



INTEGRAL UNIVERSITY, LUCKNOW

INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF ALLIED AND HEALTHCARE SCIENCES

MASTERS IN MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY - (MMRIT)

SYLLABUS

YEAR/ SEMESTER: I/I





Integral University, Lucknow
Department of Allied and Healthcare Sciences
Study and Evaluation Scheme

Program: MMRIT

Semester-I

Program Curriculum											Semester 1		
S. N.	Course code	Course Title	Type of Paper	Period Per hr./week/Sem			Evaluation Scheme				Total Marks Theory: a+b=100 Practical: a+C=100	Credit	Total Credits
							Theory		Practical				
				L	T	P	CIE(a)	ESE(b)	CIE(a)	ESE(C)			
1	MMRIT01	Radiological and Medical Physics	Core	2	1	6	30	70	30	70#	200	2:1:3	6
2	MMRIT02	Clinical Special Radiography Positioning	Core	2	2	6	30	70	30	70#	200	2:2:3	7
3	MMRIT03	Biostatistics and Research Methodology	Core	2	1	-	30	70	-	-	100	2:1:0	3
4	MMRIT	Radiology Clinical Education Part-I Studentship		-	-	15	-	-	30	70	100	0:0:5	5
Total				06	04	27					600	21	21

S.N.	Course code	Course Title	Type of Paper	Attributes							United Nation Sustainable Development Goal (SDGs)
				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES											
1	MMRIT01	Radiological and Medical Physics	Core	√	√	√	√		√	√	3,4
2	MMRIT02	Clinical Special Radiography Positioning	Core	√	√	√	√		√	√	3,4
3	MMRIT03	Biostatistics and Research Methodology	Core	√	√	√	√		√	√	3,4
	MMRIT	Radiology Clinical Education Part-I Studentship									

Student Contact Hours Per Week: 36Hrs.**Theory and practical periods of 60 minutes each.** Medium of Instruction: **English** Total Marks: **500** Abbreviations: ESE- End Semester Exam, CIE- Continuous Internal Evaluation, L - Lectures, T - Tutorial, P - Practical*Internal Assessment, # External Assessment. *Internal Assessment (Institutional Level examination) marks are not to be counted for the grade at the end of the semester.



Integral University, Lucknow

Effective from Session: 2026-27							
Course Code	MMRIT01	Title of the Course	Radiological and Medical Physics	L	T	P	C
Year	I	Semester	I	2	1	6	6
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	To ensure the knowledge of basic concept of Radiological and Medical Physics.						

Course Outcomes: After the successful course completion, learners will develop following attributes:

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

Unit	Topic and contents	Hours	Marks
1.	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.	4	5
2.	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. Electromagnetic waves: Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere.	4	5
3.	Electronics 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.	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.	4	5
5.	Heat: 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	5
6.	Interaction of ionizing radiation with matter -Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation. 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.	4	5
7.	Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number. Radiation intensity and exposure, photon flux and energy flux density. LET, range of energy relationship for alpha, beta particles with X-Rays. Physical quantity, its unit and measurement: Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit.	3	5

8.	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;	4	5
9.	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 QA procedures.	4	5
10.	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.	4	5
11.	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; 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.	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.	3	5
13.	Control of scattered radiation and 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 reciprocator movement.	2	5
14.	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 visualizing 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.	4	5
15.	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.	2	3
Total		54	70



Integral University, Lucknow
SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	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

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO7	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO8	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO10	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO11	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO12	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO13	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO14	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
MMRIT01	Radiological and Medical Physics	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√			√	√	

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	MMRIT01 Radiological and Medical Physics	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. 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. Demonstrations of reflections, folds and pouches.	1
5.	Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder, Radiographs of abdomen – IVP, retrograde cystogram. 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. 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 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 practical's/demonstrations.		



Integral University, Lucknow
SUGGESTED LEARNING RESOURCES

Effective from Session: 2026-27							
Course Code	MMRIT02	Title of the Course	Clinical Special Radiography Positioning	L	T	P	C
Year	I	Semester	I	2	2	6	7
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	To ensure the knowledge of basic concept of Clinical Special Radiography Positioning.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Understand the basic patient positioning during radiographic investigation.
CO2	Apply special positioning skills for different pathological and physical conditions.
CO3	Application of equipment's 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.

Unit	Topic and contents	Hours	Marks
1.	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 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.	6	5
2.	Upper limb: Special 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	6	9
3.	Lower limb: Special 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.	6	9
4.	Shoulder Girdle and Thorax: Special projections for the shoulder joint, Scapula, Acromion- Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs. Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.	6	6
5.	Vertebral Column: 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.	6	6
6.	Skull: 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.	6	6

7.	Pelvic girdle and hip region: Special projections for the whole pelvis, Sacro-Ileac joints, hip joint and Neck of Femur. 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.	6	6
8.	Dental Radiography: Technique for intra oral full mouth. - Occlusal projections Extra oral projections including orthopantomography. - Supplementary techniques. Upper respiratory system Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva man oeuvre. - Phonation.	6	6
9.	Lungs and Mediastinum: Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection. - Expiration technique. - Technique for pleural fluid levels and adhesions. Abdominal viscera- Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus.	6	6
10.	Mammography: Basic views, special views, wire localization.	6	3
11.	Trauma radiography/Emergency radiography: 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.	Soft Tissue Radiography: High and low kilo voltage technique; differential filtration. Non - screen technique - simultaneous screen and non -screen technique. Multiple radiography. Uses of soft tissue radiography. High kV Radiography: General principles Relation to patient dose Change in radiographic contrast. Neonatal and Pediatrics Radiography Forensic Radiography Scatter elimination; beam collimation; grid ratio. Speed and type of grid movement	6	5
Total		72	70

SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	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

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO7	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO8	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO10	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO11	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO12	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO13	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO14	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO15	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO16	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
MMRIT02	Clinical Special Radiography Positioning	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√			√	√	



Integral University, Lucknow

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	MMRIT02 Clinical Special Radiography Positioning	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 Multiple radiography High kV Radiography Scatter elimination; beam collimation; grid ratio Speed and type of grid movement Radiographic factor; application and uses	10
13.	Neonatal and pediatrics Radiography; Forensic Radiography Microradiography Localization of foreign bodies	5
	Total	108



Integral University, Lucknow

SUGGESTED LEARNING RESOURCES

Effective from Session: 2026-27							
Course Code	MMRIT03	Title of the Course	Biostatistics and Research Methodology	L	T	P	C
Year	I	Semester	I	2	1	--	3
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	To ensure the knowledge of basic concept of Biostatistics and Research Methodology.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
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

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 Meaning, Interpretation and Calculation of Median. Ungrouped and Grouped; Meaning and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.	6	15
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
Total		54	70

SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	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	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
MMRIT03	Biostatistics and Research Methodology	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
		√	√	√			√	√	3,4

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	MMRIT03 Biostatistics and Research Methodology	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



INTEGRAL UNIVERSITY, LUCKNOW
INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH
DEPARTMENT OF ALLIED AND HEALTHCARE SCIENCES

MASTERS IN RADIOLOGY AND IMAGING TECHNOLOGY

(MMRIT)

SYLLABUS

YEAR/ SEMESTER: I/II



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Integral University, Lucknow
Department of Allied and Healthcare Sciences
Study and Evaluation Scheme

Program: MMRIT

Semester-II

S. N.	Course code	Course Title	Type of Paper	Period Per hr./week/Sem			Evaluation Scheme				Total Marks Theory: a+b=100 Practical: a+C=100	Credit	Total Credits
							Theory		Practical				
				L	T	P	CIE(a)	ESE(b)	CIE(a)	ESE: (C)			
1	MMRIT04	Modern Radiological Imaging Equipment and Physics	Core	2	1	4	30	70	-	-	100	2:1:2	5
2	MMRIT05	Modern Imaging and Special Radiological Procedures	Core	2	1	4	30	70	30	70#	200	2:1:2	5
3	MMRIT06	Media and Interventional Radiology	Core	2	1	4	30	70	30	70#	200	2:1:2	5
4	MMRIT	Radiology Clinical Education Part-II Studentship		-	-	15	-	-	30	70	100	0:0:5	5
Total				06	04	27					600	21	21

S.N.	Course code	Course Title	Type of Paper	Attributes							United Nation Sustainable Development Goal (SDGs)
				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES											
1	MMRIT04	Modern Radiological Imaging Equipment and Physics	Core	√	√	√	√		√	√	3,4
2	MMRIT05	Modern Imaging and Special Radiological Procedures	Core	√	√	√	√		√	√	3,4
3	MMRIT06	Media and Interventional Radiology	Core	√	√	√	√		√	√	3,4
	MMRIT	Radiology Clinical Education Part-II Studentship									

Student Contact Hours Per Week: 36Hrs. **Theory and practical periods of 60 minutes each.** Medium of Instruction: **English**

Total Marks: **600** Abbreviations: ESE- End Semester Exam, CIE- Continuous Internal Evaluation, L - Lectures, T - Tutorial, P - Practical

*Internal Assessment, # External Assessment. *Internal Assessment (Institutional Level examination) marks are not to be counted for the grade at the end of the semester.

ESE)



Integral University, Lucknow

SUGGESTED LEARNING RESOURCES

Effective from Session: 2026-27							
Course Code	MMRIT04	Title of the Course	Modern Radiological Imaging - Equipment and Physics	L	T	P	C
Year	I	Semester	II	3	1	4	6
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The purpose of this course is to provide an understanding of Modern radiological Imaging Equipment and Physics provides the students' knowledge about the modern x-ray equipment and working principle.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Describe the special radiological equipment's
CO2	Describe the digital and computed radiography
CO3	Describe PACS, RIS and HIS

Unit	Topic and contents	Hours	Marks
1.	Modern x-ray tube: its principle, physics & equipment	5	
2.	Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units	5	
3.	Dual energy x-ray absorptiometry (DEXA) scan: its principle, physics & equipment	5	
4.	Computed radiography: its principle, physics & equipment.	5	
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5	
6.	Modern dental equipment's. Cone beam dental CT	5	
7.	Bone mineral density test: its principle, physics & equipment	5	
8.	Picture archiving and communication system (PACS), RIS, HIS and Teleradiology	5	
9.	Computed Tomography	7	
10.	Magnetic Resonance Imaging	5	
11.	Ultrasound Imaging	5	
12.	Hybrid Imaging	5	
13.	Smart Simulator/virtual imaging	5	
14.	Artificial Intelligence in Modern Radiological Imaging	5	
Total		72	



Integral University, Lucknow
SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	Publication
1	Textbook of Radiology: Physics	Amol Sasane, Hariqbal Singh, Roshan Lodha	Jaypee Brothers Medical Publishers
2	The Physics Of Radiology And Imaging	THAYALAN K	Jaypee Brothers Medical Publishers
3	Christensen's Physics of Diagnostic Radiology	Thomas S.Curry (Author), James E. Dowdey (Author), Robert E. Murry (Author)	Lea &Febiger, U.S
4	Textbook Of Radiology For Residents And Technicians	BHARGAVA S. K	CBS; publishers
5	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
6	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
7	Physics and Technical Aspects Diagnostic Ultrasound	DINESH K BAGHEL (Author)	AITBS PUBLISHERS

Course Articulation Matrix: (Mapping of COs with POs and PSOs)																
PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
MMRIT04	Modern Radiological Imaging - Equipment and Physics	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√			√	√	

SUGGESTED PRACTICALS/DEMONSTRATIO

Sr. No	MMRIT04 Modern Radiological Imaging - Equipment and Physics	Hours
1.	Modern x-ray tube: its principle, physics & equipment	5
2.	Digital Radiography	5
3.	Dual energy x-ray absorptiometry (DEXA) scan: its principle, physics & equipment	2
4.	Computed radiography	3
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5
6.	Modern dental equipment's. Cone beam dental CT	3
7.	Bone mineral density test: its principle, physics & equipment	2
8.	Picture archiving and communication system (PACS), RIS, HIS and Teleradiology	5
9.	Computed Tomography	5
10.	Magnetic Resonance Imaging	5
11.	Ultrasound Imaging	5
12.	Hybrid Imaging	5

13.	Smart Simulator/virtual imaging AI Imaging	4
Demonstration will be part of theory/tutorial classes. There is in separate credit for the practical's/demonstrations.		54



Integral University, Lucknow

Effective from Session: 2026-27							
Course Code	MMRIT05	Title of the Course	Contrast Media and Interventional Radiology	L	T	P	C
Year	I	Semester	II	2	1	4	5
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	To ensure the knowledge of basic concept of Contrast Media and Interventional Radiology.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Know the basic principle and physics of interventional equipment.
CO2	Know the management and positioning of patients while performing interventional radiological procedure.
CO3	Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.
CO4	Understand the patient preparation needed before any interventional radiological procedures.
CO5	Have knowledge about the post procedural care and safety.

Unit	Topic and contents	Hours	Marks
1.	Contrast Media: Positive and Negative, Ionic & Non-Ionic, Adverse Reactions to contrast media and patient management.	8	10
2.	Introduction to interventional procedures DSA: principles and types Equipment: Basics of angiographic equipment's, single and biplane angiographic equipment's, angiographic table, image intensifier, flat panel detectors, recording systems, pulse oximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography	8	10
3.	Interventional procedures: Catheter- classification, types and applications, Guide wire- classification, types and applications, Pressure Injector and Accessories, Percutaneous catheterization, Digital Subtraction Angiography, Catheterization Sites, Asepsis	8	10
4.	Arteriography: Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography Venography: Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography	20	20
5.	Safety considerations in angiography room; room design, protective devices, radiation monitoring	5	10
6.	Care and maintenance tests: General care, functional test Quality assurance program: Acceptable limits of variation, corrective action	5	10
Total		54	

SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	Publication
1	The practice of interventional radiology	Karim valji	
2	Interventional Radiology a survival guide	EBIR Kessel, David, MB, BS, MA, MRCP, FRCP(Auth) FRCR Robertson, Iain, MB, ChB, MRCP	Elsevier Health Sciences
3	Handbook of Interventional Radiologic Procedures	Krishna Kandarpa (author), lindsay machan (author), janettedurham (author)	Lippincott Williams and Wilkins
4	Interventional Survival Guide	Radiology:	A

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
MMRIT05	Contrast Media and Interventional Radiology	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√			√	√	

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	MMRIT05 Contrast Media and Interventional Radiology	Hours
1.	Contrast Media	10
2.	Basics of angiographic equipment's	10
3.	Catheter and guide wires	10
4.	Arteriography and venography procedures	20
5.	Safety considerations in angiography room	12
6.	Care and maintenance tests Quality assurance program:	10
	Total	72

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Integral University, Lucknow

Effective from Session: 2026-27							
Course Code	MMRIT06	Title of the Course	Modern Imaging and Special Radiological Procedures	L	T	P	C
Year	I	Semester	II	2	1	4	5
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	To ensure the knowledge of Contrast & Special Radiological Procedures are diagnostic procedures usually performed by giving contrast through oral or intravenous to diagnose the disease.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Prepare management and positioning of patients while performing radiological procedures.
CO2	Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures.
CO3	Understand the patient preparations needed before any radiological examination.
CO4	Generalize knowledge of post procedural care.
CO5	Students will be able position the patients for radiological procedures.
CO6	Knowledge of image quality in radiological images.
CO7	Management of patients in radiology department for various procedures.
CO8	Ability to handle emergency situations in radiology department.
CO9	Precautions and care required in interventional suits.

Unit	Topic and contents	Hours	Marks
1.	Introduction: General approach to Special Radiographic procedures, Responsibility of Radiology Technologist during radiological procedures, Preparation of patient for different procedures, Room layout in interventional radiology and fluoroscopy.	6	5
2.	Basics and modern Emergency Equipment's in the Radiology Department	4	5
3.	Gastrointestinal Tract: Barium Swallow; Barium Meal - Single and Double Contrast; Barium Meal Follow Through; Small Bowel Enema (Enteroclysis); Barium Enema - Gastrograffin Enema; Loopogram Advanced procedures of Gastrointestinal Tract	10	15
4.	Biliary Tract: Oral & Intravenous Cholecystography; Percutaneous Transhepatic Cholangiography; Percutaneous Transhepatic Biliary Drainage; Endoscopic Retrograde Cholangiopancreatography Advanced procedures of Biliary Tract	10	15
5.	Urinary System: IVU (Intravenous Urography), Retrograde Pyeloureterography (RGU), Micturating Cysto Urethrography, Ascending Urethrography. Advanced procedures of Urinary System	10	15
6.	Reproductive System: HysteroSalpingogram, FTR (Fallopian Tube Recanalization) Advanced procedures of Reproductive System	5	5
7.	Respiratory System: Bronchography, Percutaneous Lung Biopsy Advanced procedures of Respiratory System	5	5
8.	Other procedures in radiology: Arthrography, Sialography, Lymphography, Sinography & Fistulography, Dacryocystography, Embolization & embolic agents Related Advanced procedures.	4	5
Total		54	70

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Integral University, Lucknow
SUGGESTED LEARNING RESOURCES

S.NO	Title of Books:	Autho	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	Bhushan and Lakkhar	Arya Publications
2	A guide to radiological procedures	Chapman	Elsevier

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3	3
CO7	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO8	3	2	3	3	3	2	3	2	2	3	2	3	2	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs
MMRIT06	Modern Imaging and Special Radiological Procedures	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	No.
		√	√	√			√	√	3,4

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	MMRIT06 Modern Imaging and Special Radiological Procedures	Hours
1.	General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures Contrast media and their adverse reactions to contrast media and patient management	10
2.	Procedures for gastrointestinal tract including barium studies Procedures for biliary tract	15
3.	Procedures for urinary system and reproductive system	15
4.	Procedures for central nervous system and respiratory system	15
5.	Other procedures in radiology: Arthrography, Sialography, Lymphography, Sinography & Fistulography, Dacryocystography, Embolization & embolic agents Related Advanced procedures.	17
	Total	72