Course Information:

School/ Department:	Glocal School of Paramedical Science & Research Centre
Programme:	BRIT
Course Tile:	Technique and Instrumentation of Magnetic Resonance Imaging
Course Code:	MRT-301
Course Level (UG/PG)	UG
Credits	4- L - T 1-P.
Prerequisite	No
Year/Semester	3rd

Course Objectives: This course focuses on information of techniques & basic principle of Magnetic Resonance Imaging, electricity and magnetism and laws of magnetism.

Course Outcomes: 1. Awareness of Basic Principle of Magnetic Resonance Imaging and its hardware.
2. Should be able to do slice selection Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling.
3. Knowledge of MRI safety.
4. Should be able to perform all routine MRI procedures & knowledge of MRI angiography and flow phenomenon compensation.
5. Should be able to do patient monitoring in medical emergencies.

Teaching Methodology:

Methodology	Mention Appropriate Methods (Yes/No)
Explanations by the Instructor	**Yes**
Group/Pair Work	**Yes**
Class Discussion	**Yes**
Assignment/s	**Yes**
Viva Voice	**Yes**
Audio/video Class	**Yes**
Practical/ Case Study/Diary	**Yes**
Presentations	**Yes**
Hospital Posting	**Yes**

COURSE CONTENT

No	Description	Weightage (%)
1	**Introduction and Basic Principle of Magnetic Resonance Imaging :** History of MRI, Electricity & Magnetism, Laws of magnetism, Atomic structure, Motion within the atom, The Hydrogen nucleus, Precession, Larmor equation, Resonance, MR signal, Free induction decay signal, Relaxation, T1 recovery, T2 decay, Pulse timing& parameters.	20
2	**MRI Hardware-** Introduction, Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils, the pulse control units, Patient transportation system, Operator interface b) Gradients, Slice selection, Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling and fast Fourier transformation.	20
3	**Pulse sequences-** Introduction To basic pulse sequences. Spin echo sequences, Conventional spin echo, Fast spin echo Inversion recovery, STIR, FLAIR Proton Density Imaging, Gradient echo pulse sequences Conventional gradient echo**,** The study state, SSFP**,** Coherent residual transverse magnetization**,** Incoherent residual transverse magnetization**,** Ultra- fast imaging, Advanced imaging techniques EPI. b) **MRI parameters & Trade offs** -Introduction, Signal to Noise Ratio (SNR) & How to increase SNR, Contrast to Noise Ratio (CNR), Spatial resolution & how to increase the spatial resolution, Scan time & how to reduce time, Tradeoffs, Decision making, Volume imaging.	25
4	**MRI Artefacts -** Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artefact, Chemical missregistration, Truncation artefact/Gibbs phenomenon, Motion of the patient Magnetic susceptibility artefact, Magic angle artefact, Zipper artefact, shading artefact Cross excitation and cross talk.	10
5	**Flow Phenomena & MRI angiography** Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intravoxel Dephasing. **Flow phenomena compensation**-Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography. **Clinical Applications, Scanning Protocols and Safety aspects**	25

	Protocols for whole body imaging , The main magnetic field, Gradient magnetic field, Radiofrequency fields, Projectiles, Implants and prostheses, Pacemakers, Medical emergencies, Patient monitoring, Monitors and devices in MRI Claustrophobia, Quenching, Safety tips, Layout planning.	

Lecture Plan

Unit Number	Unit Title	Number of Lectures
1	**Introduction and Basic Principle of Magnetic Resonance Imaging**	20
2	**MRI Hardware**	15
3	**Pulse Sequences**	23
4	**MRI Artefacts**	8
5	**Flow Phenomena , Scanning Protocols & MRI Safety**	25

Practical Description:

1. Patient preparation, patient positioning, performing all non-contrast and contrast MRI procedures.
2. Planning of different scanning planes, parameters and their tradeoffs & patient monitoring during the procedures.
3. Various post processing techniques and evaluation of image quality and clinical findings.
4. Post procedural care of the patient.

Credit Hours: 2/week

Literature/Reference: Lab Manual

Evaluation Scheme

	External	Internal	Total
Assessment (theory)	70	30	100
Evaluation of Practical/Dissertations	35	15	50

Internal Evaluation of Theory	Class Test(2 best out of 3)	Assignment	Attendance	Total
	20	5	5	30

Textbooks, Reference, Supplementary Materials

1. McRobbie DW, Moore EA, Graves MJ. MRI from Picture to Proton. Cambridge university press; 2017 Apr 13.
2. Huettel SA, Song AW, McCarthy G. Functional magnetic resonance imaging. Sunderland: Sinauer Associates; 2004 Apr 1.
3. Westbrook, Catherine, and Carolyn Kaut Roth. *MRI in Practice*. John Wiley & Sons.
4. Westbrook, Catherine. *Handbook of MRI technique*. John Wiley & Sons, 2014.
5. Möller, Torsten B., and Emil Reif. *MRI parameters and positioning*. Thieme, 2010.
6. Dale BM, Brown MA, Semelka RC. MRI: basic principles and applications. John Wiley & Sons; 2015 Aug 6.

Cos\ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1										✓		
CO2			✓							✓		
CO3			✓	✓						✓		
CO4				✓						✓		
CO5				✓						✓		

Departmental Quality Assurance Committee Approval			
No.	**Name**	**Digital Signature**	**Date**
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Course Information:

Course Objectives: This subject focuses on need for interventional radiology, knowledge of

School/ Department:	Glocal School of Paramedical Science & Research Centre
Programme:	BRIT
Course Tile:	Technique & Equipment of Nuclear Medicine Technology & Interventional Radiology
Course Code:	MRT-302
Course Level (UG/PG)	UG
Credits	4-L - T 1-P.
Prerequisite	No
Year/Semester	3rd

Nuclear medicine and the uses radioactive materials to help diagnose and treat a wide variety of diseases and disorders.

Course Outcomes: 1. Knowledge of Patient monitoring, role of technologist in interventional procedure.
2. Aware of types of contrast media, method of administration, contraindication, contrast reaction management, emergency crash cart.
3. Handling of radionuclides, gamma camera, Angiographic equipment, sterile techniques and interventional procedures.
4. Knowledge of digital subtraction angiography and its types.
5. Should be able to assist interventional procedures.

Teaching Methodology:

Methodology	Mention Appropriate Methods (Yes/No)
Explanations by the Instructor	**Yes**
Group/Pair Work	**Yes**
Class Discussion	**Yes**
Assignment/s	**Yes**
Viva Voice	**Yes**
Audio/video Class	**Yes**
Practical/ Case Study/Diary	**Yes**
Presentations	**Yes**
Hospital Posting	**Yes**

COURSE CONTENT

No	Description	Weightage (%)
1	**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.	15
2	**Production of Radio nuclides** Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators.	13
3	**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.	12
4	**Equipments of NMT** Gamma camera, PET, SPECT (working principle)	10
Interventional Radiology		
5	**Introduction to Interventional Radiology, Contrast media & Emergency Drugs** Need for interventional procedures, Informed consent, patient care, patient preparation, Patient monitoring, role of technologist in interventional procedure Types of contrast media, method of administration, contraindication, contrast reaction management, emergency crash cart.	10
6	**Angiographic Equipment, Catheters & guide wires** Basics of Angiographic equipments, Single and biplane angiographic equipment, Angiographic Table, Image intensifier, Flat panel detector, electromechanical injectors, Catheters, types of catheters & guidwires , seldinger technique.	15
7	**Digital Subtraction Angiography** Types, Instrumentation	10
8	**Sterile Techniques & Radiation Protection** Laying up a sterile trolley, sterile techniques, radiation protection for staff and patient, protective devices, monitors .	5
9	**Interventional Procedures**	10

	Cardiac, Vascular, Nonvascular	

Lecture Plan

Unit Number	Unit Title	Number of Lectures
1	**Introduction to NMT and Radioactive Transformation**	08
2	**Production of Radio nuclides**	08
3	**Radio pharmacy & Handling & Transport of Radio-nuclides**	12
4	**Equipments of NMT**	08
5	**Introduction to Interventional Radiology, Contrast media & Emergency Drugs**	7
6	**Angiographic Equipments, Catheters & guide wires**	10
7	**Digital Subtraction Angiography**	5
8	**Sterile Techniques & Radiation Protection**	5
9	**Interventional Procedures**	15

Practical Description:

1. Patient preparation, patient positioning, performing all procedures.
2. Patient monitoring during the procedures.
3. Various post processing techniques and evaluation of image quality and clinical findings.
4. Post procedural care of the patient

Credit Hours: 2/week

Literature/Reference: Lab Manual

Evaluation Scheme

	External	Internal	Total
Assessment (theory)	70	30	100
Evaluation of Practical/Dissertations	35	15	50

Internal Evaluation of Theory	Class Test(2 best out of 3)	Assignment	Attendance	Total
	20	5	5	30

Textbooks, Supplementary Materials

1. Cherry SR, Sorenson JA, Phelps ME. Physics in Nuclear Medicine E-Book. Elsevier Health Sciences; 2012 Feb 14.
2. 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.
3. Sutton, David. "A textbook of radiology and imaging." (1987).
4. Waterstram-Rich KM, Gilmore D. Nuclear Medicine and PET/CT-E-Book: Technology and Techniques. Elsevier Health Sciences; 2016 Jul 30.
5. Bailey DL, Townsend DW, Valk PE, Maisey MN. Positron emission tomography.London: Springer; 2005

Interventional Radiology

1. Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins; 2011.
2. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.
3. Valji K. The Practice of Interventional Radiology, with Online Cases and Video E-Book: Expert Consult Premium Edition-Enhanced Online Features. Elsevier Health Sciences.
4. Adam A, Dixon AK, Gillard JH, Schaefer-Prokop C, Grainger RG, Allison DJ. Grainger & Allison's Diagnostic Radiology E-Book. Elsevier Health Sciences; 2014 Jun 16.
5. Kessel D, Robertson I. Interventional Radiology: A Survival Guide E-Book. Elsevier Health Sciences; 2016 Oct 22

Cos\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓				✓
CO2								✓				✓
CO3		✓								✓		✓
CO4		✓								✓		✓
CO5		✓			✓					✓		✓

Departmental Quality Assurance Committee Approval			
No.	Name	Digital Signature	Date
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Course Information:

Course Objectives: This subject introduces patient care and electronic patient monitoring, patient care during investigation and infection control.

School/ Department:	Glocal School of Paramedical Science & Research Centre
Programme:	BRIT
Course Tile:	Patient Care and Management
Course Code:	MRT-303
Course Level (UG/PG)	UG
Credits	3-L - T -P.
Prerequisite	No
Year/Semester	3rd

Course Outcomes: 1. Students would be able to do patient care in pre and post procedural techniques.
2. Knowledge of patient transfer and restraint technique, infection control and prevention.
3. Handling the emergencies in radiology department.
4. Knowledge of medicine administration.
5. Should be able to do isolation and sterilization techniques.

Teaching Methodology:

Methodology	Mention Appropriate Methods (Yes/No)
Explanations by the Instructor	**Yes**
Group/Pair Work	**Yes**
Class Discussion	**Yes**
Assignment/s	**Yes**
Viva Voice	**Yes**
Audio/video Class	**Yes**
Practical/ Case Study/Diary	**Yes**
Presentations	**Yes**
Hospital Posting	**Yes**

COURSE CONTENT

No	Description	Weightage (%)
1	**Patient care and Assessment**	20

	Taking history, Assessing current physical status, Skin temperature, colour, consciousness, Breathing, Obtaining Vital signs, Electronic Patient Monitoring	
2	**Responsibilities of the Imaging Technologist-** Medication administration, routes of administration, List of frequently used medications. **Patient transfer technique &Restraint technique-** Preparation for transfer, wheelchair transfer, stretcher transfer, immobilization techniques. .	20
3	**Handling the emergencies in Radiology** Reaction to contrast media, Oxygen administration and suction, Respiratory emergencies, Cardiac emergencies, Trauma, Shock **Patient care during Investigation-** G.I. Tract, Biliary tract, Respiratory tract, Gynecology, Cardiovascular, Lymphatic system, C.N.S. etc	20
4	**Infection Control** Microorganism- Bacteria, Viruses, Fungi, Prions, Protozoa Cycle of Infection, Immunity, Infectious disease Transmission modes Isolation techniques Sterilization & sterile techniques.	20
5	**Patient Education & Communication** Patient communication problems Explanation of examinations Radiation Safety / Protection Interacting with terminally ill patient Informed Consent	20

Lecture Plan

Unit Number	Unit Title	Number of Lectures
1	**Patient care and Assessment**	10

2	**Responsibilities of the Imaging Technologist.**	10
3	**Handling the emergencies in Radiology Patient care during Investigation**	15
4	**Infection Control**	10
5	**Patient Education & Communication**	15

Evaluation Scheme

	External	Internal	Total
Assessment (theory)	70	30	100
Evaluation of Practical/Dissertations	35	15	50

Internal Evaluation of Theory	Class Test(2 best out of 3)	Assignment	Attendance	Total
	20	5	5	30

Textbooks, Reference, Supplementary Materials

1. Ehrlich RA, Coakes DM. Patient Care in Radiography-E-Book: With an Introduction to Medical Imaging. Elsevier Health Sciences; 2016 Jan 19.
2. Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy-E-Book. Elsevier Health Sciences; 2013 Aug 7.
3. Grol R, Wensing M, Eccles M, Davis D, editors. Improving patient care: the implementation of change in health care. John Wiley & Sons; 2013 Mar 18.
4. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012 Mar 20.

Cos\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓				
CO2								✓				
CO3				✓				✓				
CO4			✓	✓				✓				
CO5		✓		✓				✓				

Departmental Quality Assurance Committee Approval			
No.	Name	Digital Signature	Date
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Course Information:

Course Objectives: This course focuses on biostatics and research methodology and their importance in radio diagnosis.

Course Outcomes: 1. Knowledge of biostatistics, role of statistics in health science and health care delivery system.
2. Analysis of qualitative and quantitative data.
3. Utilization of appropriate software to assist in the retrieval of information and data analysis.
4. Should be able to understand research design.
5. Should be able to handle clinical audit.

School/ Department:	Glocal School of Paramedical Science & Research Centre
Programme:	BRIT
Course Tile:	Biostatics & Research Methodology
Course Code:	MRT-304
Course Level (UG/PG)	UG
Credits	3-L - T -P.
Prerequisite	No
Year/Semester	3rd

Teaching Methodology:

Methodology	Mention Appropriate Methods (Yes/No)
Explanations by the Instructor	**Yes**
Group/Pair Work	**Yes**
Class Discussion	**Yes**
Assignment/s	**Yes**
Viva Voice	**Yes**
Audio/video Class	**Yes**
Practical/ Case Study/Diary	**Yes**
Presentations	**Yes**
Hospital Posting	**No**

COURSE CONTENT

No	Description	Weightage (%)

1	**Introduction** : 1. Biostatistics – Definition, Role of statistics in health science and health care delivery system. 2. Research Methodology - Research process, Steps involved in research process , Research methods and methodology	20
2	**Accessing research literature:** Use of databases and other sources .	15
3	**Understanding research design:** Qualitative and quantitative methodologies – their differences and potential integration. Evaluating research and its potential for informing practice. Developing research questions and devising methods for their investigation. Ethical issues in research	25
4	**Analysis:** Analysis of qualitative and quantitative data. Utilization of appropriate software to assist in the retrieval of information and data analysis	20
5	**Clinical audit:** Distinctiveness of research and audit processes and their function **Research Skills and Management**: The role of evidence based practice within health and welfare.	20

Lecture Plan

Unit Number	Unit Title	Number of Lectures
1	**Introduction**	10

2	**Accessing research literature**	06
3	**Understanding research design**	15
4	**Analysis**	10
5	**Clinical audit, research skills and management**	10

Evaluation Scheme

	External	Internal	Total
Assessment (theory)	70	30	100
Evaluation of Practical/Dissertations	35	15	50

Internal Evaluation of Theory	Class Test(2 best out of 3)	Assignment	Attendance	Total
	20	5	5	30

Textbooks, Reference, Supplementary Materials

1. Mahajan BK: Methods in Biostatistics for medical students and research workers, 6th edition Jaypee, 1997
2. Kothari CR. Research Methodology (Methods & Techniques) Wiley Eastern Limited. New Delhi.
3. Rao, PSS Sundar, and J. Richard. *Introduction to biostatistics and research methods*. PHI Learning Pvt. Ltd., 2012.
4. Pagano M, Gauvreau K, Pagano M. Principles of biostatistics. Pacific Grove, CA: Duxbury; 2000 Mar.

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

School/ Department:	Glocal College of Paramedical Science and Research Center
Programme:	BRIT
Course Tile:	Hospital Postings
Course Code:	MRT-351
Course Level (UG/PG)	UG
Credits	-L -T 6-P .
Prerequisite	No
Year/Semester	3rd

POs												
CO1											✓	
CO2											✓	
CO3											✓	
CO4											✓	
CO5											✓	

Departmental Quality Assurance Committee Approval			
No.	**Name**	**Digital Signature**	**Date**
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Course Information:

Course Objectives: The main objective of this subject is deputation of students in various laboratories of Radiology so that they can understand the proper working mechanisms of equipment in Radio imaging Department.

Course Outcomes: 1. After completion of this subject student would be able to demonstrate and perform all techniques used in Radio-diagnosis,
2. Should be able to do patient care during and after radio diagnosis.
3. Able to do patient preparation for different radiographic procedures.
4. Knowledge of applicability of paraclinical sciences and computer sciences in medical imaging. 5. Advance knowledge of all techniques and their types used in radiology department.

Teaching Methodology:

Methodology	Mention Appropriate Methods (Yes/No)
Explanations by the Instructor	**Yes**
Group/Pair Work	**Yes**
Class Discussion	**No**
Assignment/s	**Yes**
Viva Voice	**Yes**
Audio/video Class	**No**
Practical/ Case Study/Diary	**Yes**
Presentations	**Yes**
Hospital Posting	**Yes**

COURSE CONTENT

No	Description	Weightage (%)
1	Students shall be deputed to various labs of Radiology department wherein they shall undergo practical training of handling patients, collection and processing of investigation (X Ray, Special procedures, MRI, Interventional Procedure etc) and equipment.	100

	Identification of patient's particulars based on CR number, Lab Number and transfer of samples from collection to different labs. Process of performing various tests in different labs Each student is required to maintain a logbook of the various posting. Student's performance shall be evaluated on continuous basis by the faculty posted in various sections. The faculty shall submit the assessment records of each student posted in his/her section on monthly basis to the HOD. Marks will be awarded out of 50.	

Practical Description:
Based on course content.

Credit Hours: 12/week

Literature/Reference: Lab Manual

Evaluation Scheme

	External	Internal	Total
Assessment (theory)	70	30	100
Evaluation of Practical/Dissertations	35	15	50

Internal Evaluation of Theory	Class Test(2 best out of 3)	Assignment	Attendance	Total
	20	5	5	30

Cos\ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		✓			✓	✓			✓	✓		

CO2		✓				✓				✓		
CO3		✓	✓			✓		✓		✓		
CO4		✓	✓			✓				✓		
CO5		✓	✓			✓			✓	✓		

Departmental Quality Assurance Committee Approval			
No.	**Name**	**Digital Signature**	**Date**
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