**Subject: Human Anatomy**

**Subject Code: BMRIT - 001**

## RATIONALE

Anatomy is a key component of all education programmes for MRITs 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 preparation and positioning. The radiographic anatomy component will enable MRITs to evaluate images prior to reporting by the radiologist.

## COURSE OUTCOMES

At the end of the course students will be able to...

**CO1:** Describe the general anatomy of human body

**CO2:** Explain normal disposition of various structures and organs in the body and its clinical correlation

**CO3:** Describe the microscopic structure of various tissues

**CO4:** Determine the topography of various structures on the surface of the body

**CO5:** Identify and locate structures of the body

**CO6:** Identify organs and tissues under microscope

**CO7:** Point out various features of appearance of normal body in skiagrams

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | **T** | **P** | **C** | **CIE** | **ESE** | **CIE** | **ESE** | |
| **3** | **--** | **--** | **3** | **30** | **70** | **--** | **--** | **100** |

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

## TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Unit | Topic and contents | Hours | Marks |
|---|---|---|---|
| **I** | **Introduction: Human Body as a Whole**<br>Definition of anatomy and its subdivisions, Terms of location, positions and planes, Cell and its organelles, Epithelium – definition, classification, describe with examples, functions, Glands – classification, describe serous and mucous glands with examples, Basic tissues – classification with examples | **08** | 14 |

| | | | |
|---|---|---|---|
| **II** | **Locomotion and Support**<br><br>Cartilage – types, examples and histology<br><br>Bone – classification, examples and histology. Parts of long bone, names of all bones, vertebral column and intervertebral disc. Fontanel's of fetal skull.<br><br>Joints – classification of joints with examples, typical synovial joint (in detail). Muscular system – classification of muscular tissue and histology<br><br>Important muscles of the body- Sternocleidomastoid, Trapezius, Muscles of tongue, Deltoid, Biceps brachii, Intercostal muscles, Thoracic diaphragm, Rectus abdominis, External oblique, Internal oblique, Transversus abdominis, Pelvic diaphragm, Gluteus maximus, Gluteus medius, Gluteus Minimus, Quadriceps femoris, Soleus. | **08** | 14 |
| **III** | **Cardiovascular System**<br><br>Heart – size, location, chambers, exterior and interior, Blood supply of heart, Pericardium, Systemic and pulmonary circulation, Branches of aorta - common carotid artery, subclavian artery, Axillary artery, brachial artery, radial artery, superficial palmar arch, femoral artery, popliteal artery, dorsalis pedis artery., Peripheral pulse, Inferior venacava, portal vein, portosystemic anastomosis, Great saphenous vein, median cubital vein, Dural venous sinuses, Lymphatic system – cisterna chyli and thoracic duct, Lymphatic tissues and its histology, Regional lymph nodes – cervical, axillary and inguinal lymph nodes.<br><br>**Respiratory System**<br><br>Parts of RS – nose, nasal cavity, paranasal air sinuses, larynx, trachea, lungs, pleura, bronchopulmonary segments, Histology of trachea and lungs. | **08** | 20 |
| **IV** | **Gastro-Intestinal System Theory**<br><br>Parts of GIT- oral cavity (lip, cheek, tongue, salivary glands, palate, dentition) pharynx (Waldeyer's ring) esophagus, stomach, small and large intestine and appendix, Liver, gall bladder, pancreas and spleen, Histology of esophagus, stomach, small and large intestine, liver, gall bladder and pancreas.<br><br>**Peritoneum**<br><br>Description of reflection, folds and pouches in brief. | **08** | 14 |
| **V** | **Urinary System**<br><br>Kidney, ureter, urinary bladder, male and female urethra, Histology of kidney, ureter and urinary bladder.<br><br>**Reproductive System**<br><br>Parts of male reproductive system- testis, vas deferens, epididymis, prostate, Parts of female reproductive system- uterus, fallopian tubes, ovary, mammary gland, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary.<br><br>**Endocrine Glands** | **08** | 20 |

| | | | |
|---|---|---|---|
| | Names of all endocrine glands, describe in detail on pituitary gland, thyroid gland and parathyroid gland, suprarenal gland, Histology of pituitary, thyroid, parathyroid, suprarenal gland. | | |
| **VI** | **Nervous System**<br><br>Neuron, Classification of nervous system, Cerebrum, cerebellum, brain stem, spinal cord & spinal nerve, Meninges, ventricles and cerebrospinal fluid, Blood supply of the brain, Cranial nerves (in brief), Nerve plexus (Brachial & lumbar)<br><br>**Sensory Organs**<br><br>Skin and its appendages, Eye – parts of eye ball and lacrimal apparatus, Extra-ocular muscles, Histology of cornea and retina, Ear – parts of ear- external, middle and inner ear and contents<br><br>Embryology<br><br>Spermatogenesis and oogenesis, Ovulation, fertilization, Placenta | **08** | 14 |
| | | | |
| **Total** | | **48** | 96 |

**SUGGESTED PRACTICALS/DEMONSTRATION**

| **Sr. No** | | **Hours** |
|---|---|---|
| 1. | Demonstration of Histology of types of epithelium, Histology of serous, mucous and mixed salivary gland, Surface marking of the body region wise. | 1 |
| 2. | Demonstration of Histology of hyaline, elastic and fibrocartilage, Demonstration of all bones showing parts, radiographs of normal bones and joints, Histology of compact bone (TS and LS), Demonstration of all muscles of the body, Histology of skeletal, smooth and cardiac muscle. | 1 |
| 3. | Demonstration of heart, pericardium and vessels of the body, Histology of large artery, medium sized artery and large vein, Histology of lymph node, spleen, tonsil and thymus, Normal chest radiograph showing heart shadows, Normal angiograms.<br><br>Demonstration of parts of respiratory system, Normal radiographs of chest, Histology of lung and trachea. | 1 |
| 4. | Demonstration of parts of GIT, liver, gall bladder, pancreas and spleen, Histology of tongue, salivary glands, esophagus, stomach, small and large intestine, liver, gall bladder, pancreas and spleen, Radiographs of abdomen plain and contrast.<br><br>Demonstrations of reflections, folds and pouches. | 1 |

| Sr. No | | Hours |
|---|---|---|
| 5. | Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder, Radiographs of abdomen – IVP, retrograde cystogram.<br>Demonstration of section of male and female pelvis with organs in situ, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary, Radiographs of pelvis – Hysterosalpingogram.<br>Demonstration of the glands, Histology of pituitary, thyroid, parathyroid, suprarenal glands. | 1 |
| 6. | Demonstration of Histology of peripheral nerve and optic nerve, Demonstration of major nerves in the body, Demonstration of cranial cavity and parts of brain, Histology of cerebrum, cerebellum, spinal cord<br>Demonstration of Histology of thin and thick skin, Demonstration of histology of cornea and retina. | 1 |
| | **Total** | **6** |
| Demonstration will be part of theory/tutorial classes. There is in separate credit for the practicals/demonstrations. | | |

**Evaluation System**

**Continuous Internal Evaluation (CIE)**

| Sl. No. | Component | Marks | Weightage | IA marks |
|---|---|---|---|---|
| 1. | Sessional test(s) | | | |
| | Two Written tests<br>Same pattern as Summative test<br>Average of two to be considered<br>Absence without prior permission to be marked as 0 | 50 | | |
| | ***Total*** | ***50*** | ***0.3*** | ***15*** |
| 2. | Continuous assessment | | | |
| | Seminars/Case presentations/ Logbook/ Case records/Record book/assignment | | | |
| | ***Total*** | ***50*** | ***0.3*** | ***15*** |
| | ***Total CIE marks*** | | | ***30*** |

**End Semester Evaluation (ESE)**

**Written Paper**

| Type of question | No. of questions | Marks per question | Total |
|---|---|---|---|
| Essay Question (EQ) | 3 (to answer 2) | 10 | 20 |
| Short Essay Question (SEQ) | 9 (to answer 7) | 5 | 35 |
| Short Answer Question (SAQ) | 7 (to answer 5) | 3 | 15 |
| Total marks | | | 70 |
| Duration (minutes) | | | 150 |

**Question Paper Blueprint**

| Unit | | Marks (± 5%) |
|---|---|---|
| 1. | Introduction Human Body as a Whole | 14 |
| 2. | Locomotion and Support | 14 |
| 3. | Cardiovascular System, Respiratory System | 20 |
| 4. | Gastro-Intestinal System, Peritoneum | 14 |
| 5. | Urinary System, Reproductive System, Endocrine Glands | 20 |
| 6. | Nervous System, Sensory Organs, Embryology | 14 |
| | **Total Marks (including optional questions)** | **96** |

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Human Anatomy, Vol.1,2 &3, 5th edition, 2010, | B.D. Chaurasia | CBS publishers & distributors Pvt. Ltd. |
| 2 | Physiology & Anatomy with Practical Considerations | Ester. M. Grishcimer | J.P. Lippincott. Philadelphia |
| 3 | Manipal Manual of Anatomy, 2nd edition, 2012 | Sampath Madhyastha | CBS publishers & distributors Pvt. Ltd |
| 4 | Text Book of General Anatomy, 2nd edition, 2013 | Shobha Rawlani and Shivlal Rawlani | Jaypee brothers |
| 5 | Langman's Medical Embryology, 11th edition, 2009 | T.W Sadler | Wolters Kluwer |

**Subject: PHYSIOLOGY**

**Subject Code: BMRIT - 002**

**RATIONALE**

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how various imaging modalities are to be selected depending upon the clinical history.

**COURSE OUTCOMES**

At the end of the course students will be able to...

**CO1:** Explain the normal functioning of organs and systems.

**CO2:** Understand the interrelationships and interactions among various organs and systems for maintaining homeostasis.

**CO3:** Assess the relative contribution of each organ systems toward the maintenance of constant internal environment

**CO4:** Differentiate between normal and abnormal functioning of organs and systems,

**CO5:** Understand physiological basis of pathogenesis and treatment of diseases and disorders.

**CO6:** Apply the physiological basis in the field of allied health care

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| L | **T** | **P** | **C** | **CIE** | **ESE** | **ESE** | **CIE** | |
| **3** | **--** | **--** | **3** | **30** | **70** | **--** | **--** | **100** |

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

**TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

**THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Unit | Topic and contents | Hours | Marks |
|---|---|---|---|
| I | **General physiology**<br><br>Introduction to Physiology, Concept of Homeostasis, cell – Morphology – Functions of organelles and Cell membrane, Transport mechanisms, Body fluid compartments.<br><br>**Muscle nerve physiology**<br><br>Neurons: Morphology, Action Potential, Neuroglia: Types & functions, Muscles: Types, structure of sarcomere. Neuromuscular junction, sliding filament mechanism of contraction.<br><br>**Blood**<br><br>Composition, properties, functions. Plasma proteins: Concentrations and functions, RBC: Morphology, functions, count, physiological variations and life span Erythropoiesis – stages, essential factors, regulation of Erythropoiesis, Hemoglobin: Functions, concentration, physiological variations. Fate of Hemoglobin – Jaundice, types, Color index, MCH, MCV, MCHC, PCV – normal values, WBC: Morphology, functions of all types including T & B lymphocytes, total and differential counts, physiological variations, Platelets: Morphology, count, functions, thrombocytopenia & bleeding time, Blood groups: Basis of blood grouping. Landsteiner's laws, ABO system, determination of blood groups, blood transfusion, complications of incompatible blood transfusion, Rh group, erythroblastosis foetalis, prevention and treatment, Blood bank.<br><br>Haemostasis: Mechanisms. Clotting mechanism: factors, intrinsic and extrinsic pathways.<br><br>Disorders of clotting – hemophilia, vitamin K deficiency. Anticoagulants – mechanism of action and their uses, Anemia: Classification – Morphological and Etiological, Blood volume: normal values. | **10** | **15** |
| II | **Cardiovascular system**<br><br>Organization of cardiovascular system, greater and lesser circulation, Physiological anatomy of the heart, nerve supply, Junctional tissues of heart (pacemaker), Cardiac cycle: Mechanical events, Heart sounds, causes, characteristics and significance, Normal ECG, clinical significance of ECG, Heart rate – Physiological variations, Cardiac output: Definitions, normal values, physiological variations, Arterial blood pressure: Definitions, normal values, physiological variations, factors maintaining blood pressure. Role of baroreceptors in regulation of blood pressure. | **10** | **10** |
| III | **Respiratory system**<br><br>Respiratory and Non-respiratory function of respiratory system. Physiological anatomy of respiratory system Functions of respiratory | **8** | **10** |

| | | | |
|---|---|---|---|
| | tract. Respiratory membrane. Respiratory muscles. Surfactant: functions, respiratory distress syndrome.<br><br>Definitions of terms used in respiratory physiology: Eupnea, Hyperpnoea, Tachypnea, Apnea, Dyspnea.<br><br>Mechanics of breathing – intrapulmonary and Intrapleural pressure changes during a respiratory cycle.<br><br>Spirometry – Lung volumes and capacities. Vital capacity.<br><br>Oxygen transport: Role of hemoglobin, factors affecting, oxygen carrying capacity. Carbon dioxide transport: forms, chloride shift (Hamburgers phenomenon).<br><br>Respiratory centers. Role of chemo receptors in regulation of respiration. Pulmonary ventilation and alveolar ventilation.<br><br>Partial pressure of gases, Calculation of partial pressure of gasses in mixture. Arterial and venous blood gas concentrations and contents.<br><br>Hypoxia: Types and effects Cyanosis, Asphyxia, Periodic Breathing, Acclimatization.<br><br>Hyperbaric O2 therapy, Artificial respiration and Ventilators. | | |
| **IV** | **Excretory system**<br><br>Functions of kidneys. Nephrons – Juxta glomerular apparatus – functions, Steps in Urine formation – Ultrafiltration, Tubular Reabsorption, Tubular Secretion, GFR.<br><br>Definition, normal values, factors affecting GFR, measurement of GFR, Renal threshold for glucose, tubular load for glucose, Role of aldosterone and ADH in urine formation, Micturition, Innervation of bladder. Diuresis, Renal functions tests – Based on analysis of urine and analysis of blood, Skin: Functions of skin. Sweat glands. | **4** | **05** |
| **V** | **Digestive system**<br><br>Introduction, structure of alimentary canal, Saliva: Composition, functions, Stomach: Functions. Gastric Juice: composition, functions, Pancreatic Juice: Composition and functions, Liver: Functions, Bile: composition, functions, Gall bladder: functions, Succusentericus: Composition, functions. Functions of large intestine, Movements of small intestines, Deglutition. | **4** | **05** |
| **VI** | **Endocrine system**<br><br>Major endocrine glands- Hormone: Definition, Anterior pituitary: hormones and their functions, disorders – Giganitism, acromegaly, dwarfism, Posterior pituitary:<br><br>Hormones – diabetes insipidus, Thyroid: Hormones, normal values, functions, role of TSH. Disorders: simple goitre, myxoedema, | **8** | **15** |

| | | | |
|---|---|---|---|
| | cretinism, Grave's disease, Adrenal cortex: hormones, functions of cortisol and aldosterone. Addison's disease, Cushing's syndrome, Adrenal medulla: actions of adrenaline and noradrenaline, Endocrine pancreas: Insulin & glucagon, functions, Regulation of blood glucose level, diabetes mellitus, Parathyroid: Functions of PTH.<br><br>**Nervous system**<br><br>Synapse: Types, Transmission, Sensory receptors: Definition, Classification Organization of spinal cord, Functions of Dorsal column and Spinothalamic tract,<br><br>Functions of Corticospinal tract, Reflex Action: Definition, reflex arc, Functions of Cerebellum, Basal ganglia, Thalamus, Hypothalamus, Cerebral cortex:<br><br>Lobes & functions. EEG – Definition and uses, Autonomic nervous system: Organization & functions, Cerebrospinal fluid: Composition and function. | | |
| **VII** | **Special senses**<br><br>Vision: Physiological anatomy of eye ball, rods & cones, Refractive errors: Myopia, hypermetropia, presbyopia & astigmatism, Audition: Functions of outer, middle & inner ear, cochlea, Deafness – types, Taste: Taste buds, primary taste sensation, Smell: Receptors, modalities of smell<br><br>**Reproductive system**<br><br>Male reproductive system: functions of testes, puberty, spermatogenesis functions of testosterone, semen, Female reproductive system: Ovarian hormones functions – Menstrual cycle, Hormonal basis of changes in menstrual cycle, Family Planning. | **10** | **10** |
| **Total** | | **54** | **70** |

**Suggested Practicals/Demonstration**

| | **SUGGESTED PRACTICALS/DEMONSTRATION** | **Hours** |
|---|---|---|
| | Study of Microscope and its uses<br>Collection of blood and study of hemocytometer<br>Hemoglobinometry<br>Determination of RBC count<br>Determination of WBC count<br>Determination of blood groups<br>Determination of bleeding time | 8 |

| | SUGGESTED PRACTICALS/DEMONSTRATION | Hours |
|---|---|---|
| | Determination of clotting time<br>Recording of Arterial Blood Pressure,<br>Clinical examination of Radial pulse<br>Recording of spirogram and determination of vital capacity<br>Artificial respiration, CPR<br>Demonstration of ECG recording | |
| | Total | 8 |
| Demonstration will be part of theory/tutorial classes. There is in separate credit for the practicals/demonstrations. | | |

**Evaluation System**

**Continuous Internal Evaluation (CIE)**

| Sl. No. | Component | Marks | Weightage | IA marks |
|---|---|---|---|---|
| 1. | Sessional test(s) | | | |
| | Two Written tests<br>Same pattern as Summative test<br>Average of two to be considered<br>Absence without prior permission to be marked as 0 | 50 | | |
| | ***Total*** | ***50*** | ***0.3*** | ***15*** |
| 2. | Continuous assessment | | | |
| | Seminars/Case presentations/ Logbook/ Case records/Record book/assignment | | | |
| | ***Total*** | ***50*** | ***0.3*** | ***15*** |
| | ***Total CIE marks*** | | | ***30*** |

**End Semester Evaluation (ESE)**

**Written Paper**

| Type of question | No. of questions | Marks per question | Total |
|---|---|---|---|
| Essay Question (EQ) | 3 (to answer 2) | 10 | 20 |
| Short Essay Question (SEQ) | 9 (to answer 7) | 5 | 35 |
| Short Answer Question (SAQ) | 7 (to answer 5) | 3 | 15 |
| Total marks | | | 70 |
| Duration (minutes) | | | 150 |

**Question Paper Blueprint**

| Unit | | Marks (± 5%) |
|---|---|---|
| 1. | General physiology, Muscle nerve physiology, Blood | 18 |
| 2. | Cardiovascular system | 14 |
| 3. | Respiratory system | 14 |
| 4. | Excretory system | 9 |
| 5. | Digestive system | 9 |
| 6. | Endocrine system, Nervous system | 18 |
| 7. | Special senses, Reproductive system | 14 |
| | **Total Marks (including optional questions)** | **96** |

**Suggested Learning Resources**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Foundation of Anatomy and Physiology | Ross Wilson | Churchill Livingstone. |
| 2 | Physiology & Anatomy with Practical Considerations | Ester. M. Grishcimer | J.P. Lippincott. Philadelphia |
| 3 | Text Book of Physiology | A. P. Krishna | Suman Publication |
| 4 | Text Book of Physiology | A.K. Jain | Avichal Publishing Company; |

**Subject: Basics of Radiation Physics**

**Subject Code: BMRIT - 003**

## RATIONALE

Radiation physics is one of the primary pillars underlying the practice of radiology technology and understanding the principles of radiation physics helps BMRIT become better technologist.

## COURSE OUTCOMES

At the end of the course students will be able to...

**CO1:** Describe general physics related to imaging

**CO2:** Differentiate between within general radiation

**CO3:** Identify construction of radiology equipment's

**CO4:** Interpret quality of control of radiology equipment's

**CO5:** Differentiate between x-ray equipment's and other radiology related equipment's

**CO6:** Describe production of x-rays

**CO7:** Describe circuit system of radiology equipment's

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | Total Marks |
| **L** | **T** | **P** | **C** | **CIE** | **ESE** | **CIE** | **ESE** | |
| **2** | **--** | **6** | **5** | **30** | **70** | **30** | **70** | **200** |

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

## TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Unit | Topic and contents | Hours |
|---|---|---|
| I | **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-Isotopes-Ionization-excitation-Binding energy-electron volt-Electromagnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum. | 5 |
| II | **Electricity and magnetism**: Electric charges, Coulomb's law-Unit of charge-Electric potential, unit of potential-Electric induction, capacitance and Capacitors, series and parallel connection-electric current, unit, resistance, ohm's law, electric power, Joule's law. Varying currents-Growth and decay of current in LR circuit time constant, charge and discharge of a Capacitor through a resistance and inductance. Oscillations in an LC circuit. Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits, DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Kirchhoff's law, heating effect of current.<br><br>**Electromagnetic waves**: Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere. | 6 |
| III | **Electronics**<br><br>Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers. Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply.<br>Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers. | 5 |
| IV | **Discovery of x-rays-X-ray production and properties**: Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets. | 5 |
| V | **Heat**<br>Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer-conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling, Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes). | 4 |
| VI | **Interaction of ionizing radiation with matter**-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.<br>Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance. | 5 |

| | | |
|---|---|---|
| **VII** | **Exponential attenuation** (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.<br>Radiation intensity and exposure, photon flux and energy flux density.<br>LET, range of energy relationship for alpha, beta particles with X-Rays.<br><br>**Physical quantity, its unit and measurement**: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit. | **6** |
| **Total** | | **36** |

**SUGGESTED PRACTICALS/DEMONSTRATION**

| **Sr. No** | | **Hours** |
|---|---|---|
| 1. | Basic concepts | **108** |
| 2. | Electricity and magnetism, Electromagnetic waves | |
| 3. | Electronics | |
| 4. | Discovery of x-rays-X-ray production and properties | |
| 5. | Heat | |
| 6. | Interaction of ionizing radiation with matter- | |
| 7. | Exponential attenuation, Physical quantity, its unit and measurement | |
| Total | | **108** |

**Evaluation System**

**Continuous Internal Evaluation (CIE)**

| Sl. No. | Component | Marks | Weightage | IA marks |
|---|---|---|---|---|
| 1. | Sessional test(s) | | | |
| | Two Written tests<br>• Same pattern as Summative test<br>• Average of two to be considered<br>• Absence without prior permission to be marked as 0 | 50 | | |
| 2. | Continuous assessment | | | |
| | Seminars/Case presentations/ Logbook/ Case records/Record book/assignment | | | |
| | ***Total*** | ***50*** | ***0.3*** | ***15*** |
| | ***Total CIE marks*** | | | ***30*** |

**End Semester Evaluation (ESE)**

**Written Paper**

| Type of question | No. of questions | Marks per question | Total |
|---|---|---|---|
| Essay Question (EQ) | 3 (to answer 2) | 10 | 20 |
| Short Essay Question (SEQ) | 9 (to answer 7) | 5 | 35 |
| Short Answer Question (SAQ) | 7 (to answer 5) | 3 | 15 |
| Total marks | | | 70 |
| Duration (minutes) | | | 150 |

**End Semester Evaluation (ESE)**

There shall be practical examination for 70 marks in the subject.

Distribution of marks for ESE practical exams:

| ESE | | CIE | | **Grand total** |
|---|---|---|---|---|
| Practical | Viva | | Sub Total | |
| 50 | 20 | 30 | 100 | 100 |

**Question Paper Blueprint**

| Unit | Marks (± 5%) |
|---|---|
| Basic concepts | 10 |
| Electricity and magnetism, Electromagnetic waves | 10 |
| Electronics | 06 |
| Discovery of x-rays-X-ray production and properties | 25 |
| Heat | 06 |
| Interaction of ionizing radiation with matter- | 25 |
| Exponential attenuation, Physical quantity, its unit and measurement | 14 |
| **Total Marks (including optional questions)** | **96** |

## SUGGESTED LEARNING RESOURCES

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Basic radiological physics | K. Thayalan | Jaypee Brothers Medical Publishers (P) Limited, 2003 |
| 2 | Christensen's physics of diagnostic radiology | Curry and Dowdey | Wolters Kluwer |
| 3 | X-Ray Equipment for Student | D.N. And M.O. Chesney | Blackwell Science Ltd |
| 4 | A Textbook Of Radiation Physics For Radiologic Technology | Surendra Maharjan, Suraj Sah | Samiksha Publications |
| 5 | A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques | Lalit Agarwal | JBD Publications |

**Subject: Introduction to Healthcare**

**Subject Code: BMRIT - 004**

**RATIONALE**

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| **L** | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

**THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Topic and contents | Hours |
|---|---|
| Introduction to Health:<br>Definition of Health, Determinants of Health, Health indicators of India, Health team concept<br>National Health Policy<br>National Health Programs (Brief objectives and scope)<br>Family welfare programs in India<br>Introduction to Nursing:<br>Nursing and Nursing principles, Interpersonal relationships, Bandaging basic turns, Bandaging extremities, Triangular bandages and their applications<br>Nursing position, bed making, prone, lateral, dorsal, dorsal re-cumbent, Fowler's position, comfort measures, Aids, rest and sleep<br>Lifting and transporting patients, Transferring patients to wheel chair, transferring from bed to stretcher<br>Bedside Management: Proper usage of bed pan, Observation of stools, urine, sputum. Understand the use and care of catheters. Enema procedures<br>Method of giving nourishment: Feeding, tube feeding, drips, transfusion | **18** |

| | |
|---|---|
| Monitoring and recording of vitals<br>Simple aseptic techniques, sterilization and disinfection<br>Observation of surgical dressings<br>Concepts of First Aid | |

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Principles and Practice of Nursing Management and Administration | Jogindra Vati | Jaypee Brothers Ltd |
| 2 | Textbook of Preventive and Social Medicine | K Park | Banarsidas Bhanot Publishers |
| 3 | Introduction to Healthcare | Dakota Mitchell and Lee Haroun | Delmar |
| 4 | Introduction to Healthcare and Careers | Roxann Delaet | Joanes and Bartlett Learning |

**Subject: Medical Terminologies and Record Keeping**

**Subject Code: BMRIT - 005**

## RATIONALE

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| **L** | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Topic and contents | Hours |
|---|---|
| Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests. Topics to be covered under the subject are as follows:<br>1. Derivation of medical terms.<br>2. Define word roots, prefixes, and suffixes.<br>3. Conventions for combined morphemes and the formation of plurals.<br>4. Basic medical terms.<br>5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.<br>6. Interpret basic medical abbreviations/symbols.<br>7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.<br>8. Interpret medical orders/reports.<br>9. Data entry and management on electronic health record system. | **18** |

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Medical Terminology, Documentation, and Coding | Anne P. Stich | Routledge Publisher |
| 2 | Medical Terminology for Health Professions | Ann Ehrlich, Carol L. Schroeder | Cengage Learning |
| 3 | Medical Terminology | M. Mastenbjörk M.D. S. Meloni M.D. Medical Creation David Andersson | Medical Creations |
| 4 | Medical Records: Organization and Management | GD Mogli (Author) | Jaypee Brothers Medical Publishers |

**Subject: Basic Computers and Information Science**

**Subject Code: BMRIT - 006**

## RATIONALE

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| **L** | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| **Topic and contents** | **Hours** |
|---|---|
| Topics to be covered under the subject are as follows:<br>1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.<br>2. Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).<br>3. Processor and memory: The Central Processing Unit (CPU), main memory.<br>4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.<br>5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).<br>6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.<br>7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs. | **18** |

| | |
|---|---|
| 8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.<br>9. Introduction of Operating System: introduction, operating system concepts, types of operating system.<br>10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.<br>11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.<br>12. Application of Computers in clinical settings.<br><br>Practical on fundamentals of computers -<br><br>1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.<br>2. To install different software.<br>3. Data entry efficiency | |

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Basic of Computer and Information Technology | Ashok Arora | Vikas |
| 2 | Computer and Information Science | Roger Lee (editor) | Springer |
| 3 | Computer and Information Sciences | Tadeusz Czachórski , Erol Gelenbe, Krzysztof Grochla, Ricardo Lent (Editor | Springer |
| 4 | Information science and computer basics: An introduction | Mitchell, Ruth K | Clive Bingley |

**Subject: Medical law and ethics**

**Subject Code: BMRIT – 007**

**RATIONALE**

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum.

<table>
<tr><td colspan="4">Teaching Scheme (In Hours)</td><td>Total Credits (L+T+P)</td><td>Examination Scheme</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2"></td><td rowspan="2">Institute level exam only:<br>The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results.</td></tr>
<tr><td>1</td><td>--</td><td>--</td><td>1</td></tr>
</table>

L, lecture; T, Tutorial; P, Practical

**THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| **Topic and contents** | **Hours** |
|---|---|
| The important and relevant topics that need to focus on are as follows:<br>1. Medical ethics - Definition - Goal - Scope<br>2. Introduction to Code of conduct<br>3. Basic principles of medical ethics – Confidentiality<br>4. Malpractice and negligence - Rational and irrational drug therapy<br>5. Autonomy and informed consent - Right of patients<br>6. Care of the terminally ill- Euthanasia<br>7. Organ transplantation<br>8. Medico legal aspects of medical records – Medico legal 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. | **18** |

| | |
|---|---|
| 9. Professional Indemnity insurance policy<br>10. Development of standardized protocol to avoid near miss or sentinel events<br>11. Obtaining an informed consent.<br>12. Medical ethics - Definition - Goal - Scope<br>13. Introduction to Code of conduct<br>14. Basic principles of medical ethics – Confidentiality<br>15. Malpractice and negligence - Rational and irrational drug therapy<br>16. Autonomy and informed consent - Right of patients<br>17. Care of the terminally ill- Euthanasia<br>18. Organ transplantation<br>19. Medico legal aspects of medical records – Medico legal 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.<br>20. Professional Indemnity insurance policy<br>21. Development of standardized protocol to avoid near miss or sentinel events<br>22. Obtaining an informed consent. | |

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Medical Law and Ethics | Bonnie F. Fremgen | Pearson |
| 2 | Medical Law and Ethics | Jonathan Herring | OUP UK |
| 3 | Medical Law and Ethics | Purosottam Behera | Mittal Publications |
| 4 | Reflections on Medical Law and Ethics in India | Bismi Gopalakrishnan, Mercy Khaute, B. Sandeepa Bhat | Eastern Law House |

**Subject: Professionalism and Values**

**Subject Code: BMRIT – 008**

## RATIONALE

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| L | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Topic and contents | Hours |
|---|---|
| 1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality<br>2. Personal values- ethical or moral values<br>3. Attitude and behavior- professional behavior, treating people equally<br>4. Code of conduct, professional accountability and responsibility, misconduct<br>5. Differences between professions and importance of team efforts<br>6. Cultural issues in the healthcare environment | **18** |

## SUGGESTED LEARNING RESOURCES

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Textbook of Medical Ethics | Erich H Loewy | Springer |
| 2 | Professionalism, Professional Values and Ethics in Nursing | Suresh K Sharma, Asha P Shetty | Jaypee Brothers Medical Publishers |

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 3 | Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students | Varinder Kaur | CBS Publishers and Distributors Pvt. Ltd |
| 4 | Textbook of Professional Ethics and Human Values | R S Naagarazan | New age International Publishers |

**Subject: Principals of Management**

**Subject Code: BMRIT – 009**

## RATIONALE

The course is intended to provide a knowledge about the basic principles of Management.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| **L** | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Topic and contents | Hours |
|---|---|
| 1. Introduction to management<br>2. Strategic Management<br>3. Foundations of Planning<br>4. Planning Tools and Techniques<br>5. Decision Making, conflict and stress management<br>6. Managing Change and Innovation<br>7. Understanding Groups and Teams<br>8. Leadership<br>9. Time Management<br>10. Cost and efficiency | **18** |

**SUGGESTED LEARNING RESOURCES**

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students | Varinder Kaur | CBS Publishers and Distributors Pvt. Ltd |
| 2 | Professionalism Professional Values and Ethics in Nursing | Suresh K Sharma | Jaypee Brothers |
| 3 | Professionalism, Professional Values & Ethics | Shama Lohumi and Rakesh Lohumi | CBS publishers and Distributers PVT Ltd |

**Subject: English and Communication skills**

**Subject Code: BMRIT - 010**

## RATIONALE

Patients need to feel safe enough to communicate honestly and openly with their care providers to receive effective treatments. Providers need to convey treatment plans and health education clearly, accessibly, and empathetically so that patients can receive optimal care.

| Teaching Scheme (In Hours) | | | Total Credits (L+T+P) | Examination Scheme |
|---|---|---|---|---|
| **L** | **T** | **P** | **C** | Institute level exam only: The Institute level examination will be held before the commencement of the University examinations. A Pass in the subject with a minimum of 50 marks (50% of the total 100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results. |
| **1** | **--** | **--** | **1** | |

L, lecture; T, Tutorial; P, Practical

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

| Topic and contents | Hours |
|---|---|
| **Language-Basic**<br>Content: Review of grammar, Remedial study of grammar, building vocabulary Introduction<br>Parts of speech<br>Exercise on use of grammar Tense, Number, Gender<br>**Assessment methods:** Objective type, Fill in the blanks.<br>Content: Read and comprehend prescribed course books Reading, Summarizing, Comprehension<br>**Assessment methods:** Fill in the blanks and one-mark questions<br>Content: Various Forms of Composition Letter writing<br>Note taking<br>Precise | **18** |

writings Diary
writing

Reports on health
problem etc. Official
correspondence:

Outgoing correspondence, replying incoming correspondence, writing circulars, notices, charge memos, note taking, writing summaries, observation reports. Teaching learning activities: Exercise on writing: Letter writing, resume/CV Essay writing.

**Assessment methods**: Applications, short reports to be written.

Content: English- Spoken mode, Debates, Telephonic conversion, formal & informal conversation: Agreeing emphasizing, interrupting, politely, opinions, interviews, visual presentation.

Teaching learning activities: Participating in seminar, Telephonic conversion, conversation in different situations, practice in public speaking

**Assessment methods:** Assessment of the skills based on the checklist.

Content: Listening to comprehension media, audio, video, speeches, definition of listening, types of listening, purposes of listening, obstacles for listening, contexts of listening, to be a good listener, listening to a lecture etc.

Teaching learning activities: Listening to audio, video tapes and identify the key points.

**Assessment methods:** Practical test of listening and filling out the blanks, essay type.

**SUGGESTED LEARNING RESOURCES**

| S.No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | Communicative English for General Nursing Students | Tom Koorkkakala | K.J. Publications |
| 3 | How to write and speak Better, Reader's | John Ellison Kahn | Reader's Digest Association |
| 4 | Communication and Soft Skill Development | Ashwini Deshpande | Career Publications |

**BMRIT Radiology Clinical Education – part I (studentship)**

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

**Studentship or observership must include:**

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.