



INTEGRAL UNIVERSITY, LUCKNOW
INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF PARAMEDICAL SCIENCES

**MASTERS OF MEDICAL RADIOLOGICAL IMAGING
SCIENCES
(MMRIS)**

SYLLABUS

YEAR/ SEMESTER: II/III



Integral University, Lucknow
Department of Paramedical Sciences
Study and Evaluation Scheme

Program: MMRIS

Semester-III

S. N.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits
				L	T	P	CT	TA	Total	ESE			
THEORIES													
1	RS601	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	Core	3	1	0	40	20	60	40	100	3:1:0	4
2	RS602	Interventional & Nuclear Medicine Techniques	Core	3	1	0	40	20	60	40	100	3:1:0	4
3	RS603	Research Methodology and Biostatistics	Core	3	1	0	40	20	60	40	100	3:1:0	4
PRACTICAL													
1	RS604	Synopsis	Core	0	3	0	50	50	00	00	100	0:3:0	3
2	RS605	Residency – III Lab	Core	0	0	10	40	20	60	40	100	0:0:5	5
3	RS606	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging - Lab	Core	0	0	8	40	20	60	40	100	0:0:2	2
4	RS607	Interventional & Nuclear Medicine Techniques – Lab	Core	0	0	8	40	20	60	40	100	0:0:2	2
Total				09	06	26	290	170	360	240	700	24	24

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	RS601	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	Core	√	√	√			√	√	3,4
2	RS602	Interventional & Nuclear Medicine Techniques	Core	√	√	√	√		√	√	3,4
3	RS603	Research Methodology and Biostatistics	Core	√	√	√	√		√	√	3,4
PRACTICAL											
1	RS604	Synopsis	Core	√	√	√			√	√	3,4
2	RS605	Residency – III Lab	Core	√	√	√	√		√	√	3,4
3	RS606	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging - Lab	Core	√	√	√	√		√	√	3,4
4	RS607	Interventional & Nuclear Medicine Techniques – Lab	Core	√	√	√	√		√	√	3,4

L: Lecture **T:** Tutorials **P:** Practical **CT:** Class Test **TA:** Teacher Assessment **ESE:** End Semester Examination,
AE= Ability enhancement, **DSE-** Discipline Specific Elective, **Sessional Total:** Class Test + Teacher Assessment **Subject Total:** Sessional Total + End Semester Examination (ESE)



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS601	Title of the Course	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	L	T	P	C
Year	II	Semester	III	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn the aim, objective, philosophy and principle of Quality control, Quality Assurance and Care & Maintenance.						

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

CO1	Student will have knowledge on Objectives of Quality Control & Quality Assurance.
CO2	Student will have knowledge on QA of Image Receptors & QA Program Tests.
CO3	Student will have knowledge on QA & QC of Cassette, Film and Care and Maintenance.
CO4	Student will have knowledge about care and maintenance of equipments in radiology department.
CO5	Student will have knowledge about QA & QC of Advance Modalities.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION TO QUALITY CONTROL & QUALITY ASSURANCE	<p>Quality Control: Objectives of Quality Control, Improve the quality of imaging thereby increasing the diagnostic value; To reduce the radiation exposure; Reduction of film wastage and repeat examination; To maintain the various diagnostic and imaging units at their optimal performance.</p> <p>Quality Assurance: Basic concepts of quality assurance, Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance.</p>	8	CO1
2	QA PROGRAMME IN THE RADIOLOGICAL FACULTY LEVEL	<p>Quality Assurance Programme in the Radiological Faculty level: Responsibility, Purchase, Specifications, Acceptance, Routine testing, Evaluation of results of routine testing, Quality assurance practical exercise in the X ray generator and tube, Image receptors, Radiographic equipment, Fluoroscopic equipment, Mammographic equipment, Conventional tomography, Computed tomography, Film processing, manual and automatic, Consideration for storage of film and chemicals, Faults tracing, Accuracy of imaging, Image distortion for digital imaging devices.</p>	8	CO2
3	QA TESTS	<p>Quality Assurance Programme Tests: General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually, Machine calibration, LASER printer, Light beam alignment. X-ray out-put and beam quality check, KVp check, Focal spot size and angle measurement, Timer check, mAs test, Grid alignment test, High and low contrast resolutions, Mechanical and electrical checks, Cassette leak check, Proper screen-film contact test, Safe light test, Radiation proof test, Field alignment test for fluoroscopic device, Resolution test, Phantom measurements, CT, US and MRI.</p>	8	CO3
4	ROUTINE CARE AND MAINTENANCE	<p>Maintenance and care of equipment: Safe operation of equipment, Routine cleaning of equipment and instruments, Cassette, screen maintenance, Maintenance of automatic processor and manual processing unit & Routine maintenance of equipments.</p> <p>Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.</p> <p>General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.</p>	8	CO4
5	QA & QC OF ADVANCE MODALITIES	<p>Quality Assurance and quality control of Modern Radiological and Imaging Equipment which includes Digital Radiography, Computed Radiography, CT scan, MRI Scan, Ultrasonography and PACS related.</p> <p>Image artifacts their different types, causes and remedies.</p>	8	CO5

Reference Books:

1. Sherer MA, Visconti PJ, Ritenour ER, Haynes K. Radiation Protection in Medical Radiography-E-Book. Elsevier Health Sciences; 2014Mar12.
2. Brandon AN, Hill DR. Selected list of books and journals in allied health. Bulletin of the Medical Library Association, 1996.
3. Long BW, Frank ED, Ehrlich RA. Radiography Essentials for Limited Practice-E-Book. Elsevier Health Sciences; 2016 Sep6
4. Durrani SA, IlicR, editors. Radon measurements by etched track detectors: applications in radiation protection, earth sciences and the environment. World scientific
5. Turner JE. Atoms, radiation, and radiation protection. John Wiley & Sons; 2008Jan8

e-Learning Source:

1. https://en.wikipedia.org/wiki/Radiation_protection
2. <https://youtu.be/mvjYRGjrKHc>
3. <https://www.slideshare.net/RubiSapkota/radiation-protection-and-personnel-monitoring-devices>

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

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

CO2	2	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3
CO3	3	3	3	2	3	3	3	3	2	2	3	3	2	2	2	3
CO4	3	3	2	3	2	3	2	3	3	2	3	3	3	3	2	2
CO5	2	3	3	3	2	3	2	3	2	2	2	3	2	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS601	Quality Assurance and Quality Control in Diagnostic Radiology and Imaging	√	√	√			√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	RS602	Title of the Course	Interventional & Nuclear Medicine Techniques	L	T	P	C
Year	II	Semester	III	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the special procedures done with the interventional approaches in radiology department and Nuclear Medicine Technologies.						

Course Outcomes

CO1	At the end of the course, student will have knowledge on: Equipment, procedure, technique and outcome of angiography & Arthrography.
CO2	At the end of the course, student will have knowledge on Interventional Procedures Cardiac, Vascular, and Nonvascular.
CO3	Students will have the Knowledge about Basic principle, instrumentation and clinical application of nuclear medicine Technology.
CO4	Students will have the Knowledge about Radioactive transformation
CO5	Students will have the Knowledge about Production, handling & transportation of radio-nuclides.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	INTRODUCTION TO INTERVENTIONAL RADIOLOGY	<p>Introduction to Interventional Radiology: Need for interventional procedures, History, technique, patient care, Percutaneous catheterization, catheterization sites, Asepsis, Guide wire, catheters, pressure injectors, accessories.</p> <p>All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure and aspiration cytology under fluoroscopy, CT, USG, MRI guidance.</p> <p>Digital Subtraction Angiography (DSA), Types, Instrumentation.</p>	10	CO1
2	ANGIOGRAPHY & VENOGRAPHY	<p>Angiography: Angiographic Equipment, Catheters & guide wires, Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors.</p> <p>Carotid Angiography (4 Vessel angiography), Thoracic and Arch Aortography. Vertebral angiography, femoral arteriography. Selective studies: Renal, SMA, Coeliac axis. Angiocardiography.</p> <p>Venography: Peripheral venography, Cerebral venography, Inferior and superior Venocavography, Relevant visceral phlebography.</p>	8	CO2
3	INTRODUCTION TO NMT	Introduction to NMT and Radioactive Transformation, Basic atomic and nuclear physics, History of radioactivity, Units & quantities, Isotopes, Isobars, Isomers, Radioactivity and half-life, Exponential decay, specific activity, Modes of Radioactive decay, parent daughter decay.	8	CO3
4	PRODUCTION OF RADIO NUCLIDES & EQUIPMENT OF NMT	Production of Radio nuclides, Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators, equipments of NMT, Gamma camera, PET, SPECT (working principle).	8	CO4
5	RADIO PHARMACY & HANDLING & TRANSPORT OF RADIO-NUCLIDES	Radio pharmacy & Handling & Transport of Radio-nuclides Cold kits, Radio pharmacy used in nuclear medicine, Radiopharmaceuticals used in various procedures, Safe handling of radioactive materials, Procedures for handling spills.	6	CO5

Reference Books:

- Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins; 2011.
- Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.
- Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences; 2012 Feb 14.
- Bomford CK, Miller J, Kunkler H, Sherriff IH, Bomford SB, IH Kunkler SB. Walter and Miller's textbook of radiotherapy: radiation physics, therapy, and oncology. 1993.
- Sutton, David. "A textbook of radiology and imaging." (1987).

e-Learning Source:

- <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/interventional-radiology#:~:text=What%20is%20interventional%20radiology%3F,ultrasound%20help%20guide%20the%20radiologist>.
- https://www.cdc.gov/nceh/radiation/nuclear_medicine.htm#:~:text=Nuclear%20medicine%20uses%20radioactive%20material,x%2Drays%3A%20how%20they%20work
- <https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine>

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

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
	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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	2	3	2	2

CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS602	Interventional & Nuclear Medicine Techniques	√	√	√	√		√	√	3,4



Integral University, Lucknow

Effective from session: 2023-24							
Course Code	RS604	Title of the Course	SYNOPSIS	L	T	P	C
Year	II	Semester	III	0	3	0	3
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	Through the synopsis of Project work/Dissertation., students are expected to carry out innovative project work and prove their analytical ability and practical skills obtained in the area that they have specialized in. This course also would build the research acumen among students who are interested to pursue research as their career.						

Course Outcomes	
CO1	Students will identify the research problems associated with forensic science and criminalistics
CO2	Students will review the literatures and will be able to decide the topic.
CO3	Students will appraise the research work conducted in relation to topic chosen.
CO4	Students will decide the techniques and methodology for performing the research.
CO5	Students will present the synopsis of the topic chosen for Project work/Dissertation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1-5	Review the literatures	1. Students are expected to decide on the specific project area and title and review the literatures of that specific topic.	30 Hrs.	CO1-CO5
	Title	2. Decide the title of the Project work/ Dissertation/ Thesis.		
	Formatting the Synopsis	3. Decide the methodology for performing the research and formatting the synopsis.		
	Presentation and viva-voce	4. Presentation of the Synopsis and viva voce examination for the same will be Conducted.		
	Final Report of Synopsis	5. The final synopsis report will be evaluated by a panel of examiners consisting of HOD, Guide, and Co-guide (wherever applicable).		

Reference Books:
1. K. Ramakant; Elementary Statistics in a world of applications, Goodyear California Pub. Co.,1979
2. K. D. Broota, Experimental designs in psychological research, Wiley eastern, New York, 1992
3. Statistical Methods by S.P. Gupta.
4. Research methodology by CR Kothari

EVALUATION OF SYNOPSIS

MMRIS. : Students has to prepare synopsis report and oral presentation; each student will be assessed in a 20 minutes time (15 min for presentation & 5 minutes for discussion).The evaluation of synopsis will be done by a panel of examiners with proper approval of concern authorities.

The evaluation for internal examination of 100marks will be distributed:

Work done during the Synopsis Period: **50**

Synopsis Report: **25** Presentation and Viva Voce: **25** Total: **100**

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	PSO4	PSO5	PSO6	PSO7
	CO1	3	3	2	3	3	2	3	3	2	3	2	3	3	3	3	3	3
CO2	2	3	3	3	2	3	3	3	2	2	2	3	3	3	3	3	2	3
CO3	3	2	2	2	3	2	3	3	3	3	2	3	2	2	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO5	3	3	3	3	2	3	3	2	3	2	3	3	3	3	3	2	3	2

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS604	SYNOPSIS	√	√	√			√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS605	Title of the Course	Residency – III Lab	L	T	P	C
Year	II	Semester	III	0	0	10	5
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective of the Residency Lab is to learn about patient handling, radiation protection and procedures done in the department.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Students will be able to learn how to deal with a patient during examination in the Radiology department.
CO2	Students will be able to learn how to perform X-Ray Examinations.
CO3	Students will be able to learn how to perform contrast studies along with their preparation and management.
CO4	Students will be able to learn how to perform ward mobile radiography on critically ill patients.
CO5	Students will be able to learn how to perform CT scans, MRI, Fluoroscopy and Mammography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	In the residency, the professional is expected to work and contribute in the medical imaging unit.	100	CO1, CO2, CO3, CO4, CO5

Reference Books:	
1.	Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical.
2.	Applications and Quality Control. Elsevier Health Sciences; 2015 Sep 2.
3.	Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
4.	Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
5.	Curry TS, Dowdey JE, Murry RC. Christensen's physics of diagnostic cardiology. Lippincott Williams & Wilkins; 1990.
6.	Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar20.
7.	Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.
8.	Hagen-Ansert SL. Textbook of diagnostic ultrasonography. Mosby Elsevier;2006.
e-Learning Source:	
1.	https://en.wikipedia.org/wiki/High-resolution_computed_tomography
2.	https://youtu.be/IhjbvEnRrM
3.	https://en.wikipedia.org/wiki/Doppler_ultrasonography

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	2	3	2	2	1	2	1	1	1	1	3	1	2	3	3	2
CO2	1	3	2	2	2	1	3	2	1	3	3	2	2	2	3	3
CO3	2	3	3	2	2	3	1	2	1	1	3	2	2	3	3	3
CO4	1	3	2	1	3	1	3	3	1	3	3	3	2	1	3	2
CO5	2	3	1	1	1	1	2	1	1	2	3	1	2	2	3	2

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

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS605	Residency – III Lab	√	√	√	√				3,4



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS607	Title of the Course	Interventional & Nuclear Medicine Techniques – Lab	L	T	P	C
Year	II	Semester	III	0	0	4	2
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the special procedures done with the interventional approaches in radiology department and Nuclear Medicine Technologies.						

Course Outcomes	
CO1	At the end of the course, student will have knowledge on: Equipment, procedure, technique and outcome of angiography & Arthrography.
CO2	At the end of the course, student will have knowledge on Interventional Procedures Cardiac, Vascular, and Nonvascular.
CO3	Students will have the Knowledge about Basic principle, instrumentation and clinical application of nuclear medicine Technology.
CO4	Students will have the Knowledge about Radioactive transformation
CO5	Students will have the Knowledge about Production, handling & transportation of radio-nuclides.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	1. Introduction to Interventional Radiology: Need for interventional procedures. 2. Catheterization, catheterization sites 3. Guide wire, catheters, pressure injectors, accessories. 4. Drainage procedure and aspiration cytology under fluoroscopy, CT, USG, MRI guidance. 5. Digital Subtraction Angiography (DSA), Types, Instrumentation. 6. Angiography 7. Venography 8. NMT and Radioactive Transformation 9. Modes of Radioactive decay, parent daughter decay. 10. Production of Radio nuclides 11. Gamma camera 12. PET 13. SPECT 14. Radio pharmacy & Handling & Transport of Radio-nuclides	80	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins; 2011.
- Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.
- Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences; 2012 Feb 14.
- Bomford CK, Miller J, Kunkler H, Sherriff IH, Bomford SB, IH Kunkler SB. Walter and Miller's textbook of radiotherapy: radiation physics, therapy, and oncology. 1993.
- Sutton, David. "A textbook of radiology and imaging." (1987).

e-Learning Source:

- <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/interventional-radiology#:~:text=What%20is%20interventional%20radiology%3F,ultrasound%20help%20guide%20the%20radiologist>.
- https://www.cdc.gov/nceh/radiation/nuclear_medicine.htm#:~:text=Nuclear%20medicine%20uses%20radioactive%20material,x%2Drays%3A%20how%20they%20work
- <https://www.iaea.org/resources/rpop/health-professionals/nuclear-medicine>

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	2	2	3	3	3	3	3	2	2	2	3
CO2	2	3	2	2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	3	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

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

Course Code	Course Title	Attributes & SDGs							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS607	Interventional & Nuclear Medicine Techniques – Lab			√					3,4, 11



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INTEGRAL INSTITUTE OF ALLIED HEALTH SCIENCES & RESEARCH

DEPARTMENT OF PARAMEDICAL SCIENCES

**MASTERS OF RADIOLOGICAL IMAGING SCIENCES
(MMRIS)**

SYLLABUS

YEAR/ SEMESTER: II/IV



Integral University, Lucknow
Department of Paramedical Sciences
Study and Evaluation Scheme

Program: MMRIS

Semester-IV

S. N.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits
				L	T	P	CT	TA	Total	ESE			
THEORIES													
1	RS608	Advanced CT, MRI & USG	Core	3	1	0	40	20	60	40	100	3:1:0	4
2	RS609	Patient Care in Diagnostic Radiology	Core	3	1	0	40	20	60	40	100	3:1:0	4
PRACTICAL													
1	RS610	Seminar	Core	0	3	0	50	50	100	00	100	0:3:0	3
2	RS611	Residency – IV Lab	Core	0	0	10	40	20	60	40	100	0:0:5	5
3	RS612	Advanced CT, MRI & USG Lab	Core	0	0	8	40	20	60	40	100	0:0:4	4
4	RS613	Dissertation	Core	0	10	0	40	20	60	40	100	0:10:0	10
Total				06	15	18	250	150	400	200	600	30	30

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	RS608	Advanced CT, MRI & USG	Core	√	√	√	√		√	√	3,4
2	RS609	Patient Care in Diagnostic Radiology	Core	√	√	√	√		√	√	3,4
PRACTICAL											
1	RS610	Seminar	Core	√	√	√			√	√	3,4
2	RS611	Residency – IV Lab	Core	√	√	√	√		√	√	3,4
3	RS612	Advanced CT, MRI & USG Lab	Core	√	√	√	√		√	√	3,4
4	RS613	Dissertation	Core	√	√	√	√		√	√	3,4

L: Lecture **T:** Tutorials **P:** Practical **CT:** Class Test **TA:** Teacher Assessment **ESE:** End Semester Examination,
 AE= Ability enhancement, DSE- Discipline Specific Elective, **Sessional Total:** Class Test + Teacher Assessment **Subject Total:** Sessional Total + End Semester Examination (ESE)



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS608	Title of the Course	Advanced CT, MRI & USG	L	T	P	C
Year	II	Semester	IV	3	1	0	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the recent advancements & new imaging modalities. Outline of advanced CT/ MRI/ USG & Doppler.						

Course Outcomes	
CO1	At the end of the course, student will have knowledge on: Latest upgraded hardware & software of different imaging modalities.
CO2	Students will have abundant Knowledge on New techniques used to achieve images for special conditions. Various post processing techniques.
CO3	Students will have Knowledge on Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- biopsy procedures, assurance to patients.
CO4	Students will have Knowledge on CT of head and neck – thorax – abdomen – pelvis – Musculo skeletal system – spine – PNS. Anatomy– clinical indications and contraindications – patient preparation – technique – contrast media-types.
CO5	Students will have abundant Knowledge on injection technique; timing, sequence - image display – patient care – utilization of available techniques & image processing facilities to guide the clinician- CT anatomy and pathology of different organ systems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	HELICAL & MDCT SCAN	Helical CT scan: Slip ring technology, advantages, Multi detector array helical CT , cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT Post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose	06	CO1
2.	MRI IMAGING METHODS	MRI imaging methods – Head and Neck, Thorax, Abdomen, Musculoskeletal System imaging, Clinical Indications and Contraindications, types of common sequences on imaging Protocols for various studies, Slice section, patient preparation, Positioning of the patient, Plain studies, Contrast studies, Special procedures, Reconstructions, 3D images, MRS blood flow imaging, diffusion/perfusion scans, strength and limitations of MRI.	08	CO2
3.	TECHNIQUES OF SONOGRAPHY	Techniques of sonography , selection, Preparations, instructions and positioning of the patient for TAS, TVS, TRUS, neck USG and extremities, Biopsy procedures, assurance to patients.	08	CO3
4.	CT OF DIFFERENT BODY PARTS	CT of Head and Neck, Thorax, Abdomen, Pelvis, musculoskeletal system, Spine & PNS. Anatomy, clinical indications and contraindications, patient preparation, technique, contrast media, types, dose, injection technique; timing, sequence, image display, Patient care, Utilization of available techniques & image processing facilities to guide the clinician, CT anatomy and pathology of different organ systems.	10	CO4
5.	NMT FOR DIFFERENT BODY PARTS	In vivo technique, Static and dynamic studies, Thyroid imaging, Imaging of bone, Respiratory system, Urinary system, GI system, Cardiovascular system, Iodine 131 uptake studies, Iodine 131 therapy of thyrotoxicosis and thyroid ablation.	08	CO5

Reference Books:

- Faro SH, Mohamed FB, editors. Functional MRI: basic principles and clinical applications. Springer Science & Business Media; 2006 Nov, 22
- Baert AL. Parallel imaging in clinical MR applications. Springer Science & Business Media; 2007 Jan 11.
- Johansen-Berg H, Behrens TE, editors. Diffusion MRI: from quantitative measurement to in vivo neuroanatomy. Academic Press; 2013 Nov 4
- Bernstein MA, King KF, Zhou XJ. Handbook of MRI pulse sequences. Elsevier.
- Recent Trends in medical imaging (CT, MRI and USG)

e-Learning Source:

- <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/computed-tomography-ct-scan#:~:text=A%20CT%20scan%20is%20a%20diagnostic%20imaging%20procedure%20that%20uses,detailed%20than%20standard%20X%2Drays>
- <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/ct-scan>

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	2	2	3	3	3	3	3	2	2	2	3
CO2	2	3	2	2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	3	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
RS608	Advanced CT, MRI & USG	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS610	Title of the Course	SEMINAR	L	T	P	C
Year	II	Semester	IV	0	3	0	3
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to expertise the student in presenting seminars for improvement of self-confidence.						

Course Outcomes	
CO1	Student will be able to present seminar under concern topic in places like conferences, workshops, meets etc.
CO2	Student will have the knowledge on Power point presentation.
CO3	Student will have the presentation skill.
CO4	Student will have the knowledge on how to prepare a presentation for any event.
CO5	Student will be able to organize a Seminar, Webinar & Workshop.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	SEMINAR	1. Each student will be assigned topics for presentations as seminars, will explore recent innovations in the depaRSment of Radiological Imaging Techniques for presenting topics during Seminar and shall be holding group discussions along with in the presence of faculty.	60	CO1-5

Reference Books:

1. Brandon AN, Hill DR. Selected list of books and journals for the small medical library.
2. Bulletin of the Medical Library Association. 1981 Apr;69(2):185.
3. Recent Research topics in Radio imaging (Diagnostic radiology)
4. RSNA (Journals from Radiological Society of North America)
5. AJR (American Journal of Radiology)/ (BJR) British Journal of Radiology
6. IJR (Indian journal of Radiology)/Internet journal of Radiology

e-Learning Source:

1. <https://www.who.int/>
2. <https://main.mohfw.gov.in/>

SEMINAR PRESENTATION ASSESSMENTN FORM

Name of Student:		Session:	
Enrolment Number:		Date:	
Name of Subject:	Seminar	Subject code:	RS306
Topics:			

Criteria	Sub-Criteria	Max. Marks	Marks Obtained
Introduction (Max marks-10)	Use appropriate background information	04	
	Has clear statement of purpose	04	
	Shows a logical sequence	02	
Factual Content (Max marks- 20)	Includes accurate information	04	
	Shows up-to-date content	04	
	Presents relevant content	04	
	Shows in-depth and sufficient details	02	
	Addresses all important issues	02	
	Is selective	02	
	Use of proper English Grammar in the text	02	
Presentation Quality (Max marks-06)	Has a good design of presentation (appropriate font, type, size, color, matter per slide etc.)	04	
	Has a clear verbal expression and eye contact with audience	02	
Response to questions (Max marks-10)	Answers question(s) correctly	04	
	Has the ability to think on the spot	04	
	Shows an ability to defend content of presentation	02	
Time Management (Max. mark-04)	Completes the presentation within allocated time	04	
Total Marks		50	

Note: In case of Oral Presentation, each student will be assessed in a 20 minutes time (15 min for presentation & 5 min for discussion) out of 50 marks.

Comments/Suggestions:

Name and signature of Incharge

Head, Paramedical

EVALUATION OF SEMINAR

The evaluation for internal examination of 100 marks will be distributed:

Seminar Presentation=**50marks**.

Viva voce =**45 marks**

Attendance=**5 marks**

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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	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	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

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

Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS610	SEMINAR	√	√	√			√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS611	Title of the Course	Residency – IV Lab	L	T	P	C
Year	II	Semester	IV	0	0	10	5
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective of the Residency Lab is to learn about patient handling, radiation protection and procedures done in the department.						

Course Outcomes: After the successful course completion, learners will develop following attributes:	
CO1	Students will be able to learn how to deal with a patient during examination in the Radiology department.
CO2	Students will be able to learn how to perform X-Ray Examinations.
CO3	Students will be able to learn how to perform contrast studies along with their preparation and management.
CO4	Students will be able to learn how to perform ward mobile radiography on critically ill patients.
CO5	Students will be able to learn how to perform CT scans, MRI, Fluoroscopy and Mammography.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	In the residency, the professional is expected to work and contribute in the medical imaging unit.	100	CO1, CO2, CO3, CO4, CO5

Reference Books:

- Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical.
- Applications and Quality Control. Elsevier Health Sciences; 2015 Sep 2.
- Lakhkar B N, Banavali S, Shetty C. Radiological quiz-head and neck. Indian Journal of Radiology and Imaging.
- Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 Aug 13.
- Curry TS, Dowdey JE, Murry RC. Christensen's physics of diagnostic cardiology. Lippincott Williams & Wilkins; 1990.
- Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar20.
- Zwiebel WJ, Sohaey R. Introduction to ultrasound. WB Saunders Company;1998.
- Hagen-Ansert SL. Textbook of diagnostic ultrasonography. Mosby Elsevier;2006.

e-Learning Source:

- https://en.wikipedia.org/wiki/High-resolution_computed_tomography
- <https://youtu.be/ThjvEnIRrM>
- https://en.wikipedia.org/wiki/Doppler_ultrasonography

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	2	3	2	2	1	2	1	1	1	1	3	1	2	3	3	2
CO2	1	3	2	2	2	1	3	2	1	3	3	2	2	2	3	3
CO3	2	3	3	2	2	3	1	2	1	1	3	2	2	3	3	3
CO4	1	3	2	1	3	1	3	3	1	3	3	3	2	1	3	2
CO5	2	3	1	1	1	1	2	1	1	2	3	1	2	2	3	2

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

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS611	Residency – IV Lab	√	√	√	√		√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS612	Title of the Course	Advanced CT, MRI & USG Lab	L	T	P	C
Year	II	Semester	IV	0	0	8	4
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective is to learn about the recent advancements & new imaging modalities. Outline of advanced CT/ MRI/ USG & Doppler.						

Course Outcomes	
CO1	At the end of the course, student will have knowledge on: Latest upgraded hardware & software of different imaging modalities.
CO2	Students will have abundant Knowledge on New techniques used to achieve images for special conditions. Various post processing techniques.
CO3	Students will have Knowledge on Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- biopsy procedures, assurance to patients.
CO4	Students will have Knowledge on CT of head and neck – thorax – abdomen – pelvis – Musculo skeletal system – spine – PNS. Anatomy– clinical indications and contraindications – patient preparation – technique – contrast media-types.
CO5	Students will have abundant Knowledge on injection technique; timing, sequence - image display – patient care – utilization of available techniques & image processing facilities to guide the clinician- CT anatomy and pathology of different organ systems.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1.	COURSE CONTENTS	1. Helical CT scan 2. MSCT 3. CT Angiography 4. CT Fluoroscopy 5. HRCT 6. MRI Head and Neck 7. MRI Thorax and Abdomen 8. MRI Musculoskeletal System 9. Patient preparation, Positioning of the patient 10. Contrast studies 11. Techniques of sonography 12. CT of Head and Neck 13. CT of Thorax, Abdomen & Pelvis 14. CT of Spine & PNS 15. NMT of Thyroid imaging 16. NMT of bone and Respiratory system 17. NMT of the Urinary system, GI system and Cardiovascular system 18. Iodine 131 uptake studies	80	CO1 CO2 CO3 CO4 CO5

Reference Books:

- Faro SH, Mohamed FB, editors. Functional MRI: basic principles and clinical applications. Springer Science & Business Media; 2006 Nov, 22
- Baert AL. Parallel imaging in clinical MR applications. Springer Science & Business Media; 2007 Jan 11.
- Johansen-Berg H, Behrens TE, editors. Diffusion MRI: from quantitative measurement to in vivo neuroanatomy. Academic Press; 2013 Nov 4
- Bernstein MA, King KF, Zhou XJ. Handbook of MRI pulse sequences. Elsevier.
- Recent Trends in medical imaging (CT, MRI and USG)

e-Learning Source:

- <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/computed-tomography-ct-scan#:~:text=A%20CT%20scan%20is%20a%20diagnostic%20imaging%20procedure%20that%20uses,de%20tiled%20than%20standard%20X%20Drays>
- <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/ct-scan>

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	2	2	3	3	3	3	3	2	2	2	3	3
CO2	2	3	2	2	3	3	3	3	2	3	3	2	2	3	3	3
CO3	3	2	3	2	3	2	3	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	3	3	2	3	3	2	3	3	2	3	3	2
CO5	2	3	3	3	2	3	2	3	2	3	2	3	2	3	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation Attributes & SDGs

Course Code	Course Title	Attributes							SDGs No.
		Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
RS612	Advanced CT, MRI & USG Lab	√	√	√	√		√	√	3,4



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	RS613	Title of the Course	Dissertation	L	T	P	C
Year	II	Semester	IV	0	10	0	10
Pre-Requisite	Nil	Co-requisite	Nil				
Course Objectives	The objective of the course is to help the students making a dissertation presentation.						

Course Outcomes	
CO1	Students will be able to learn how to prepare presentation.
CO2	Students will have abundant Knowledge on explaining the presentation Infront of the Examiners.
CO3	Students will be able to learn about how to do new research in respected field.
CO4	Students will be able to learn about Methods of Data Collection.
CO5	Students will have abundant Knowledge on how to write dissertation and thesis.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	COURSE CONTENTS	<p>It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by staff of the department based on participation of students in various teaching/ learning activities. It may be structured and assessment shall be done using checklists that assess various aspects. Model checklists are given which may be copied and used.</p> <p>Journal Review Meeting (Journal Club): the ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting using a checklist (see Model Checklist).</p> <p>Seminars/ symposia: the topics should be assigned to the student well in advance to facilitate in depth study. The ability to do literature search, in depth study, presentation skills and use of audio- visual aids are to be assessed.</p>	200	CO1, CO2, CO3, CO4, CO5

Reference Books:	
1. S. Ramakrishnan, K G Prasannan and R Rajan: Text book of Medical Biochemistry, Orient Longman, Madras, 1990.	
2. D R Whitehat: Biochemistry of the Eye, 2nd edition, Butterworth Heinemann, Pennsylvania, 2003	
3. S.Ramakrishnan:Essentials of biochemistry and ocular biochemistry, Annamalai University Publications, Chidambaram, India, 1992.	
e-Learning Source:	
1. https://www.youtube.com/watch?v=P_WNPIZGvbM	
2. https://www.youtube.com/watch?v=P_WNPIZGvbM	

Name of Student		Session		
Enrollment Number		Date		
Name of Subject	Thesis/Dissertation	Subject Code	RS613	
Topics				
S. No.	Evaluation	Point to be Considered	Max. Marks	Marks Obtained
1.	On the basics of continuous assessment (10 Marks)	Periodic Consultation with Guide	2	
2.		Regular collection of Data with the consultation of guide.	2	
3.		Command of the topic & presentation skill	2	
4.		Methods, analysis, dissuasion and Conclusions	2	
5.		Contribution to knowledge and thesis structure	2	
Review all heading				
1.	On the basics of External Evaluators at the time of End Semester Examination.	Introduction	3	
2.		Aims, objectives & research hypothesis	3	
3.		Review of literature	3	
4.		Material & Methods	3	
5.		Data analysis & results	3	
6.		Discussion, lamination & future study	3	
7.		Conclusion, signification.	3	
8.		Bibliography	3	

9.		Tables, graph, diagram & Annexure (if any) Statistical Analysis MasterChart	3	
10.		The deface of study	3	
Total Score			40	

Note: Evaluation of Dissertation of MMRIS- Students has to prepare oral presentation; each student will be assessed in a 20 minutes time (15 min for presentation & 5 min for discussion). The evaluation of dissertation by external examiner with proper approval of concern authorities. The end semester examination will be 40 marks as external evaluations and 60 marks will be by the internal examiner (continuous assessment):

Comments/Suggestions:

(Name and signature of Incharge)

(Head, Paramedical)

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	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	3	2	3	2	2	3	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation
Attributes & SDGs

Course Code	Course Title	Attributes						SDGs No.	
RS613	Dissertation	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	3,4
		√	√	√	√		√	√	