



**Subject: Radiological and Medical Physics**

**Subject Code: MMRT01**

### **RATIONALE**

Radiological and Imaging Technology instrumentation and its physics are the primary pillars underlying the practice of radiological and Imaging technology and understanding the principles of radiation physics helps MMRT to become a qualified MMRT 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

**CO8:** Describe the structure and working of x-ray tube, production of x-rays

**CO9:** Describe the types of x-ray tube and heat dissipation methods

**CO10:** Explain the x-ray generator circuits

**CO11:** Describe the different circuit types

**CO12:** Describe the meters and exposure timers

**CO13:** List the control of scattered radiation

**CO14:** Describes about the fluoroscopy

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	200
2	1	6	6	30	70	30	70	

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
1.	<b>Basic concepts:</b> 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.	4	5
2.	<b>Electricity and magnetism:</b> 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.  <b>Electromagnetic waves:</b> Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere.	4	5
3.	<b>Electronics</b> 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. 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.	4	5
4.	<b>Discovery of x-rays-X-ray production and properties:</b> 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.	4	5
5.	<b>Heat</b> 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,	4	5

	Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).		
6.	<p><b>Interaction of ionizing radiation with matter</b>-Types of interactions of X-and gamma radiation, Photoelectric &amp; Compton, Pair production, annihilation radiation.</p> <p>Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-phonuclear 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.</p>	4	5
7.	<p><b>Exponential attenuation</b> (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.</p> <p>Radiation intensity and exposure, photon flux and energy flux density.</p> <p>LET, range of energy relationship for alpha, beta particles with X-Rays.</p> <p><b>Physical quantity, its unit and measurement:</b> Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit.</p>	3	5
8.	<p><b>X-ray tube:</b> 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.</p> <p><b>Production of x-rays:</b> 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;</p>	4	5
9.	<p><b>Rotating anode x - ray tube:</b> 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.</p> <p><b>Grid controlled and high-speed tubes,</b> focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection.</p>	4	5

	<b>Heat dissipation methods</b> , tube rating, heat units, operating conditions and maintenance and QA procedures.		
10.	<b>Filament current and voltage</b> , 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. <b>X-ray generator circuits:</b> 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.	4	5
11.	<b>High tension circuits:</b> 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; 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.	2	2
12.	<b>Meters and exposure timers:</b> 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.	3	5
13.	<b>Control of scattered radiation and Beam limiting devices:</b> 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.	2	5
14.	<b>Fluoroscopy:</b> 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	4	5

	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.		
15.	<b>Care and Maintenance of X-ray equipment;</b> 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.	2	3
<b>Total</b>		<b>54</b>	<b>70</b>

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	Radiological physics	Hours
1.	Discovery of X-ray production and properties	10
2.	Interaction of ionizing radiation with matters	10
3.	Exponential attenuation, Physical quantity, its unit and measurement	10
<b>Medical Physics</b>		
4.	X-ray tube; Production of x-rays	18
5.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	10
6.	Filament current and voltage; X-ray generator circuits	10
7.	High tension circuits; Interlocking circuits; Relays	10
8.	Meters and exposure timers	10
9.	Fluoroscopy	10
10.	Care and Maintenance of X-ray equipment	10
	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		
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

### End Semester Evaluation (ESE)

#### Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

### End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

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

## SUGGESTED LEARNING RESOURCES

### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Basic radiological physics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2.	Christinsens 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 Publication
5.	Radiographic Imaging (Cbs) I.C.R.P.	D.N. Chesney & M.O Chesney	CBS Publishers & Distributors
6.	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
7.	Radiological Science for technologists	Stewart C Bushong	Mosby
8.	Equipment for Diagnostic Radiography	E. Forster	Springer Dordrecht



## Subject: Clinical Special Radiography Positioning

Subject Code: MMRIT02

### RATIONALE

Clinical Radiography Positioning 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.
- CO9:** Prepare management and positioning of patients
- CO10:** Correlate of indications, contraindications of the patient
- CO11:** Understand the patient preparations needed before any radiological examination.
- CO12:** Generalize knowledge of post procedural care.
- CO13:** Students will be able position the patients for radiological procedures.
- CO14:** Knowledge of image quality in radiological images.
- CO15:** Management of patients in radiology department for various procedures.
- CO16:** Ability to handle emergency situations in radiology department.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	CIE	ESE	CIE	ESE	
2	2	6	7	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	Marks
1.	<p><b>Principles of Radiography:</b></p> <p>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 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.</p>	6	5
2.	<p><b>Upper limb:</b></p> <p>Special projections for the whole hand, fingers, wrist joint, forearm, elbow joint and humerus.</p> <p>Supplementary projections for Scaphoid, Carpal tunnel, Ball Catchers projections, Head of the Radius, Supracondylar fracture and Olecranon process</p>	6	9
3.	<p><b>Lower limb:</b></p> <p>Special projections for the whole foot, toes, calcaneum, ankle joint, leg, knee- joint, patella and femurs.</p> <p>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.</p>	6	9
4.	<p><b>Shoulder Girdle and Thorax:</b></p> <p>Special projections for the shoulder joint, Scapula, Acromio-Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs.</p> <p>Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.</p>	6	6

5.	<p><b>Vertebral Column:</b> Special 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, Scoliosis and Kyphosis, Sacro Iliac Joint.</p>	6	6
6.	<p><b>Skull:</b> Special 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.</p>	6	6
7.	<p><b>Pelvic girdle and hip region:</b> Special projections for the whole pelvis, Sacro-Iliac joints, hip joint and Neck of Femur. Supplementary projections for the greater and lesser trochanters of Femur. Frog leg projection, Ischium, Symphysis Pubis, Ileum, Acetabulum and Congenital Dislocation of Hip, Arthrodesis. <b>Skeletal survey:</b> Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.</p>	6	6
8.	<p><b>Dental Radiography</b> Technique for intra oral full mouth.- Occlusal projections Extra oral projections including orthopantomography.- Supplementary techniques. <b>Upper respiratory system</b> Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre. - Phonation.</p>	6	6
9.	<p><b>Lungs and Mediastinum:</b> Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection. - Expiration technique. - Technique for pleural fluid levels and adhesions. <b>Abdominal viscera-</b> Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus.</p>	6	6

10.	<b>Mammography:</b> Basic views, special views, wire localization.	6	3
11.	<b>Trauma radiography/Emergency radiography</b> General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.	6	3
12.	<b>Soft Tissue Radiography:</b> High and low kilo voltage technique; differential filtration. Non - screen technique - simultaneous screen and non -screen technique. <b>Multiple radiography.</b> Uses of soft tissue radiography. <b>High kV Radiography:</b> General principles Relation to patient dose Change in radiographic contrast. <b>Neonatal and Paediatric Radiography</b> <b>Forensic Radiography</b> <b>Scatter elimination; beam collimation; grid ratio.</b> <b>Speed and type of grid movement</b>	6	5
<b>Total</b>		<b>72</b>	<b>70</b>

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Principles of Radiography	5
2.	Upper limb	10
3.	Lower limb	10
4.	Shoulder Girdle and Thorax	10
5.	Vertebral Column	10
6.	Skull	10
7.	Pelvic girdle and hip region, Skeletal survey	5
8.	Dental Radiography; Upper respiratory system	5
9.	Lungs and Mediastinum; Abdominal viscera	10
10.	Radiography in the ward; Mammography	13
11.	Operation theatre techniques; C-arm	5
12.	Soft Tissue Radiography	10

Sr. No		Hours
	Multiple radiography High kV Radiography Scatter elimination; beam collimation; grid ratio Speed and type of grid movement Radiographic factor; application and uses	
13.	Neonatal and Paediatric Radiography; Forensic Radiography Macroradiography Localization of foreign bodies	5
	Total	108

### Evaluation System

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests <ul style="list-style-type: none"> <li>• Same pattern as Summative test</li> <li>• Average of two to be considered</li> <li>• Absence without prior permission to be marked as 0</li> </ul>	50		
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

#### End Semester Evaluation (ESE)

## Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

## End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

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

## 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	GarkalGs	Jaypee Brothers Medical Publishers

**Subject: Biostatistics and Research Methodology****Subject Code: MMRIT03****RATIONALE:**

The application of statistical techniques to scientific research in health-related fields, including medicine, biology, and public health, and the development of new tools to study these areas.

**COURSE OUTCOMES**

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

**CO1:** Understand the Importance of statistics course in the curriculum

**CO2:** Understands Statistical Terms

**CO3:** Possess Knowledge and Skill in the use of Basic Statistics in the analysis and interpretation of data

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	CIE	ESE	CIE	ESE	100
2	1	--	3	30	70	--	--	

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
1.	Introduction: Meaning, Definition, Characteristics of Statistics; Importance of the Study of Statistics. Branches of Statistics; Descriptive and Inferential Statistics; Variables and Their Types. Measurement Scales.	6	10
2.	Tabulation of Data: Raw Data, the Array, Frequency Distribution. Basic Principles of Graphical Representation; Types of Diagrams - Histograms, Frequency Polygons, Smooth Frequency Polygon, Commutative Frequency Curve, O give; Normal Probability Curve.	6	10
3.	Measure of Central Tendency: Need For Measures of Central Tendency; Definition and Calculation of Mean; Ungrouped and Grouped Mean, Interpretation and Calculation of Median	6	15

	Ungrouped and Grouped; Meaning and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.		
4.	Measure of Variability: Need For Measure of Dispersion. The Range, the Average Deviation, The Variance and Standard Deviation; Calculation of Variance and Standard Deviation, Ungrouped and Grouped.	6	15
5.	Probability and Standard Distributions: Meaning of Probability of Standard Distribution, The Binominal Distribution, The Normal Distribution; Divergence from Normality - Skewness, Kurtosis	6	10
6.	Sampling Techniques: Need For Sampling - Criteria for Good Samples. Application of Sampling in Community, Procedures of Sampling and Sampling Designs Errors. Sampling Variation and Tests of Significance.	6	10
<b>Total</b>		<b>54</b>	<b>70</b>

## 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		
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	<b>Total</b>	<b>50</b>	<b>0.3</b>	<b>15</b>
	<b>Total CIE marks</b>			<b>30</b>

### End Semester Evaluation (ESE)

## Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

## SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Elements of Health Statistics	Rao.N.S	
2	An introduction of Biostatistics	Sunder Rao	
3	Methods in Bio-Statistics	B.K. Mahajan	
4	Elementary Statistics in Medical Workers	Inderbir Singh	
5	An Introduction to. Statistical Methods, Ram Prasad & Sons	Gupta C.B	

## MMRIT Radiological Clinical Education- part I (studentship): 16 hrs/week

The course may offer hands-on training or practical sessions, allowing participants to enhance their skills in teaching and research.

