Second Semester

Subject: Basics of Microbiology

Subject Code: BMRIT - 011

RATIONALE

Basics of Microbiology helps students to gain information about structure, metabolism reproduction, function and diseases caused by bacteria, viruses, bacterial viruses, animal viruses, archaea, mycoplasma and Phytoplasma. It also makes students aware of the nature and other important aspects of the microorganisms.

COURSE OUTCOMES

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

CO001: Describe the structure, classification, morphology and growth of bacteria

CO002: Describe the methods sterilization and disinfection and its applications

CO003: Explain the concepts of immunity, hypersensitivity and immunization

CO004: Describe Nosocomial infections and methods for prevention of Hospital acquired infections

CO005: Describe the management of biomedical waste

CO006: List the common fungi and viruses and explain their importance

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	**--**	**--**	**2**	**70**	**30**	**--**	**--**	**100**

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

THEORY COMPONENTS

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

Unit	Topic and contents	Hours
I	Morphology of Bacteria: (Structure, size, shape, arrangement cell wall, flagella, spore, capsule, fimbria) Physiology of Bacteria: (Bacterial growth curve, Temp, O2, Co2, micro and macro nutrient growth requirements) Culture Media	9

	Culture Methods Antimicrobial sensitivity tests Sterilization and Disinfections: Definition, Dry heat Sterilization, Moist heat Sterilization, Chemical disinfectants, Gaseous disinfection, Test for disinfection / Sterilization control	
II	Infection: Classification, Sources of infection, Modes of transmission Nosocomial infection including biomedical waste management: Definition, Classification, Significance, Prevention and control Biomedical waste management	**8**
III	Immunology: Immunity, Antigen, Antibody, Hypersensitivity	**5**
IV	General Properties of fungi. (General characters, classification, Morphology, Reproduction) General Properties of Viruses. (General character, classification based on Genome, Capsid, Envelope & replication and cultivation of virus).	**7**
V	Applied Microbiology: Pyrexia of unknown origin, Meningitis, Zoonotic infections, Hepatitis, HIV infection and AIDS, Food poisoning, Diarrhea, Urinary tract infections, Pulmonary Tuberculosis	**7**
Total		**36**

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests • Same pattern as Summative test • Average of two to be considered • 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%)
Unit I	26
Unit II	20
Unit III	13
Unit IV	22
Unit V	15
Total Marks (including optional questions)	**96**

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Text book of Microbiology	Ananthnarayana&Panikar	University Press
2	Text book of Microbiology	Baveja	Arya Publications
3	Text book of Microbiology	Sathish Gupte	JPB
4	Textbook of Microbiology	Dr Arora	CBS Publishers & Distributors Pvt. Ltd

Subject: Basics of Biochemistry

Subject Code: BMRIT - 012

RATIONALE

Biochemistry is a key component of all education programmes for MRITs and should have a strong focus on laboratory investigation with radiological procedures. The topics provide the student with an understanding of the blood investigation and relationships of the systems which are essential in patient preparation and procedures.

COURSE OUTCOMES

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

CO1: Understand the responsibility of health care personals and hazards faced in the clinical laboratory

CO2: Explain the different types, use, care and maintenance of laboratory apparatus and instruments.

CO3: Understand the fundamental chemistry and knowledge of different solutions

CO4: Understand what acids, bases, salts and indicators are and also know about acid base balance

CO5: Describe the sample collection procedure to analyse various biochemical parameters

CO6: Describe assimilation of nutrients and consequences of malnutrition

CO7: Understand the different functional tests like LFT (Liver function test), RFT (Renal function test)

CO8: Understand the overview of tumor markers, cardiac markers, blood sugar and GTT, lipid profile and diagnostic enzymology

CO9: Describe the applications of radioisotopes

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	**--**	**--**	**2**	**30**	**70**	**--**	**--**	**100**

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

THEORY COMPONENTS

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

Unit	Topic and contents	Hours
I	**Nutrition** Calorific value Nitrogen Balance Respiratory quotient BMR Nutritional importance of carbohydrate, lipids, proteins, vitamins and minerals Emphasis on parenteral nutrition	9
II	**Acid–Base Balance** Henderson Hassel Bach equation Buffers of the body fluids Ph regulation Disturbance in acid base balance Anion gap Basic principles & estimation of blood gases and ph. **Water & Electrolyte balance** Over view of water and electrolyte balance Basic principles in estimation of Electrolyte Normal values and interpretation	9
III	**Clinical chemistry** **Brief over view of normal values and interpretation of results** Renal function tests Liver function tests Tumor markers Cardiac markers Diagnostic Enzymology Lipid profile	9

	Blood sugar and GTT Normal &Abnormal urine analysis	
IV	Radioisotopes: Definition, Application &Hazards Normal and abnormal urine analysis Clinical charts on LFT, RFT, and diagnostic enzymology	**9**
Total		**36**

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests • Same pattern as Summative test • Average of two to be considered • 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 to Clinical Biochemistry, Chemicals & Reagents, Preparation of solution,** Specimen collection and handling	25
2.	**Nutrition**	20
3.	**Acid–Base Balance;** Water & Electrolyte balance	22
4.	Clinical chemistry; Brief over view of normal values and interpretation of results	14
5.	Radioisotopes: Definition, Application & Hazards	15
6.		
	Total Marks (including optional questions)	**96**

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Text Book of biochemistry for dental students	Vasudevan, Sreekumari, Kannan Vaidyanathan	Jaypee Brothers
2	Biochemistry for Physiotherapy and allied health sciences students.	Nandini M, Beena V Shetty, Vinitha Ramanath Rai	Jaypee Brothers Medical Publisher (India)
3	Clinical chemistry	Varley	CBS Publishers & Distributors
4	Textbook of biochemistry for paramedical students	P Ramamoorthy	Jaypee Brothers Medical Publishers

Subject: Conventional Radiography and Equipment

Subject Code: BMRIT -013

RATIONALE

Conventional Radiography and Equipment provide the students' knowledge about the x-ray equipment working and also about how x-rays are produced.

COURSE OUTCOMES

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

CO001: Describe the structure and working of x-ray tube, production of x-rays

CO002: Describe the types of x-ray tube and heat dissipation methods

CO003: Explain the x-ray generator circuits

CO004: Describe the different circuit types

CO005: Describe the meters and exposure timers

CO006: List the control of scattered radiation

CO007: Describes about the fluoroscopy

CO008: Explains about the care and maintenance of x-ray 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**	
4	**--**	**2**	**5**	**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
I	**X-ray tube:** historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-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. **Production of x-rays:** X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, methods of cooling the anode, rating chart and cooling chart;	**10**
II	**Rotating anode x - ray tube:** construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum. **Grid controlled and high speed tubes**, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation).Interlocking and X-ray tube overload protection. **Heat dissipation methods**, tube rating, heat units, operating conditions and maintenance and Q.A procedures.	**10**
III	**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-high frequency generators-falling load generators, Capacitors discharge and grid control systems. **X-ray generator circuits:** Vacuum tube diodes-semi-conductor diodes-transistor-Rectification-half and full wave-self rectification-X-ray generator; 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.	**10**
IV	**High tension circuits:** H.T. generator for x-ray machines, three phase rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high and medium frequency circuits; capacitance filter control and stabilizing equipment;	**10**

	mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage, kV compensator; high tension selector switch, filament circuit, control of tube current, space charge compensation. **Interlocking circuits: Relays:** description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.	
V	**Meters and exposure timers:** Moving coil galvanometer: construction and working/conversion to millimeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines, pre reading kV meter and millimeter, digital panel meters. Clockwork timers, synchronous motor timer, electronic timers, photo metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber-based timers, integrated timer.	**10**
VI	**Control of scattered radiation: Beam limiting devices:** cones, diaphragms, light beam collimator, beam centering device, methods to verify beam centering and field alignment; Filters- inherent filters, added filters, heavy metal filters, grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.	**8**
VII	**Fluoroscopy:** Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualising intensified image, basic principles of closed circuit television camera and picture tube. Vidicon camera, CCD. Automatic brightness control, automatic exposure control, chamber selection during fluoroscopy. Serial radiography: Manual cassette changer, rapid automatic film changer, basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube.	**8**
VIII	**Care and Maintenance of X-ray equipment;** General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an x-ray tube, testing the light beam diaphragm, practical precautions pertaining to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as well as accessory equipment.	**6**
Total		**72**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	X-ray tube; Production of x-rays	5
2.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	4
3.	Filament current and voltage; X-ray generator circuits	5
4.	High tension circuits; Interlocking circuits; Relays	5
5.	Meters and exposure timers	5
6.	Control of scattered radiation: Beam limiting devices	4
7.	Fluoroscopy	4
8.	Care and Maintenance of X-ray equipment	4
	Total	36

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests • Same pattern as Summative test • Average of two to be considered • 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	TOPICS	Marks (± 5%)
1.	X-ray tube; Production of x-rays	16
2.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	15
3.	Filament current and voltage; X-ray generator circuits	10
4.	High tension circuits; Interlocking circuits; Relays	10
5.	Meters and exposure timers	9
6.	Control of scattered radiation: Beam limiting devices	16
7.	Fluoroscopy	10
8.	Care and Maintenance of X-ray equipment	10
	Total Marks (including optional questions)	**96**

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	D.N. Chesney & M.O Chesney	CBS Publishers & Distributors
2	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
3	Radiological Science for technologists	Stewart C Bushong	Mosby
4	Equipment for Diagnostic Radiography	E. Forster	Springer Dordrecht
5	The Physics Of Radiology And Imaging	K Thayalan	Jaypee

Subject: Clinical Radiography Positioning (Part I)

Subject Code: BMRIT - 014

RATIONALE

Clinical Radiography Positioning Part- 1 provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken.

COURSE OUTCOMES

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

CO1: Understand the basic patient positioning during radiographic investigation.

CO2: Apply special positioning skills for different pathological and physical conditions.

CO3: Application of equipments while working in radiology departments.

CO4: Choose proper position during radiography.

CO5: Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.

CO6: Explain the use of accessories.

CO7: Explain the anatomic and physiological basis of the procedure to be undertaken.

CO8: Explain the radiographic appearances of both normal and common abnormal conditions.

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**	
4	**1**	**6**	**8**	**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	**Principles of Radiography:** Preparation of the Room, Apparatus and Instruments Positions of the Patient: Erect, Sitting, Supine, Prone, Lateral, Oblique, Decubitus Etc. Relative position of X-Ray tube and patient, relevant exposure factors. Use of accessories such as radiographic cones, grid and positioning aids. Anatomic and Physiological basis	**8**

	of the procedure, Association with theory with practical work. Radiographic appearances, both normal and common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique. Modifications in technique for various disabilities and types of subject. Radiation protection, use of gonad shield, practical methods of reducing radiation dose to the patient.	
II	**Upper limb:** Routine projections for the whole hand, fingers, wrist joint, forearm, elbow joint and humerus. Supplementary projections for Scaphoid, Carpal tunnel, Ball Catchers projections, Head of the Radius, Supracondylar fracture and Olecranon process	**10**
III	**Lower limb:** Routine projections for the whole foot, toes, calcaneum, ankle joint, leg, knee-joint, patella and femurs. Supplementary projections for Talo-Calcaneal joint, Forced projections for torn ligaments, Flat Feet, Club Feet, Intercondylar projections for loose bodies in the knee, Axial projection for Patella.	**10**
IV	**Shoulder Girdle and Thorax:** Routine projections for the shoulder joint, Scapula, Acromio-Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs. Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.	**10**
V	**Vertebral Column:** Routine projections for Atlanto -Occipital joint, cervical spine, Cervico- thoracic Junction, thoracic Spine, lumbar Spine, Lumbo Sacral Region, Sacrum and Coccyx. Supplementary projections for the intervertebral foramina, posterior arch of Atlas, Flexion and Extension of Cervical Spine, Scoleosis and Kyphosis, Sacro Ileac Joint.	**12**
VI	**Skull:** Routine projections for cranium and facial bones; Supplementary projections for trauma, Towne's method, Sellaturcica, Optic foramina, Jugular foramina, Temporal bones, Mastoids, Petrous bone, Zygomatic arches, Orbits, Maxillae, Nasal bones, Mandible, Temporomandibular joints. Nasal Sinuses: Techniques for Frontal, Maxillary, Ethmoidal and Sphenoid Sinuses, erect and horizontal projections for fluid levels.	**12**
VII	**Pelvic girdle and hip region:** Routine projections for the whole pelvis, Sacro-Ileac joints, hip joint and Neck of Femur.	**10**

	Supplementary projections for the greater and lesser trochanters of Femur. Frog leg projection, Ischeum, Symphysis Pubis, Ileum, Acetabulum and Congenital Dislocation of Hip, Arthrodesis. **Skeletal survey:** Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.	
Total		**72**

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		**Hours**
1.	Principles of Radiography	15
2.	Upper limb	17
3.	Lower limb	17
4.	Shoulder Girdle and Thorax	14
5.	Vertebral Column	15
6.	Skull	15
7.	Pelvic girdle and hip region, Skeletal survey	15
	Total	**108**

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests • Same pattern as Summative test • Average of two to be considered • 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

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	TOPICS	Marks (± 5%)
1.	Principles of Radiography	13
2.	Upper limb	15
3.	Lower limb	13
4.	Shoulder Girdle and Thorax	13
5.	Vertebral Column	15
6.	Skull	13
7.	Pelvic girdle and hip region, Skeletal survey	14
	Total Marks (including optional questions)	**96**

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Atlas of Radiographic Positioning and Radiological Procedures	Philip W Ballinger, Eugene D. Frank	Mosby
2	Clarks Positioning In Radiography	Ra Swallow, E Naylor	Lippincott Williams and Wilkins
3	Merrill's Atlas of Radiographic Positioning and Procedures	Bruce W. Long &Jeannean Hall Rollins & Barbara J. Smith	Mosby
4	Bontrager's Textbook Of Radiographic Positioning And Related Anatomy	John Lampignano and Leslie E Kendrick	Elsevier Science
5	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	Garkal Gs	Jaypee Brothers Medical Publishers
6	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

BMRIT Radiology Clinical Education – part II (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 semester.
- 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.

NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
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