiac arrest, and other life-threatening emergencies like hypotension and shock, arrhythmias, acute asthma, anaphylaxis etc
5. Should be able to assist the anesthesiologist in carrying out cannulation of central vein, arterial cannulationetc
6. Should demonstrate competency in setting up advanced invasive monitoring
7. Should be able to discuss the principles behind monitoring and carry out basic monitoring of the patient including hemodynamics (heart rate, blood pressure, saturation, end-tidal carbon-dioxide monitoring) as well as urine output
8. Should be able to co-ordinate with laboratory service and arrange for investigations, results, and requisitions as and when required
9. Should be able to set up a blood and product transfusion including cross matching the product and spiking and setting up blood and component therapy bags
10. Should be able to carry out safe patient transfer before and after surgery in operating theatres and also in other areas like ICUs, including identifying the equipments used for transport, the fluid shifts during transport and care of multiple lines, catheters and infusions that the patient may be on
11. Describe and perform physical preparation and care that the surgical patient may receive prior to surgical procedures

12. Evaluate items on pre-op patient checklist
13. Demonstrate the identification process for a surgical patient
14. Review the patient for completeness of the knowledge of legal and procedural aspects of obtaining any informed consent
15. Describe in detail the sections and functions of the operating room table
16. Should have a thorough knowledge of various patient positions and be able to assist in the same
17. List the indications for urinary catheterization, and identify the supplies required for catheterization
18. Discuss the rationales and steps for surgical skin preparation
19. Compare and contrast different methods for sterilization
20. Discuss the sources of contamination; demonstrate sterile technique including steps of hand washing and employ the same when gowning and gloving members of the theatre team including self
21. Employ sterile technique when gowning and gloving self and when assisting the theatre team
22. Demonstrate the aseptic principles of draping the patient, equipment and other items
23. Should be competent in helping the theatre sister in setting up a surgical trolley

SCOPE OF THE COURSE

The Operation theatre technologists are allied health professionals responsible for direct and indirect patient care, equipment set-up and operative procedures as well as demonstrate the same competencies and responsibilities in other remote areas as and when required. They are trained to assist primarily the anesthesiologists, as well as the surgeons during surgical procedures and assume responsibility for completion of other functions as assigned.

This course (BSc in OT Technology) will be taught at the graduate level and students who have accomplished their higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi can apply for this course. The selection of candidates will be through an admission entrance examination.

Once students have successfully finished the B.Sc.in OT Technology course, they can work as technologists in operating room theatres and in allied areas like catheterization laboratories, MRI/ CT rooms and critical care units. These candidates are needed mostly in hospitals. So, many career opportunities are available for them in the private and public-sector firms. Business as well as research is another field which these technologists can choose. The remuneration of these technologists is expected to be quite reasonable. With sufficient experience in the field concerned, aspirants can expect good salaries. Graduates of this field have also been successful in getting jobs abroad.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN OPERATION THEATRE TECHNOLOGY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

a) ELIGIBILITY FOR ADMISSION

Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b) DURATION OF THE COURSE AND COURSE OF STUDY

The period of certified study and training of the B.Sc. Operation theatre and Anesthesia Technology degree course should be of **three academic years**. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical &lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Operation theatre and Anesthesia Technology when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given three chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practicals
3. Clinical and bedside demonstrations
4. Seminars
5. Assignments
6. Hands on training

This course shall be divided into three academic years and there will be final examination at the end of each year of the B.Sc. OTAT course. The scheme for the final examination is discussed below

EXAMINATION SCHEME

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	Total Marks Practical
1st year							
Paper I	Basic Anatomy	75	25	100	75	25	100
Paper II	Basic Physiology	75	25	100	75	25	100
Paper III	Basic Biochemistry	75	25	100	75	25	100
Paper IV	Biomedical sciences	75	25	100	75	25	100
2nd Year							
Paper-I	Applied Basic sciences (Anatomy, Physiology, Clinical Pathology)	75	25	100	-	-	-
Paper-II	Principles of Anaesthesia and basic anaesthesia techniques – Part I	75	25	100	75	25	100
Paper III	Basic anaesthesia Techniques (including medical ethics and medicine applied to anesthesia)- Part II	75	25	100	75	25	100
Paper IV	Clinical pharmacology and microbiology	75	25	100	-	-	-

Paper	Subjects	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	Total Marks Practical
3rd Year							
Paper-I	Principles of surgery and sterilization procedures	75	25	100	75	25	100
Paper-II	Advanced anaesthetic techniques and anaesthesia for specialty surgery	75	25	100	75	25	100
Paper-III	Super specialty surgery (including advances in theatre and hospital technology)	75	25	100	75	25	100
Paper IV	Basics of intensive care	75	25	100	75	25	100

1ST YEAR

I. BASIC ANATOMY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in OT & AT and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

ANATOMY

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurouns Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands
- **Reproductive System**: Parts of the system. Gross structure of both male and female

reproductive organs

- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Hematoxylin and eosin staining of given paraffin section

EXAMINATION PATTERN (Basic Anatomy)

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where OT and ATs are being required to take a more active role in side effect recognition and management. This may be in departments where OT and ATs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia,

Cyanosis, asphyxia. Methods of artificial respiration

- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes , cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.
- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System :** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.
- **Practical Exercise & lab postings**
- Study of appliances for haemotology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT,CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and

what will happen in their deficiency.

The broad outline of the course will be:

- Carbohydrates – Glucose and Glycogen Metabolism
- Proteins-Classification of proteins and functions
- Lipids- Classification of lipids and functions
- Enzymes- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isoenzymes and Enzyme pattern in diseases
- Vitamins & Minerals- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor
- Acids and bases-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- Hormones
- Applied Chemistry: .

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests,anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization ofmethods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine estimation
- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

1. Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
2. Text book of Medical Biochemistry by Ramakrishna

3. Text Book Biochemistry by Vasudevan and SreeKumari

IV. BIOMEDICAL SCIENCE

Bio-medical science is essential for the OT and AT technologist since he/she will have to continuously deal with various kinds of equipments and should be able to understand their working and be able to trouble shoot any equipment problems. Although a broad understanding of the physics behind machines will be dealt with, it will be mainly related to anesthesia and surgical equipments.

The broad outline of the course will be:

- **Fundamentals of Medical Instrumentation (Chapter-1)**

  Role of Technology in medicine; Landmark developments in Biomedical Instrumentation; Physiological Systems of the body: The Cardiovascular System, The Respiratory System, The Nervous System, Other Systems (Biological Variables); Sources of Biomedical Signals: Bio-Electric Signals, Bio-Acoustic Signals, Bio-Mechanical Signals, Bio-Chemical Signals, Bio-Magnetic Signals, Bio-Optical signals, Bio-Impedance Signals, Signal-to-Noise Ratio; Basic Medical Instrumentation System; Performance Requirements of Medical Instrumentation Systems; Intelligent Medical Instrumentation Systems; Consumer and Portable Medical Equipment; Implantable Medical Devices; Micro-Electro-Mechanical Systems (MEMS); Wireless Connectivity in Medical Instruments; General Constraints in Design of Medical Instrumentation System; Regulation of Medical Devices: Regulations, Standards, Codes, Specifications, Types of Standards, Regulatory Requirements, Definitions of Common Terms; Equipment Classification based on Method of Protection: Class-I, Class-II, Class-III Products; Equipment Types based on Degree of Protection.

- **Bioelectric Signals and Electrodes**

  Origin of Bioelectric Signals: Electrocardiogram, Electroencephalogram, Electromyogram; Recording Electrodes: Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts; Ag-AgCl Electrodes; Electrodes for ECG: Limb Electrodes, Welsh Cup Electrode or Suction Electrode, Floating Electrodes, Pregelled Disposable Electrodes, Pasteless Electrodes, Fabric-based Electrodes; Electrodes for EEG; Electrodes for EMG; Electrical Conductivity of Electrode Jellies and Creams; Microelectrode: Glass Microcapillary Electrodes, Metal Microelectrodes.

- **Biomedical Recorders**

  Electrocardiograph: The ECG Leads, Effects of Artifacts on ECG Recording, Multi-Channel ECG Machine; Vector Cardiograph (VCG); Phonocardiograph (PCG): Origin of Heart Sound, Microphones for Phonocardiography, Writing Methods for Phonocardiography; Digital Stethoscope; Electroencephalograph (EEG): Block Diagram Description of Electroencephelograph, Recording of Evoked Potential; Electromyograph (EMG): Common Artifacts in EMG; Other Biomedical Recorders: Apexcardiograph, Ballistocardiograph (BCG), Electro-oculography, Electroretinograph (ERG); Bio-Feedback Instrumentation: Electrodermal Activity.

- **Patient Monitoring Systems**

  System Concepts; Cardiac Monitor; Bedside Patient Monitoring Systems; Central Monitors;

Measurement of Heart Rate: Average Calculation, Beat-to-Beat Calculation, Combination of Beat-to-Beat Calculation with Averaging, Average Heart Rate Meters, Instantaneous Heart Rate Meters; Measurement of Pulse Rate; Blood Pressure Measurement: Direct Methods of Monitoring Blood Pressure, Indirect Methods of Blood Pressure Measurement, Automatic Blood Pressure Measuring Apparatus using Korotkoff's method, The Rheographic method, Differential Auscultatory Technique, Oscillometric measurement method, Ultrasonic Doppler Shift method; Measurement of Temperature; Measurement of Respiration Rate: Displacement method, Thermistor method, Impedance Pneumography, CO_2 method of Respiration Rate measurement, Apnoea Detectors; Catheterization Laboratory Instrumentation.

- **Arrhythmia and Ambulatory Monitoring Instruments**

  Cardiac Arrhythmias; Arrhythmia Monitor; QRS Detector Techniques: ST/AR Arrhythmia Algorithm, Detection of Ventricular Fibrillation; Exercise Stress Testing: Treadmill Test, Bicycle Test, Stress Testing Instrumentation; Ambulatory Monitoring Instruments: Ambulatory ECG Monitoring (Holter Monitors, Event Recorders, Real-Time Continuous Cardiac Monitoring Systems, Implantable Loop Recorders), Ambulatory ECG with Wearable Electrodes, Microwave Sensor based Ambulatory Monitoring, Implantable Cardiac Monitors, Ambulatory Blood Pressure Monitoring.

- **Oximeters**

  Oximeters: In Vitro Oximetry, In Vivo Oximetry; Ear Oximeter; Pulse Oximeter; Skin Reflectance Oximeter; Intravascular Oximeter.

- **Blood Flow and Cardiac Output Measurement**

  Blood Flow measurement: Electromagnetic Blood Flow Meter, Ultrasonic Blood Flow Meter, NMR Blood Flow Meter, LASER Doppler Blood Flow Meter; Cardiac Output Measurement: Indicator Dilution method, Dye Dilution method, Thermal Dilution techniques, Measurement of Continuous Cardiac Output derived from the Aortic Pressure Waveform, Impedance Technique, Ultrasound method, Bioreactance method, CO_2 Rebreathing method.

- **Pulmonary Function Analyzers**

  Pulmonary Function Measurements: Respiratory Volumes, Respiratory Capacities, Compliance and Related Pressures, Dynamic Respiratory Parameters; Spirometry: Basic Spirometer, Wedge Spirometer, Ultrasonic Spirometer; Pneumotachometers: Fleisch Pneumotachometer, Venturi type Pneumotachometer, Turbine type Pneumotachometer; Measurement of Volume: Flow-Volume Curve, Area of the Flow-Volume, Nitrogen Washout technique; Pulmonary Function Analyzers: Impedance Pneumograph; Respiratory Gas Analyzers: Infrared Gas Analyzers, Paramagnetic Oxygen Analyzer, Polarographic Oxygen Analyzer, Thermal Conductivity Analyzer, N_2 Analyzer based on Ionization technique.

- **Patient Safety**

  Electric Shock Hazards: Gross Shock, Effects of Electric Current on the Human Body, Micro-current Shock, Electrophysiology of Ventricular Fibrillation; Leakage Currents: Types of Leakage Current, Precautions to be minimize Electric Hazards; Safety Codes for Electro-Medical Equipment.

- **Instruments for Surgery**

  Principle of Surgical Diathermy: Cutting, Coagulation, Fulguration, Desiccation; Surgical

Diathermy Machine, Automated Electrosurgical Systems (Size and Shape of the Cutting Electrode, Type and Speed of Cut, Different Tissue Properties, Soft Coagulation, Forced Coagulation, Spray Coagulation), Electrosurgery Techniques (Mono-Polar Techniques, Bi-Polar Techniques), Electrodes used with Surgical Diathermy (Needle Electrode, Angulated Lancet Electrode, Wire Loop Electrode, Angulated Band Loop Electrode, Straight Lancet Electrode, Shape and Sizes of Coagulation Electrodes); Safety Aspects in Electrosurgical Units, Burns, High Frequency Current Hazards, Explosion Hazards; Surgical Diathermy Analyzers.

- **Anaesthesia Machine**

  Need for Anaesthesia; Anaesthesia Machine: Gas Supply System, Gas Flow Measurement and Control, Vapour Delivery System (Variable Bypass Vapourizer, Measured Flow Vapourizer), Gas Delivery System, Humidification, Patient Breathing System, Ventilators, Scavenging, Monitoring System; Capnography

- **Ventilators (Chapter-33) (pp. 859 – 873)**

  Mechanics of Respiration; Artificial Ventilation; Types of Ventilators: Anaesthesia Ventilators, Intensive Care Ventilators; Ventilator Terms: Lung Compliance, Airway Resistance, Mean Airway Pressure (MAP), Inspiratory Pause Time, Inspiratory Flow, Expiratory Flow, Tidal Volume, Minute Volume, Respiration Rate, Conventional Mechanical Ventilation (CMV), Intermittent Mandatory Ventilation (IMV), Inspiratory Expiratory Phase Time Ratio (I:E Ratio), Synchronized Intermittent Mandatory Ventilation (SIMV), Sigh Volume, Patient Circuit, Oxygen Percentage (F_1O_2), Peak Airway Pressure, Spontaneous Ventilation, Bias Flow, Sensitivity, Mandatory Minutes Volume Ventilation (MMV), Controlled Mandatory Ventilation, Assisted Spontaneous Breathing (ASB), Positive End Expiratory Pressure (PEEP), Continuous Positive Airway Pressure (CPAP), Assist / Control Ventilation, Pressure Relief Valve; Classification of Ventilators: Based on the method on Inspiratory Phase, Based on Power Transmission, Based on Pressure Pattern, Based on the type of Safety Limit, Based on Cycling Control (Cycling from Inspiration to Expiration, Cycling from Expiration to Inspiration), Based on the Source of Power; Pressure-Volume-Flow Diagrams; Modern Ventilators; High Frequency Ventilators; Humidifiers, Nebulizers and Aspirators.

TEXT BOOK

1. "Handbook of Medical Instrumentation" by R S Kanpur. McGraw Hill Education (India) Private Limited, (ISBN: 9789339205430).

PRACTICALS

- Equipment Available: Specification, Name Plate, Use and It's importance
- Packing and unpacking of equipment
- Accessories: Importance of accessories and its uses.
- Manuals: Installation Manual, Operation Manual, Maintenance Manual; Subsystems and Functions
- Guarantee and Warranty
- Test Reports / Certificates

- Standards and Calibration
- Hazards & Safety, Precautions, Alarms and Warning.
- Sterilization and Storage
- Equipment Types: Manual, Automatic, Smart, Intelligent
- Equipment Characteristics: Error, Accuracy, Precision, Resolution, Sensitivity, Range, Span, Offset, Drift, Linearity, Threshold, Saturation, Conformance, Repeatability, Reproducibility, Reliability.
- Sources of Error: Installation Error; Operation Error; Interference Error; Equipment Error
- Record Keeping: (a) Operation Record: Log Book, date, time, number of operations, problems faced if any; (b) Maintenance Record: daily, periodic, annual, preventive; (c) Consumables Record: storage, safety, expiry, date & time of requisition, date & time of arrival, time gap between requisition and availability; (d) sterilization record: list of accessories to be sterilized, procedure adopted.
- Treatment of Disposable / Waste Materials
- Measurement Device- Usage of Digital Multimeter, measuring voltage, resistance, continuity & temperature. Measures the AC voltage in a Power cord
- Battery-introduction, Care & maintainence. Nickel-cadmium cells and batteries. Measures different types of batteries (Nickel-cadmium cells and batteries, Lead-acid batteries, Mercury dry cells, carbon-zinc and alkaline dry cells, Gel cell batteries & lithium cells).Battery charging protocols.
- Introduction, Safety features & preuse check for Electrosurgery Unit (or) Diathermy, Pulse Oximeter, light source, Sphygmomamometer.
- Electromagnetic Interference to Medical Electronic Equipment
- Computers in Biomedical Equipment
- Electrical Safety in the Medical Environment

TEXT BOOKS RECOMMENDED

1. "Handbook of Medical Instrumentation" by R S Kanpur. McGraw Hill Education (India) Private Limited, (ISBN**:** 9789339205430).

V. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, PowerPoint, excel etc.
- Uses of computers & applications: Multimedia: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.

- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.

VI. ENGLISH

- **Introduction:** Study techniques, Organization of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct& indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VII. REGIONAL LANGUAGE: ODIYA

2ND YEAR

I. APPLIED BASIC SCIENCES RELATED TO ANAESTHESIA

Applied basic sciences as related to anesthesia is important for applying the theoretical knowledge of the **anatomy and physiology** of the human body to the clinical scenario, which is required when dealing with patients. The broad outline of the content will be:

ANATOMY AND PHYSIOLOGY

Respiratory system

- Structure and function of the respiratory tract in relation to respiratory system
- Nose - Role in humidification
- Pharynx - Obstruction in airways
- Larynx - Movement or vocal cords, Cord palsies.
- Trachea & Bronchial tree - vessels, nerve supply, respiratory tract, reflexes, bronchospasm
- Alveoli - Layers, Surfactants
- Respiratory Physiology
- Control or breathing
- Respiratory muscles - diaphragm, intercostals
- Lung volumes - dead space, vital capacity, FRC etc.
- Pleural cavity - intrapleural pressure, pneumothorax.
- Work of breathing - airway resistance, compliance
- Respiratory movements under anesthesia
- Tracheal tug - signs, hiccup
- Pulmonary Gas Exchange and Acid Base Status
- Pulmonary circulation
- Pulmonary oedema
- Pulmonary hypertension
- Pulmonary function tests
- Transfer of gases - oxygen & Carbon dioxide
- Acid base status, definitions, acidosis types, Alkalosis types, buffers in the body
- Oxygen: properties, storage, supply, hypoxia

- Respiratory failure, type, clinical features, causes.
- Cardiovascular system
- Anatomy
- Chambers of the heart, major vasculature
- Coronary supply, innervation
- Conduction system
- Cardiac output - determinants, heart rate, preload, after load
- Coronary blood flow& myocardial oxygen supply
- ECG: Arrhythmias, cardiovascular response to anesthetic & surgical procedures.
- Hypotension - causes, effects, management
- Cardio-pulmonary resuscitation
- Myocardial infarction, hypertension
- Fluids and electrolytes
- Body Fluids – Composition: water, sodium and potassium balance
- I.V. Fluids - composition & administration
- I.V. Cannulation
- Blood transfusion
- Blood grouping, storage, administration
- Complications of blood transfusion

CLINICAL PATHOLOGY

It is essential to comprehend the pathologic basis of disease and therefore, a basic knowledge of clinical pathology will be expected from the student pursuing this course.

The broad contents of the course will cover:

- Cellular adaptation and cell death
- Inflammation and repair, infection, circulatory disorders, immune defense
- Genetics of disease
- Neoplasia
- Cell injury and adaptation
- Atrophy, hypertrophy, metaphase, hyperplasia
- Classification of tumors, premalignant lesion

- Types of inflammation & system manifestations of inflammation
- Disorders of vascular flow & shock (brief introduction)
- Oedema, hyperemia or congestion, thrombosis, embolism, infarction shock, ischemia, over hydration, dehydration
- The response to infection
- Categories of infectious agents, host barriers to infection
- How disease is caused
- Inflammatory response to infectious agents
- Hematopoietic and lymphoid System
- Hemorrhage, various types of anemia, leucopenia, leukocytosis, bleeding disorders coagulation mechanism

RECOMMENDED TEXT BOOKS

1. Illustrated Pathology – McFarlen
2. Basic Pathology by Robbins

II. PRINCIPLES OF ANAESTHESIA (Part I)

A thorough knowledge of the principles of anaesthesia forms the background for the course of BSc in OT and AT. As such, students pursuing this course will be taught in depth the principles behind the art and science of anaesthetic practice.

The broad contents of the course will cover:

Medical gas supply

- Compressed gas cylinders
- Color coding
- Cylinder valves; pin index
- Gas piping system
- Recommendations for piping system
- Alarms & safety devices
- Scavenging of waste anesthetic gases

Anesthesia machine

- Hanger and yoke system
- Cylinder pressure gauge

- Pressure regulator
- Flow meter assembly
- Vaporizers - types, hazards, maintenance, filling and draining, etc

Breathing system

- General considerations: humidity & heat
- Common components - connectors, adaptors, reservoir bags
- Capnography
- Pulse oximetry
- Methods of humidification
- Classification of breathing system
- Mapleson system - a b c d e f
- Jackson Rees system, Bain circuit
- Non rebreathing valves - AMBU valves
- The circle system

Face masks & Airway laryngoscopes

- Types, sizes
- Endotracheal tubes - Types, sizes
- Cuff system
- Fixing, removing and inflating cuff, checking tube position, complications

Anesthesia ventilator and working principles

Monitoring

- Electrocardiography(ECG)
- Pulse oximetry(Sp02)
- Temperature- central and peripheral
- End tidal carbon dioxide(EtCO2)
- Anesthesia gas monitoring
- Non-invasive blood pressure (NIPB) and Invasive blood pressure(IBP)
- Central venous pressure(CVP)
- PA Pressure, LA Pressure & cardiac output
- Anesthesia depth monitor

- Neuromuscular transmission monitor

PRACTICALS

- Supply of compressed gases
- Types of gases and their chemical and physical properties
- Types of containers, their checking and maintenance
- Types of compressors
- Structure and mechanism of various type of gauges, liquid oxygen storage and supply system
- Structure of reducing valves
- Mechanism of pressure reducing valves
- Their maintenance and safety checks
- Structure and mechanism of flow meters, maintenance and safety checks
- Volatile anaesthetic agents
- Selection of material to be used for containers of the volatile anaesthetic agents
- Structure of different types of vaporizers
- Principles of various vaporizers, their maintenance and safety precautions.
- Types of circuits
- Open, Semi closed and closed circuits
- Non-rebreathing valves
- T-piece circuit and its modifications
- To and fro system and circle absorber
- Types of valves used in the different circuits: structure and working of Heidbrink's valve, Rubin valve nu-man valve etc.
- **Basic techniques of anesthesia**

  Resuscitation techniques

  - Basic life support (Airway, breathing, circulation) and the equipment used for it
  - Drugs used in CPR
  - AED and Defibrillators

  Anesthesia drugs and techniques

  - Principles of anesthesia
  - Basics of general anesthesia, depth, mechanism and intubation

- Techniques of general anesthesia
- Various intravenous and inhalational agents
- Regional anesthesia, spinal and epidural, posture and drugs
- Local Anaesthetic agents
- Neuro muscular blocking agents
- Principles of oxygen administration along with the apparatus
- Care of patient in the recovery room
- Post-operative pain: evaluation and management
- Types of fluid and therapy
- Blood and blood components transfusion
- Preparation of anesthesia machine, intubation kit, suction machine, anesthesia drugs
- Patient identification, marking, shifting to OT before surgery and out of OT to recovery room after surgery, complete takeover and handover of the patient with vital signs recording before and after surgical procedure to the nursing staff

PRACTICALS

- Anesthesia work station
- Apparatus and technique of the intravenous injections
- Selection of the material used for intravenous injection
- Different types of intravenous needles and cannulas
- Theoretical study for testing of the toxicity of the materials
- Resuscitation equipment and Resuscitation techniques
- Endotracheal tubes and other airway gadgets
- Selection of the material used for various types of tubes
- Study of the structure of various types of the endotracheal tubes
- Cleaning and sterilization of tracheal tubes
- Connectors: Various connectors, size and material used
- Mask: Material, structure and importance of dead space of face mask
- Supraglottic airways (LMAs, iGELs)
- Spinal and epidural blocks: equipment, types of spinal and epidural needles, their structure; instruments used for spinal and epidural blocks
- Laryngeal sprays: Types, structure and material used, mechanism, uses and their maintenance

TEXT BOOKS RECOMMENDED:

- **Arun Kumar Paul's Drugs and Equipments in Anaesthetic practice by Churchill Livingstone**

III. PRINCIPLES OF ANAESTHESIA AND BASIC ANAESTHETIC TECHNIQUES (PART II) (INCLUDING MEDICAL ETHICS AND MEDICINE)

This further enhances the candidates' knowledge in anesthesia including medicine and ethics in anesthesia.

The broad course contents will cover:

- Airway management including tracheostomies
- Positioning issues under anesthesia
- Impact of co-existing diseases on anesthesia
- Specifics of invasive and non-invasive monitoring
- Monitored anesthesia care
- Anesthesia in remote locations
- Principles of organ protection
- Therapeutic hypothermia

MEDICAL ETHICS

- Medical ethics - Definition - Goal – Scope
- Code of conduct – Introduction
- Basic principles of medical ethics – Confidentiality
- Malpractice and negligence - Rational and irrational drug therapy
- Autonomy and informed consent - Right of patients
- Care of the terminally ill- Euthanasia
- Organ transplantation
- Medico legal aspects of medical records - Medicolegal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects

MEDICINE OUTLINES

- Disorder of haemopoiesis - Anaemias - iron deficiency anaemia
- Infectious diseases - Sepsis and septic stock, fever of unknown origin, infective endocarditis, infection of skin, muscle, soft tissue, infection control in hospital, diseases caused by bacteria,

viruses, mycobacterium, fungi and protozoa and helminths, common secondary infection in HIV

- Diseases of CVS - congenital RHD - Rheumatic fever, CAD, Peripheral vascular diseases
- Respiratory system – asthma, pneumonia
- Kidney & Urinary tract - acute renal failure, Glomerulonephritis, Haemodialysis, Transplant, Urinary tract infection
- Liver and biliary tract disease - Viral hepatitis, alcoholism
- Endocrinology and metabolism - Diabetes mellitus, Hyper - and hypothyroidism

TEXT BOOKS RECOMMENDED:

1. **Textbook of Anaesthesia Arun Kumar Paul- 7th edition Jaypee Publisher**
2. **Clinical Anaesthesia Arun Kumar Paul Academic Publishers Kolkata**

IV. CLINICAL PHARMACOLOGY & MICROBIOLOGY

A knowledge of clinical pharmacology and microbiology is expected to strengthen the roots of the student undergoing the course of BSc in OT and AT since he/she is expected to deal with multiple drugs that are used in the theatres, critical care areas and catheterization laboratories. Also, knowledge of microbiology will help the technologist to understand the basis of disease-causing pathogens and methods to deal with them, including asepsis. Keeping in view these aspects.

The broad course content will cover:

CLINICAL PHARMACOLOGY

- Antisialagogues: Atropine, Glycopyrrolate
- Sedatives & Anxiolytics: Diazepam, Midazolam, Phenergan, Lorazepam, Chlorpromazine, and Triclofos
- Narcotics: Morphine, Pethidine, Fentanyl, Pentazozine, tramadol
- Antiemetics: Metoclopramide, Ondanseteron, Dexamethasone
- Induction Agent: Thiopentone, Diazepam, Midazolam, Ketamine, Propofol, Etomidate
- Muscle Relaxants: Depolarizing – Suxamethonium; Non depolarizing – Pancuronium, Vecuronium, Atracurium, Rocuronium
- Inhalational Gases: Gases-O2, N2O, Air;VolatileAgents-Halothane, Isoflurane, Sevoflurane, Desflurane
- Reversal Agents: Neostigmine, Glycopyrrolate, Atropine, Naloxone, Flumazenil
- Local Anesthetics: Xylocaine, Bupivacaine; Topical, Prilocaine-jelly, Emla - Ointment, Etidocaine. Ropivacaine.
- Emergency Drugs : Mode or administration, dilution, dosage and effects

- Adrenaline, Atropine
- Ephedrine,Mephentramine, phenyl-epherine
- Bicarbonate, calcium, potassium
- Inotropes: dopamine, dobutamine, noradrenaline
- Anti-arrythmics- amidarone, xyolcard
- Aminophylline, hydrocortisone, antihistaminics
- Antihypertensive –Beta-blockers, Ca-channel blockers, ACE inhibitors
- Vasodilators- nitroglycerin & sodium nitroprusside
- Respiratory system- Bronchodilators
- Renal system- Diuretics, frusemide, mannitol

CLINICAL MICROBIOLOGY

- Morphology
    - Classification of microorganisms, size, shape and structure of bacteria
    - Use of microscope in the study of bacteria.
- Growth and nutrition
    - Nutrition, growth and multiplications of bacteria
    - Use of culture media in diagnostic bacteriology
    - Antimicrobial sensitivity test
- Sterilization and Disinfection
    - Principles and use of equipment of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptic and disinfectants
- Immunology
    - Immunity, vaccines, types of vaccine and immunization schedule, principles and interpretation of common serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA
- Rapid tests for HIV and HBsAg (excluding technical details)
- Systematic Bacteriology
    - Morphology, cultivation, diseases caused, laboratory diagnosis including specimen collection of the following bacteria (excluding classification, antigenic structure and pathogenicity)
    - Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, C. diphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, E. coli, Klebsiella, Proteus, Vibrio cholerae, Pseudomonas & Spirochetes
- Parasitology

- Morphology, life cycle, laboratory diagnosis of following parasites: E. histolytica, Plasmodium, tape worms, Intestinal nematodes

- Nosocomial infections

- Bio-medical waste management

TEXT BOOKS RECOMMENDED

1. Anantnarayana and Paniker. Textbook of pharmacology
2. CP.Baveja. Textbook of Microbiology for nurses.4th Ed. Arya Publishing Company; 2014.
3. Seema Sood. Microbiology for Nursing Students & Nurses. 2nd Ed. Elsevier India Pvt.Ltd; 2006.

3rd YEAR

I. PRINCIPLES OF SURGERY

History of Surgery, role of the surgeon, importance of team work and anticipating the needs of surgeons; stresses that may arise during operative procedure, surgical terminology, types of incision and indications for the use of particular incision are important learning aspects of this course. In addition, the candidate will be expected to know:

- Haemorrhage-signs and symptoms of internal and external; classification and management; Identification of types of tourniquets reasons for use and duration of application, dangers of use
- Wounds, types, process of healing, treatment and complications; inflammation; wound infections-causes and treatment; incision and drainage of abscesses; importance of personal cleanliness and aseptic techniques
- Pre-operative and post-operative care of the surgical patient; Emergency procedures; Knowledge of surgical asepsis, skin preparation for invasive procedures
- General surgical procedure and para-surgical equipment
- Operating tables: structure, material used, maintenance, control, Hydraulic system and Electrical system
- Different types of diathermy machine. Monopole, Bipolar, Ligasure, Harmonic Scalpel, CUSA-Principle, hazards, prevention, functioning and maintenance
- Types of operation lights and light sources: Features, Care, cleaning, sterilization and maintenance
- Operation Theatre sterilization- Different recent advances
- LAR/APR--Positioning of patient, care-Prevention of hazards
- Total thyroidectomy—with emphasis on proper positioning
- Transthoracic esophagectomy—Different approaches
- Venesection and Tracheostomy
- Laparoscopic Cholecystectomy – pneumoperitoneum - Creation and removing, principles
- Nephrectomy
- Breast surgery
- Positioning of patient for different operations: Problems and hazards
- Hypothermia and hyperthermia.

CSSD PROCEDURES

- Principles of sterilization and disinfection

- Methods of sterilization
- Dry Sterilization
- Wet sterilization
- Gaseous sterilization
- Chemical sterilization
- Sterilization by radiation (Gamma rays, ultraviolet rays)
- Techniques of sterilization of rubber articles. (LMA, FOB, ETT, Laryngoscopes, Anesthesia machines and circuits.)
- Technique of sterilization of carbonized articles
- Methods of disinfection
- Boiling
- Chemical disinfection
- Hazards of sterilization
- Prevention of hazards of sterilization
- Precautions to be taken during sterilization
- Recent advances in the methods of sterilization
- Waste disposal collection of used items from user area, reception protective clothing and disinfection safe guards
- Use of disinfectants, sorting and classification of equipment for cleaning purposes, sharps, blunt lighted etc. contaminated high risk baby care - delicate instruments or hot care instruments
- Cleaning process - use of detergents. Mechanical cleaning apparatus, cleaning instruments, cleaning jars, receivers bowls etc. trays, basins and similar hand ware utensils. Cleaning of catheters and tubings, cleaning glass ware, cleaning syringes and needles
- Materials used for wrapping and packing assembling pack contents. Types of packs prepared. Inclusion of trays and parts in packs, Method of wrapping and making use of indications to show that a pack of container has been through a sterilization process date stamping
- General observations principles of sterilization. Moist heat sterilization. Dry heat sterilization, EO gas sterilization.H202 gas plasma vapor sterilization

TEXT BOOKS RECOMMENDED

1. Fuller JK , Ness E Surgical Technology Principles and Practice , Ed 4; Elsevier
2. Nancy MarieFortunato Phillips, Edna Cornelia Berry : Berry and Kohn's operating room technique Ed11, 2007, Mosby

II. ADVANCED ANAESTHESIA TECHNIQUES AND ANAESTHESIA FOR SPECIALITY SURGERY

The candidate will be exposed to the various advances in anesthesia and anesthesia for specialty surgery, so as to understand the nuances involved in the management of such patients presenting for surgery.

The broad content of the course will cover:

Advanced anesthesia techniques

- Heart as a pump
- Cardiac cycle
- Cardiac contractility and stroke volume
- Cardiac output and its measurement
- Various ECG Leads, their placement and Normal ECG.
- Cardiac Arrhythmias (atrial fibrillation, ventricular tachycardia, extra systoles)
- Circulatory shock and its physiology
- Cardiac failure
- Physics of blood flow and pressure
- Measurement of blood flow
- Electromagnetic flow meter, ultrasonic flow meter, plethysmography
- Regulation of arterial pressure and hypertension (Drugs used for treatment of hypertension)
- Arterial circulation including cardiopulmonary bypass
- Artificial ventilation and related equipment:
    - Physiology of IPPV (Intermittent positive pressure ventilation)
    - Principles of mechanical ventilation
    - Various modes of IPPV
    - Automatic pressure and time cycled ventilators
    - Operating room ventilators
    - Other types of ventilators (HFJV, NIV)
    - Complications in patients on ventilators
    - General care of a patient on ventilator
    - Disinfection and sterilization of ventilators
    - Humidification

- Principles of oxygen administration and methods used to deliver oxygen
- Acid base balance
- Electrolyte imbalance and its relevance to anesthesia

ANAESTHESIA FOR SPECIALTY SURGERY

Neuro-anaesthesia

- Glasgow coma scale
- Premedication in the patient for neurosurgery
- Principles of neuroprotection
- Induction of the patient presenting for neurosurgery
- Reinforced Endotracheal tubes
- Positioning in neuro surgery
- I.C.P
- Air embolism
- Reversal of the patient
- Transferring to I.C.U. / Ward
- Dealing with the head injury patient

Obstetrics anaesthesia

- Differences between a pregnant and a normal lady
- Risks for anaesthesia including full stomach
- Precautions to be taken
- Check list
- Regional v/s GeneralAnaesthesia
- Induction / maintenance and recovery
- Resuscitation of the new born, apgar score
- Reversal and extubation
- Obstetrical Emergencies
- manual removal of placenta
- A.P .H
- P.P.H
- Ruptured uterus

- Ectopic Pregnancy

Paediatric Anaesthesia

- Theatre setting
- Check list
- Premedication – modes
- Induction
- Intubation - Securing the EIT
- Reversal &extubation – Problems
- Transferring / ICU management
- Pain management
- ENT Anaesthesia
- Anaesthesia for adenotonsillectomy
- Anaesthesia for mastoidectomy
- Bronchoscopy and oesophagoscopy
- Cardiac anaesthesia
- NYHA classification
- Arrhythmias
- Angina
- Dyspnea
- Premedication of the cardiac surgical patient and patient transfer to theatre
- Setting up of monitoring system: invasive and non – invasive
- Induction of cardiac patient, precautions to be taken (e.g, inotropes prepared and kept)
- Principles of Cardiopulmonary bypass
- Weaning of CPB
- Transferring the patient to ICU (with ET tube, lines and monitoring)
- I.C.U management including chest tube management, dialysis, IABP and postop pain

Day care anaesthesia

- Special features
- Set up, advantages, disadvantages, complications and future
- Discharge criteria

- Postop nausea and vomiting
- Geriatric anaesthesia
- Physiological changes
- Diseases of aging
- Nervous system
- Geriatric pharmacodynamics / pharmacokinetics
- Postoperative nervous system dysfunction
- Patient positioning and care for prevention of injury to nerves and vessels
- Postoperative delirium, hypothermia etc
- Anaesthesia for trauma and shock
- Resuscitation
- Preop investigation & assessment
- Circulatory management
- Management of anaesthesia
- Rapid sequence induction
- Other problems
- Thoracic anaesthesia
- Pulmonary function tests
- Bed side
- Vitalograph
- Preoperative preparation
- Premedication
- Check list
- Induction, Intubation
- Double lumen tubes
- Monitoring
- Pain management
- Extubation
- ICU management

Postoperative problems

- Nausea & Vomiting
- Sore throat
- Laryngeal granuloma
- Neurological complications
- Vascular complications
- Trauma to teeth
- Headache
- Backache
- Ocular complications
- Auditory complications
- Major catastrophes
- Mortality
- Causes of death
- Cerebral damage
- Prevention

Anaesthesia outside the operating theatres

- Cath Lab (Neuro and cardiac)
- Radiology (CT/MRI)
- E.C.T
- Endoscopy suites

III. SUPER SPECIALTY SURGERY (INCLUDING ADVANCES IN THEATRE AND HOSPITAL TECHNOLOGY)

The focus of this module will be to enable the candidate to understand the nuances of various types of super-specialty surgical procedures undertaken in this institute. The candidates will have regular posting in their final semester with the various super-specialty surgical disciplines to further refine their understanding of the subspecialties.

The broad outlines of this course will cover:

- Positioning during various neurosurgical procedures including sitting, prone, lateral and position for trans-sphenoidal hypophysectomy
- Fixation of head during various neurosurgical procedures and the associated intracranial and hemodynamic changes

- Prone and knee chest position for spine surgery
- Requirements during intubation in a case of cervical spine fracture including fiber- optic laryngoscopy, awake intubation, LMA family especially ILMA.
- Surgical requirements during intracranial aneurysm surgery
- Surgical requirements during micro neurosurgery including types of microscopes, principle, structural features, microscopic photography and cameras used
- Surgical requirements during thyroid surgery, adrenal surgery
- Surgical requirements during abdominal surgery including Laparoscopic surgery, genitourinary surgery including percutaneous nephrolithotomy, endoscopic surgery, TURP, TURBT, Lithotripsy, ESWL (Extracorporeal shock wave therapy)
- Surgical requirement during renal transplant donor and recipient surgery including care and precautions during operative procedures of hepatitis B & hepatitis C positive patients
- Surgical requirement during pediatric and neonatal surgical procedures including emergency procedures like tracheo-esophageal fistula, sub diaphragmatic hernia, major abdominal and thoracic procedures. Foreign body bronchus and esophagus
- Intraoperative and postoperative problems and complications of cardiac surgery
- Management of emergency caesarean section
- Management of massive obstetrical hemorrhage
- Surgical management in major burns and craniofacial surgery
- Surgical management of joint replacement and arthroscopy
- Surgical management of endoscopies, laryngectomy with RND and cochlear implant
- Urological procedures
- Management of PPV and perforating eye injury

ELECTRONICS AND TECHNOLOGY IN OT AND HOSPITAL

- Electrical safety precautions in operation theatre. OT tables, OT lights, suction machines, electrodes, pressure transducers, electrical safety, application, handling operation
- Basic electronics, basic principle, care and maintenance and uses of surgical diathermy machine, defibrillator, anesthesia workstations, monitors, pace-makers, CPB machine, ABG machines, IABP machines, stimulators etc.
- Engineering aspects of operation theatre equipment, power supplies, CVT, servo-stabilizers, and ups etc
- Book keeping and Stock maintenance
- Moral aspects and duties of OT technologist
- Indenting and storage procedures of different articles

- Co-ordination with all working personal in operation theatre
- Psychological aspects of patient, staff and relatives of the patients
- Management of operation theatre in routine and emergency.
- Computer data processing, software information and Data management
- Logging on and off, Security concepts, Sending and receiving Emails
- Hospital information system

IV. BASIC INTENSIVE CARE

This module will wrap up the training of the student and provide him/her with a complete perspective.

The broad contents of this course are:

- Care and maintenance of ventilators, suction machine, monitoring devices
- Sterilization and disinfection of ventilators
- Care, maintenance and operational capabilities of beds, lights and other apparatus
- Air conditioning and control of pollution in ICU
- Attachment and intraoperative utility of ventilators and monitoring devices
- Care of unconscious adult and pediatric patients
- Physiotherapy techniques, feeding, Ryle's tube insertion and hyper alimentation
- Suctioning and posturing of semiconscious and unconscious patients
- Oxygen therapy, maintenance of clear Airway
- Assist in setting up central venous access, and other forms of invasive monitoring
- Know the principles involved in the general care of the ICU patient
- Ventilator associated pneumonia and risk factors
- DVT prophylaxis
- Care of bed sores
- Humidification methods, including HME, humidifier etc
- Input/output
- Antiobiotics in the ICU
- Inotropes, vasodilators and anti-arrhythmics
- Indications for blood and component transfusion
- Sepsis and septic shock syndrome

RECOMMENDED TEXT BOOKS:

1. **Step by step Critical Care: Arun Paul ;2nd edition : Jaypee publisher**
2. **Principles and practice of critical care; P.K Verma; B.I Publications Pvt.Ltd, New Delhi**

CURRICULUM FOR

B. Sc. (Hons.)

Medical Laboratory Technology (MLT)

INTRODUCTION

AIMS & OBJECTIVE

Medical laboratory science is the branch of science which deals with all the clinical laboratory investigations on clinical samples for laboratory diagnosis of various diseases. Blood, tissue and body fluids are analyzed and examined for various types of foreign organisms and abnormalities. This information is then used by the medical team to make decisions regarding a patient's medical care.

B.Sc (Medical Laboratory Technology) will be a bachelor course in which students will be trained with a wide spectrum of knowledge in clinical laboratory science and practices. The students, after successful completion of the course would be able to acquire comprehensive knowledge about the processes involved in performing various laboratory tests and procedures. He/She should be able to develop and evaluate test systems and interpretive algorithms, manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information and should also be able to perform multiple allied requirements in the clinical laboratory like preparation of reagents, handling of various sample types, handling of various routine & sophisticated laboratory equipments (Fully automated biochemistry analysers, automated blood cell counter, coagulation analysers, microbiology systems etc.)

At the end of the course the student should be able to:

1. Perform routine clinical laboratory testing.
2. Make specimen-oriented decisions on predetermined criteria including working knowledge of critical values.
3. Communicate with other members of healthcare team, customers and patients in an effective manner.
4. Process information and ensure quality control as appropriate to routine laboratory procedures.
5. Upgrade knowledge and skills in a changing healthcare scenario.
6. Should know the logical interpretation of clinical lab investigations.
7. Should be able to extrapolate data acquired from the test results
8. Should be able to understand the principle and working of automated analysers

SCOPE OF THE COURSE

The Medical Laboratory technologists are allied health professionals responsible for direct and indirect patient care by performing various laboratory tests and procedure which helps in diagnosis and management of all the disease processes. They are trained to assist primarily the laboratory physicians to carry out various diagnostic tests and procedures in the medical laboratory.

This course (BSc in Medical Laboratory Technology) will be taught at the graduate level and students who have accomplished their higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi can apply for this course. The selection of candidates will be through an admission entrance examination.

Once students have successfully finished the B.Sc.in Medical Laboratory Technology course, they can work as technologist sin hospitals and laboratories and perform varied ranges of tests and specialize

in various branches of laboratory medicine (Pathology, Hematology, Biochemistry, Microbiology, Transfusion Medicine, Molecular biology/ medicine).the avenues of getting into research and academics is well open after pursuing the post-graduation and Doctorate in any specialty of laboratory sciences. The remuneration of these technologists is expected to be quite reasonable. With sufficient experience in the field concerned, aspirants can expect good salaries. Graduates of this

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN MEDICAL LABORATORY TECHNOLOGY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

ELIGIBILITY FOR ADMISSION

a. Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b. The period of certified study and training of the B.Sc. Medical Laboratory Technology degree course should be of **three academic years**. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical &lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory

as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Medical Laboratory Technology when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given 3 chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practical's
3. Demonstrations
4. Assignments
5. Hands on training

EXAMINATION SCHEME

This course shall be divided into three academic years and there will be final examination at the end of each year of the B.Sc. MLT course. The scheme for the final examination is discussed below

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	**Total Marks Practical**
1st year							
Paper I	Basic Anatomy	75	25	100	75	25	100
Paper II	Basic Physiology	75	25	100	75	25	100
Paper III	Basic Biochemistry	75	25	100	75	25	100
Paper IV	Pathology-I (General and hematology & clinical pathology)	75	25	100	75	25	100
Paper V	Microbiology-I	75	25	100	75	25	100
2nd Year							
Paper-I	Transfusion Medicine	75	25	100	75	25	100
Paper-II	Pathology II (Special Hematology)	75	25	100	75	25	100
Paper-III	Microbiology-II (Bacteriology & Parasitology)	75	25	100	75	25	100
Paper-IV	Biochemistry-II (Clinical Biochemistry)	75	25	100	75	25	100

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	**Total Marks** **Practical**
3rd Year							
Paper-I	Pathology-III (Histopathology & Cytopathology)	75	25	100	75	25	100
Paper-II	Microbiology-III (Mycology & Virology)	75	25	100	75	25	100
Paper-III	Recent Advances in laboratory Medicine (including Quality Assurance & Biostatistics and laboratory organization & management)	40	10	50	40	10	50

1ST YEAR

I. BASIC ANATOMY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in MLT and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurons Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands
- **Reproductive System**: Parts of the system. Gross structure of both male and female reproductive organs

- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Hematoxylin and eosin staining of given paraffin section.

II. BASIC PHYSIOLOGY OF HUMAN BODY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where MLTs are being required to take a more active role in side effect recognition and management. This may be in departments where MLTs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia, Cyanosis, asphyxia. Methods of artificial respiration
- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes , cutaneous receptors, joint receptors,

sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.

- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System :** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.

Practical Exercise & lab postings

- Study of appliances for haemotology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT,CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. PATHOLOGY-I (GENERAL PATHOLOGY & HEMATOLOGY and CLINICAL PATHOLOGY)

General Pathology

- **Cell Injury and Cellular Adaptations:** Normal Cell**.** Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, cellular swelling. Cell death : types- autolysis, necrosis, apoptosis & gangrene. Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.
- **Inflammation:** Acute inflammation - vascular event, cellular event, inflammatory cells. Chronic Inflammation - general features, granulomatous inflammation, tuberculoma.
- **Hemodynamic Disorders: Oedema**, hyperemia, congestion, haemorrage, circulatory disturbances, thrombosis, ischemia& infarction.
- **Neoplasia :**Definition, Etiopathogenesis, Classification, difference between benign tumor and malignant tumor.

- **Healing:** Definition, different phases of healing, factors influencing wound healing
- **Infection & Immunity**

Practical Exercise & Clinical Lab Postings

- Characteristics of good technician
- Preparation of specimen collection material
- Test/ Lab request form
- Basic steps for drawing a blood specimen by venipuncture
- Complications of venipuncture
- Patient after care
- Specimen rejection criteria for blood specimen
- Haemolysis of blood
- Blood collection by skin puncture (Capillary Blood)
- Arterial puncture
- Deciding specimen types and selection of -Anticoagulant- EDTA, Citrate, Oxalate, Heparin, sodium fluoride
- Separation of serum and plasma
- Changes in blood on keeping
- Maintenance of specimen identification
- Transport of the specimen
- Effect of storage on Blood Cell Morphology
- Universal precautions

Hematological Disorders

- General-Hematology: Origin, development, morphology, maturation, function and fate of blood cells, nomenclature of blood cells.
- Various methods of blood collection, anticoagulants-mechanism and uses
- Counting chamber- hemocytometry. Enumeration of RBC including various counting chambers, diluting fluids for RBC count.
- Hemoglobinometry. Principles and methods of quantitating Hb. Concentration of blood including knowledge of errors and quality control in various method. Abnormal hemoglobin and its investigation. Principles and methods of determining PVC calculation and interpretation of red cell indices.
- ESR: introduction, factors affecting ESR, principles and methods of determining ESR, increasing and decreasing conditions of ESR.

- WBC: introduction, development of WBC, diluting fluids. Absolute eosinophil count, errors in sampling, mixing, diluting and counting.
- Cell counting, advantages and disadvantages, uses and mechanism of cell counting, quality control in cell counts.
- Preparation of peripheral smear. Thin smear, thick smear. Buffy coat smear, wet preparation. Romanowsky stain. Preparation advantages and disadvantages.
- Principle and methods of staining of Blood smears and bone marrow smears. Supravital stain. Recticulocyte count. Heinz bodies.
- Description of morphology of normal and abnormal red cells. Blood differential WBC counting. Recognition of abnormal cell. Anaemia – definition etiology classification and laboratory diagnosis.
- Hemolytic anaemia, definition, causatives, laboratory investigations. Auto hemolysis, acid hemolysis.
- Various benign leucocyte reaction – Leukocytosis. Neutrophilia, Eosinophilia, Lymphocytosis. Infectious mononucleosis. Leucopenias

Urine & body fluids:

- Urine- Method of collection, Normal constituents. Physical examination, chemical examination, microscopic examination
- Stool examination- Method of collection, Normal constituents and appearance, Abnormal constituents (ova, cyst, parasites, occult blood)
- CSF examination- Physical examination, Chemical examination, Microscopy: Cell count, Staining, culture, serology (bacterial, fungal, viral antigen) etc.
- Semen analysis- Patient preparation, Collection, Examination, sperm count, sperm morphology, special tests, immunological tests, biochemical tests; Fructose test etc.
- Other body fluids- Pleural, Peritoneal, Pericardial, Synovial and Amniotic fluids & Sputum examination

Practical Exercise & Clinical Lab Postings

- Basic requirements for hematology laboratory
- Equipment's for Hematology
- Preparation of anticoagulants
- Preparation of various stains in hematology
- Complete Blood Counts
- Determination of Hemoglobin
- TRBC Count by Hemocytometer
- TLC by Hemocytometer

- Differential Leukocyte count
- Determination of Platelet Count
- Determination of ESR by various methods
- Determination of PCV by Wintrobe method
- Erythrocyte Indices- MCV, MCH, MCHC
- Reticulocyte Count
- Absolute Eosinophil Count
- Morphology of Red Blood Cells
- Demonstration of representative pathological slides
- Components & setting of the Compound microscope, focusing of object. Use of low &high power objectives of microscope and oil immersion lens. Care and Maintenance of the microscope.
- Different types of microscopes

IV. BIOCHEMISTRY-I

- **Introduction of biochemistry**: Elementary knowledge of inorganic chemistry – Atomic weight, molecular weight, equivalent weight, Organic Aliphatic and aromatic compounds, Alcohols, Aldehydes, Ketones, Amines, Esters, Phenol etc.

  Buffers, pH indicators: pH paper, universal and other indicators, pH measurement: different methods

  Definition and preparing of solutions – Percent solution, Molar solution, Normal solution, Buffer solution etc.

  Definition and preparation of reagents (AR, LR, CR)

  Unit of measurement, SI units

- **Chemistry of carbohydrates & their related metabolsim -**

  Introduction, definition, classification, biomedical importance & properties.Brief outline of meatbolism : Glycogenesis & glycogenolysis (in brief), Glycolysis, citric acidcycle & its signifiance, HMP shunt & Gluconeogenesis (in brief), regulation of blood glucose level.

- **Chemistry of Proteins & their related metabolism -**

  Introduction, definition, classification, biomedical importance. Metabolism : Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle, metabolic disorders in urea cycle, catabolism of amino acids especially Phenylalanine, Tyrosine & Tryptophan, Creatine, Creatinine , Proteinuria **Amino acids -** Definition, classification, essential &non-essential amino acids

- **Chemistry of Lipids & their related metabolism -**

  Introduction, definition, classification, biomedical importance, essential fatty acids. Brief

outline of metabolism: Beta oxidation of fatty acids, fatty liver, ketosis, cholesterol & it's clinical significance, lipoproteins in the blood composition & their functions in brief, Atherosclerosis.

- **Enzymes -** Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.
- **Acid base balance concepts & disorders -** pH, Buffers, Acidosis, Alkalosis
- Laboratory glassware and its uses – Types of pipettes, calibration of pipettes, cleaning of glassware; Analytical balance, pH meter, Oven and incubator, ELISA reader & washer- Uses care & maintenance.
- Centrifuge: Working principle, different types and application
- Refrigerators: 4^0 C, -20^0C, -80^0C
- Working Principles and application of photometry, colorimeter, spectrophotometry and flame photometry.
- Working principle and application of distillation plant and deionizer
- Overview of techniques: Chromatography, Electrophoresis, PCR, ELISA, Flowcytometry
- Overview of Automated chemistry systems
- Overview of Arterial Blood gas analyser

Practical Exercise & Clinical Lab Postings

- Centrifugation: Principle, types & applications.
- Uses, Care and Maintenance of various instruments of the laboratory
- Demonstration of automated chemistry analyser
- Demonstration & working of spectrophotometer/ colorimeter/ photometer
- Preparation of cleaning solution for glassware, cleaning glassware and drying
- Pipettes types, clearing, sterilization, uses, calibration
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine
- Serum Sodium and Potassium
- Pathological Urine analysis
- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests, anticoagulants,

reagents, cleaning of glassware, isotonic solution, standardization of methods, preparation of solution & interpretation of result, normal values.

- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Glucose tolerance test & Glycosylated haemoglobin.

V. MICROBIOLOGY-I (GENERAL MICROBIOLOGY & IMMUNOLOGY & SEROLOGY)

- General characters and classification of Bacteria.
- Characteristics of Bacteria- Morphology - Shape, Capsule, Flagella, Inclusion, Granule, Spore.
- Growth and Maintenance of Microbes- Bacterial division, Batch Culture, Continuous culture, bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO2 requirement, temperature, pH, light
- Sterilization and Disinfection- Physical agents- Sunlight, Temperature less than 1000C, Temperature at 1000C, steam at atmospheric pressure and steam under pressure, irradiation, filtration. Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.
- Culture Media- Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media
- Staining Methods- Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation
- Collection and Transportation of Specimen- General Principles, Containers, Rejection, Samples- Urine, Feces, Sputum, Pus, Body fluids, Swab, Blood
- Care and Handling of Laboratory Animals- Fluid, Diet, Cleanliness, Cages, ventilation, Temperature, Humidity, handling of animals, Prevention of disease
- Immunity - Definition and classification. General Principles of Innate & Acquired Immunity

IMMUNOLOGY & SEROLOGY

- Immunity - Definition and classification. General Principles of Innate & Acquired Immunity
- Immune Response **-** Humoral immunity & cell mediated immunity
- Antigen - Definition, classes, properties
- Antibodies/Immunoglobulins - Definition, Properties, Sub types of Immunoglobulins
- Antigen/Ab Reaction/Serological Reactions
- Features of antigen/antibody Reaction- Precipitation, Agglutination, Complement fixation test, Neutralization, Opsonization, Immune adherence, Immunofluorescence
- Structure and functions of Immune System- Parts of Immune system. T/B cells, other cells & their functions

- Hyper sensitivity Reactions- General Principles of different types of hypersensitive reactions
- Autoimmunity & Histocompatibility
- Immunoassays: Principles and various types of immunoassays and their applications

Biosafety & handling of lab waste

- Role of Medical Laboratory technologists – ethics of laboratory practice
- Biosafety: General Principles, biosafety guidelines, codes of practice, Common laboratory accidents their prevention and their first aid
- Laboratory design & facilities, laboratory equipments, Health & medical surveillance training
- Biomedical waste handling. Categories of biomedical waste, Disposal of biomedical waste
- Sterilization: Definition, general principles and classification. Autoclave-structure functioning, control & indicator
- Antiseptics & Disinfectants: Definition, types, mode of action and uses

Practical Exercise & lab Postings

- Disinfection practices in laboratory and wards.
- Assay for disinfection
- Handling and care of laboratory animals
- Serological tests – VDRL, Widal, ASO titer, CFT, IHA, ELISA etc.
- Skin test- tuberculin etc
- Using of autoclave hot air oven, other common laboratory equipment etc
- Disinfection practices in laboratory and wards.
- Biomedical waste disposal, Color coding of waste bags
- Identification of instruments.
- Preparation of swabs/sterile tubes & bottles
- Staining.: Gram &Ziehl -Neelsen staining& other relevant stains
- Preparation of Culture media
- Identification of common microbes
- Using of autoclave hot air oven, other common laboratory equipment etc.
- Principles of ELISA
- Serological procedure: immunochromatography, ELISA
- Preparation of swabs/sterile tubes & bottles
- Preparation of smear

- Staining.: Gram &Ziehl -Neelsen staining
- Identification of Culture media
- Identification of instruments
- Identification of common microbes
- Using of autoclave hot air oven, other common laboratory equipment etc.
- Assay for disinfection
- Serological tests – VDRL, Widal, ASO titer, CFT, IHA, ELISA etc.
- Using of autoclave hot air oven, other common laboratory equipment etc

VI. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, power point, excel etc.
- Uses of computers & applications: Multi media: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.
- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.

VII. ENGLISH

- **Introduction:** Study techniques, Organization of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VIII. REGIONAL LANGUAGE: ODIYA

2ND YEAR

I. TRANSFUSION MEDICINE

- **Blood grouping:** Introduction**,** Human Blood Group system**,** ABO Subgroups**,** Red Cell Antigen**,** Natural Antibodies System**,** Rh Antigens & Rh Antibodies**,**
- Principal of Blood grouping, antigen-antibody reaction, Agglutination, Hemagglutination, Condition required for antigen antibody reaction,
- Blood grouping techniques, Cell grouping, Serum grouping. Methods for ABO grouping. Slide &Tube Method, Cell grouping, Serum grouping, Rh grouping by slide & tube method. Difficulties in ABO grouping.
- Rouleaux formation, how it interferes with Blood grouping, auto agglutinins. Antiserum used in ABO test procedures, Anti –A, Anti-B Anti- AB Antiserum. Inheritance of the Blood groups. Control, A&B Cells preparation, Auto control.
- **Blood Transfusion:** Principal & Practice of blood Transfusion, Guide lines for the use of blood, Appropriate use of Blood, Quality Assurance.
- Objectives of Quality Assurance in Blood Transfusion services, Standard operating procedures for usage, donation & storage of blood, screening of donor, compatibility testing safety, procurement of supplies.
- **Blood Donation:** Introduction**,** blood donor requirements**, c**riteria for selection & rejection Medical history & personal details. Self-exclusion, health checks before donating blood. Screening for TTI.
- **Blood Collection:** Blood collection bags, Anticoagulants, Taking & giving sets in Blood transfusion. Techniques of collecting blood from a doctor. Instructions given to the donor after blood donation. Adverse donor reaction.
- **Testing Donor Blood:** Screening donor's blood for infectious agents - HIV, HCV, HBV, Syphilis, Malaria, contaminated blood etc.
- **Blood Donor Records:** Blood donation record book, recording results, blood donor card.
- **Storage & Transport:** Storage & issue of blood and components**.** Transportation.
- **Maintenance of blood bank records:** Blood bank temperature sheet. Blood bank stock sheet. Blood transfusion request form.
- **Compatibility Testing:** Purpose**, s**ingle tube compatibility techniques using AHG reagent. Emergency compatibility testing. Difficulties in cross matching. Labeling & issuing cross-matched blood.
- **Blood components preparation:** Collection of blood components for fractional transfusion. Platelets packed Red Cell, Platelet rich Plasma, Platelets concentrate. Preparation of concentrated (packed) Red cells. Techniques of preparation.
- **Blood Transfusion Reaction:** Investigation of a Transfusion reaction. Hemolytic transfusion reaction. Actions to be taken when transfusion reaction occurs.

Practical Exercises & Blood bank posting

- Blood grouping- Slide & Tube Methods
- Crossmatching
- Screening of donors.
- Coomb's test
- Screening of blood
- ELISA test
- Preparation of blood components

II. PATHOLOGY-II (SPECIAL HEMATOLOGY-II)

- Bone Marrow: Cell composition of normal adult Bone marrow, Aspiration, Indication, Preparation & Staining, Special Stain for Bone Marrow -Periodic Acid Schiff, Sudan Black, Myeloperoxidase, Reticulin, Nonspecific esterase, Acid phosphatase, Leucocyte alkaline phosphatase, etc.
- Leukemia: Classification, Blood Picture, Differentiation of blast cells.
- Methods of identification of abnormal hemoglobin- electrophoresis, HPLC
- Principles of HPLC – Thalassemia and Hemoglobinopathies
- Hemostasis - Definition, Basic concept and principle, Basic steps involved in Hemostasis
- Coagulation - Basic Physiology, coagulation factors. Mechanism of blood coagulation. Extrinsic Pathway, Intrinsic Pathway, Regulators of blood coagulation.
- Testing of blood coagulation - Bleeding Time, Duke's method. Clotting Time- Capillary tube method & Lee white's method. PT, aPTT, TT.
- Quality Assurance for routine Hemostasis Laboratory: Introduction, Sample collection technique (Phlebotomy), Sample preparation, Anticoagulant used, Importance of use of Sodium Citrate.
- Role in Diseases, Bleeding disorders. Platelet disorder - Thrombocytopenia - causes including aplastic anemia, DIC, ITP, Hemophilia

Practical & lab postings

- Prothrombin time exercise
- Activated partial thromboplastin time exercise
- Bleeding time & clotting time exercise
- Preparation of Hemolysate
- Preparation of bone marrow smears.

- Special stains for bone marrow smear
- Identification of various cells in marrow smears and special stains
- Preparation of reagents for coagulation studies
- Osmotic fragility of RBC
- Sickling test
- LAP score
- Documentation in transfusion medicine
- Bleeding of donors
- Recent advances in transfusion medicine

III. MICROBIOLOGY-II: (BACTERIOLOGY & PARASITOLOGY)

BACTERIOLOGY

- Study of - *Staphylococcus, Streptococcus, Pneumococcus, Neisseira gonorrhoea, Neisseira meningitis, Corynebacterium diptheriae, Mycobacterium, Clostridium, Escherechia coli, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio & Spirochaetes* with reference to their :- Morphology, cultural characteristics, biochemical reaction, pathogenesis/ disease caused & lab diagnosis.

Practical exercise and clinical lab postings

- Composition and preparation of stains.
- Simple staining methods and gram stains
- Special staining methods – capsule, spore, acid fast, Metachromatic etc,
- Tests for motility in bacteria.
- Preparation of media.
- Using of autoclave hot air oven, other common laboratory equipment etc.
- Techniques of cultivation of bacteria.
- Isolation of bacteria from clinical specimens.
- Biochemical testing.
- Serological techniques.
- Antibiotic susceptibility testing methods.
- Methods of maintaining stock cultures.

- Safety in microbiology.

PARASITOLOGY

- Definition - parasitism, HOST, Vectors etc.
- Classification of Parasites
- Phylum Protozoa- general Pathogenic and nonpathogenic protozoa.
- Phylum Nemathelminthes/Round words (Nematoda)
- Phylum Platyhelminthes - class-Cestoda, class-Trematoda
- Collection and preservation of specimens for parasitological examination, preservation of specimens of parasitic eggs and embryos, Preserving Fluids, Transport of specimens
- Lab diagnosis of parasitic infections
- **Protozoa :**
    - Intestinal Amoebae
        i. *E. Histolytica*: Life cycle, Morphology, Disease & Lab Diagnosis
        ii. *E. coli*: Life cycle, Morphology, Disease & Lab Diagnosis
    - Flagellates of intestine/genitalia
        i. Giardia lamblia: Life cycle, Morphology, Disease & Lab Diagnosis
        ii. Trichomonas vaginalis: Life cycle, Morphology, Disease & Lab Diagnosis
        iii. Malarial Parasite: Plasmodium: Life cycle, Morphology, disease & lab diagnosis; Differences between P. vivax, P. malaria, P. falciparum &P.ovale.
- **Nematodes :**
    - Intestinal Nematodes :
        i. *Ascaris lmbricoides* : Life cycle, Morphology, disease & lab diagnosis.
        ii. Brief discussion about *Enterobius vermicularis* (Thread worm) *Ancylostoma duodenale* (Hook worm)
        iii. Tissue Nematodes : W. bancrofti - Life cycle, Morphology, Disease & Lab Diagnosis
- **Cestodes -** T. solium, T. saginata& E. granulosus. (in brief)
- **Trematodes -** S. haematobium & F. hepatica (in brief)

Practical Exercise & lab postings

Stool Examination

- Collection and preservation of specimens for parasitological examination
- Processing of stool samples

- Special stains used in stool examination
- Preparation of stains used for stool examination
- Identification of Plasmodium species
- Preparation of thick & thin smears
- Identification of different ova & cysts in stool samples
- Identification of Arthropods of Medical importance
- Recent advances in parasitology

IV. BIOCHEMISTRY-II

- Photometry-Definition, laws of photometry, absorbance, transmittance, absorption maxima, instruments, parts of photometer, types of photometry–colorimetry, spectrophotometry, flame photometry, choice of appropriate filter, measurements of solution, calculation of formula, applications.
- Water & Mineral Metabolism- Distribution of fluids in the body, ECF & ICF, water metabolism, dehydration, mineral metabolism, macronutrients (principal mineral elements) & trace elements.
- Liver Functions & their Assessment
- Renal Functions & their assessment-Various Tests, GFR & Clearance
- Immunoassay techniques & applications
- Electrophoresis - Principle, Types & Applications
- Polymerase Chain Reaction -Principle & Applications
- Autoanalyzer's - Principle & Applications
- Vitamins- Fat & water soluble vitamins, sources, requirement, deficiency disorders & biochemical functions.
- Cardiac Profile - In brief Hypertension, Angina, Myocardial Infarction, Pattern of Cardiac enzymes in heart diseases
- Gastric Function Tests,
- CSF analysis

ENDOCRINOLOGY

- Introduction, Difference between hormones and enzymes. Classification of hormones, Regulation and general mechanism of action of hormones.
- Pituitary gland & hypothalamus. Hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Luteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotropic hormone (ACTH). Hormones of

neurohypophysis- Oxytocin, Antidiuretic hormone (ADH)

- Hormones of the Thyroid gland- chemistry and normal physiology, Thyroid disorders-goiter, myxedema, autoimmune thyroiditis, tumors of the thyroid gland, hyperthyroidism, Graves' disease, Calcitonin, Parathyroid Hormone (PTH)
- Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addison's disease,
- Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
- Adrenal medulla-metabolism of catecholamines
- Reproductive Hormones: Testosterone, Estrogens, Progesterone, their synthesis and functions.
- Human Chorionic Gonadotropin (HCG), hormone, menstrual cycle, Menopause
- Pancreatic hormones: Insulin secretion, functions. Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin.
- Renal hormones - Renin

TUMOR & CANCER MARKERS

- Introduction: Carcinogens-definition. Oncogene-definition-Mechanism of action of Oncogenes (outline). Characteristics of growing tumor cells-general and morphological changes, biochemical changes.
- Tumor Markers- Introduction and definition, Clinical applications of tumor markers. Enzymes as tumor markers, Alkaline Phosphatase (ALP), Creatine kinase (CK), Lactate dehydrogenase (LDH), Prostatic acid phosphatase (PAP), Prostate specific antigens (PSA).
- Hormones as tumor markers (introduction of each type in brief).
- Oncofetal antigens, Alpha-feto protein (AFP), Carcinoembryonic Antigen (CEA). CA 15-3, CA 125. Blood group antigen (brief introduction of each type)-CA 19-9, CA 50, CA 72-4 etc.

Practical & Clinical lab Postings

- Assays of hormones by various procedures such as ELISA, chemiluminescence
- Assays of tumor markers
- Working of fully automated immunoassay analyzer
- Immunoassays techniques
- Trouble shooting of immunoassay analyzer
- Standard Curve and reagent Preparation for-
- Plasma Glucose by Nelson-Somogyii Method
- Serum Urea by DAM method

- Serum Creatinine by Alkaline picrate Method
- Serum Cholesterol by Modified Zak's method
- Serum Protein by Biuret method
- Serum Protein Electrophoresis
- Paper Chromatography
- Blood urea estimation
- Serum creatinine estimation
- Serum uric acid estimation
- Serum total protein estimation
- Serum albumin estimation
- Serum globulin estimation
- Serum glucose estimation
- Total cholesterol estimation
- Serum Bilirubin estimation
- Alkaline phosphatase estimation
- Serum sodium estimation
- Serum potassium estimation
- Serum TG,,HDL and Fried Wald's Formula
- Serum ALT and AST
- CSF analysis

3rd YEAR

The student shall be posted and rotated in the clinical laboratories of Department of Biochemistry, Pathology and Microbiology full time for a maximum of six months in the academic year for direct exposure to the all the practical aspect in running the laboratory. The student is expected to regularly attend these postings. At the end of the each posting an internal exam will be conducted to assess the candidate. At the end of the year the candidate will also be assessed on the basis of theory and skill based practical examination including viva voce in the subject of microbiology pathology and biochemistry along with the core subjects.

I. PATHOLOGY-III (HISTOPATHOLOGY & CYTOPATHOLOGY)

- Definition, sources and types histological specimens.
- Labeling, fixation, properties of fixatives, classification and composition of fixatives. Advantages and disadvantages of secondary fixatives.
- Tissue processing, dehydration and cleaning.
- Embedding. Water soluble substances, embedding in paraffin nitrocellulose.
- Equipment for sectioning microtome, knife, honing and stropping. Types, care and use of microtome.
- Technique for sectioning – Paraffin embedded tissue. Errors in sectioning and remedies. Attaching blocks to carriers.
- Frozen section.
- Technique of processing bone for histological studies.
- Mounting and covering. Mounting media.
- Staining – theory, types of staining agent. Mordants and differentiation. H & E staining. Types of hematoxylin and its preparation. Eosin stock stain and other counter stain used.
- Stains for bacteria including AFB, fungi, and amoeba.
- Principles of Immuno-histochemistry and its application
- Demonstration of neuron, neuroglia, myelin and axon
- Demonstration of fat, iron, amyloid, bile in large sections of tissue
- Special stains in histopathology
- Cytology – introduction, definition, types of cytological specimen, preparation of slide for microscopic studies, stains used.
- FNAC, definition, techniques involved in preparation of smear and staining.
- PAP smear, Body fluid cytology
- Museum technique. Preparation, setting up of and arrangement of museum.

- Preparation of cell blocks, mailing of slides.

Practical & Lab posting

- Parts of microtome
- Paraffin section cutting
- Tissue processing
- H&E staining
- Quality Control in histopathology
- Immunohistochemistry staining & preparation
- Demonstration of collagen, reticulin, elastin and fat
- Demonstration of amyloid, glycogen and mucin.
- Demonstration of pigments and minerals (malarial, mercury, bile, lipofuscin, calcium, iron, copper
- Museum techniques

II. MICROBIOLOGY-III: (MYCOLOGY & VIROLOGY)

Mycology:

- Fundamentals of mycology
- Morphology and identification of contaminant and pathogenic fungi.
- Laboratory diagnosis of common superficial, subcutaneous, and deep Fungal infections of man.

Virology

- General properties of viruses – structure, replication, growth, classification, identification.
- Common viral disease – mode of infection, spread, laboratory Diagnosis – Polio, Influenza, Parainfluenza, mumps, Measles, Rubella, Respiratory syncytial virus, Rhinovirus, Rotavirus, Hepatitis, arboviruses prevalent in India (Dengue, West Nile, Japanese Encephalitis, KFD), Chicken pox, Adenovirus, Papovavirus, Herpes, HIV, Cytomegaloviruses, etc.
- Diagnostic techniques for viral disease
- Principles of animal culture & their use in virology

Practical Exercise & Lab postings

- Culture Media used for fungus.
- Fungal culture
- Methods of lab diagnosis & virus

III. RECENT ADVANCES IN LABORATORY MEDICINE (INCLUDING LABORATORY ORGANIZATION & AUTOMATION, QUALITY ASSURANCE & BIOSTATISTICS)

Newer techniques

- PCR technique: Principles, types & applications
- Electrophoresis: Principles, types & applications
- HPLC/ Chromatography: Principles, types & applications
- Flow cytometry: Principles, techniques & applications
- FISH: Principles, techniques & applications
- Gene sequencing: Principles and application in brief
- Immunoassays: Principles, types & applications
- Recent advances in microbiology
- Recent advances in biochemistry
- Recent advances in blood banking
- Introduction to Quality control
- Total quality management framework
- Quality laboratory processes, Quality assurance, Quality assessment, Quality control, Quality planning and Quality improvement
- Internal quality control, basic steps, sources of error and their correction methods, CAPA - corrective action & preventive action
- Sources of variation in laboratory results
- Quality control charts, Levy- Jennings and Cusum charts
- External quality control
- Quality control program, Systematic and random errors
- Current trends in laboratory accreditation, ISO/NABL accreditation, Westgard Rules
- Demonstration of various methods of quality control
- Construction and setting up a laboratory, space, air-conditioning, electricity, generator, UPS. Cold Lab. Administration, Human resource development, Staff orientation & training
- Operational Management, Maintenance of Laboratory Equipments
- Maintenance of Laboratory Records
- Lab information systems (LIS)
- Legal aspect of Laboratory Medicine; Safe laboratory Practices, Confidentiality of patient's report, Protection of laboratory employees, Summon from Consumer court.

- Laboratory Accreditation

Laboratory Automation

- Automation - Introduction, meaning, advantages, history
- Continuous flow analyzers
- Single channel continuous flow analyzers-advantages, disadvantages
- Multi channel flow analyzers
- Discrete auto analyzers - basic features, types, semi automated, fully automated
- Batch analyzers and Random access analyzers (RAA)
- Component steps in fully automated analyzers
- Auto analyzers based on immunoassay techniques, Micro particle enzyme immunoassay (MEIA) etc.
- Dry chemistry analyzers
- Automation in hematology
- Automation in microbiology & molecular biology
- **Biostatistics:** Principles of biostatistics, classification of data, Frequency distribution, Representation of Biometric data, Central tendency – Mean, Medium, Mode, Measures of dispersion, Tests of hypothesis, Tests of significance, Chi square test, Probability, P-value, Confidence Interval

Laboratory Posting

- Quality laboratory processes, Quality assurance, Quality assessment, Quality control, Quality planning and Quality improvement
- Internal quality control, basic steps, sources of error and their correction methods, CAPA - corrective action & preventive action
- Sources of variation in laboratory results
- Quality control charts, Levy- Jennings and Cusum charts
- External quality control
- Quality control program, Systematic and random errors
- Current trends in laboratory accreditation, ISO/NABL accreditation, Westgard Rules
- Demonstration of various methods of quality control
- Demonstration of PCR
- Demonstration of electrophoresis
- Demonstration of HPLC
- Demonstration of flow cytometry

CURRICULUM FOR

B. Sc. (Hons.)

Medical Technology in Radiography (MTR)

INTRODUCTION

AIMS AND OBJECTIVES

Medical imaging studies have been main ingredient in medical diagnosis since long. Current technological advances along with addition of new imaging modalities now place medical imaging among the expanding and high demand fields in clinical medicine. The B.Sc. course in Medical Technology in Radiography is designed to prepare students to practice competently and effectively as medical imaging professionals in radiology, nuclear medicine and radiotherapy. The program will focus on teaching students to handle and troubleshoot imaging machines under supervision, learn medical ethics, assume responsibilities and maintain a clear work environment in hospital set-up.

At the end of the course the student is expected to be able to do following

1. Undertake all routine & specialized radiological procedures such as X-ray, sonography, mammography, CT scan and MRI independently.
2. Assist in specialized radiological procedures.
3. To do the image processing.
4. Handle all radiological and imaging equipment independently.
5. Should ensure radiation protection and quality assurance
6. Undertake care and maintenance of all radiological and imaging equipment
7. Evaluate images for technical quality
8. Identify and manage emergency situations.
9. Able to receive and document verbal, written and electronic orders in the patient's medical record.

SCOPE OF THE COURSE

Diagnostic radiography is a fast-moving and continually changing profession, and long-term career prospects include: management, research, clinical work, teaching etc.

Diagnostic radiographers provide a service for most departments within the hospital including, accident and emergency, outpatients, operating theatres and wards. Close liaison and collaboration with a wide range of other health care professionals is therefore vital. After completion of this curriculum, a Medical Radiology & Imaging Technologist gets opportunities to work at various health care institutes under designations as Radiographer, Radiological Technologist, CT scan Technologist, MRI Technologist, Applications Specialist, Radiological Safety Officer , Interventional Technologist, Quality control Technologist, PACS manager, Sales and marketing of radiology industry, Other Administrative posts in Medical Imaging department & hospital, Teaching & research faculty in Medical colleges, Research Scientists in Medical imaging industry

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN MEDICAL TECHNOLOGY IN RADIOGRAPHY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

ELIGIBILITY FOR ADMISSION

a. Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b. The period of certified study and training of the B.Sc. Medical Technology in Radiography degree course should be of **three academic years**. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical &lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Medical Technology in Radiography when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given 3 chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practical's
3. Demonstrations
4. Assignments
5. Hands on training

This course shall be divided into three academic years and there will be final examination at the end of each year of the B.Sc. MTR course. The scheme for the final examination is discussed below

EXAMINATION SCHEME

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	**Total Marks Practical**
1st year							
Paper I	Basic Anatomy	75	25	100	75	25	100
Paper II	Basic Physiology	75	25	100	75	25	100
Paper III	Basic Biochemistry	75	25	100	75	25	100
Paper IV	Medical physics-I	75	25	100	75	25	100
Paper V	Radiology-I	75	25	100	75	25	100
2nd Year							
Paper-I	Medical physics-II	75	25	100	75	25	100
Paper-II	Radiology-II	75	25	100	75	25	100
3rd Year							
Paper-I	Medical Physics-III	75	25	100	75	25	100
Paper-II	Radiology-III	75	25	100	75	25	100
Paper-III	Basic Nuclear medicine	75	25	100	75	25	100
Paper IV	Basic Radiotherapy	75	25	100	75	25	100
Paper V	Medical Physics-Nuclear Medicine and Radiotherapy	75	25	100	75	25	100

1st YEAR

I. BASIC ANATOMY AND PHYSIOLOGY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in MTRs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

ANATOMY

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurouns Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands
- **Reproductive System**: Parts of the system. Gross structure of both male and female

reproductive organs

- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Hematoxylin and eosin staining of given paraffin section

EXAMINATION PATTERN (Basic Anatomy)

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where MTRs are being required to take a more active role in side effect recognition and management. This may be in departments where MTRs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia,

Cyanosis, asphyxia. Methods of artificial respiration

- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes , cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.
- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System :** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.
- **Practical Exercise & lab postings**
- Study of appliances for haemotology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT,CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and what will happen in their deficiency.

The broad outline of the course will be:

- Carbohydrates – Glucose and Glycogen Metabolism
- Proteins-Classification of proteins and functions
- Lipids- Classification of lipids and functions
- Enzymes- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isoenzymes and Enzyme pattern in diseases
- Vitamins & Minerals- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor
- Acids and bases-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- Hormones
- Applied Chemistry: .

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests,anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization ofmethods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine estimation
- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

- Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
- Text book of Medical Biochemistry by Ramakrishna
- Text Book Biochemistry by Vasudevan and SreeKumari

IV. RADIOLOGY-I

Patient care and hospital administration (orientation session)

- Introduction to Hospital Structure, Department, Medical and Non-Medical Staffs
- Radiography as a profession: Importance and Scope, Projecting professional and personal
- Qualities of Technologist, working ethics (DOs and DON'Ts). Communications and Relational Skills: Development of appropriate communication skills with patients, verbal and non-verbal communication, appearance and behavior of Radiographer.
- Moving & lifting patients- Hazards of Lifting, rules for correct lifting, transfer from chair to trolley and vice-versa, safety of both "lifter" and the "lifted" must be emphasized. Special emphasis on handling of Geriatric, Pediatrics and Trauma Patient.
- Communicable diseases (Special Reference to AIDS), Cross Infection andPrevention, Patient, personal and Departmental Hygiene, handling of infectious patients, application of Asepsis, inflammation and infection processes.
- Patient Vital Signs: Temperature, Pulse, Respiration, and Blood Pressure (Normal Methods oftaking and recording them)
- Medico-legal consideration-Clinical and Ethical Responsibilities, Handling Female Patients and Practice in Pregnancy.

X-RAY PROJECTIONS (BASIC AND SPECIAL VIEWS)

- Upper extremity
- Lower extremity
- Chest, thoracic cage and sternum
- Spine: cervical, thoracic, lumbar and sacral
- Skull: including trauma cases
- Facial bones (nasal bones, zygoma, orbit and maxilla)
- Mandible, temporo-mandibular joint, mastoid, petrous and temporal
- Abdomen – erect, supine, lateral decubitus
- Soft tissue radiography: larynx, pharynx, nasopharynx and thoracic inlet
- Dental radiography
- General pediatric radiography
- Foreign body localization
- High kev technique
- Macro radiography

Radiological Contrast Media

- Introduction to contrast media in Diagnostic Radiology and it's need.
- Classification of Contrast Media and its Application in different modalities.
- Dosages of Contrast Media (Cases and Patient Specific) and different modes of administration.
- Possible adverse reactions of Contrast Media
- Management of Adverse Contrast Reactions

Dark Room

- The processing area, dark room design, construction, illumination, Safe Lightings
- Storage and shelving of films
- Cleaning and Maintenance

Film Processing

- Principles: Acidity, Alkalinity, pH, processing cycle, development and developer solution
- Fixing, Fixer Solution, Washing and Drying
- Replenishment Rates, manual and automatic processing.

Radiographic Film

- Structure, Construction of different films, Handling of Exposed and unexposed films.
- Types, advantages/limitations of different types, safe light requirement.

Equipment for Film Processing

- Functions of various components
- Film roller transport, Transport Time, Film Feed system
- Importance and Relation to temp, fixed and variable time cycles.
- Care and maintenance

V. MEDICAL PHYSICS-I

Physical quantity, its unit and measurement

- Fundamental and derived quantity, SI unit, various physical/radiation quantity used in radiology and its unit (for example, KvP, mA, mAS, Heat unit (HU), Radiation exposure.

Atomic Structure

- Atomic and nuclear structure (protons, neutrons, electrons), Atomic number, atomic nuclides and isotopes, early atomic models, difficulties with Rutherford's model, limitations of Bohr's model.

Radioactivity

- Structure and property of nucleus, Nuclear forces, Binding energy, Radioactive decay. Radioactive decay (decay equation, half-life, mean life), excitation, ionization, characteristic X Ray, alpha, beta, positron, gamma emissions, electron capture, internal conversion, Naturally occurring radio-nuclides.

Electromagnetic radiation

- Electromagnetic spectrum, properties of electromagnetic waves, Use of principle of rectilinear propagation of light in radiology (e.g. magnification, CT Umbra, penumbra, Inverse square law. Interaction of X-ray with matter (coherent scattering, Compton Effect, Photo-electric effect, pair production), energy absorption in X-ray.

Production of X-Rays, X-Rays tubes

- Design Characteristics X-Rays, Bremsstrahlung X-ray production, factors affecting X-Ray emission spectra, X-Ray quality and quantity, heel effect, soft and hard X-Rays, added and inherent filtration.
- X-Ray tube : Construction of X-Ray tubes, requirements for X-Ray production(electron source. target and anode material), tube voltage, current, space charge, X-Ray production efficiency, anode angulation and rotating anode, speed of anode rotation, focal spot size, target angle, inherent filtration, radiation leakage and scattered radiation). Heat dissipation methods, heat units.

X-Ray Generators and Circuits

- Filament current and voltage, X-Ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits.

Control of Scattered Radiation

- Methods of minimizing formation of scatter radiation, effectiveness of grids [types (moving grids), composition and grid ratio) in preventing scattered radiation, use of cones, diaphragm, light beam devices and effectiveness of collimation in reducing effects of scatter.
- Effects of scatter radiation on radiograph image quality, patient dose

Radiation units Dosimetry and Detection of ionizing radiation

- Units of radiation, ICRU definition of absorbed dose, exposure, dose equivalent, relationship between absorbed dose and equivalent dose. Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors, thermo-luminiscent dosimeters, film batches.

Biological effects of radiation

- Action of radiation on cell, tissue and organ, radio sensitivity, effects of whole body and acute irradiation, effects of ionizing radiation on each of major organ system including stochastic and non-stochastic effects, mean and lethal dose.

- Biological effects of non-ionizing radiation (ultrasound, sound lasers, IR, UV and magnetic fields).

Radiation Protection

- Need for protection, principle of radiation protection, ALARA, radiation monitoring devices (film badge and TLD), radiation shielding devices available for protecting staff, patient and public and how to use them. (Methods of Radiation Protection of patients, radiation workers and public)
- Time - distance and shielding, radiation survey, occupational exposure, ICRP, AERB guidelines for radiation protection and Dose Limits of General Public and Employees.

X-Ray film and Image processing

- Composition of single and double coated radiographic films, structure of emulsion, Latent image formation; process of film developing (composition of fixer, developer and other processing solution), automatic processing (processing cycle), film characteristics (speed, base + fog, gamma, latitude)
- Fluorescence, Image intensifiers and cassettes (structure and function), intensifying factor. Factors affecting Image Quality.
- Meaning of radiographic image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur.

Dark room design and accessories

- Site, layout and safe light compatibility. Portables and Mobiles Types of mobile units, mobile image intensifiers, advantages and limitations, radiation protection.

Computer Portion

- Digital electronics and computers fundamental Number systems
- Binary, octal, decimal and Hexa-decimal number systems, conversion from one number system to another one, Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC). Computer fundamentals: Central Processing Unit (CPU), Memory RAM (random access memory) And ROM (read only memory), Arithmetic and Logic Unit (ALU), Display devices, Hard copy devices, Input device (keyboard, mouse etc.)

VI. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, power point, excel etc.
- Uses of computers & applications: Multi media: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.

- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.
- **Practical Lab Posting: 30 Hours**

VII. ENGLISH

- **Introduction:** Study techniques, Organisation of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VIII. REGIONAL LANGUAGE: ODIA

2nd YEAR

I. RADIOLOGY-II

Conventional Contrast Radiography

- Includes anatomical, physiological and pathological aspects. Also contrast media selection, its dosages and safe administration, procedure, indications, contraindication and complications.
- Urinary system: IVU, MCU & RGU
- Gastrointestinal tract imaging: barium swallow, barium meal, barium meal follow through, barium enema, small bowel enema, distal colography, defeacography.
- Biliary system: t-tube cholangiography, PTC, ERCP.
- Sialography and sinography
- Hysterosalpingography
- Rare procedures: myelography, pelvimetry, oral cholecystography, discography, dacrocystography, arthrography

Conventional Non-Contrast Radiography

- Pediatric Radiography: Special needs of Pediatric Patients, Role of Radiographer in minimizing radiation dosage.
- Geriatric Radiography
- Trauma and Emergency Radiography
- OT Radiography
- Mammography: Anatomy of Breast, Nature of X-Ray Beam, Indications and Contraindications, Possible complications, Standard Projections (CC & MLO), Positioning and Exposure, Special Projections, Magnifying Cups and Significance of Compression.
- **COMPUTED TOMOGRAPHY**

  Includes Anatomical, Physiological and Pathological Aspects. Patient preparation. Also Contrast Media Selection, its dosages and safe administration, Procedure, Indications, Contraindication and Complications.

  - **HEAD & NECK- NCCT**&CECT brain and cerebral angiography, NCCT&CECT neck soft tissue, carotid angiography
  - **Orbit, PNS & Face, Temporal Bone and Inner Ear**
  - **THORAX:** NCCT and CECT thorax, pulmonary angiogram, aortogram and coronary angiography.
  - **ABDOMEN PELVIS, KUB:** NCCT and CECT scans, abdominal angiography

- **PERIPHERAL ANGIOGRAPHY:** Lower and Upper Limbs
- **CT GUIDED PROCEDURES:** CT guided biopsy and CT guided celiac block
- CT sinogram& CT fistulogram

- **INTRODUCTION TO MRI SEQUENCES, TECHNIQUES AND APPLICATIONS**
  - **INTRODUCTION TO MRI:** Magnetic Resonance, NMR, Concept of TR, TE, TI, T1, T2 & PD Weighted Images, Contrast agents
  - **Various MRI** pulse sequences

II. MEDICAL PHYSICS-II

Mammography and Xeroradiography

- Mammography and Xeroradiography introduction, Background, Diagnosis and Screening. Equipment suitable for X-Ray generation (Tube, Compression, Grids and AEC), nature of X-Ray beam, exposure factors, radiation protection & Image Recording devices.
- Interventional: Accessories Biopsy Equipment's

CR Systems

- Cassette Radiography and Devices Used.
- Types of Cassettes and Exposure Factors & Cassette Readers and Laser Imagers.

DR Systems and PACS

- Introduction to Digital Radiography, Technical aspects and equipments used in Digital Radiography.
- Types of Detectors, Integrated Grids, Table Top Detectors and Console Computer Systems.
- Different Laser Imagers used in DR Systems and types of Films used in Laser Imagers.
- Image acquisition, photostimulable phosphors, digital chest radiography and future developments Picture characteristics, archiving possibilities, transfer system and designs. image recording devices, laser imager and multiformatter.
- Image Acquisition and Digital Spot Imaging.

Computerized Tomography (CT)

- Historical background, various generations of scanners, advancement in CT technology (helical), ultra-fast scanners
- System components, CT performance parameters, image quality and methods of image reconstruction.
- CT Applications
- Advantages and Limitations, Basic Data acquisition concepts , CT Detectors Technology,

Image Reconstruction, display and recording systems. CT control console.

- Tools used in CT Guided Interventions & optional accessories.
- Dosimetry and Image quality in CT.
- Future Developments.

Film Archiving Systems

- Image recording devices and Laser Imagers.
- Multiformatter automatic film handling systems.
- Optical Disc Systems (ODS), Systems design and restrictions.

Pediatric Radiography

- Dedicated Equipments, Selection of Exposure Factors, Radiation protection in Pediatric Radiography and Image Quality Considerations

Geriatric Radiography

- Technical Considerations, Equipments and accessories, Selection of exposure factors.

Trauma and Emergency Radiography

- Dedicated Equipments, Selection of Exposure Factors, Radiation protection in Trauma Radiography and Image Quality Considerations, Special Radiographic Projection and sequences.

Operation Theatre Radiography

- Careful use of FluoroscopicEquipments, Radiation protection.

Dental Radiography

- Equipment suitable for X-Ray generation, nature of X-Ray beam, exposure factors, radiation protection & Image Recording devices.
- The Orthopontomograph Unit and The Cephalostat

Mass Miniature Radiography

- Design construction and function.
- Film loading and handling.

Mobile Radiography

- Portable X-Ray Units
- Capacitor Discharge Units
- Cordless Mobiles

- Mobile Image Intensifiers and Limitations

Fluoroscopic equipment and image intensifiers

- Fluoroscopic screen, tilting tables, over and under couch tubes, safety features, image intensifier tubes.
- Types of day light film handling system, types of optical coupling and methods of viewing, recording of intensified image, CCTV, cine fluorography.
- Kinescopy, Image Intensifier Tube, Triple Field Image Intensifier, Vidicon Camera Tube, Plumbicon Camera Tube, Cine Flouroscopy

Angiography Systems (DSA)

- Equipments (Present and past)
- Serial Imaging Devices, Subtraction process, Accessories and choices (Guide Wires and Catheters)
- Interventional Angiography : Accessories and usages. e.g..: Coils and Stents.
- Radiation Protection in DSA
- X-Ray equipment, serial imaging devices, tine camera, optical system X-Ray room specifications and administrative information Setting up of a new X-Ray unit, staff requirement, AERB (Atomic Energy Regulatory Board) specifications for site planning and mandatory guidelines

Diagnostic Ultrasound

- The nature and propagation of sound wave (the characteristics of sound, wave theory), speed of sound in a material medium, intensity of sound, the decibel, ultra sound wave, ultra sound wave properties propagation in tissue, absorption, scattering, reflection and refraction, acoustic impedance, Doppler's effect, Ultrasonic wave production of ultrasonic wave (piezo-electric effect) in ultrasonography, transducers.
- Ultrasonography, A, B and M scanning modes, Use of principle of Doppler's effect in Diagnostic radiology (e.g. Echo, blood flow measurement), Ultrasound image formation and storage/ documentation devices.
- Types of Transducers, Recording Devices and Orientation of Images, Focus of the beam, sensitivity and gain.
- Quality Control / Artifacts

Quality assurance (Q.A), acceptance testing and quality control tests

- Meaning of the term and aspects of a QA program, equipment and staff requirements, and benefits of QA procedures in an imaging department.

3rd YEAR

I. BASICS OF NUCLEAR MEDICINE (Including Medical Physics related to Nuclear Medicine)

Radiation Physics

- Radioactivity & Interaction of Radiation: Radioactivity - Discovery– Natural & Artificial Radioactivity- Isotopes and nuclides – binding forces between nuclear particles –alpha & beta particles – gamma radiation - mechanisms of radioactive decay – half life - Interaction of electrons, X-rays & ɤ-rays with matter - Radiation intensity & exposure - radiation dose - Radiation quality – law of exponential attenuation – half value layer – linear attenuation coefficient – Scattering – photoelectric effect – Compton-scattering – pair production – particle interactions – total attenuation coefficient- relative clinical importance.

Physics of Nuclear Medicine Instrumentation

- Radiation detectors: lonization Chamber – Isotope calibrator – Proportional Counter – Geiger muller counter – Uses of Gas – filled detectors – Semiconductor detectors, Scintillation detector: Thallium activated Sodium lodide crystal – Photo multiplier tube, electron multiplication, high voltage supply, Shielding, collimators, field of view. Well counter. Signal output, Pre-amplifier – reasons for use – Voltage amplifier – liquid scintillation detector.
- Gamma camera: Camera head construction and principle of operation Collimators – parallel multi hole, high resolution, high sensitivity pin hole, diverging hole, slant hole. Collimators Scintillation crystal, size Light guide – Photo multipliers per amplifiers.
- PET-CT: detectors, principles

Radiochemistry and Radiopharmacy

- Isotope generators: (a) Production of radio nuclides by artificial methods (b) cyclotron Produced radionuclide (c) Nuclear reactor produced radionuclides. Principles of generator systems - Ion Exchange system - Solvent extraction system - Parent - daughter relationship-growth of daughter product equilibrium with parent elements etc. Chemistry of Tc99m, Mo99-Tc99m generators - Assay - Mo99 contamination check Aluminum break through test etc (f) Sterilization
- Radiophramacheuticals: Lyophilisation, Preparation of cold kits. - DTPA, GHA, DMSA, MDP, Albumin microspheres, S. Colloid etc. Labeling of cold kits with required radio isotopes and their Quality control tests like RC purity, RN purity, sterility check, Chromatography (Various methods) pyrogen test, bio distribution studies.
- Dispensing of radio pharmaceuticals - Specific activity tracer dose preparation - Tracer dose administration etc.

Nuclear Medicine Techniques and Special Procedures

- In vivo techniques - (Imaging & non-imaging Procedures) a) General Principles of non-imaging techniques, Tracer dose, uptake studies, compartmental analysis in radio nuclide

studies, volume dilution studies. (b) General Principles of scintigraphy: Introduction, imaging modalities, documentation of images, analog\digital images, hard copy, formatter, intensity settings, image resolution and contrast, gray scale, color scale. (c) Clinical Nuclear Medicines - Diagnostic studies.

- Thyroid scan, whole body I-131 scan, thyroid uptake scan, pertechnetate test, bone scan, VQ scan, brain perfusion studies, Cisternography, DMSA scan, DTPA/EC scan, DRCG scan, scrotal scintigraphy, esophageal transit study, Gastric emptying, gastrointestinal bleed scintigraphy, Meckels' scintigraphy, hepatobiliaryscintigraphy, liver scan, stress cardiac studies, MUGA scan, Lymphoscintigraphy:- Radiopharmaceutical dosimetry, technique & analysis.
- Radio iodine therapy

II. BASICS OF RADIOTHERAPY (Including Medical Physics related to Radio therapy)

Radiotherapy Physics & Principles of Radiotherapy

- Nuclear Transformation: Natural and artificial radioactivity, Decay constant, Activity, Physical and Biological Effective half-lives, Mean life, Decay processes, Radioactive series, Radioactive equilibrium
- Interaction of radiation with matter: Attenuation, scattering, absorption, Transmission, Attenuation coefficient, Half Value (HVL), Energy transfer, Absorption and their coefficients, Photoelectric effect, Compton effect, Pair-production, relative importance for different attenuation processes at various energies. Electron interactions with matter: Energy loss mechanism - Collision losses, radioactive losses, Ionization, Excitation, Heat production, Delta rays, Polarization effects. Scattering, stopping power, absorbed dose, secondary electrons. Interactions of charged particles: Ionization vs. Energy, stopping power, Linear Energy Transfer (LET), Bragg curve, Definition of particle range.
- Basic Radiation Therapy Physics: Historical developments in Radiotherapy, Physical components of telecobalt Unit/ Linear Accelerator Unit/ Remote after loading Brachytherapy Unit, / Gamma Knife Unit / Simulator and their descriptions,. Various types of sources used in Radiotherapy and their properties, Physics of Photons, electrons, protons and neutrons in radiotherapy, Physical parameters of dosimetry such as percentage depth dose, Tissue-Air Ratio, Tissue maximum Ratio, Physics of Bolus and phantom materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices, Port film, processing and development, Special techniques in Radiotherapy such as SRS, SRT, IMRT, IGRT and Tomotherapy.
- Beam Therapy: Various sources used in Radiotherapy and their properties- Physics of Photons, Electrons, Protons and Neutrons in Radiotherapy. Physical Parameters of dosimetry- Phantoms – percentage depth dose – Factors affecting percentage depth dose – Tissue air ratio- Back scatter factor, Tissue maximum Ratio – Factors affecting TAR & BSF, TMR. SSD technique and SAD technique – Rotation technique- Conversion of percentage depth dose from one SSD to another – Time and Dose calculations in SSD, SAD and Rotation techniques Worked examples.
- Treatment planning Concepts: Physics of Bolus & Phantom material-Isodose Curves- Comparison of isodose curves measurement of isodose curve – factors affecting the isodose distribution –Wedge filters – Design of wedge filters – application of wedge filters in radiotherapy, and compensating filters –Shielding Blocks, Patient immobilization devices,

Port film, Processing and development. Dose calculations with isodose curves and wedge fields.

- Pharmacokinetics & pharmacodynamics of the Cytotoxic and other drugs used for the management of cancer -patient with disease kidneys /liver etc which may result in alternation in metabolism/excretion of the drugs; rationale use of available drugs. Practicals 1. Measurements of output from cobalt therapy machine 2. Measurement of depth dose and calculation of depth dose 3. Brachytherapy planning for manual after loading Cs-137 system. 4. Ir-192 Implant dose calculation 5. Treatment planning of (a)single direct field, (b)two opposite field 6. Treatment planning of (a) 3 fields, (b) cross fire technique
- Acceptance tests on Cobalt-60 units
- Uses of simulator for treatment verification.
- Treatment planning with computer.
- Radiation survey of Tele therapy installation.

Radiotherapy Techniques, Applications& Maintenance

- Biological effects of Radiation: Effects of various radiation on normal tissues and malignant tumor: Early and late reaction on Skin, Mucous membrane, GI tract, Genito urinary system, respiratory system, CNS - Effects of radiation on living cell, action on cancer tissue - Radio-sensitivity of different tissues, skin reaction and their treatment, Reaction on muscle membrane, Late effects on workers, effects on blood, effects on reproductive organs, effects on other organs, Radiation sickness. Effect of low LET and high LET radiation on cell. Cell survival curves. Effect of sensitizing and protective agents. Dose modifying factors and their determination. Variation of response with growth and the progression of cell through the phases of cell cycle. Hyperthermic and photodynamic injury. Biological hazards of irradiation - effects on the embryo and the fetus, life shortening, leukaemogenesis and carcinogenesis, genetic and somatic hazards for exposed individuals and population. Biological basis of radiological protection. -Importance of correct dosage, Blood supply, time factor, fractionation, Quality-Radical and palliative treatment.
- Factors influencing radiation response. Physical factors: dose, dose quality, dose rate temperature - Chemical factor: Oxygen, radio sensitizers, radio protectors- Biological factors: Type of organism, cell type and stage, cell density and configuration, age, sex.- Host factors: Partial and whole body exposure.
- Methods of Treatment of Malignant Disease: Principle affecting the treatment of malignant disease; Chemotherapy, Hormone therapy, Radiotherapy and surgery in management of malignant disease, relative value of each method for individual tumors or tumor sites.
- Choice of treatment: Anatomical site, relation to other tissue, extent of tumor and histology, place of previous treatment, place of radical and palliative therapy.
- Choice of Radiotherapy: Tumor sensitivity, anatomical site, relation to other structure availability of equipment.
- Radiotherapy Equipments; Historical developments in Radiotherapy- Kilo voltage UnitGrenz Ray Therapy-contact therapy- superficial therapy- Deep therapy Megavoltage therapy. Vande Graff generator –Physical components of Linear accelerator- Betatron- microtron –

Cyclotron- Heavy particle beams. Radio Isotope units –Physical Components of Cobalt 60 unit- source housing beam collimation and penumbra –Caesium 137 units – Advantages and Disadvantages – Gamma Knife unit –Simulator and its descriptions.

- Co-60 units: Comprehensive description of the unit, Safety mechanism, source capsule.
- Linear accelerators: History, development, detailed description of modern, dual mode linear accelerator, Physical components of Linear accelerator- Betatron- microtron – Cyclotron Linac head and its constituents, safety mechanisms, . computer-controlled Lilacs, record and verify systems - accuracy of mechanical or digital readout for gantry, couch, and collimator rotation. Beam symmetry - jaw symmetry - uniformity checks - field flatness - wedges - wedge angle checking - mechanical safety - collision devices check Equipment - Radiation field analyzer - film densitometry - Relative merits and demerits of Co60 and Linac units.
- Acceptance testing of teletherapy machines - telecobalt,- beam congruence test - isocenter check - laser alignments - timer error - shutter error - periodic output calculations - monthly checks - quarterly checks - annual checks
- Simulators: Need for them, detailed description of typical unit, CT Simulator - Mechanical movements - isocentre - gantry - collimator couch check - beam congruence of field delineators and collimators. Mechanical safety devices - installation of collision devices - auto centering of image intensifier camera 6.Teletherapy Beams Characteristics of photon beams: Quality of beams, Difference between MV and Me, Primary and scattered radiations. Percentage depth dose, Tissue-Air Ratio, Scatter Air Ratio, Tissue-Phantom Ratio, Tissue Maximum Ratio, Scatter Maximum Ration, Back Scatter Factor, Peak Scatter Factor, Off-Axis Ratio, Variation of these parameters with depth, field size source-skin distance beam quality or energy, beam flattering filter, target material .Central axis depth dose profiles for various energies.- Equivalent square concept, surface dose (entrance and exist), skin sparing effect, Output factors.- Practical applications: Co-60 calculations (SSD and SAD technique), Acceleration- calculations (SSD and SAD technique)-Beam profiles, Iodise curves, Charts Flatness, Symmetry, Penumbra (Geometric-Transmission and Physical), Field size definition.
- Beam directing devices: Different types of collimators- penumbra trimmers-Front and back pointer-pin and arc. Tissue compensation-Field blocks-field shaping-multi leaf collimator-IMRT concept-separation of adjacent fields. - Electron contamination – penumbra and penumbra trimmers – front and back pointer- pin and arc- their application in radiotherapy.
- Treatment planning system: Quality assurance - accuracy of data - percentage depth dose - tissue maximum ratio - scattered factors - collimator factors - etc - accuracy of interpolation techniques - accuracy of input and output devices such as digitizer, printer, plotter.
- Beam therapy data: Phantom and bolus-Build up and dose maximum-percentage depth dose-tissue air ratio-back scatter factor- Equivalent square field concept-Scatter air ratio Irregular field concept-tissue phantom ratio-tissue maximum ratio SSD and SAD technique rotation technique--Time and dose calculations in SSD,SAD and rotation therapy. Worked examples for cobalt-60 and Linac treatments Electron beam therapy-interactions-energy specification-calibration-characteristics of electron beams.
- Brachytherapy: Radioactive sources – exposures rate constant – calibration of –Brachytherapy sources Brachytherapy methods-mould –Implant –intracavitary-radiography examination of implant – radiographic examination of intracavitary application and implant dosimetry – Radiographic verification of implant-Orthogonal verification of intracavitory application-

dose calculation in intracavitary application- dose calculation methods. After loading systems BARC Cs-137 kit-LDR remote after loading system and HDR remote after loading system Physical components of LDR, HDR Brachy unit. Various type of sources used in brachy therapy and their properties.

- QC in Brachytherapy: Aim - manual after loading - intracavitary sources - leak tests - uniformity of activity checks - auto radiograph swipe test - source identity - activity calibration - applicators - quality control of applicators - Interstitial sources - source uniformity - auto radiograph - activity calibration - source identity - Remote after loading - source calibration - commissioning and acceptance of remote after loading equipments - source movements - pneumatic system air pressure check –
- Treatment planning concepts: Isodose chart-Measurement of isodose curves-parameters of isodose curves. Wedge filters-Wedge field techniques-Combination of radiation fields Isocentric techniques-tumor dose specification. Simulator-treatment verification-Correction for contour irregularities-Corrections for tissue in homogeneities. Treatment planning system external beam planning-brachytherapy planning
- Test cases - periodic checks of decay correction of output - repetition of quality assurance tests after software up gradation - speed of processor. Measurement of entry and exit doses - doses to critical organs.
- The care and use of Equipment and responsibilities: Observation of all apparatus (including timing and measuring devices) The reporting of faults – care and use of accessory equipment – Beam directional devices – Applicators and diaphragms – lead rubber- skin. Marking – Ink – bolus bags – Immobilization devices. Management of Radiotherapy machines – records supervision of patients work in other departments – administration – some legal points.

Radiation Biology & Radiation Safety

- Biological effects of Radiation - induction of Radiation injury – somatic and hereditary effects of radiation – effects of radiation on embryo – normal and abnormal human exposure to radiation – maximum permissible levels – Choice of Radiopharmaceutical for the clinical situation and the equipments in hand – personnel monitoring – instruments used in radiation survey & monitoring.
- Communication for Professionals
- Bio Statics and Hospital Management
- Basics Principles of Radiation Physics
- Basic Principles of Radiotherapy
- Radiation Physics and Modern Imaging Techniques
- Radiography and Dark Room Techniques
- Hospital Training-I
- Fundamentals of Computer Sciences
- Patient Care Relevant to Diagnostic Radiotherapy
- Quality Assurance in Diagnostic radiotherapy
- Radiotherapy: Planning & Techniques
- Radiation Hazards, Prevention and Safety

- General Principles of Hospital Practice and Patient Care
- Recent Advances in Radiotherapy
- Applied Imaging Technology
- Advanced Diagnostic Techniques and Radiation Hazards
- Ultrasound and Computerized Tomography
- Image Production and Evaluation
- Special Investigation Techniques
- Medical Physics related to Radiotherapy

III. RADIOLOGY-III

Magnetic Resonance Imaging

- Includes Anatomical, Physiological and Pathological Aspects. Also Contrast Media Selection, its dosages and safe administration, Procedure, Indications, Contraindication and Complications.
- Planning and Acquisition Techniques
- Case Specific Pulse Sequence and applications
- MRCP
- MR Urography
- MR Angiography
- Musculo-skeletal MRI & MR mammogram

IV. MEDICAL PHYSICS-III

Magnetic Resonance Imaging

- **Introduction to Magnetic Resonance Imaging-** History, advantage over other imaging modalities, equipment terminology.
- Introductory Physics of MRI, Phenomenon of NMR, Relaxation Time Concept.
- Physical principle, NMR signals, pulse sequences, spectroscopy parameters, hardware, site selection and safety. Image formation and storage devices.
- MR System Components, Magnet System and Reconstruction System, Host Computer, Viewing
- Archiving and Hard Copy.
- Magnetic Shielding and RF Shielding.
- Advanced Concepts: Spatial Localization, Phase and Frequency encoding, k-Space concept and Chemical Shift Concept, Introduction to MR Spectroscopy
- MR Hardware: Various RF Coils.

CURRICULUM FOR

B. Sc. (Hons.)

Medical Technology in Radiotherapy (MTRT)

INTRODUCTION

AIMS AND OBJECTIVES

BSc (MTRT) will be a bachelor course in which students will be trained with a wide spectrum of knowledge in learning and handling mega-voltage radiotherapy equipment. The students, after successful completion of the course would be able to acquire comprehensive knowledge about the various aspects of ionizing radiation, rules and norms regarding radiation safety and should also be able to perform multiple allied requirements like handling various radiotherapy machines like linear accelerator, brachy therapy, simulator etc. and trouble shoot equipments. In addition, the students, after training, should be able to assist the radiation oncologist in treatment planning and execution.

Keeping in mind the above aims, the **broad objectives of the course will be**:

1. Should be able to assist radiation oncologist from simulation of the patient to positioning, immobilizing and treating.
2. Should be able to handle all basic and advanced radiation equipments including treatment planning system, linear accelerator, brachytherapy, etc
3. Should be able to identify, prepare and handle all kinds of mould room as well as immobilization procedures.
4. Should be able to help medical physicist performing Quality Assurance (QA) tests on various radiation equipments
5. Should be able to assist the radiation oncologists in carrying out various treatment related procedures and certain emergency maneuver required to save patient if develop any kind of emergency during treatment.
6. Should demonstrate competency in setting up advanced treatment protocols like 3D-Conformal, IMRT, IGRT, SBRT etc.
7. Should be able to discuss the principles of radiation safety and AERB requirement.
8. Should be able to co-ordinate with medical physicist and radiation oncologist as and when required
9. Should be able to communicate with patient while positioning and preparing for various kinds of treatment
10. Should be able to understand functioning of various radiation machines and their safe handling.
11. Describe in detail the sections and functions of the treatment room.
12. Should have a thorough knowledge of various patient positions and be able to assist in the same
13. Should be competent, co-operative and communicative with various personnel and group related with patient treatment.

SCOPE OF THE COURSE

Every year thirteen lakh new patients are diagnosed with cancer in India. Almost 80% of all cancer patients shall need radiotherapy for their treatment at some point or other. There is a mismatch between patient load and treatment delivery system. Every year the country is adding at least 20 new radiotherapy machines. With innovation in technology, the treatment machines have undergone paradigm shift. From tele-cobalt we are moving towards modern linear accelerators. At the same time from manual operation, the machines are becoming almost computer driven.

Therefore, there is a need to produce skilled man-power, keeping abreast developing technology. In recent years there is a scarcity of Radiotherapy technician in the country.

AIIMS being an institute of national importance, it has got responsibility to fill in this deficiency/gap between therapeutic machines and required trained man power to operate the same. BSc Medical Technology in Radiotherapy (MTRT) course will produce radiotherapy technologist.

This course (BSc in OT Technology) will be taught at the graduate level and students who have accomplished their higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi can apply for this course. The selection of candidates will be through an admission entrance examination. The successful candidates shall have many career opportunities in any cancer hospital.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN MEDICAL TECHNOLOGY IN RADIOTHERAPY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

ELIGIBILITY FOR ADMISSION

a. Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b. The period of certified study and training of the B.Sc. Medical Technology in Radiotherapy degree course should be of three academic years. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of

theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical &lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Medical Technology in Radiotherapy when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given 3 chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practicals
3. Clinical and bedside demonstrations
4. Seminars
5. Assignments
6. Hands on training

This course shall be divided into three academic years and there will be final examination at the end of each year of the B.Sc. MTRT course. The scheme for the final examination is discussed below

EXAMINATION SCHEME

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	Total Marks **Practical**
1st year							
Paper I	Basic Anatomy	75	25	100	75	25	100
Paper II	Basic Physiology	75	25	100	75	25	100
Paper III	Basic Biochemistry	75	25	100	75	25	100
Paper IV	Basic Radiological Physics & Medical Physics	75	25	100	75	25	100
2nd Year							
Paper-I	Physics of radiotherapy & imaging techniques	75	25	100	75	25	100
Paper-II	Basic radiotherapy equipment's and procedure	75	25	100	75	25	100
Paper III	Principles and practice of radiotherapy	75	25	100	75	25	100
Paper IV	Hospital practice, patient care & medical ethics	75	25	100	75	25	100
3rd Year							
Paper-I	Advanced radiotherapy equipment's & process	75	25	100	75	25	100
Paper-II	Clinical radiotherapy	75	25	100	75	25	100
Paper-III	Radiobiology& radiation protection	75	25	100	75	25	100
Paper IV	Biostatistics, computer skills & patient data maintenance	75	25	100	75	25	100

1ST YEAR

I. BASIC ANATOMY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in MTRs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

ANATOMY

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurouns Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands

- **Reproductive System**: Parts of the system. Gross structure of both male and female reproductive organs
- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Hematoxylin and eosin staining of given paraffin section

II. PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where MTRs are being required to take a more active role in side effect recognition and management. This may be in departments where MTRs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia, Cyanosis, asphyxia. Methods of artificial respiration
- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve

impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes , cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.

- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System :** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.

Practical Exercise & lab postings

- Study of appliances for haemotology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT,CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and what will happen in their deficiency.

The broad outline of the course will be:

- Carbohydrates – Glucose and Glycogen Metabolism
- Proteins-Classification of proteins and functions
- Lipids- Classification of lipids and functions

- Enzymes- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isoenzymes and Enzyme pattern in diseases
- Vitamins & Minerals- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor
- Acids and bases-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- Hormones
- Applied Chemistry: .

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests,anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization ofmethods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine estimation
- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

- Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
- Text book of Medical Biochemistry by Ramakrishna
- Text Book Biochemistry by Vasudevan and SreeKumari

IV. BASIC RADIOLOGICAL PHYSICS & MEDICAL PHYSICS

- **Basic concepts:** Units and measurements -Force, work, power and energy-Temperature and heat-SI units of above parameters. Atomic structure-atom model-Nucleus-electronic configuration-periodic table - Constituents of atoms, atomic and mass numbers, electron

shells, atomic energy levels, Nuclear forces, Nuclear energy levels. Isotopes - Ionization – Excitation - Binding energy - electron volt

- **Electricity and magnetism**: Electricity: Electric charges, Coulomb's law, Unit of charge - Electric potential, unit of potential - resistance, ohm's law - electric current, unit, electric power, heating effects of current, Joule's law - capacitance and capacitors, series and parallel connection of resistors, capacitors and inductors. Magnetism : Magnetic induction - magnetic properties – classification of materials, Hysteresis - magnetic effect of current Electrical instruments : Galvanometer, Voltmeter, Ammeter.

- **Electromagnetic Induction:** Induced electro motive force, Faradays experiments, laws of electromagnetic induction, inductor coil, solenoid coil, Self and mutual induction.

- **Alternating current**: Peak and RMS values, AC circuits with resistance, capacitance and inductance, total resistance in a circuit, Impedance, Choke coil, eddy current. Transformer - theory, design, losses – types of transformers, auto transformer, high voltage transformer, electric power transmission, AC generator, commercial unit of electric energy consumption.

- **Electromagnetic radiation**: Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum, Energy quantization, Relationship between wavelengths, Frequency, Energy.

- **X-rays :** Thermionic Emission, History, Discovery of x-rays, properties-production, x-ray spectrum, bremsstrahlung and characteristic x-rays- X-ray tube; Coolidge tube, tube design, line focus principle, space charge effect, Modern x-ray tubes; stationary anode, rotating anode, grid controlled x-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating Quality and intensity of x-rays, factors influencing them – measurement of kV,mA and time.

- **X-ray generator circuits:** Vacuum tube diodes, Rectifiers, Semiconductor diode, diode as rectifier, half and full wave, self-rectification – X-ray generator; Electrical accessories for x-ray tubes, circuits and components, filament circuit- kilo voltage circuit-single phase generator-three phase generator - constant potential generator. Fuses, switches and interlocks-Exposure switching and timers-HT cables - earthing. Half value layers, determination of HVL. Energy absorbed from x-rays, x-ray scattering, x-ray transmission through the medium, linear and mass attenuation coefficient, HVT and TVT.

- **Radioactivity:** Discovery of radioactivity, natural radioactivity - activity units - Radioactive series, radium, thorium and uranium series- alpha, beta decay and gamma rays - radioactive disintegration exponential decay, half-life period, decay constant. Artificial radioactivity – production of radioisotopes - nuclear reactor, cyclotron – neutron flux, fission and fusion-chain reaction-atom bomb.

- **Non-Ionizing Radiation Physics** : Role of Non-ionizing radiation in Medicine, Bioacoustics, Ultrasound – Principles, Production, properties and uses in medical diagnostics and therapy. Radiofrequency and Microwave radiation, Infra-red and Ultraviolet radiations, lasers and its applications in medicine.

- **General concepts of measurements**: Fundamental definitions – accuracy and precision, repeatability and reliability of measurements – Different kinds of errors – internal and external estimation of errors in laboratory experiments.

REFERENCE BOOKS

- First year Physics for Radiographers - Hay & Hughes.
- Basic radiological physics-K.Thayalan, Jaypee publishers (P) Ltd, New Delhi(2001)
- Fundamental of X-ray and Radium Physics - Joseph Selman
- Basic Medical Radiation Physics - Stanton.
- Chrtistensen's Physics of Diagnostic Radiology – Christensen.

V. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, power point, excel etc.
- Uses of computers & applications: Multi media: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.
- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.
- **Practical Lab Posting: 30 Hours**

VI. ENGLISH

- **Introduction:** Study techniques, Organisation of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VII. REGIONAL LANGUAGE: ODIYA

2nd YEAR

I. PHYSICS OF RADIOTHERAPY & IMAGING TECHNIQUES

- **Interaction of Radiation with matter** Radiation transmission through matter, Interaction of electromagnetic radiation with matter – Thomson scattering (coherent scattering), Photoelectric and Compton effects – Pair production – relative importance - energy absorption – attenuation co-efficient. law of exponential attenuation, half value layer, linear attenuation coefficient-Interaction of particle radiation with matter – neutrons, heavy ions, nuclear reactions – range and Bragg curve. Interactions of x and gamma rays in the body; fat-soft tissue-bone- contrast media-total attenuation coefficient-relative clinical importance

- **Radiation and radioactivity units and quantities :**

    - Flux, Fluence, Exposure, Activity, photon fluence, intensity, absorbed dose, KERMA, LET, SI units of radiation quantities.,

    - Radiation therapy – beam therapy – particle therapy, History & properties of Radium needles, tubes and its uses, Co-60 and Cs-137, Ir-192 seeds and wires.

- **Basic Radiotherapy Physics**

    - Historical developments in Radiotherapy, Physical components of Telecobalt Unit / Linear Accelerator Unit / Remote After loading Unit / Gamma Knife Unit / Simulator and their descriptions, Various types of sources used in Radiotherapy and their properties.

    - Physics of Photons, electrons, protons and neutrons in radiotherapy, Build up and dose maximum, Physical parameters of dosimetry such as Percentage Depth Dose, Tissue-Air Ratio, Tissue Maximum Ratio, back scatter factor- Equivalent square field concept, Physics of Bolus and Phantom materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices. Use of PDD charts for isodose distribution- SSD and SAD technique - rotation technique--Time and dose calculations in SSD,SAD and rotation therapy. Worked examples for cobalt-60 and linac treatments.

    - Electron beam therapy - interactions - energy specification – characteristics of electron beams.

- **Physics of Imaging:**

    - Basic principles of radiation imaging techniques. Absorption characteristics of body tissues. Computerized Tomography(CT) – History, CT Generations, geometric generation of tomography – Image reconstruction –basic principles. - Ultrasound imaging – Doppler effect, Piezo Electric Effect, Scintillation detectors.- Basic principles of Magnetic Resonance Imaging(MRI) - Isotope imaging techniques – Nuclear Medicine – Rectilinear Scanners and Gamma Cameras – Positron Emission Tomography (PET) & SPECT. Isotopes used in Radioisotope imaging techniques. Isotopes used in Nuclear Medicine, Biological and Effective

    - Half Life, Absorbed dose arising from Radionuclides within the body. Diagnostic and Therapeutic uses of colloidal Radioactive Isotopes. Digital Image processing – Grey scale, histogram, signal to noise ratio, digital filtering, Data acquisition, display devices, data storage devices.

- **Radiographic Film Processing:**
    - The X-ray Dark Room, light proofing, ventilation, radiation protection. Film markers, pass through filters. Developer, Fixer solution, their chemical composition, preparation and process of developing a film. The radiographic image, effect of exposure factors on contrast and image qualities.
- **Radiation detection and measurements**: Principle of radiation detection - Ionisation of gases, fluorescence and phosphorescence, effect on photographic emulsion. Ionization chamber-proportional counter-GM counters - scintillation detectors - semiconductor detector-Gamma ray spectrometer. free air ionization chamber-thimble ion chamber-condenser chamber - Victoreen electrometer-secondary standard dosimeter – photographic film dosimeter - calorimeter - chemical dosimeter - Thermoluminescent dosimeter, Radiation survey meter-zone monitor-contamination monitor, their function use and maintenance. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

REFERENCE BOOKS

- The Physics of radiation therapy - Faiz M Khan, Williams and Wilkins(1994)
- Johns.Harold and Cunningham : Physics of radiology (USA Charles C Thomas)
- Massey and Meredith – Text book of physics applied to radiotherapy and radio diagnosis.
- Joseph Selman – Part II Physics of radiotherapy explained
- Radiographic Imaging - Chesney & Chesney, Blakwell scientific publications, oxford(1981)
- Radiographic imaging-Derrick P.Roberts and Nigel L.Smith.Churchill Livingstone, Edinburgh (1994)
- Radiographic Latent image processing - W.E.J. Mckinney
- Photographic processing, quality control and evaluation of photographic material -J.E. Gray
- Physical and photography principles of Medical Radiography -Seeman& Herman.
- Avinash C. Kak, Principles of Computerized Tomographic Imaging. IEEE PRESS
- The Physics of Medical Imaging, S. Webb, Institute of Physics Publishing, 1988.
- Christensen's Physics of Diagnostic Radiology by Thomas S. Iii Curry, James E. Dowdey, Robert C., JrMurry, Lea &Febiger Publishing, 4th edition, 1990.
- Introduction to Radiological Physics and Radiation Dosimetry, F. H. Attix, John Wiley and Sons Publishing, 1986
- The Modern Technology of Radiation Oncology, J. Van Dyk, Medical Physics Publishing, 1999.

II. BASIC RADIOTHERAPY EQUIPMENTS AND PROCEDURE

- **Overview &Scope:** The following syllabus is intended to be comprehensive in the range of subjects to be covered without being detailed. Candidates should possess a sound knowledge

of the subjects and those of practical procedures which technologists might be called upon to undertake.

- Teletherapy machines: Kilvoltage units-Grenz ray therapy-contact therapy-superficial therapy-Deep therapy. Mega voltage therapy - Van de Graff generator - Linear accelerator betatron-microtron. Radioisotope machines - History – Teleradium and Telecaesium units, Cobalt-60 units –source housing – various shutter mechanisms, beam collimation and penumbra Heavy particle beams.
- Treatment planning concepts: Isodose chart-Measurement of isodose curves parameters of isodose curves. Wedge filters-Wedge field techniques-Combination of radiation fields-Isocentric techniques-tumor dose specification. Simulator - treatment verification Correction for contour irregularities-Corrections for tissue inhomogeneities. Treatment planning system-external beam planning-brachytherapy planning.
- Beam directing devices: Different types of collimators- penumbra trimmers-Front and back pointer-pin and arc. Tissue compensation-Field blocks-field shaping-multileafcollimator IMRT concept-separation of adjacent fields.
- Brachytherapy: Radioactive sources - calibration of brachytherapy sources- After loading systems - Manual pre loading systems - manual after loading systems - BARC Cs-137 kit-LDR remote after loading system and HDR remote after loading system - different types of applicators and templates, Brachytherapy methods-Mould-implant-Intracavitory-Intraluminal Radiographic verification of implant-Orthogonal verification of intracavitory application-dose calculation methods.
- Radiotherapy simulators Conventional simulators - CT simulators - cone beam CT simulators (CBCT) – comparison and quality assurance of simulators - different simulation techniques - Orthogonal, Semiorthogonal, Isocentric, Variable angle and Stereo-Shift.

REFERENCE BOOKS

- The Physics of radiation therapy-Faiz M Khan, Williams and Wilkins(1994)
- Johns.Harold and Cunningham : Physics of radiology (USA Charles C Thomas)
- Massey and Meredith – Text book of physics applied to radiotherapy and radio diagnosis.
- Joseph Selman – Part II Physics of radiotherapy. explained
- Fletcher, Gilbert : Radiation therapy in the management of cancers
- Barnes and Rees : Concise text book of radiotherapy
- Walter and Miller : Short text book of radiotherapy
- Moss: Radiation Oncology – Rationale, technique & results

III. PRINCIPLES AND PRACTICE OF RADIOTHERAPY

- **Cell cycle/structure/function**, Tissue structure/types/ features and functions/ Tissue importance in Radiation Therapy. Organs and systems (Structure/function) – Skin/ Central Nervous System/ Autonomic Nervous System / Peripheral Nervous System /Lymphatic

System/ Endocrine System/ Urinary/ Respiratory System / Digestive System / Cardiovascular System, Bone and Muscle, Surface Anatomy/ Cross-sectional Anatomy – Brain & Cranial NS Surface Anatomy – Head & Neck/ Lower Limb (Pelvis)/ Chest/ Abdomen and Limbs Organs and Systems – Skin/ Central Nervous System/ Autonomic Nervous System / Peripheral Nervous System /Lymphatic System/ Endocrine System (Diseases encountered in the region) Multidisciplinary approach to cancer diagnosis and management and how the patient arrives in R.T. Treatment Intent: Curative, Palliative, Prophylaxis - Procedure in Radiotherapy department – Treatment Review, Importance of Follow-up – Instructions to Patients

- **Basic Pathology & staging of malignant tumor:** Basic Pathology-Carcinoma, Sarcoma-Lymphoma, pattern of Spread, Biopsy/Investigations related to malignant tumor-staging work up and TNM. Introduction of different malignant tumor treated in radiotherapy department including TNM. Skin-lip-oral cavity & Para nasal sinus-nasopharynx-orophaynx-hypopharynx-larynx-thyroidpostcricoid—oesophagus-mediastinum- lungs-pancreas-liver-breast- cervix-body of the uterusvagina-valva-kidney,ureter,bladder,rectum-prostate,penis,testis-lymporeticulam, tissue-bone marrow - CNS, eye, orbit-soft tissue & bone-pediatric tumor, retinoblastoma, Wilms's tumor, rhabdomyosarcoma

- Care of Cancer Patients General welfare of the patient during and after the treatment including the care any intercurrent disease (diabetic, tuberculosis, arthritis). Diet and fluid intake. The observation and reporting any change in the signs and symptoms of patients receiving treatment. The use of blood count in the control of certain treatment. The care of local and systemic reaction. Local reaction should include those in the ear, nose, throat and eye and those arising from treatments given to the pelvis. Care of cancer patients. (Mucositis, Dermatitis, Cystitis, proctitis)

REFERENCE BOOKS

- Walter and Miller: Short text book of radiotherapy
- Meredith W J (et al) Radiation dosage the Manchester system
- Smith : Ivan H (et al) Cobalt 60 teletherapy
- Silver and Solomon: Radioactive isotopes in Med. & Biol.
- Wachsmann :Felise and Berth Gunther Moving field radiation therapy.
- Murphy and Walter : Radiation Therapy
- Sulton and Maurice : Cancer explained
- Fletcher, Gilbert : Radiation therapy in the management of cancers
- Moss William : Therapeutic radiology

IV. HOSPITAL PRACTICE, PATIENT CARE & MEDICAL ETHICS

General overview &scope:

This section is intended to emphasize to the student technologist the importance of patient welfare. Many of the points included in this section may be considered during the teaching of other subjects also; but it is strongly urged that specific teaching and as much practical demonstration

and instruction as possible should be given in this section.

Modern hospital treatment is based on team work, it is essential that the student should appreciate the technologists role and that the importance of co-operation with OPD, wards and other departments.

The students should be attached to wards or the accident and emergency department for a definite training period.

- Hospital Procedure: Hospital staffing and organization; records relating to patients and departmental statistics; Radiotherapy Department staffing and organization; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments/organization; minimizing waiting time; out-patient and follow-up clinics; stocktaking and stock keeping.
- **Care of the patient** : First contact with patients in the department; management of wheel chair and stretcher patients and aids for this, management of the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients (for example clean linen and receptacles, nursing care; temperature, pulse and respiration; essential care of the patient who has a tracheostomy; essential care of the patient who has a colostomy; bedpans and urinals; simple application of a sterile dressing.
- **First Aid:** Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons.
- **Infection:** Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis.
- **Principles of asepsis:** Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radiotherapy department
- **Drugs in the department: S**torage: classification; labeling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-hypertensive etc.

Medical Ethics:

- **Introduction to Medical Ethics:** What is Ethics? What are the values & norms? Relationship between being ethical & human fulfillment. How to form a value system in one's personal & professional life? Heteronomous Ethics & Autonomous Ethics. Freedom & personal Responsibility.
- **Definition of Medical Ethics:** Difference between medical ethics & bio-ethics Major Principles of Medical Ethics Beneficence=fraternity, Justice=equality, Self-determination(au tonomy)=liberty
- **Perspective of Medical Ethics:** The Hippocratic oath. The Declaration of Helsinki, The WHO

Declaration of Geneva International code of Medical Ethics(1993), MCI Code of Ethics(2002)

- **Ethics of the individual:** The patient as a person, The Right to be respected, Truth & confidentiality, The autonomy of decision, The concept of disease, health & healing, The Right to health, Ethics of Behaviour modification, The Physician-Patient relationship, Organ donation
- **The Ethics of Human life:** What is human life? Criteria for distinguishing the human & the non-human Reasons for respecting human life, The beginning of human life Conception, contraception, Abortion, Prenatal sex-determination, IVF,AIH, AID, SIFT, GIFT, ZIFT, genetic Engineering
- **The Family & Society in Medical Ethics:** The Ethics of human sexuality, FP perspectives, Prolongation of life, Advanced life directivesThe Living Will, Euthanasia, Cancer & Terminal Care
- **Death & Dying: U**se of life-support systems, Death awareness, The moment of death, Prolongation of life, Ordinary & extraordinary life support, Advanced life directives, Euthanasia-passive & active, Suicide-the ethical outlook, The right to die with dignity.
- **Professional Ethics:** Code of conduct, Contract & confidentiality, Charging of fees, Fee-splitting, Prescription of drugs, Over-investigating the patient, Low-Cost drugs, vitamins & tonics, Allocation of resources in health care, Malpractice & Negligence.
- **Research Ethics:** Animal & experimental research/humanness, Human experimentation, Human volunteer research-Informed Consent, Drug trials.

REFERENCE BOOKS

- Deeley – A guide to Radiotherapy nursing.
- Care of patient in diagnostic Radiography - Chesney & Chesney.
- Chesney's Care of the patient in Diagnostic Radiography – Pauline J .Culmer.
- Aid to Tray and Trolley Setting - Marjorie Hougton
- First Aid – Haugher &Gardner
- A guide to Oncology nursing (Livingstone) - Deeley
- Practical nursing and first- aid - Ross and Wilson.
- Capra : Care of the cancer patient
- Sutton P M : Nature of cancer (London, English University press)
- Sulton and Maurice : Cancer

List of Practicals for MTRT- II year students:

- Radiation Survey of the Teletherapy installation
- Radiation Survey of the Brachytherapy installation
- To prove Inverse Square Law.
- To verify Area/Perimeter method
- To find the HVL / attenuation factors

3rd YEAR

I. ADVANCED RADIOTHERAPY EQUIPMENTS & PROCESS

- The following paper is intended to be comprehensive in the range of subjects to be covered without being detailed. Candidates should possess a sound knowledge of the various modern radiotherapy equipments and those of practical procedures which technologists might be called upon to undertake.
- **Linear accelerators** Components of modern linear accelerator-Standing and travelling wave guides, Magnetrons and Klystrons. Bending Magnet, Target, Flattening filter, Collimators. Need for high quality portal imaging - Fluoroscopic, diode, crystal, Ionization chamber detectors and film detectors, amorphous silicon - Diagnostic imaging on a linear accelerator - portal dose images, Portal Dosimetry. TelecobaltVsLinacs.
- Conformal Radiotherapy With Multi Leaf Collimator Introduction to CRT with MLC-Modern developments in MLC – Different categories of MLC – commercially available MLC systems – Universal wedge – Enhanced Dynamic wedge for Linac – clinical application.
- **Intensity Modulated & Image Guided Radiation Therapy** Introduction to IMRT –Target and critical structure definitions for IMRT – Static MLC IMRT, Dynamic MLC IMRT, compensator based IMRT – comparison of IMRT delivery systems –– Introduction to serial Tomotherapy and Helical Tomotherapy. Methods to manage respiratory motion in radiation treatment – x-ray imaging techniques for guidance in the Radiation therapy setting – clinical procedures in employing x-ray imaging technologies – Effect of motion on the total dose distribution – basics of 4D computed tomography imaging and treatment planning.
- **Stereotactic Radio Surgery And Radiotherapy** Introduction to SRS and SRT – SRS with Co-60 sources; the Gamma knife – stereotactic multiple – arc radiotherapy with a Linac – Cyber knife - Dynamic SRS – Dynamic collimation for SRS with multiple arc - Intra operative radiation therapy.
- **QA in Radiotherapy** : Accessories and tools used for QA tests in Radiotherapy such as Front Pointer, Back Pointer, Laser Alignment etc., Optical and radiation field congruence, Beam shaping blocks, Beam shaping jaws, Delineator/Diaphragm movements, Isocentre alignment, Patient support system, Beam on and off mechanisms, Technician's role in QA tests on telecobalt/ Linear Accelerator/Brachytherapy /Simulator/CT Simulator machines.

REFERENCE BOOKS

- Linear Accelerators for Radiation Therapy (Peter C. Williams)
- Radiotherapy: Principles to Practice (Griffith)/Basics of Radiotherapy, Technical Aspects of techniques 3. The Physics of radiation therapy-Faiz M Khan, Williams and wilkins(1994)
- Johns.Harold and Cunningham : Physics of radiology (USA Charles C Thomas)
- Massey and Meredith – Text book of physics applied to radiotherapy and radio diagnosis.

II. CLINICAL RADIOTHERAPY

- **Principles of Radiotherapy & Chemotherapy** Tumours from different organs and organ systems. Basic Principles of Radiotherapy and different Radiotherapeutic technique. Basic Principles, Classification, mechanism of action, Indication & toxicity of Cancer Chemotherapy.
    - **Patient Treatment setup** Mould Room activities, Errors – Immobilization / Positioning Procedures, Positioning Aids – Benefits / Limitations, Care of Patient – Lifting and Moving Techniques for patient and staff safety, Benefits / Limitations of Thermoplastic Mask, Hip and pelvis positioning and immobilization, Breast and Thorax Positioning, Limitations of Breast and Thorax Positioning.
    - Beam Shielding blocks, preparation, HVL requirements, materials used, Critical organs, dose limits for organs, Styrofoam cutting, shadow trays, Electron filters.
    - Bolus requirements, tissue compensating bolus, bolus materials,
    - **Principles of Professional Practice Professional Aspects** –, Appearance and Hygiene, Universal Precautions – History and role of radiotherapy in cancer, Human body with typical technical terminology, General Care of the patient, Setup reproducibility, Basic Nursing Procedures for patient care and emergency situations
    - Procedure in Radiotherapy department – First Visit to include Room Preparation, Equipment and Documentation and assistance with procedures / examinations, Professional development skills Treatment preparation, Treatment equipment, Treatment set-up and delivery, Patient care, Care of the Cancer Patient.
    - **Nutrition** Nutrition – It's health aspect and importance in Oncology, Health education, Psychosocial aspect of Oncology, Knowledge of Occupational disease & health aspects of Industries & other Occupations.
    - **Environment Science and Health** Introduction to Environment and Health Sources, health hazards and control of environmental pollution, Water, The concept of safe and wholesome water. The requirements of sanitary sources of water. Understanding the methods of purification of water on small scale and large scale. Various biological standards, including WHO guidelines for third world countries. Concept and methods for assessing quality of water. Domestic refuse, sullage, human excreta and sewage their effects on environment and health, methods and issues related to their disposal.

REFERENCE BOOKS

- Walter and Miller: Short text book of radiotherapy
- Meredith W J (et al) Radiation dosage the Manchester system
- Smith: Ivan H (et al) Cobalt 60 teletherapy.
- Text Book of Environmental Studies for under graduate courses By Erach Bharucha Reprinted in 2006, Orient Longman Private Limited /Universities Press India Pvt. Ltd.
- Silver and Solomon: Radioactive isotopes in Med. & Biol.
- Wachsmann: Felise and Berth Gunther Moving field radiation therapy.
- Murphy and Walter: Radiation Therapy

- Sulton and Maurice: Cancer explained
- Fletcher, Gilbert: Radiation therapy in the management of cancers
- MosWilliam: Therapeutic radiology

III. RADIOBIOLOGY& RADIATION PROTECTION

- **Biological effects of radiation:** Physical Basis of Radiobiology, The Cell, Cell Cycle, cell divisions, Mode of action of ionizing radiation, effect of ionizing radiation on cell, chromosomal aberration, Radiation induced injuries at cellular level, cell survival after irradiation, Acute Radiation syndrome, Radiobiology of High LET Radiation, Oxygen effect, RBE, Effect of Ionizing Radiation on different organs & systems of the body. Fractionation. Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and chronic exposure.
- **Radiation Protection** AERB Guidelines, ICRU reports, Philosophy of Radiation Protection, Effect of time, Distance and shielding, Calculation of workload, Calculation of weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and radiotherapy practices. Equivalent Dose, Weighting Factors, Effective Dose, Natural Background Radiation, Occupational Exposure limits, Dose limits for public.
- **Planning of radiation installation** Protection from primary, leakage and scattered radiation. Planning consideration for radiology and radiotherapy installation including workload, use factor & occupancy factor, effect of different shielding material. Barrier design-barrier materials-concrete, brick& lead. Primary & secondary barrier design calculations. Design of doors. Control of radiation-effects of time, distance and shielding.
- **Personnel monitoring systems** Principle and objective- Pocket dosimeters, Film Badges, TLD badges and their use in personnel monitoring. Area monitoring and radiation survey, practical use of survey meter, zone monitors and phantoms. Survey in teletherapy, brachytherapy and simulator units. Advantages and disadvantages of various PM badges. Personnel Monitoring Service.
- **Radiation emergencies** Emergency preparedness, safety and prevention. Radiation Emergency Procedures : Safety and security of radiation sources, case histories of emergency situations and preparedness, equipment's and tools including role of Gamma Zone monitor & Survey meters. Regulatory requirements and prevention of emergency, Preventive maintenance and Safety Culture, Role of Technicians in handling radiation emergencies.
- **Safety code and work Practices** Built in safety specification for teletherapy and brachytherapy units-treatment room and control room safety-operational safety-radiation protection program-personnel requirements and responsibilities-regulatory controls Regulatory requirements : National regulatory body, responsibilities, organization, safety standards, codes and guides, responsibilities of licenses, registrants and employers and enforcement of regulatory requirements.

Demonstration:

- Time, Distance and shielding, measurement of HVT & TVT. Familiarisation of radiation survey meters and their functional performance checks, Radiological Protection Survey of Radiotherapy, Simulator and CT Simulator installations, QA on X-ray, Simulator and

Radiotherapy Equipments, Procedures followed for calibration of measuring and monitoring instruments.

REFERENCE BOOKS

- Radiobiology for the Radiologist, Eric J. Hall, Lippincott Williams & Wilkins, 5th edition, 2000
- Radiation Protection in Hospitals. Richard F.Mould
- Basic radiological physics: K.ThayalanJaypee brothers pvt ltd, New Delhi
- An Introduction to Radiation Protection. Allen Martin &Samuel
- Radiation safety in Medical practice. M.M. Rehani.
- Radiation Protection. Ronald L. Kathren
- AERB safety code, Mumbai

IV. BIOSTATISTICS, COMPUTER SKILLS & PATIENT DATA MAINTENANCE

- **Introduction to Biostatistics** Introduction and scope of biostatistics, use of statistics in biology. Population and sample. Stages of research, types of data and methods of data collection.
- **Tabulation of Data** Data arrangement and presentation, formation of tables and charts. Raw data, the array, frequency distribution. Basic principles of graphical representation. Types of diagrams - histograms, frequency polygons, smooth frequency polygon,commulative frequency curve, Normal probability curve.
- **Measure of Central Tendency** Need for measures of central tendency, Definition and calculation of mean - ungrouped and grouped Meaning, interpretation and calculation of median ungrouped and grouped. Meaning and calculation of mode. Comparison of the mean, and mode. Guidelines for the use of various measures of central tendency.
- **Measure of Variability** Need for measure of dispersion's range, the average deviation. The variance and standard deviation. Calculation of variance and standard deviation ungrouped and grouped. Properties and uses of variance
- **Probability and Standard Distributions**. Probability rules. Binomial, poisson and normal distributions. Hypothesis testing: Student 't' test, Chi square test, Analysis of variance. Correlation and regression. Experimental designing, planning of an experiment, replication and randomization.

Computer Skills:

- **Introduction to computers** I/O devices – memories – RAM and ROM – kilobytes. MB, GB their conversions –Operating systems– DOS, Windows, Linux and Unix- Number system – Binary and decimal conversions –– Networking – LAN, WAN.
- **Word processing Typing text in MS word –** Manipulating text – Formatting the text – using different font sizes, bold, italics – Bullets and numbering – Pictures, file insertion – Aligning the text and justify – choosing paper size – adjusting margins – Header and footer, inserting

page No's in a document – Printing a file with options – Using spell check and grammar – Find and replace – Mail merge – inserting tables in a document.

- **Spreadsheets Creating table in MS-Excel** – Cell editing – Using formulas and functions – Manipulating data with excel – Using sort function to sort numbers and alphabets – Drawing graphs and charts using data in excel – Auto formatting – Inserting data from other worksheets.
- **Slide/Powerpoint presentations** Preparing new slides using MS-POWERPOINT – Inserting slides – slide transition and animation – Using templates – Different text and font sizes – slides with sounds – Inserting clip arts, pictures, tables and graphs – Presentation using wizards.
- **Internet and its uses Introduction to Internet** – Using search engine – Google search – Using Web Browsers – Uploading and Download of files and images – E-mail ID creation – Sending messages – Attaching files in E-mail – Introduction to Software languages – Components of Software languages - Different variables, declaration, usage – Constants – Sub programs – Interpreter & compiler.

Patient Data Management

- **Medical Records Revision:** Definition and history of medical record-Values, purposes and uses of medical record Contents and components of medical record-Responsibilities of Radiotherapy technicians, hospital administrators, Doctors, nurses and allied health professionals in relation to medical records.
- **Management of medical records** Numbering, filing, storing and retrieving medical records-Maintenance of Registers- admission, discharge, MLC registers – Daily treatment/simulation/ mould room Registers, Radiotherapy registration - Analysis of medical records - Medico legal aspects, Medical confidentiality Consents – Types of consent (Informed, implied, express, etc.)
- **Use of computers for data management** Introduction to the design, maintenance and use of data management systems for the collection and analysis of research data, especially epidemiologic research data on humans. MS Access, MS Excel and other data management & Statistical packages are emphasized. Topics include: database development, data manipulation and cleaning, data summarization, and selected topics in statistical analysis programming.
- **Demonstration/Practicals**

  Identification of various parts of the PC, Demonstration of dis-assembly and assembly of PC and interconnection of Input and Output devices to PC, Familiarization with start menu, taskbar icons, windows explorer, Control panel of settings MS-Word, Basics of Letter writing,tempalates, wizards, formatting documents Creating Graphics, tables, etc. using MS-Word, Building a sample worksheet using MS-Excel Formulas for calculations, sorting etc.

REFERENCE BOOKS

- B.K. Mahajan & M. Gupta (1995) Text Book of Preventive & Social Medicine, 2002, 17th Edition Jaypee Brothers.

List of Practical for MTRT- III-year students:

- **Mould Room 1: Thermoplastic Immobilization cast preparation**
- **Mould Room 2: Build up bolus preparation**
- **Mould Room 3: Custom shielding block preparation**
- **Teletherapy Simulation of patient using CT machine**
- **Brachytherapy Simulation for ICRT patients**
- **Treatment Delivery: Teletherapy – simple parallel opposing fields**
- **Treatment Delivery: Teletherapy – multiple fields (more than 2) setup**
- **Treatment Delivery: Brachytherapy**

CURRICULUM FOR

B. Sc. (Hons.)

Perfusion Technology (PT)

INTRODUCTION

AIMS AND OBJECTIVES

BSc (Perfusion Technology) will be a bachelor course in which students will be trained with a wide spectrum of knowledge in cardiovascular perfusion techniques & procedures. The students, after successful completion of the course would be able to acquire comprehensive knowledge about the nuances involved in cardiovascular perfusion sciences and develop a strong knowledge in cardiothoracic anatomy, physiology and patho-physiology, as well as pharmacology, fetal and neonatal cardiac development and perfusion science. Clinical perfusionists shall be trained to be the expert members of the cardiac surgical team, and provide lifesaving support to patients requiring extracorporeal circulation, including but not limited to major cardiothoracic, vascular and transplant surgeries, as well as support to the critically-ill patient.

Keeping in mind the above aims, the **broad objectives of the course will be**:

1. Should be able to Demonstrate clinical skills in cardiopulmonary bypass and mechanical circulatory devices
2. Should be able to Demonstrate clinical skills in auto transfusion, blood conservation, and blood product management
3. Should be able to Demonstrate clinical skills in laboratory analysis of blood gases, hematocrit, and coagulation
4. Should be able to integrate perfusion theory to clinical applications
5. Should be able to Demonstrate acquired knowledge of various perfusion equipment and supplies used in the healthcare setting
6. Should demonstrate competency in setting up advanced invasive monitoring
7. Able to transfer knowledge and skills to students as well as younger professionals.
8. Able to actively participate and also independently work in research in the field of cardiac perfusion technology /clinical research/trials and related areas.
9. Should be able to discuss the principles behind monitoring and carry out basic monitoring of the patient including hemodynamics (heart rate, blood pressure, saturation, end-tidal carbon-dioxide monitoring) as well as urine output
10. Should be able to co-ordinate with laboratory service and arrange for investigations, results, and requisitions as and when required
11. Should be able to set up a blood and product transfusion including cross matching the product and spiking and setting up blood and component therapy bags
12. Should be able to carry out safe patient transfer before and after surgery in operating theatres and also in other areas like ICUs, including identifying the equipment's used for transport, the fluid shifts during transport and care of multiple lines, catheters and infusions that the patient may be on

SCOPE OF THE COURSE

The Perfusion technologists are allied health professionals responsible for direct and indirect cardio-thoracic care, equipment set-up and operative procedures as well as demonstrate the same competencies and responsibilities in other remote areas as and when required. They are trained to assist primarily the cardio-thoracic surgeons, during surgical procedures and assume responsibility for completion of other functions as assigned.

This course (BSc in Perfusion Technology) will be taught at the graduate level and students who have accomplished their higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi can apply for this course. The selection of candidates will be through an admission entrance examination.

Once students have successfully finished the B.Sc.in Perfusion Technology course, they can work as Perfusionist in the cardo-thoracic set up and in allied areas like catheterization laboratories, and advanced cardiac critical care units. These candidates are needed mostly in hospitals. So, many career opportunities are available for them in the private and public-sector firms. Business as well as research is another field which these technologists can choose. The remuneration of these technologists is expected to be quite reasonable. With sufficient experience in the field concerned, aspirants can expect good salaries. Graduates of this field have also been successful in getting jobs abroad.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN PERFUSION TECHNOLOGY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

a) ELIGIBILITY FOR ADMISSION

Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b) DURATION OF THE COURSE AND COURSE OF STUDY

The period of certified study and training of the B.Sc. Perfusion Technology degree course should be of **three academic years**. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical & lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Perfusion Technology when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given three chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practicals
3. Clinical and bedside demonstrations
4. Seminars
5. Assignments
6. Hands on training

This course shall be divided into three academic years and there will be final examination at the end of each year of the B.Sc. OTAT course. The scheme for the final examination is discussed below

EXAMINATION SCHEME

Paper	**Subjects**	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Marks Theory	Maximum Marks (Practical)	Internal Assessment (Practical)	**Total Marks Practical**
1st year							
Paper I	Basic Anatomy	75	25	100	75	25	100
Paper II	Basic Physiology	75	25	100	75	25	100
Paper III	Basic Biochemistry	75	25	100	75	25	100
Paper IV	Physics for Perfusionists	75	25	100	75	25	100
2nd Year							
Paper-I	Applied Pathology & Hematology	75	25	100	-	-	-
Paper-II	Clinical Diagnostics	75	25	100	75	25	100
Paper III	Principles of Perfusion Technology	75	25	100	75	25	100
Paper IV	Applied Pharmacology and microbiology	75	25	100	-	-	-
3rd Year							
Paper-I	Clinical Applications of Cardio-Pulmonary bypass Techniques	75	25	100	75	25	100
Paper-II	Perfusion for Special Procedures	75	25	100	75	25	100
Paper-III	Advanced Perfusion Techniques	75	25	100	75	25	100

1ST YEAR

I. BASIC ANATOMY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in OT & AT and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

ANATOMY

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurouns Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands

- **Reproductive System**: Parts of the system. Gross structure of both male and female reproductive organs
- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Hematoxylin and eosin staining of given paraffin section

EXAMINATION PATTERN (Basic Anatomy)

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where OT and ATs are being required to take a more active role in side effect recognition and management. This may be in departments where OT and ATs are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of

oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia, Cyanosis, asphyxia. Methods of artificial respiration

- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes , cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.
- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System :** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.
- **Practical Exercise & lab postings**
- Study of appliances for haemotology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT,CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the

science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and what will happen in their deficiency.

The broad outline of the course will be:

- Carbohydrates – Glucose and Glycogen Metabolism
- Proteins-Classification of proteins and functions
- Lipids- Classification of lipids and functions
- Enzymes- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isoenzymes and Enzyme pattern in diseases
- Vitamins & Minerals- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor
- Acids and bases-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- Hormones
- Applied Chemistry: .

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests,anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization ofmethods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and CAppireatinine estimation
- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

1. Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
2. Text book of Medical Biochemistry by Ramakrishna

3. Text Book Biochemistry by Vasudevan and SreeKumari

IV. APPLIED PHYSICS FOR PERFUSIONISTS

An introduction to the properties of liquids and gases and the medical application of pressures in fluids and the cardiovascular system, mass and heat transfer as they apply to equipment used in extra- corporeal perfusion.

- Introduction to thermal sciences, review of calculus
- Pressure, hydrostatics, and intro concepts in thermodynamics
- Conservation of mass
- The first law of thermodynamics and mechanical energy balance
- Applications of conservation of energy
- Integral conservation of linear momentum
- Concepts in cardiovascular fluid mechanics Flow through tubes
- Intro to differential analysis and the continuity equation
- The Navier-Stokes equations
- Transport applications in cardiopulmonary bypass: oxygenation and ultrafiltration
- Mass transfer and the differential component mass balance
- Gas laws, solubility of gases
- Volume, pressure, flow
- Mass, density, viscosity
- Heat units, temperature scales, heat transfer
- Diffusion/osmosis
- Molarity, concentrations
    - Sterilization and Disinfection
    - Cardiac operation Theatre Etiquette

TEXT BOOKS RECOMMENDED

1. Gravlee Cardiopulmonary Bypass: Principles and Practice

V. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology

- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, power point, excel etc.
- Uses of computers & applications: Multi media: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.
- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.

VI. ENGLISH

- **Introduction:** Study techniques, Organization of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VII. REGIONAL LANGUAGE: ODIYA

2ND YEAR

I. APPLIED PATHOLOGY AND HEMATOLOGY

It is essential to comprehend the pathologic basis of disease and therefore, a basic knowledge of clinical pathology will be expected from the student pursuing this course.

The broad contents of the course will cover:

- Cellular adaptation and cell death
- Inflammation and repair, infection, circulatory disorders, immune defense
- Genetics of disease
- Neoplasia
- Cell injury and adaptation
- Atrophy, hypertrophy, metaphase, hyperplasia
- Classification of tumors, premalignant lesion
- Types of inflammation & system manifestations of inflammation
- Disorders of vascular flow & shock (brief introduction)
- Oedema, hyperemia or congestion, thrombosis, embolism, infarction shock, ischemia, over hydration, dehydration
- The response to infection
- Categories of infectious agents, host barriers to infection
- How disease is caused
- Inflammatory response to infectious agents
- Hematopoietic and lymphoid System
- Hemorrhage, various types of anemia, leucopenia, leukocytosis, bleeding disorders coagulation mechanism

CARDIOVASCULAR PATHOLOGY

- Atherosclerosis
- Ischemic heart disease
- Valvular heart disease
- Cardiac hypertrophy and hypertensive heart disease
- Cor pulmonale and pulmonary hypertension
- Myocarditis
- Cardiomyopathies

- Pericardial disease
- Endocrines and the heart
- Heart tumors
- Arrhythmias and conduction disorders
- Diseases of the aorta: Aneurysms and dissections

HAEMATOLOGY

- Anaemia – definition, morphological types and diagnosis of anemia brief concept about haemolytic anaemia and polycythemia.
- Leukocyte disorders – briefly leukaemia, leukocytosis, agranulocytosis etc.,
- Bleeding disorders – definition, classification, causes and effects of important types of bleeding disorders. Briefly various laboratory tests used to diagnose bleeding disorders.

Blood Transfusion Techniques

- Blood grouping
- Minor and Major cross matching
- Venous Sample Collection
- Storing Techniques of Blood Products
- Blood collection from Donor
- Separation of the Blood products

RESPIRATORY SYSTEM

- Chronic obstructive airway diseases – definition and types
- Briefly concept about obstructive versus restrictive pulmonary diseases
- Pulmonary congestion and edema
- Pleural effusion – causes, effects and diagnosis

RENAL SYSTEM

- Clinical manifestation of renal diseases
- Briefly causes, mechanism, effects of acute renal failure and chronic renal failure. Briefly glomerulonephritis and pyelonephritis Brief concept about obstructive uropathy

RECOMMENDED TEXT BOOKS

1. Illustrated Pathology – McFarlen
2. Basic Pathology by Robbins

II. CLINICAL DIAGNOSTICS

Basics of diagnostic techniques-

- Laboratory investigations in relation to perfusion technology
- Chest of X-ray,
- ECG,
- ABG
- Angiography,
- 2 D Echo
- TEE

Monitoring and instrumentation-

- Instrumentation technology of ECG machine, pressure transducers, syringe and
- peristaltic pumps, monitors, ventilators, pulse oximeters, temperature probes
- and thermo regulatory monitoring,defibrillators.
- Hemodynamic monitoring, Haemostatic monitoring.
- Maintenance of oxygen, carbon dioxide and acid base status andtheir monitoring
- Coagulation Monitoring
- Coronary artery and graft flow measurement
- Resuscitation and support
- Catheterisation
- Angiography
- Angioplasty
- EPS Studies
- Valvuloplasty
- lntra-aortic balloon

III. PRINCIPLES OF PERFUSION TECHNOLOGY

Physiology of extra-corporeal circulation

- Assessment of patients before bypass; going on & coming offbypass.
- Hemodilution and priming solutions
- Principles of extracorporeal gas exchange

- Analyzing & correction of ABG,VBG and other blood investigations

Perfusion Equipment - Hardware:

- Heart-lung machines/centrifugal pumps
- Pressure and low level alarm devices
- Heart-lung heater/coolers
- Mechanical/electronic flow meters, blenders
- Perfusion data's recording, store keeping
- In-line oxygen saturation devices
- In-line blood gas devices
- Oxygen analyzers
- Cell savers
- lntra-aortic balloon pump

Pathophysiology of Cardio Pulmonary Bypass

- Blood cells trauma & Anticoagulation in bypass: its monitoring and complications Blood conservation & Auto transfusion
    - Risks of blood transfusion
    - Blood conservation techniques
- Myocardial Protection & Cardioplegia
    - History
    - Various methods of myocardial protection
    - Reperfusion injury, oxygen free radicals ,myocardial edema
    - Myocardial protection for specific clinical problems
    - problems during Cardioplegia delivery
    - Hot shot
- Effects of CPB
    - IImmune and inflammatory response
    - Fluid balance and interstitial fluid accumulation
    - Nervous system
    - Renal function
    - The lungs
    - The liver

- Hypothermia
    - Physiology
    - Deep Hypothermic Circulatory Arrest
    - Alterations with temperature change
    - Acid-base
    - Organ function

RECOMMENDED TEXT BOOKS

1. P J Mehta: Practical Medicine
2. Gravlee Cardiopulmonary Bypass:

IV. CLINICAL PHARMACOLOGY & MICROBIOLOGY

A knowledge of clinical pharmacology and microbiology is expected to strengthen the roots of the student undergoing the course of BSc in OT and AT since he/she is expected to deal with multiple drugs that are used in the theatres, critical care areas and catheterization laboratories. Also, knowledge of microbiology will help the technologist to understand the basis of disease-causing pathogens and methods to deal with them, including asepsis. Keeping in view these aspects.

The broad course content will cover:

CLINICAL PHARMACOLOGY

- Antisialagogues: Atropine, Glycopyrrolate
- Sedatives & Anxiolytics: Diazepam, Midazolam, Phenergan, Lorazepam, Chlorpromazine, and Triclofos
- Narcotics: Morphine, Pethidine, Fentanyl, Pentazozine, tramadol
- Antiemetics: Metoclopramide, Ondanseteron, Dexamethasone
- Induction Agent: Thiopentone, Diazepam, Midazolam, Ketamine, Propofol, Etomidate
- Muscle Relaxants: Depolarizing – Suxamethonium; Non depolarizing – Pancuronium, Vecuronium, Atracurium, Rocuronium
- Inhalational Gases: Gases-O2, N2O, Air;VolatileAgents-Halothane, Isoflurane, Sevoflurane, Desflurane
- Reversal Agents: Neostigmine, Glycopyrrolate, Atropine, Naloxone, Flumazenil
- Local Anesthetics: Xylocaine, Bupivacaine; Topical, Prilocaine-jelly, Emla - Ointment, Etidocaine. Ropivacaine.
- Emergency Drugs : Mode or administration, dilution, dosage and effects
- Adrenaline, Atropine
- Ephedrine,Mephentramine, phenyl-epherine

- Bicarbonate, calcium, potassium
- Inotropes: dopamine, dobutamine, noradrenaline
- Anti-arrythmics- amidarone, xyolcard
- Aminophylline, hydrocortisone, antihistaminics
- Antihypertensive –Beta-blockers, Ca-channel blockers, ACE inhibitors
- Vasodilators- nitroglycerin & sodium nitroprusside
- Respiratory system- Bronchodilators
- Renal system- Diuretics, frusemide, mannitol

CLINICAL MICROBIOLOGY

- Morphology
    - Classification of microorganisms, size, shape and structure of bacteria
    - Use of microscope in the study of bacteria.
- Growth and nutrition
    - Nutrition, growth and multiplications of bacteria
    - Use of culture media in diagnostic bacteriology
    - Antimicrobial sensitivity test
- Sterilization and Disinfection
    - Principles and use of equipment of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptic and disinfectants
- Immunology
    - Immunity, vaccines, types of vaccine and immunization schedule, principles and interpretation of common serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA
- Rapid tests for HIV and HBsAg (excluding technical details)
- Systematic Bacteriology
    - Morphology, cultivation, diseases caused, laboratory diagnosis including specimen collection of the following bacteria (excluding classification, antigenic structure and pathogenicity)
    - Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, C. diphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, E. coli, Klebsiella, Proteus, Vibrio cholerae, Pseudomonas & Spirochetes
- Parasitology
    - Morphology, life cycle, laboratory diagnosis of following parasites: E. histolytica, Plasmodium, tape worms, Intestinal nematodes

- Nosocomial infections
- Bio-medical waste management

TEXT BOOKS RECOMMENDED

1. Anantnarayana and Paniker. Textbook of pharmacology
2. CP.Baveja. Textbook of Microbiology for nurses.4th Ed. Arya Publishing Company; 2014.
3. Seema Sood. Microbiology for Nursing Students & Nurses. 2nd Ed. Elsevier India Pvt.Ltd; 2006.

3RD YEAR

I. CLINICAL APPLICATION OF CPB TECHNIQUES

1. Conduct, Monitoring & Termination of CPB

Check lists

- Flow/pressure
- Hemodilution
- Acid/base balance
- Oxygen and carbon dioxide exchange
- Patient core temperature
- Anticoagulation
- Hypothermia
- Pressure, flow, resistance
- Adequacy of perfusion
- Myocardial preservation
- General bypass : Management of Adult cardiac cases Coronary Artery Bypass Graft Surgery
- Valvular Replacement Surgery Fem-Fem bypass Emergency
- Accidents and safeguards

II. PERFUSION FOR SPECIAL PROCEDURES

1. Aortic Surgery
2. Management of Unusual Problems & Special Consideration in Perfusion

I. Sickle cell

- Pathophysiology
- Considerations for CPB
- Other blood disorders

II. Methemoglobinemia

- Pathophysiology
- Considerations for CPB

III. Thalassemia

IV. Spherocytosis & Elliptocytosis

V. Hemosiderosis & hemochromatosis

VI. Erythrobolastosis fetalis

VII. Hereditary coagulation disorders

A. Von Willebrand's disease

- Type I
- Type II
- Type III

B. Hemophilia A

C. Hemophilia B

VIII. Acquired coagulation disorders

- Disseminated intravascular coagulation (DIC)
- Primary fibrinolysis
- Vitamin K dependent deficiency

IX. Platelet disorders

- Thrombocytopenia
- Cold Agglutinin

X. Perfusion techniques for Pregnant Patients.

XI. Malignant Hyperthermia.

XII. Re-Operations

III. ADVANCED PERFUSION TECHNIQUES

- ECMO
- Counter pulsation and VENTRICULAR ASSIST DEVICES(VAD)
- Minimally Invasive Cardiac Surgery(MICS)
- Perfusion for Non cardiac Procedures
    - Liver transplant
    - Isolated Limb Perfusion

Recent advances in Perfusion Techniques

PEDIATRIC PERFUSION

- Preparation for CPB: Equipment Preparation of the Patient for CPB
- Blood Flow, ECC component and circuit selection Cannulation

- Priming conduct of Bypass

  CO_2 management & Choice of Acid Base management Fluid Management and Drug management during CPB Myocardial Protection

- ECMO for Neonates, Infants and Children – Components Circulatory assist devices for Infants and children

Blood Conservation Techniques

- Preparation for CPB:

Equipment Preparation of the Patient for CPB

- Blood Flow, ECC component and circuitselection Cannulation
- Priming Conduct of Bypass

  CO2 management & Choice of Acid Base management Fluid Management and Drug management during CPB Myocardial Protection

  ECMO for Neonates, Infants and Children – Recent Advances in Cardiac Perfusion Technology IABP and ECMO Medico legal Considerations and Record Keeping

RECOMMENDED TEXT BOOKS

1. Gravlee Cardiopulmonary Bypass: Principles and Practice
2. Robert Bojar Manual of Perioperative Care in Adult Cardiac Surgery
3. Hensley martin A Practical Approach to Cardiac Anesthesia
4. Principles and Practice Cardiac Surgery In Adults – by Lawrence Cohn
5. Pediatric Cardiac Surgery – by Constantine Mauroudi - 4thedition.

CURRICULUM FOR

B. Sc. (Hons.)

Neuro Technology

INTRODUCTION

Modern neurological practice is increasingly dependent on an array of technological investigations that requires meticulous technical expertise and sound theoretical knowledge. From electroencephalography to nerve conduction studies and polysomnography these techniques are highly labor intensive and versatile. Neurobionics is a closely linked subspecialty of Neurology which aims to develop technology involving electronic man-machine interphases in neurotherapeutics. While most technologically developed nations have instituted certification courses in each of these disciplines and have special board of studies such as American Board of EEG and EMG technology, in India very few institutions provide rigorous and dedicated training for these investigations, and the manpower demand is mostly met by personnel trained on adhoc basis with neither the knowledge grounding nor the technical precision demanded by these tests. This makes these investigations variable in their results and substandard with regard to their investigational value. Also, lack of proper certification courses in these disciplines makes the technicians unable to keep abreast with rapid expansion in the knowledge and techniques. This also curtails the scope of local research and technological innovation.

B.Sc. Neurotechnology course is developed to impart comprehensive knowledge and technological expertise in the field by using the varied and rich resources available in AIIMS Bhubaneswar. It is designed not only to impart technical know-how, but also as a basic degree that could qualify for masters and doctoral degrees in these fields.

The course is three years course out of which first year will provide orientation on basic medical science and statistical methods while the last two years will focus on the theory and practice of Neurotechnology.

At the end of the course the student should be able to:

1. Perform routine clinical laboratory testing.
2. Communicate with other members of healthcare team, customers and patients in an effective manner.
3. Process information and ensure quality control as appropriate to routine laboratory procedures.
4. Upgrade knowledge and skills in a changing healthcare scenario.
5. Should know the logical interpretation of clinical lab investigations and reports.
6. Should be able to extrapolate data acquired from the test results
7. Should be able to understand the principle and working of NCV/EMG/EPs, routine and advanced vEEG, Polysomnography, transcranial magnetic stimulation
8. Should be able to perform the test on critically ill patients and neurophysiological test in Neuro ICU.

SCOPE OF THE COURSE

The B.Sc. (Hons) Neuro-Technology Course are allied health professionals responsible for direct and indirect patient care by performing various laboratory tests and procedure which helps in diagnosis and management of the neurological disease processes. They are trained to assist primarily the

Neurophysicians and Neurosurgeons to carry out various diagnostic tests and procedures in the clinical neurophysiology lab, operation theatre and ICU etc. This course (B.Sc. (Hons) in Neuro-Technology) will be taught at the graduate level and students who have accomplished their +2 in Science can apply for this course. The selection of candidates will be through an admission entrance examination. Once students have successfully finished the B.Sc. (Hons) in Neuro-Technology course, they can work as Neuro-technologist in hospitals and diagnostic laboratories and perform varied ranges of neurological tests. With sufficient experience in the field concerned, aspirants can expect appropriate placement in the field. Graduates of this field can also apply for higher studies and research.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called "THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN NEURO-TECHNOLOGY OF AIIMS Bhubaneswar". The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

2.1. ELIGIBILITY FOR ADMISSION

1. The minimum age for admission shall be 17 years on or before 31st December of the year of examination
2. Candidates should have a pass in the Senior Secondary Examination (Academic) or intermediate science or any equivalent examination from recognized board/ University of any Indian state with a minimum of 50% marks (40% marks for SC, ST and OBC candidates) in subjects of Physics, Chemistry & Biology/Botany & Zoology) and should have English as one of the subjects.
3. Candidate should be medically fit

2.2. DURATION OF THE COURSE AND COURSE OF STUDY

The period of certified study and training of the B.Sc. Neuro-Technology degree course shall be of three academic years. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's

performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

Candidate should have scored a minimum of 40% in Theory (IA) and 40% in Practical's (IA) separately to be allowed to appear for the examinations.

6. ATTENDANCE REQUIRED FOR APPEARING EXAMINATION

Candidate must have minimum 75% attendance in theory and in practical & lab postings for appearing in examination.

7. EXAMINATIONS

Candidate has to pass separately in Theory and Practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and semester examinations. The final examinations will be conducted at the of the academic year for all the three years.

If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

8. ELIGIBILITY / MAXIMUM DURATION FOR THE AWARD OF THE DEGREE

- The candidates shall be eligible for the Degree of Bachelor of Neuro-Technology when they have undergone the prescribed course of study (three academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.
- The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a) Candidate has to pass separately in Theory and Practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and semester examinations.

b) If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c) If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d) If any candidate who could not pass all the subjects in spite of given three chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

10. PERFORMANCE VALUATION IN EXAMINATIONS

Candidates having less than the prescribed minimum marks (40%) in the internal assessment (Theory and Practical separately) will not be allowed to take the final examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practical
3. Demonstrations
4. Assignments
5. Hands on training

This course shall be divided into three years and there will be end of the year examination at the end of each year of the BSc Neurotechnology course. The scheme for and end semester examination is discussed below

EXAMINATION SCHEME

Paper	**Subject**	Total Marks (Theory)	Internal Assessment (Theory)	Total marks (Practical)	Internal Assessment (Practical)	**Grand Total Marks**
1st Year						
Paper1	Basic Anatomy	75	25	75	25	200
Paper2	Basic Physiology	75	25	75	25	200
Paper3	Basic Biochemistry	75	25	75	25	200
Paper4	Basics in Neuroelectrophysiology	75	25	75	25	200
2nd Year						
Paper1	Electroencephalography- and Evoked Potentials	75	25	75	25	200
Paper2	Nerve Conduction Studies and Electromyography	75	25	75	25	200
Paper3	Neuropathology, Neuropharmacology & Microbiology	75	25	75	25	200
Paper4	Clinical Neurology	75	25	75	25	200
3rdYear						
Paper1	Advanced EEG/ NCV/ EMG/Special tests	75	25	75	25	200
Paper2	Polysomnography & Transcranial magnetic stimulation	75	25	75	25	200
Paper3	Autonomic lab & Intraoperative monitoring	75	25	75	25	200
Paper4	Recent advances & application of clinical neurophysiology	75	25	75	25	200

1ST YEAR

I. BASIC ANATOMY AND PHYSIOLOGY OF HUMAN BODY

Anatomy is a key component of the education program for BSc in Neurotechnology and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in-patient positioning and accurate delivery of intervention.

Keeping in view the above aim, the broad outline of the course will be:

ANATOMY

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurons Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions
    - PNS - Cranial nerves, spinal and peripheral nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands

- **Reproductive System**: Parts of the system. Gross structure of both male and female reproductive organs
- **Head & Neck**
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Demonstration of skeleton - articulated and disarticulated
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues.
- Haematoxylin and eosin staining of given paraffin section

II. PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes. Physiology is important to all programs with increased depth of content required where students are being required to take a more active role in side effect recognition and management. This may be in departments where Neurotechnology students are increasingly taking some responsibility in this area or in resource constrained environments where nursing or medical staff are limited.

- **Cell:** Structure & function
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Haematocrit & ESR, blood groups- ABO & Rh, basics of coagulation, classification of anaemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia, Cyanosis, asphyxia. Methods of artificial respiration
- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve

impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes, cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus, vestibular apparatus and functions. Autonomic nervous system.

- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System:** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.

Practical Exercise & lab postings

- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus

III. BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and what will happen in their deficiency.

The broad outline of the course will be:

- **Carbohydrates** – Glucose and Glycogen Metabolism
- **Proteins**-Classification of proteins and functions
- **Lipids**- Classification of lipids and functions
- **Enzymes**- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isoenzymes and Enzyme pattern in diseases
- **Vitamins & Minerals**- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine

and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor

- **Acids and bases**-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- **Hormones**
- **Applied Chemistry.**

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labelling, routine tests, anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization of methods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine estimation
- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

- Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
- Text book of Medical Biochemistry by Ramakrishna
- Text Book Biochemistry by Vasudevan and SreeKumar

IV. Basics in Neuroelectrophysiology

INTRODUCTION TO LABORATORY

Orientation to Lab

- Glossary of terms
- Lab etiquette
- Reception area
- Requisition slips

- Lab procedures overview
- Electroencephalography laboratory
- Electroneuromyography laboratory
- Evoked potentials laboratory
- Transcranial magnetic stimulation laboratory
- Autonomic functions tests laboratory

Orientation to Hospital

- Wards – Neurology, General Medicine, Neurosurgery, Psychiatry and Paediatrics
- Outpatient Department, including Epilepsy Clinic, Neuromuscular Clinic/ special clinic
- Accident and Emergency (Casualty)
- Intensive Care Units – Neurology, Medicine and Pediatrics
- Central Sterile Supply Department

ELECTRONICS

V. Basic Electronics

- Conductors, Insulators, Semiconductors, Energy band diagram of semiconductors,
- Ohm's Law, Kirchhoff's voltage and current law, Resistors, Capacitors, Inductors,
- Resistors in serial and parallel combination, transformer.
- P-N junction diode, forward and reverse bias characteristics, PNP and NPN
- transistors, Half wave rectifier, Full wave rectifier, filters, voltage regulator.

VI. Neurology Equipment's

- Bio potentials electrodes, Transducers, Differential amplifiers, Filters (Hi-pass, lowpass, band-pass), Analog to digital convertor, recording devices – CRO, PMMC.
- Computers in neurology equipment's, calibration.
- EEG machine – Block diagram
- EMG machine – Block diagram

VII. Overview of all Medical Electronic Equipment

- Types of medical equipment – Diagnostic, Therapeutic, Analytical
- Hazards and safety measures in medical equipments
- Classification of equipment based on electrical safety
- International standards and certification of medical equipment

- Various symbols, color coding, controls and their meaning pertaining to medical equipment
- Do's and don'ts for users of medical equipment.
- Calibration - for different medical equipment and their importance

REFERENCE:

1. Bio medical Instrumentation and measurements - Leslie Corniwell, Fred J Weibell, Erich A Pfeiffer
2. Medical Devices – use and safety – Bertil Jacobson and Alan Murray
3. Biomedical Instrumentation – Dr. M. Arumugam
4. Hand book of Biomedical Instrumentation –R.S. Khadpur

Basics of Neuroelectrophysiology tests

I. Basics of EEG

1. Historical aspects of EEG
2. Neurophysiologic basis of EEG and DC potentials
3. Analog signal recording principles
4. Digital EEG
5. Polarity and field determination – electrode placement, montages, ten-twenty System

II. Basics of Evoked Potentials – anatomical basis of VEP, BAER, SEP

III. Basics of nerve conduction studies and EMG

V. COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, power point, excel etc.
- Uses of computers & applications: Multi media: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.
- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipments to computers. Reporting using various equipments.

VI. ENGLISH

- **Introduction:** Study techniques, Organisation of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

VII. REGIONAL LANGUAGE: ODIA

2ND YEAR

I. ELECTROENCEPHALOGRAPHY (EEG) and EVOKED POTENTIALS

Electroencephalography

- Normal EEG and sleep in preterm and term neonates
- Normal and sleep from infancy to adolescents
- Normal EEG and sleep in adults and elderly
- Activation methods
- Artefacts of recording
- Epileptiform and non-epileptiform paroxysmal EEG abnormalities
- Clinical EEG in seizures and epilepsies in the preterm and term neonate
- Clinical EEG in seizures and epilepsy in infants to adolescents
- Clinical EEG in epilepsy in adults and the elderly
- EEG in status epilepticus and nonconconvulsive status epilepticus
- Special techniques in recording – depth electrodes, intracranial monitoring, electrocorticography
- Techniques for Long term EEG recording – video EEG, ambulatory EEG, ICU recordings
- Polysomnography
- Magnetoencephalography
- EEG in brain tumors and strokes
- EEG in Central nervous system infections and infestations
- EEG in dementia and degenerative diseases
- EEG in metabolic disorders
- EEG in coma and brain death
- EEG in psychiatric diseases
- Role of EEG in presurgical evaluation of epilepsy

Evoked potentials

1. **Event-related potentials (ERP): general aspects and quantification**
2. **Visual evoked potential (VEP)**

   a. Anatomical basis of VEP

b. Method of recording VEP

c. Normal VEP and waveforms

d. Variables influencing VEP

e. Clinical applications of VEP

3. Brainstem auditory evoked potentials (BAEP)

a. Anatomical basis of BAEP

b. Method of recording BAEP

c. Variables influencing BAEP

d. Normal BAEP, potential field distribution, waveforms

e. Clinical applications of BAEP

4. Somatosensory evoked potentials (SEP)

a. Anatomical basis of SEP

b. Stimulation and recording procedures

c. Median somatosensory evoked potential

d. Tibial somatosensory evoked potential

e. Clinical applications of SEP

II. NERVE CONDUCTION STUDIES AND ELECTROMYOGRAPHY

1. History of nerve conduction studies
2. Electro diagnostic signals and their measurements

   a. Principles of motor nerve conduction

   b. Principles of sensory nerve conduction
3. Basic components of electromyography instruments
4. Nerve conduction techniques
5. Anatomical guide and normative data for common nerve conduction studies

   a. Brachial plexus and branches

   b. Lumbar plexus and branches

   c. Sacral plexus and branches
6. Required tests for specific problems like carpal tunnel syndrome
7. Pediatric nerve conduction study
8. Artefacts in NCS

9. Nerve conduction of non-limb nerves – techniques and normal values
10. Physiological and non-physiological factors affecting NCS
11. Anomalous innervations of extremities
12. Late responses
13. Autonomic nervous system testing
14. Introduction to EMG
15. Technique of EMG
16. Clinical applications of EMG and NCV in neurological disorders
17. Repetitive nerve stimulation
18. Single fibre and macro electromyography

III. NEUROPATHOLOGY, NEUROPHARMACOLOGY AND MICROBIOLOGY

Neuropathology

General Pathology

- **Cell Injury and Cellular Adaptations:** Normal Cell**.** Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, cellular swelling. Cell death : types- autolysis, necrosis, apoptosis & gangrene. Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.
- **Inflammation:** Acute inflammation - vascular event, cellular event, inflammatory cells. Chronic Inflammation - general features, granulomatous inflammation, tuberculoma.
- **Hemodynamic Disorders: Oedema**, hyperemia, congestion, haemorrage, circulatory disturbances, thrombosis, ischemia& infarction.
- **Neoplasia :**Definition, Etiopathogenesis, Classification, difference between benign tumor and malignant tumor.
- **Healing:** Definition, different phases of healing, factors influencing wound healing

Infection & Immunity

Neuropathology

- Disorders of muscle – Normal structure of muscle, muscular dystrophies, myopathies, myasthenia.
- Disorders of nerve – Normal structure of peripheral nerve, pathology of neuropathy (demyelinating and axonal), inflammatory neuropathy (Guillaine Barre Syndrome, Chronic inflammatory demyelinating neuropathy), vasculititc neuropathy, critical illness myoneuropathy
- Disorders of brain and spinal cord – Epilepsy, Dementia, Demyelinating disorders (multiple sclerosis, neuromyelitis optica)

Neuropharmacology

- General pharmacology: definitions, routes of drug administration, pharmacokinetics, pharmacodynamics
- Drugs acting on the autonomic nervous system
- General and local anesthetics, skeletal muscle relaxants
- Sedatives & Anxiolytics: Diazepam, Midazolam, Phenergan, Lorazepam, Chlorpromazine, and Triclofos
- Antiepileptic drugs
- Antiparkinsonian drugs
- Drugs used in mental illness
- CNS stimulants and cerebroactive drugs
- Drugs affecting coagulation, bleeding and thrombosis
- Antiseptics, disinfectants
- Local Anesthetics: Xylocaine, Bupivacaine; Topical, Prilocaine-jelly, Emla - Ointment, Etidocaine. Ropivacaine
- Emergency Drugs: Mode or administration, dilution, dosage and effects

TEXT BOOKS RECOMMENDED

1. Essentials of Medical Pharmacology by K D Tripathi
2. Basic and Clinical Pharmacology by B G Katjung

Microbiology (including sterilization)

- **Bacteriology** - Morphology Classification of microorganisms, size, shape and structure of bacteria, Use of microscope in the study of bacteria. Growth and nutrition Nutrition, growth and multiplications of bacteria Antimicrobial sensitivity test
- **Sterilization and Disinfection** Principles and use of equipment of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptic and disinfectants
- **Immunology** Immunity, vaccines, types of vaccine and immunization schedule, principles and interpretation of common serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA
- **Rapid tests** for HIV and HBsAg (excluding technical details)
- **Parasitology** - Morphology, life cycle, laboratory diagnosis of following parasites: E. histolytica, Plasmodium, tape worms, Intestinal nematodes
- **Nosocomial infections**
- **Bio-medical waste management**

TEXT BOOKS RECOMMENDED

1. Anantnarayana and Paniker. Textbook of pharmacology
2. CP.Baveja. Textbook of Microbiology for nurses.4th Ed. Arya Publishing Company; 2014.
3. Seema Sood. Microbiology for Nursing Students & Nurses. 2nd Ed. Elsevier India Pvt.Ltd; 2006.

IV. CLINICAL NEUROLOGY

Introduction to Neurology

- Neurological diseases – a basic approach
- Clinical examination basics
- Episodic impairment of consciousness
- Delirium and altered sensorium
- Stupor and Coma
- Memory Impairment
- Child with developmental delay
- Behavioral disorders
- Apraxia, agnosia and aphasia
- Disorders of vision
- Hearing impairment and vertigo
- Cranial and facial pain
- Brainstem syndromes
- Ataxic disorders
- Movement disorders
- Gait disorders
- Hemiplegia and monoplegia
- Paraplegia
- Proximal and distal weakness
- Floppy infant
- Sensory abnormalities of face, trunk and limbs
- Neurological causes of bladder, bowel and sexual dysfunction
- The Epilepsies

3RD YEAR

I. ADVANCED EEG /NCV/ EMG/ SPECIAL TESTS

- Pediatric nerve conduction study
- Artefacts in NCS
- Nerve conduction of non-limb nerves – techniques and normal values
- Physiological and non-physiological factors affecting NCS
- Anomalous innervations of extremities
- Nerve Conduction of special nerves
- Repetitive nerve stimulation
- Single fibre and macro electromyography
- EMG guided intramuscular injections
- Long term Video EEG
- Techniques for Long term EEG recording – video EEG, ambulatory EEG, ICU recordings
- Common artefacts in LT VEEG
- Portable EEG monitoring bedside
- EEG in status epilepticus and nonconconvulsive status epilepticus
- Special techniques in recording – depth electrodes, intracranial monitoring, electrocorticography
- Polysomnography
- Magnetoencephalography – basics and principles
- Gait analysis

II. POLYSOMNOGRAPHY AND TRANSCRANIAL MAGNETIC STIMULTION

Polysomnography

- Anatomy of Sleep
- Medical Disorders of Sleep
    - Insomnia
    - Obstructive Sleep Apnea
    - Central Sleep Apnea
    - Sleep disorders in elderly
    - Narcolepsy and related disorders

- Polysomnography
- Median Sleep Latency (MSLT)
- Actigraphy

Transcranial magnetic stimulation

- Anatomical basis of TMS
- Recording procedures
- Clinical application

III. AUTONOMIC LAB AND INTRA-OPERATIVE MONITORING

Autonomic Laboratory Testing

- Cardiovascular autonomic functions
- Using head up tilt test and beat to beat recording
- Assessment of other cardiac physiology and dysfunction

Intraoperative Monitoring

- Instrumentation for Intraoperative monitoring (IOM)
- Precautions to be taken during IOM
- Electrode placement, stimulation parameters for tethered cords, brachial plexus, dorsal column, cranial nerves, peripheral nerves and brainstem nuclei
- Brainstem auditory evoked potentials for cerebello-pontine angle tumors, microvascular decompression cases
- Somatosensory evoked potentials for aneurysm surgery, spinal cord surgery
- Motor evoked potentials using transcranial electrical stimulation for spinal cord monitoring, monitoring of cases with intramedullary tumors, intradural extramedullary tumors and scoliosis correction
- Electrocorticography

IV. RECENT ADVANCES AND APPLICATION OF CLINICAL NEUROPHYSIOLOGY

Recent advances and application of clinical neurophysiology in Trauma and the nervous system, Vascular diseases of the nervous system, Cancer and the nervous system, Infections of the nervous system, Multiple sclerosis and other white matter diseases, Inborn errors of metabolism, mitochondrial disorders, channelopathies, Dementias, Sleep and its disorders, Headache and other cranio-facial pain, Cranial neuropathies, Parkinsonism and related movement disorders, disorders of cerebellum and tracts, disorders of bones, joints, ligaments, and meninges, Motor Neuron diseases, Epilepsy

Reference Books

1. Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic-Ultrasound Correlations by David C. Preston MD (Author), Barbara E. Shapiro MD PhD (Author)
2. Clinical Neurophysiology: Nerve Conduction, Electromyography, Evoked Potentials, 4e by U.K. Misra and J Kalita
3. EEG in Clinical Practice by Kurupath Radhakrishnan, Jagarlapudi M K Murthy
4. EEG Simplified by Satish Khadilkar, Girish Soni, et al
5. Fisch and Spehlmann's EEG Primer: Basic Principles of Digital and Analog EEG by Bruce Fisch

CURRICULUM FOR

B. Sc. (Hons.)

Endoscopy Technology

INTRODUCTION

Endoscopy is a standard and well accepted method of diagnosis and treatment of Gastrointestinal, Respiratory, Urology and Gynecological disorder. All the major hospitals in Odisha and outside the state have endoscopy units. At present there is no formal endoscopy technician course in Odisha and Eastern India and endoscopy technicians are usually self-trained people. Because of the lack of adequate training, there is no uniformity in the expertise of endoscopy technician and learning curve also can be quite variable. The help of a qualified well trained endoscopy technician will be great help in improving endoscopic standard in our hospitals.

GOALS

1. Practice efficiently and effectively backed by scientific knowledge and skill base.
2. Show empathy and a caring attitude towards patients and relatives and maintain high ethical standards.
3. Evidence of keen interest in continuing medical education
4. Be a motivated teacher keen to share knowledge and skills with colleagues, juniors, or learners.

AIMS AND OBJECTIVES

National objectives

At the end of the course, the candidates should be able to

1. Work in any hospital in India with minimum facilities efficiently both on an elective and an emergency basis.

Institutional objectives

The objectives are laid out to achieve by the time the candidates complete the course. The objectives may be considered under the following subheadings:

1. Knowledge
2. Skills
3. Human values, ethical practices and communication abilities.

1. Knowledge:

At the end of the training, the candidate must be able to:

- Demonstrate understanding of basic sciences in endoscopy.
- Describe the basics of human anatomy.
- Describe basic Endoscopic Anatomy.
- Describe the basics of the OT setting.
- Describe OT working protocols.

- Describe the setup of the Endoscopy room.
- Discuss the importance of Aseptic techniques & Sterilization.
- Practice aseptic techniques
- Perform sterilization of equipment
- Assist the Endoscopist during Endoscopy procedures
- Prepare trolley in OT for Endoscopy
- Describe basic terminologies related to Endoscopy
- Explain common problems/complications encountered during endoscopy and their management.
- Monitor the patient's intra-operative and post-operative periods.
- Perform the basic maintenance, cleaning, and storage of equipment.
- Identify various types of endoscopies and their parts.
- Identify social, economic, environmental, and emotional determinants in a given case and take them into account for planning therapeutic measures.
- He/she updates herself/ himself by self-studying and by attending courses, updates, workshops, conferences, and seminars relevant to endoscopy.

2. Skills

At the end of the training, the candidate must be able to:

- Assist in all types of endoscopic procedures independently
- Complete patient monitoring, including pre-procedural, procedural, and post-procedural care of patients.

3. Human values, ethical practice, and communication abilities:

- Adopt ethical principles in all aspects of his profession.
- Develop communication skills, in particular, the skill to explain the various options available for management and to obtain true informed consent from the patient or the attendant.
- Provide leadership and get the best out of his team in a congenial working atmosphere.
- Be humble and accept the limitations in his knowledge and skills to ask for help from colleagues when needed.
- Respect patient's rights.

SCOPE OF THE COURSE

Bachelor of Science Degree in Endoscopy Technology course will open a new career oriented academic programme on a strong scientific back ground and which will improve the employment opportunity of youth. As of now degree level programme in endoscopy technology is available among very few

universities in India. As there is no formal training course in Odisha there will be great demand trained technicians for the next many years.

Once students have successfully finished the B.Sc.(H) EndoscopyTechnology course, they can work as technologists in Endoscopy Suites, Operation Theatres and Bronchoscopy Suites. These candidates are needed mostly in hospitals. So, many career opportunities are available for them in the private and public-sector firms. Business as well as research is another field which these technologists can choose. The remuneration of these technologists is expected to be quite reasonable.

With sufficient experience in the field concerned, aspirants can expect good salaries. Graduates of this field have also been successful in getting jobs abroad.

1. SHORT TITLE AND COMMENCEMENT

These regulations shall be called **"THE REGULATIONS FOR THE BACHELOR OF SCIENCE IN ENDOSCOPY TECHNOLOGY OF AIIMS Bhubaneswar".** The regulation and syllabus will be subjected to modifications by AIIMS Bhubaneswar from time to time.

2. REGULATIONS

a) ELIGIBILITY FOR ADMISSION

Candidates should have qualified higher secondary examination (10+2) in the subjects as per the eligibility criteria for AIIMS New Delhi and should have English as one of the subjects.

b) DURATION OF THE COURSE AND COURSE OF STUDY

The period of certified study and training of the B.Sc. Endoscopy Technology degree course should be of **three academic years**. The maximum period to complete the course successfully should not exceed six years.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction for all the subjects of study and for examinations of the course. The candidates will however be expected to gain a decent proficiency in spoken Odia as a medium of communication with patients and other hospital staff.

4. MINIMUM WORKING DAYS IN AN ACADEMIC YEAR

Each academic year shall consist of not less than 240 days with a minimum of 120 days working days per semester.

5. INTERNAL ASSESSMENT (IA):

Internal assessment (IA) will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations and will constitute 25% of marks in each of theory and practical examinations. The marks awarded will be done on the basis of the candidate's performance in the assignments, class tests –written / practical, laboratory work, preparation and presentation of project work/ seminars or any other accepted tools of assessment, as assessed by the teachers.

6. ELIGIBILITY CRITERIA FOR APPEARING IN FINAL EXAMINATION

a. Candidate must have minimum 75% attendance in theory and in practical &lab postings for appearing in examination. In case a candidate does not have 75% attendance, he/she will not be permitted to appear in the final examinations and will have to make up the for deficit by attending the same session with the junior batch before being made eligible to appear in the final examinations and will not be admitted to the next year or level.

b. Candidate should have scored a minimum of 40% in the internal assessment in both theory as well as practical separately to be allowed to appear for the final examination examinations.

7. EXAMINATIONS:

a. The final examinations will be conducted at the of the academic year for all the three years.

b. The particulars of subjects for various examinations and distribution of marks are detailed in the Scheme of Examination.

8. ELIGIBILITY FOR THE AWARD OF THE DEGREE:

a. The candidates shall be eligible for the Degree of Bachelor of Science in Endoscopy Technology when they have undergone the prescribed course of study (Three Academic years) and have passed all the prescribed examinations in all subjects in AIIMS Bhubaneswar.

b. The maximum period to complete the course successfully should not exceed the period of six years.

9. MARKS QUALIFYING FOR A PASS

a. Candidate has to pass separately in theory and practical by getting a minimum of 50% marks in the aggregate marks obtained in internal assessment and final examinations.

b. If a candidate fails in either theory or practical, he / she has to reappear for both theory and practical.

c. If a candidate fails in any subject, a maximum of only three attempts (including the first attempt) are permitted for each subject. The student cannot appear for the next level of final examination without clearing the lower-level final examination.

d. If any candidate who could not pass all the subjects in spite of given three chances, including the regular chance their result shall be declared as failed and he/she has to appear in all the subjects of that year in the subsequent annual examinations.

TEACHING LEARNING ACTIVITIES

The course content for the prescribed subjects will be covered by:

1. Interactive Lectures
2. Practical
3. Clinical and bedside demonstrations
4. Seminars
5. Assignments
6. Hands on training

10. SYLLABUS FOR BSc (H) ENDOSCOPY TECHNOLOGY COURSE

The course will be divided into three academic years and there will be final examination at the end of each year of BSc(H) Endoscopy Technology. The scheme for the final examination is discussed below.

EXAMINATION SCHEME

Paper	Subjects	Maximum Marks (Theory)	Internal Assessment (Theory)	Total Theory Marks	Maximum Marks (Practical)	Internal Assessment (Practical)	Total marks (Practical)
1st Year							
Paper I	Basics of Human Anatomy	75	25	100	75	25	100
Paper II	Basics of Physiology	75	25	100	75	25	100
Paper III	Basics of Biochemistry	75	25	100	75	25	100
Paper IV	Biomedical Sciences and Basics of Endoscopy	75	25	100	75	25	100
2nd Year							
Paper-I	Endoscopy Techniques, Principles of endoscopy/ CSSD, Instrumentation, Stores & Inventory	75	25	100	75	25	100
Paper-II	Basics to the General Surgery & ENT, Obstetrics and Gynaecology, Orthopaedics	75	25	100			
Paper-III	Clinical Pharmacology & Clinical Microbiology	75	25	100			
Paper-IV	Basics to Gastroenterology, Surgical Gastroenterology, Pulmonary Medicine	75	25	100			
3rd Year							
Paper-I	Diagnostic and Therapeutic endoscopy	75	25	100	75	25	100
Paper-II	Urology, Paediatrics, and Basics of Nursing	75	25	100			
Paper-III	Endoscopic accessories, reprocessing, and recent advances in endoscopy	75	25	100	75	25	100
Paper-IV	Endoscopy Administration, Design, Documentation, Medico-legal, Record Keeping, IT	75	25	100			

1ST YEAR

I. BASIC ANATOMY OF HUMAN BODY

Anatomy is a key component of the education program for the BSc (H) Endoscopy Technician course and the student should have a strong focus in organ position, orientation, and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in patient management in various endoscopic procedures.

General Anatomy

- **Introduction** to anatomical terms and organization of the human body
- **Cell structure & function**
- **Tissues** – Definitions, Types, characteristics, classification, location, functions and formation

Systemic Anatomy

- **Respiratory System**: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura, endoscopic anatomy of respiratory system and thorax.
- **Cardiovascular System**: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system
- **Nervous System**: Structure of Neuroglia and neurons Parts and classification
    - CNS – Structure of Brain and spinal cord and their functions.
    - PNS - Cranial nerves and spinal nerves
    - ANS - Sympathetic and Parasympathetic
- **Musculoskeletal system**: Bones – types, structure, Axial & appendicular skeleton.
    - Bone formation and growth,
    - Joints – classification and structure.
    - Types and structure of muscles. Movements at the joints and muscles producing movements.
    - Endoscopic anatomy of joints
- **Lymphatic System**: Gross and microscopic structure of lymphatic tissue
- **GI System**: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas and related organs. brief endoscopic anatomy of GI tract
- **Excretory System**: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra and all related organs, brief endoscopic anatomy of excretory system
- **Endocrine System**: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal

glands and all related organs

- **Reproductive System**: Parts of the system. Gross structure of both male and female reproductive organs, brief endoscopic anatomy of female reproductive system.
- **Head & Neck:** Parts, structure of brain, skull, nose, ear, throat and all related organs, brief endoscopic anatomy of nose, throat, and skull etc.
- **Histology Techniques**
- **Embalming Techniques**
- **Museum Techniques**

Practical Exercise & Anatomy lab postings

- Identification and description of all anatomical structures
- Demonstration of all the system with dissected parts or models
- Histological examination of cells & tissues
- Demonstration of skeleton - articulated and disarticulated
- Hematoxylin and eosin staining of given paraffin section
- Describing endoscopic anatomy of various organs.

EXAMINATION PATTERN (Basic Anatomy)

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. BASICS OF PHYSIOLOGY

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how surgical intervention can modify the function and structure of outcomes.

- **Cell: Structure & function**
- **Blood:** Blood cells, names of developmental stages of RBC, functions and fate of RBC. Functions of WBC and platelets. Hemoglobin, Hematocrit& ESR, blood groups- ABO & Rh, basics of coagulation, classification of anemia.
- **Respiratory System**: Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide. Brief account of respiratory regulation. Definition of hypoxia,

Cyanosis, asphyxia. Methods of artificial respiration

- **Cardiovascular system**: Cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief
- **GI System:** Functional anatomy of G.I.T, functions of G.I secretions, principles of secretion and movements of GIT.
- **Nervous System**: Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Brief account of resting membrane potential, action potential and conduction of nerve impulse Neuro-muscle transmission. Various parts of nervous system, C.S.F., Functions of muscle spindle and motor tracts including reflexes, cutaneous receptors, joint receptors, sensory pathways. Ascending reticular formation, EEG, functions of cerebellum, basal ganglia, thalamus &hypothalamus, vestibular apparatus and functions. Autonomic nervous system.
- **Sensory System**: Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. Hearing: Brief account external, middle and inner ear, hearing tests. Taste & smell: receptors, pathways, method of transduction.
- **Reproductive system**: Reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation. Male sex hormones and spermatogenesis. Basis of contraception.
- **Endocrine System:** Names of endocrine glands & their secretions, functions of various hormones, Brief account of endocrine disorders
- **Muscular System**: Structure in brief, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor unit
- **Renal**: Structure of nephron, measurement and regulation of GFR, mechanism of urine formation. Clearance tests & values of insulin, PAH and urea clearance.

Practical Exercise & lab postings

- Study of appliances for hematology practical. Making blood smear, staining and use of microscope for identifying, blood cells. Preparation of diluting fluids for RBC and WBC counts. Principles of haemocytometry., RBC and WBC counts, DLC, platelet count, BT, CT, ESR, Hb estimation.
- Working principles and recording of chest movements with stethograph, ECG, Blood pressure, radial pulse.
- Spirometry –recording of lung volumes and capacities.
- Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses
- Demonstration of nerve reflexes & stimulus
- **EXAMINATION PATTERN (Basics of Physiology)**
- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**

- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

III. BASIC BIOCHEMISTRY

A basic knowledge of biochemistry is essential to understand how the body handles various metabolic processes including acid-base balance and imbalance. It is also important to know the science behind nutrition and what are carbohydrates, proteins, lipids, minerals and vitamins and what will happen in their deficiency.

The broad outline of the course will be:

- Carbohydrates – Glucose and Glycogen Metabolism
- Proteins-Classification of proteins and functions
- Lipids- Classification of lipids and functions
- Enzymes- Definition, Nomenclature, Classification, Factors affecting enzyme activity, Active site. Coenzyme, Enzyme Inhibition, Units of enzymes, Isozymes and Enzyme pattern in diseases
- Vitamins & Minerals- Fat soluble vitamins (A, D, E, K), water soluble vitamins, B-complex vitamins, principal elements (Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and Sulphur), trace elements, calorific value of foods, Basal Metabolic Rate (BMR), Respiratory Quotient (RQ), Specific Dynamic Action (SDA), balanced diet, Marasmus and Kwashiorkor
- Acids and Bases-Definition, pH, Henderson – Hassel Balch equation, Buffers, Indicators, Normality, Molarity, Molality
- Hormones
- Applied Chemistry:

PRACTICAL

- Introduction- Aim, basis, interpretation, safety in clinical biochemistry Laboratory
- Laboratory organization
- Instruments, glassware, sample collection & specimen labeling, routine tests,anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization ofmethods, preparation of solution & interpretation of result, normal values.
- Identification of Carbohydrates (qualitative tests).
- Identification of Proteins (qualitative tests).
- Qualitative tests of lipids
- ABG analysis
- Serum Urea and Creatinine estimation

- Serum Sodium and Potassium
- Pathological Urine Analysis

TEXT BOOKS RECOMMENDED

1. Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
2. Text book of Medical Biochemistry by Ramakrishna
3. Text Book Biochemistry by Vasudevan and SreeKumari

EXAMINATION PATTERN

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

IV. BIOMEDICAL SCIENCES AND BASICS TO ENDOSCOPY

Bio-medical science is essential for the Endoscopy technologist since he/she will have to continuously deal with various kinds of equipment and should be able to understand their working and be able to trouble shoot any equipment problems. Although a broad understanding of the physics behind machines will be dealt with, it will be mainly related to endoscopes and surgical equipment.

The broad outline of the course will be:

- **Fundamentals of Medical Instrumentation**

Role of Technology in medicine; Landmark developments in Biomedical Instrumentation; Physiological Systems of the body: The Cardiovascular System, The Respiratory System, The Nervous System, Other Systems (Biological Variables); Sources of Biomedical Signals: Bio-Electric Signals, Bio-Acoustic Signals, Bio-Mechanical Signals, Bio-Chemical Signals, Bio- Magnetic Signals, Bio-Optical signals, Bio-Impedance Signals, Signal-to-Noise Ratio; Basic Medical Instrumentation System; Performance Requirements of Medical Instrumentation Systems; Intelligent Medical Instrumentation Systems; Consumer and Portable Medical Equipment; Implantable Medical Devices; Micro-Electro-Mechanical Systems (MEMS); Wireless Connectivity in Medical Instruments; General Constraints in Design of Medical Instrumentation System; Regulation of Medical Devices: Regulations, Standards, Codes, Specifications, Types of Standards, Regulatory Requirements, Definitions of Common Terms; Equipment Classification based on Method of Protection: Class-I, Class-II, Class-III Products; Equipment Types based on Degree of Protection.

- **Bioelectric Signals and Electrodes**

Origin of Bioelectric Signals: Electrocardiogram, Electroencephalogram, Electromyogram; Recording Electrodes: Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts; Ag-AgCl Electrodes; Electrodes for ECG: Limb Electrodes, Welsh Cup Electrode or Suction Electrode, Floating Electrodes, Pregelled Disposable Electrodes, Pasteless Electrodes, Fabric-based Electrodes; Electrodes for EEG; Electrodes for EMG; Electrical Conductivity of Electrode Jellies and Creams; Microelectrode: Glass Microcapillary Electrodes, Metal Microelectrodes.

- **Biomedical Recorders**

Electrocardiograph: The ECG Leads, Effects of Artifacts on ECG Recording, Multi-Channel ECG Machine; Vector Cardiograph (VCG); Phonocardiograph (PCG): Origin of Heart Sound, Microphones for Phonocardiography, Writing Methods for Phonocardiography; Digital Stethoscope; Electroencephalograph (EEG): Block Diagram Description of Electroencephelograph, Recording of Evoked Potential; Electromyograph (EMG): Common Artifacts in EMG; Other Biomedical Recorders: Apexcardiograph, Ballistocardiograph (BCG), Electro-oculography, Electroretinograph (ERG); Bio-Feedback Instrumentation: Electrodermal Activity.

- **Patient Monitoring Systems**

System Concepts; Cardiac Monitor; Bedside Patient Monitoring Systems; Central Monitors;

Measurement of Heart Rate: Average Calculation, Beat-to-Beat Calculation, Combination of Beat-to-Beat Calculation with Averaging, Average Heart Rate Meters, Instantaneous Heart Rate Meters; Measurement of Pulse Rate; Blood Pressure Measurement: Direct Methods of Monitoring Blood Pressure, Indirect Methods of Blood Pressure Measurement, Automatic Blood Pressure Measuring Apparatus using Korotkoff's method, The Rheographic method, Differential Auscultatory Technique, Oscillometric measurement method, Ultrasonic Doppler Shift method; Measurement of Temperature; Measurement of Respiration Rate: Displacement method, Thermistor method, Impedance Pneumography, CO2 method of Respiration Rate measurement, Apnoea Detectors; Catheterization Laboratory Instrumentation.

- **Arrhythmia and Ambulatory Monitoring Instruments**

Cardiac Arrhythmias; Arrhythmia Monitor; QRS Detector Techniques: ST/AR Arrhythmia Algorithm, Detection of Ventricular Fibrillation; Exercise Stress Testing: Treadmill Test, Bicycle Test, Stress Testing Instrumentation; Ambulatory Monitoring Instruments: Ambulatory ECG Monitoring (Holter Monitors, Event Recorders, Real-Time Continuous Cardiac Monitoring Systems, Implantable Loop Recorders), Ambulatory ECG with Wearable Electrodes, Microwave Sensor based Ambulatory Monitoring, Implantable Cardiac Monitors, Ambulatory Blood Pressure Monitoring.

- **Oximeters**

Oximeters: In Vitro Oximetry, In Vivo Oximetry; Ear Oximeter; Pulse Oximeter; Skin Reflectance Oximeter; Intravascular Oximeter.

- **Blood Flow and Cardiac Output Measurement**

Blood Flow measurement: Electromagnetic Blood Flow Meter, Ultrasonic Blood Flow Meter, NMR Blood Flow Meter, LASER Doppler Blood Flow Meter; Cardiac Output Measurement: Indicator Dilution method, Dye Dilution method, Thermal Dilution techniques, Measurement of Continuous

Cardiac Output derived from the Aortic Pressure Waveform, Impedance Technique, Ultrasound method, Bioreactance method, CO2 Rebreathing method.

- **Pulmonary Function Analyzers**

Pulmonary Function Measurements: Respiratory Volumes, Respiratory Capacities, Compliance and Related Pressures, Dynamic Respiratory Parameters; Spirometry: Basic Spirometer, Wedge Spirometer, Ultrasonic Spirometer; Pneumotachometers: Fleisch Pneumotachometer, Venturi type Pneumotachometer, Turbine type Pneumotachometer; Measurement of Volume: Flow- Volume Curve, Area of the Flow-Volume, Nitrogen Washout technique; Pulmonary Function Analyzers: Impedance Pneumograph; Respiratory Gas Analyzers: Infrared Gas Analyzers, Paramagnetic Oxygen Analyzer, Polarographic Oxygen Analyzer, Thermal Conductivity Analyzer, N2 Analyzer based on Ionization technique.

- **Patient Safety**

Electric Shock Hazards: Gross Shock, Effects of Electric Current on the Human Body, Micro-current Shock, Electrophysiology of Ventricular Fibrillation; Leakage Currents: Types of Leakage Current, Precautions to be minimize Electric Hazards; Safety Codes for Electro- Medical Equipment.

- **Orientation to OT**

List of OR equipment (Anesthesia machine, Monitor, Defibrillators, Electrocautery, Laparoscopes, Pulse Oximeter, Suction Apparatus etc), Gas Plant, Oxygen Concentrator Plant- Introduction, usage, safety features & application

- **Instruments for Surgery**

Principle of Surgical Diathermy: Cutting, Coagulation, Fulguration, Desiccation; Surgical Diathermy Machine, Automated Electrosurgical Systems (Size and Shape of the Cutting Electrode, Type and Speed of Cut, Different Tissue Properties, Soft Coagulation, Forced Coagulation, Spray Coagulation), Electrosurgery Techniques (Mono-Polar Techniques, Bi-Polar Techniques), Electrodes used with Surgical Diathermy (Needle Electrode, Angulated Lancet Electrode, Wire Loop Electrode, Angulated Band Loop Electrode, Straight Lancet Electrode, Shape and Sizes of Coagulation Electrodes); Safety Aspects in Electrosurgical Units, Burns, High Frequency Current Hazards, Explosion Hazards; Surgical Diathermy Analyzers.

- **Anaesthesia Machine**

Need for Anaesthesia; Anaesthesia Machine: Gas Supply System, Gas Flow Measurement and Control, Vapour Delivery System (Variable Bypass Vapourizer, Measured Flow Vapourizer), Gas Delivery System, Humidification, Patient Breathing System, Ventilators, Scavenging, Monitoring System; Capnography

- **Ventilators**

Mechanics of Respiration; Artificial Ventilation; Types of Ventilators: Anaesthesia Ventilators, Intensive Care Ventilators; Ventilator Terms: Lung Compliance, Airway Resistance, Mean Airway

Pressure (MAP), Inspiratory Pause Time, Inspiratory Flow, Expiratory Flow, Tidal Volume, Minute Volume, Respiration Rate, Conventional Mechanical Ventilation (CMV), Intermittent Mandatory Ventilation (IMV), Inspiratory Expiratory Phase Time Ratio (I:E Ratio), Synchronized Intermittent Mandatory Ventilation (SIMV), Sigh Volume, Patient Circuit, Oxygen Percentage (F1O2), Peak Airway Pressure, Spontaneous Ventilation, Bias Flow, Sensitivity, Mandatory Minutes Volume Ventilation (MMV), Controlled Mandatory Ventilation, Assisted Spontaneous Breathing (ASB), Positive End Expiratory Pressure (PEEP), Continuous Positive Airway Pressure (CPAP), Assist / Control Ventilation, Pressure Relief Valve; Classification of Ventilators: Based on the method on Inspiratory Phase, Based on Power Transmission, Based on Pressure Pattern, Based on the type of Safety Limit, Based on Cycling Control (Cycling from Inspiration to Expiration, Cycling from Expiration to Inspiration), Based on the Source of Power; Pressure-Volume-Flow Diagrams; Modern Ventilators; High Frequency Ventilators; Humidifiers, Nebulizers and Aspirators.

- Introduction to Endoscopes

Electro-optics (Fiber Optics and LASERS): Fiber-Optic Technology, History of fiber Optics, basics, fiber optic & application in medical equipment; LASERS-Introduction, basic concepts, types & application, Introduction to Electronics &Semi-conductors: Basic terminology & definitions – Voltage, Current, resistance, capacitance, inductance, conductor, semi-conductor, power, energy, rectifier, transformer, impedance. Ohm's law, difference between resistance & impedance, basic network analysis concepts, types of current-AC & DC; electrical receptacle; difference between AC & DC, fuses & circuit breakers, Theory of semiconductors, semiconductor diode & applications, transistor & characteristics. Special devices like LED, photo diode, diac, triac, FET & MOSFET etc

- Orientation to Endoscopes

Orientation of endoscopy and Familiarization to Endoscopes, Documentation- Familiarization with output, video photos., Endoscopy Suite /OT etiquette and protocols, Prerequisites for the endoscopy procedure – General Principles, consent, registration and basic work up , Pre and Post-operative/ procedure rooms , Introduction to endoscopes and General care in handling endoscopes , Endoscopes – different parts and their maintenance. Infection control during endoscopy, reprocessing failure of endscopes.

PRACTICALS

- Equipment Available: Specification, Name Plate, Use and It's importance
- Packing and unpacking of equipment
- Accessories: Importance of accessories and its uses.
- Manuals: Installation Manual, Operation Manual, Maintenance Manual; Subsystems and Functions
- Guarantee and Warranty
- Test Reports / Certificates
- Standards and Calibration
- Hazards & Safety, Precautions, Alarms and Warning.
- Sterilization and Storage

- Endoscope types
- Endoscope Characteristics:
- Equipment Characteristics: Error, Accuracy, Precision, Resolution, Sensitivity, Range, Span, Offset, Drift, Linearity, Threshold, Saturation, Conformance, Repeatability, Reproducibility, Reliability.
- Sources of Error: Installation Error; Operation Error; Interference Error; Equipment Error
- Record Keeping: (a) Operation Record: Log Book, date, time, number of operations, problems faced if any; (b) Maintenance Record: daily, periodic, annual, preventive; (c) Consumables Record: storage, safety, expiry, date & time of requisition, date & time of arrival, time gap between requisition and availability; (d) sterilization record: list of accessories to be sterilized, procedure adopted.
- Treatment of Biomedical Disposable / Waste Materials
- Measurement Device- Usage of Digital Multimeter, measuring voltage, resistance, continuity & temperature. Measures the AC voltage in a Power cord
- Battery-introduction, Care & maintainence. Nickel-cadmium cells and batteries. Measures different types of batteries (Nickel-cadmium cells and batteries, Lead-acid batteries, Mercury dry cells, carbon-zinc and alkaline dry cells, Gel cell batteries & lithium cells).Battery charging protocols.
- Introduction, Safety features & peruse check for Electro Surgery Unit (or) Diathermy, Multipara patient monitors, Pulse Oximeter, light source, Sphygmomamometer.
- Electromagnetic Interference to Medical Electronic Equipment
- Computers in Biomedical Equipment
- Electrical Safety in the Medical Environment

EXAMINATION PATTERN

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

COMPUTERS & LABORATORY INFORMATICS

- Introduction: Concepts of computers, Characteristics & generation of computers, Basic organization of computers, Hardware & software: trends & technology
- Introduction to disc operating system: DOS, Windows, Introduction to MS office- MS word, PowerPoint, excel etc.

- Uses of computers & applications: Multimedia: types & uses of computer in teaching and test, uses of internet & email, statistical packages & its use, applications of computer, application of computers in laboratory.
- Laboratory informatics: General purpose, Concept of medical equipment interface with computers. Methodologies and modalities of data transfer from medical equipment to computers. Reporting using various equipment.

ENGLISH (60 Hours)

- **Introduction:** Study techniques, Organization of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary& effective diction.
- **Applied Grammar**: Correct usage, the structure of sentences- Tenses, Active & passive, Direct & indirect, Prepositions, Articles. Structure of paragraphs.
- **Written Composition**: Letter writing, paragraph writing, Precise writing and Diary writing
- **Reading and comprehension**: Review of selected materials and express oneself in one's words, building of vocabulary
- **Verbal communication**: Panel discussions and summarization, debates, oral reports, use in teaching

REGIONAL LANGUAGE: ODIYA (30 HOURS)

2ND YEAR

I. ENDOSCOPY TECHNIQUES, PRINCIPLES OF ENDOSCOPY, CSSD, INSTRUMENTATION, STORES & INVENTORY

Basics of anaesthesia

Respiratory system

- Structure and function of the respiratory tract in relation to respiratory system
- Nose - Role in humidification
- Pharynx - Obstruction in airways
- Larynx - Movement or vocal cords, Cord palsies.
- Trachea & Bronchial tree - vessels, nerve supply, respiratory tract, reflexes, bronchospasm
- Alveoli - Layers, Surfactants
- Respiratory Physiology
- Control or breathing
- Respiratory muscles - diaphragm, intercostals
- Lung volumes - dead space, vital capacity, FRC etc.
- Pleural cavity - intrapleural pressure, pneumothorax.
- Work of breathing - airway resistance, compliance
- Respiratory movements under anesthesia
- Tracheal tug - signs, hiccup
- Pulmonary Gas Exchange and Acid Base Status
- Pulmonary circulation
- Pulmonary oedema
- Pulmonary hypertension
- Pulmonary function tests
- Transfer of gases - oxygen & Carbon dioxide
- Acid base status, definitions, acidosis types, Alkalosis types, buffers in the body
- Oxygen: properties, storage, supply, hypoxia
- Respiratory failure, type, clinical features, causes.
- Cardiovascular system
- Anatomy

- Chambers of the heart, major vasculature
- Coronary supply, innervation
- Conduction system
- Cardiac output - determinants, heart rate, preload, after load
- Coronary blood flow& myocardial oxygen supply
- ECG: Arrhythmias, cardiovascular response to anesthetic & surgical procedures.
- Hypotension - causes, effects, management
- Cardio-pulmonary resuscitation
- Myocardial infarction, hypertension
- Fluids and electrolytes
- Body Fluids – Composition: water, sodium and potassium balance
- Intubation various drugs, different types of anesthesia, Bascis of short GA, and its drugs and patient preparation and post procedure monitoring

Basics of Layout of Endoscopy suite

- Lighting in endoscopy suite including emergency lighting
- Use, care, maintenance and sterilisation of the common types of instruments, needles, suture and ligatures used in endoscopy procedures
- Details of operating room techniques including aseptic practices.
- Care of patients undergoing endoscopic procedures with pre-existing medical conditions (diabetes, hypertension, cardiac arrhythmia, MI, pulmonary and renal insufficiency)
- Cleanliness and sterilisation of Endoscopy Suite & Operation theatres and patient care areas
- Procedure for sending specimen for biopsy and fluid for culture
- Identification of instruments for common Endoscopic procedures operations and examinations, such as: - UGI Scopy, Colonoscopy, Bronchoscopy, Esophagoscopy, Fibre optic laryngoscopy, sinoscopy, basic laparoscopy
- Setting up of tray/ trolleys for various endoscopic procedures / Surgeries
- Preparation of dressings, swabs and packs packing of drums and sterilization
- Assisting the scrub nurse/surgeon/physician & organizing the endoscopic trolleys for various procedures.
- Endoscopy OT Stores – Indenting, storekeeping, accounting and Inventory Management
- Bio hazards and safety in medical devices
- Care of endoscopes

CSSD Techniques

- Principles of sterilization and disinfection
- Methods of sterilization: Dry Sterilization, Wet sterilization, Gaseous sterilization, Chemical sterilization, Sterilization by radiation (Gamma rays, ultraviolet rays)
- Techniques of sterilization of rubber articles. (LMA, FOB, ETT, Laryngoscopes, Anesthesia machines and circuits.)
- Technique of sterilization of carbonized articles
- Methods of disinfection: Boiling, Chemical disinfection
- Hazards of sterilization & Prevention of hazards of sterilization
- Precautions to be taken during sterilization
- Recent advances in the methods of sterilization
- Waste disposal collection of used items from user area, reception protective clothing and disinfection safe guards
- Use of disinfectants, sorting and classification of equipment for cleaning purposes, sharps, blunt lighted etc. contaminated high risk baby care - delicate instruments or hot care instruments
- Cleaning process - use of detergents. Mechanical cleaning apparatus, cleaning instruments, cleaning jars, receivers bowls etc. trays, basins and similar hand ware utensils. Cleaning of catheters and tubing, cleaning glass ware, cleaning syringes and needles
- Materials used for wrapping and packing assembling pack contents. Types of packs prepared. Inclusion of trays and parts in packs, Method of wrapping and making use of indications to show that a pack of container has been through a sterilization process date stamping
- General observations principles of sterilization. Moist heat sterilization. Dry heat sterilization, EO gas sterilization.H202 gas plasma vapor sterilization

EXAMINATION PATTERN

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. BASIC TO THE GENERAL SURGERY, ENT, OBSTETRICS AND GYNAECOLOGY, ORTHOPAEDICS

- Anatomy of Musculoskeletal system: Bones – types, structure, Axial & appendicular skeleton, Joints – classification and structure.
- Common diseases of musculoskeletal system
- Orthopaedic surgeries including arthroscopy (Basic Knowledge)
- Anatomy of ENT: parts, structures, bones, nerve supply, blood supply, endoscopic view of ENT system
- Common diseases of ENT
- ENT surgeries and laryngoscopy & removal of foreign bodies, polypectomies (Basic Knowledge) Instruments & drugs: Specific instruments used in ENT Surgery
- Anatomy of human reproductive system
- Common diseases of human reproductive system
- Obstetric surgery: Normal labour/Abnormal labour/ Ectopic pregnancy/ /MTP - MTP act - Legal and ethical aspect, Methods, complications, Tubectomy - Postpartum, Mini laparotomy and lap TL (Basic Knowledge)
- Gynaecological operations: Hysterectomy /Cystectomy/ Myomectomy/ Sling surgery/SUJ repair/ Sacropexy/ Wertheim's/ VVF repair/Tuboplasty/Cyto-reduction for ca ovary/Cx Bx /D&C/ Endometrial Bx/Bartholin Cyst excision. Diagnostic and gyn laparoscopy for infertility and other disorders, TL, LAVH, Ovarian cystectomy (Basic Knowledge), colposcopy etc. (basic knowledge)
- Various General surgeries including laparoscopic surgeries Basics of Laparoscopy, Instrumentation, Technique

III. PAPER III- CLINICAL PHARMACOLOGY & CLINICAL MICROBIOLOGY

Clinical Pharmacology

Knowledge of clinical pharmacology is expected to strengthen the roots of the student undergoing the course since he/she is expected to deal with multiple drugs that are used in the theatres, critical care areas and endoscopy suites.

- Antisialagogues: Atropine, Glycopyrrolate
- Sedatives & Anxiolytics: Diazepam, Midazolam, Phenergan, Lorazepam, Chlorpromazine, and Triclofos
- Narcotics: Morphine, Pethidine, Fentanyl, Pentazozine, tramadol
- Antiemetics: Metoclopramide, Ondanseteron, Dexamethasone
- Induction Agent: Thiopentone, Diazepam, Midazolam, Ketamine, Propofol, Etomidate
- Muscle Relaxants: Depolarizing – Suxamethonium; Non depolarizing – Pancuronium,

Vecuronium, Atracurium, Rocuronium

- Inhalational Gases: Gases-O_2, N_2O, Air;VolatileAgents-Halothane, Isoflurane, Sevoflurane, Desflurane
- Reversal Agents: Neostigmine, Glycopyrrolate, Atropine, Naloxone, Flumazenil
- Local Anesthetics: Xylocaine, Bupivacaine; Topical, Prilocaine-jelly, Emla - Ointment, Etidocaine. Ropivacaine.
- Emergency Drugs: Mode or administration, dilution, dosage and effects Adrenaline, Atropine
- Ephedrine,Mephentramine, phenyl-epherine
- Bicarbonate, calcium, potassium
- Inotropes: dopamine, dobutamine, noradrenaline
- Anti-arrythmics- amidarone, xyolcard
- Aminophylline, hydrocortisone, antihistaminics
- Antihypertensive –Beta-blockers, Ca-channel blockers, ACE inhibitors
- Vasodilators- nitroglycerin & sodium nitroprusside
- Respiratory system- Bronchodilators
- Renal system- Diuretics, frusemide, mannitol
- GI medications: Cholinergics, Anticholinergics, vasopressors, antacids, PPIs, antiemetic, emetics, laxatives, fluid and electrolytes

Clinical Microbiology

Knowledge of microbiology will help the technologist to understand the basis of disease-causing pathogens and methods to deal with them, including asepsis.

THEORY

- Morphology
    - Classification of microorganisms, size, shape and structure of bacteria
    - Use of microscope in the study of bacteria.
- Growth and nutrition
    - Nutrition, growth and multiplications of bacteria
    - Use of culture media in diagnostic bacteriology
    - Antimicrobial sensitivity test
- Sterilization and Disinfection
    - Principles and use of equipment of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptic and disinfectants

- Immunology
    - Immunity, vaccines, types of vaccine and immunization schedule, principles and interpretation of common serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA

- Rapid tests for HIV and HBsAg (excluding technical details)
- Systematic Bacteriology
    - Morphology, cultivation, diseases caused, laboratory diagnosis including specimen collection of the following bacteria (excluding classification, antigenic structure and pathogenicity)
    - Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, C. diphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, E. coli, Klebsiella, Proteus, Vibrio cholerae, Pseudomonas & Spirochetes
- Parasitology
    - Morphology, life cycle, laboratory diagnosis of following parasites: E. histolytica, Plasmodium, tape worms, Intestinal nematodes
- Nosocomial infections
- Bio-medical waste management

IV. BASICS TO GASTROENTEROLOGY, SURGICAL GASTROENTEROLOGY AND PULMONARY MEDICINE

- Anatomy of GI system: Parts, Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.
- Common Diseases of Upper GI Tract, Dysphagia, Achalasia, Cancer of the Esophagus, Diverticulae
- Polyps of stomach, gastric cancer, duodenal ulcers, Bleeding lesions, Helicobacter Pylori infection and Antral Gastritis
- Common diseases of the colon, cancer colon, polyps, diverticulae, granulomatous colitis, Ulcerative colitis, Crohn's Disease, Functional diseases, benign strictures of the colon,
- Disorders of pancreas
- Diseases of hepatobiliary system & Surgeries of Hepatobiliary system
- Bariatric surgeries
- Anatomy of pulmonary system: Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura, Brocnhoscopic view of respiratory system.
- Various respiratory diseases including diagnostic methods

- Introduction to bronchoscopy and its details
- Various interventions and procedures done during bronchoscopy
- Introduction to Endobrochial ultrasound
- Basics of Video Endoscopy Instrumentation, Mechanics, mechanics, magnification etc.
- Diagnostic Upper GI scopy, Injection Sclerotherapy,Gastric Biopsy, Procedures to acquire tiisue samples, procedures for hemostatis, dialatation procedures, foreign body removal., basics to ERCP
- Common Laparoscopic procedures, Appendix, Cholecystectomy etc

3RD YEAR

I. DIAGNOSTIC AND THERAPEUTIC ENDOSCOPY

- Gastrointestinal Surgery: Endoscopies, Drainage of pancreatic Cyst (pseudocyst), Resections of Small Bowel, Sigmoid Colon and rectum; Hemi & total Colectomy; Colostomy: Closure of colostomy, Drainage of abscess(es) in the region of the liver, Hepatic Resection
- Endoscopic procedures and bronchoscopy procedures
- Thoracotomy, thoracoplasty, ICD insertion, Costal drainage, Lobectomy, pneumonectomy, Decortication of the Lung (Basic),
- Excision of mediastinal tumours including thymus, Constrictive pericarditis (Basic)
- Portal Hypertension, Esophageal Varices, Gastric Varices
- Indications of Treatment of Bleeding lesions in the oesophagus, Glue Injection and EVL
- Gastric Polyp resection, Percutaneous Endoscopic Gastrostomy, Percutaneous Jejunostomy
- Dilatation of strictures of oesophagus, Balloon, bougies, CRE Balloons
- Dilatation of Achalsia cardia and injection of Botropase
- Placement of Various types of plastic and Expansible stents in the oesophagus for benign and malignant lesions of Oesophagus
- ERCP – Basic Introduction
- ERCP Procedure, Premedication, position, stone retrieval and placement of stent, removal of stones from PD and CBD
- Gastroduodenal stenting, SEMS and LAMS
- Laparoscopic URO Procedures, Ureteric stones, Lap Pyeloplasty, Basic understanding of the uro-surgical procedures and diseases needing laparoscopy
- Colonoscopy and various procedures
- Emergency de-rotation of colon in sigmoid volvulus

EXAMINATION PATTERN

- **Theory exam (one paper): 75 marks**
- **Practical exam: 75 marks (including viva voce)**
- **Internal assessment (theory): 25 marks**
- **Internal assessment (practical): 25 marks**
- **Total marks (theory + practical + internal assessments): 200 marks**

II. UROLOGY, PEDIATRICS AND BASICS OF NURSING

- Anatomy of human excretory system: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra
- Common Urological disorders
- Laparoscopic Urological Procedures, Ureteric Stones, Laparoscopic pyeloplasty, basic understanding of uro-surgical procedures and conditions needing laparoscopy, cystoscopy
- URS, Lithotripsy Transurethral resection of Prostate, LASER, treatment for BEP
- Common diseases of infants, and child
- Hospital admission and discharge, Admission procedure, Special considerations in Medico-legal issues, Discharge from the hospital Types: Planned discharge LAMA and abscond, Referrals and transfer, Discharge Planning, Discharge procedure
- Various positions during Endoscopy/ operations Lithotomy position, ante- Trendelenburg's position,
- Nursing care in patient Monitoring: Blood pressure, heart rate, temperature, CVP, ECG, PAWP, Pulse Oxymeter (SPO2) (Basic)
- Electrical and Fire Hazards Prevention of physical, electrical, chemical injuries / hazards to patient
- I.V. Fluids - composition & administration
- I.V. Cannulation
- Blood Transfusion & hazards of blood transfusion n and nursing care in blood transfusion (Basic Knowledge)
- Mechanical ventilation and nursing care of patients with mechanical ventilation
- RT feeding and nursing care of patients with ryles tube, Tracheostomy and Nursing care of tracheostomy patients
- Shock –Pathophysiology, of different types of shock and management and Nursing care in shock (basic knowledge)
- Pain- Pathophysiology of pain, nursing care & management of patients in pain
- Emergency Management of critical / emergency patients including first aid.
- BLS and ACLS

III. ENDOSCOPIC ACCESSORIES, REPROCESSING AND RECENT ADVANCES IN ENDOSCOPY

- Double balloon enteroscopy, Single ballon enteroscopy
- Capsule endoscopy, Different types of capsules, recording downloading data and report generation
- Pancreatic diseases needing the ERCP procedure

- Placement of Expansible stents in Antrum, duodenum, colo-rectum
- Endoscopic procedures for enteral access and feeding
- Endoscopic ultrasound, endo-brochial ultrasound and its various procedures
- Third space endoscopic procedures
- Care and reprocessing of endoscopic various accessories including Biopsy forceps, variceal band ligators, Variceal injectors, Sphinterotome, ERCP cannula, lithotripser, biliary stents, percutaneous endoscopic gastrostomy set, haemorrhoid, pH metry accessories, polypectomy snare, savary gilliard dialators, achalasia ballons, esophageal motility and anorectal motility aceesoris
- Different types of diathermy machine. Monopolar, Bipolar, Ligature, Harmonic Scalpel, CUSA-Principle, hazards, prevention, functioning and maintenance
- Basics of fluoroscopy and handling of C Arm machines
- Suction apparatus and care of suction apparatus
- Recent advances in endoscopy and GI laparoscopy.

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IV. ENDOSCOPY ADMINISTRATION, DESIGN, DOCUMENTATION, MEDICO LEGAL, RECORD KEEPING, IT

- Organization of Hospital - Organization of Endoscopy rooms - Single and Multiple theatre units - Elective and emergency endoscopies, ambulatory surgery.
- Admission & Transfer procedure; maintenance of Operative Records
- Documentation and Reporting

  Documentation: Purpose of Recording and reporting, Communication within the Health Care Team, Types of records; ward records medical/nursing records, Common record-keeping forms, Computerized documentation, Guidelines for Reporting: Factual Basis, Accuracy, Completeness Correctness, Organization, confidentiality, Methods, confidentiality, Methods of Recording, reporting: Transfer reports, Incident reports Minimizing Legal Liability through effective record keeping
- Communication and technician patient relationship

  Communication: Levels, Elements, Types, Modes, Process, Factors influencing Communication, Methods of Effective Communication, - Attending skills - Rapport building skills - Empathy

skills, Barriers to effective communication, Helping Relationship: Dimensions of Helping Relationship, Phases of a helping relationship, Communicating effectively with patient, families and team members and maintain effective human relations with special reference to communicating with vulnerable 18 group (children, woman, physically and mentally challenged and elderly)

Patient Teaching: Importance, Purposes, Process, role of technician

- Assignments-Individual and team function
- Moral- employee
- Ethical and legal issues in Operation theatre and Anesthesia
- Computers in endoscopy

SUGGESTED TEXT BOOKS FOR READING

1. "Handbook of Medical Instrumentation" by R S Kanpur. McGraw Hill Education (India) Private Limited
2. Arun Kumar Paul's Drugs and Equipment's in Anaesthetic practice by Churchill Livingstone
3. Anantnarayana and Paniker. Textbook of pharmacology
4. CP.Baveja. Textbook of Microbiology for nurses.4th Ed. Arya Publishing Company; 2014.
5. Seema Sood. Microbiology for Nursing Students & Nurses. 2nd Ed. Elsevier India Pvt.Ltd; 2006.
6. Fuller JK , Ness E Surgical Technology Principles and Practice , Ed 4; Elsevier
7. Step by step Critical Care: Arun Paul ;2nd edition : Jaypee publisher
8. Principles and practice of critical care; P.K Verma; B.I Publications Pvt.Ltd, New Delhi
9. Anatomy by B.D. Chaurasia
10. Microbiology & Sterilization by Anant Narayan
11. Basic Surgical Skills Pyse's Surgical Handicrafts.
12. Handbook Of Operation Theatre Techniques - Publisher: jaypee
13. Operating Room Technique - Berry And Kohn's -Publisher: Mosby Elsevier Health Science
14. Operating Room Technique – Raymond John Brigden
15. The Operating Room Aide -Publisher: Career Pub
16. Atlas of Textbook of laparoscopic surgery Dr. C. Pallenivelu
17. Operating theatre nursing- MC Warren Publisher: Lippincort Publishing series
18. Surgical Nursing and Technique: A book for nurses, dressers, house surgeons - CharlesPlumley Childe
19. Perioperative Nursing - Linda Shields, Helen Werder

20. Humphry and Reynolds Nurse's service digest: A Manual of Nursing

21. Textbook of Surgical Treatment including Operative Surgery - Charles Frederick William Illingworth

22. Atlas of upper GI Endoscopy Ibrar Hullah

23. Basic of Endoscopy Sinus Surgery Dr. Renuka Bradeo

24. Textbook of ENT diseases Ballinger For laryngoscopy/Oesophagoscopy/ Bronchoscopy

25. Cotton and Williams' Practical Gastrointestinal Endoscopy: The Fundamentals 8th Edition by Ph.D. Walsh, Catharine M., M.D etal.

26. Sleisenger and Fordtran's Gastrointestinal and Liver Disease- 2 Volume Set: Pathophysiology, Diagnosis, Management 11th Edition

27. Greenberger's CURRENT Diagnosis & Treatment Gastroenterology, Hepatology, & Endoscopy, Fourth Edition (Current Medical Diagnosis & Treatment in Gastroenterology)

28. Medical laboratory Procedure Manual (T-M) by K.L. Mukherjee 1987, Vol.I, II & III Tata McGraw Hill Publication.

29. Text book of Medical Biochemistry by Ramakrishna

30. Text Book Biochemistry by Vasudevan and SreeKumari