Regulations and Curricula for

Post Graduate Degree in Medical Sciences
2016

M.Sc.,[Medical Imaging Technology]





Rajiv Gandhi University of Health Sciences, Karnataka
4th 'T' Block, Jayanagar, Bangalore – 560 041.

Annexure to RGUHS Notification No: AUTH/M.Sc(Medical Imaging Technology)-282/2016-17 dated 08/07/2016

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ACA/DCD/MISC/282/2016-2017 08/07/2016

NOTIFICATION

Sub: Ordinance Governing Regulations and Curriculum for M.Sc Medical Imaging Technology.

Ref: 1. Proceedings of Academic Council Meeting dated15/06/2016.
2. Minutes of the Syndicate meeting held on 27/06/2016.

In exercise of the powers conferred under section 35(1) of the RGUHS Act 1994, the Syndicate in its meeting held on 27/06/2016 decided to implement the Ordinance Governing Regulations and Curriculum for M.Sc Medical Imaging Technology.

The above ordinance comes into effect from the Academic Year 2016-17 and onwards.

By Order,

REGISTRAR

To,

The Principals of All Colleges conducting B.Sc Medical Imaging Technology,
Affiliated to RGUHS

Copy to:
1. PA to VC/Registrar/Registrar (Evaluation).
2. DR Affiliation / DR Admission.
3. The Secretary to Government, Health and Family Welfare Department (Medical Education), Vikas Soudha, Dr B.R.Ambedkar Veedhi, Bangalore-560 001.
4. Director of Medical Education, Ananda Rao Circle, Bangalore-560 009.

Section I:
Regulations Governing M.sc Medical ImagingTechnology

1. Title of the course

Master of Science degree in Medical Imaging Technology

2. Duration of study

The duration of the course shall be on full time basis for a period of two years from the commencement of the academic term.

3. Eligibility for Admission

Candidates who have passed final year B.SC Medical Imaging Technology with 60% marks for general category and 55% for reserved category.

4. Selection Criteria

The short listed candidates will have to present themselves to a selection process, comprising aptitude test. Selected candidates would have to appear for student counseling to decide on the college of study.

5. Eligibility certificate

No candidate shall be admitted for the postgraduate degree course unless the candidate has obtained and produced the eligibility certificate issued by the university. The candidate has to make the application to the university with the following documents along with the prescribed fee.

Pass/Degree certificate issued by the parent university.
Marks card of all the university examinations passed.
Migration certificate.
Certificate of conduct.
Proof of SC/ST or category-I as the case may be.

Candidate should obtain the eligibility certificate before the last date of admission as notified by this university.

A candidate who has been admitted to post-graduate course should register his/her name in the university within a month of admission after paying the registration fee.

6. Medium of instruction

English shall be the medium of instruction for the subjects of study as well as for the examination.

7. Course of Study

The course shall be pursued on full time basis.

7.1. The training of this postgraduate degree shall be residency pattern with graded responsibilities in the management and care of patients The course is mainly focused on practical aspects of **Radiology.** Every candidate should take part in seminars, group discussions, case demonstrations, journal review meetings and clinics. Training should include involvement in laboratory and experimental work, and research studies.

7.2. The training also consists of posting the students in various hospitals for a period of two months before final year examination.

Subjects of study and teaching hours for first year and second year M.Sc, Medical Imaging Technology course are shown in Table – I and Table – II respectively.

Table – I: Distribution of Teaching Hours in First Year M.Sc., Medical Imaging Technology Subjects

Sl. N	Main Subjects	Theory No. of hours	Practical No. of hours	Total
1	Radiographic procedure &principles	130	450	580
2	Instrumentation of conventional x-Ray & specialized radiology equipments	130	450	580
3	Advanced Technique and Instrumentation of ultrasonography	65	280	345
4	Advanced Technique and instrumentation of computed tomography	80	280	360
5	Biostatistics	50	--	50

Table – II: Distribution of Teaching Hours in Second Year M.sc;Medical Imaging Subjects

Sl. No	Main Subjects	Theory No. of hours	Practical No. of hours	Total
1	Advanced Technique and instrumentation of MRI	80	280	360
2	Interventional Radiology Techniques	60	110	170
3	Care of patients in Diagnostic Radiology	50	230	280
4	Radiation Evaluation& Protection in Diagnostic radiology	60	280	340
5	Nuclear Medicine Imaging Techniques	65	250	315
	TOTAL	770	2610	3380

8. Attendance, Progress and Conduct:

8.1. A candidate pursuing this degree course should be associated with the concerned department for the full period as a full time student. No candidate is permitted to do any other course, running parallel, while studying this postgraduate course.

8.2. Each year shall be taken as a unit for the purpose of calculating attendance.

8.3. Every student shall attend symposia, seminars, conferences, journal review meetings, grand rounds, case presentations, clinics and lectures during each year as prescribed by the department and not absent himself/herself from work without valid reasons.

8.4. Every candidate is required to attend a minimum of 80% of the training during each academic year of the postgraduate course. Provided further, leave of any kind shall not be counted as part of academic term without prejudice to minimum of 80% attendance of training period each year.

8.5. Any student who fails to complete the course in the manner stated above shall not be permitted to appear for the University Examinations.

9. Monitoring Progress of studies

9.1. **Work diary / Log Book**: Each candidate shall maintain a work diary and record of his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. (Please see the model checklists and logbook specimen copy, the details of which are given towards the end of this curriculum). The work diary shall be scrutinized and certified by the Head of the

Department and Head of the Institution, and presented in the university practical examination.

9.2. **Internal Assessment (IA):** Institutions running this course shall conduct two tests in First and Second year for internal assessment. The second test shall be conducted one month prior to the university examination so that it also serves as a preparatory examination. The marks obtained in these tests will be considered for internal assessment. Average of the best of two marks will be computed for internal assessment and shall be sent to the university as per the notification issued by Registrar (Evaluation) before each university examination. Records and marks obtained in tests will be maintained by the college and made available to the university. Marks of periodic tests shall be displayed on the notice board by the principal without fail.

If a candidate is absent from the test due to genuine and satisfactory reason, such a candidate may be given a re-test within a fortnight.

Table III. Distribution of Internal Assessment marks in first year M.sc;Medical Imaging course

Sr. No	Subjects	Practical	
1.	Radiographic procedure &principles	Expt10	viva10
2.	Instrumentation of conventional x-Ray & specialized radiology equipments	Expt10	viva10
3.	Advanced Technique and Instrumentation of ultrasonography	Expt10	viva10
4.	Advanced Technique and instrumentation of computed tomography	Expt10	viva10

Table IV. Distribution of Internal Assessment marks in second year M.sc;Medical Imaging course

Sr. No	Subjects	Practical	
1.	Advanced Technique and instrumentation of MRI	Expt10	viva10
2.	Interventional Radiology Techniques	Expt10	viva10
3.	Care of patients in Diagnostic Radiology	Expt10	viva10

4.	Radiation Evaluation& Protection in Diagnostic radiology	Expt10	viva10
5.	Nuclear Medicine Imaging Techniques	Expt10	viva10

NOTE: A student must secure at least 50% of total marks fixed for internal assessment for a particular subject in order to be eligible to appear in university examination in that subject

10. Project

10.1. Every candidate pursuing M.Sc. Medical Imaging Technology course is required to carry out work on selected topics as project under the guidance of a recognized post graduate teacher for a period of one year after the submission of synopsis. The results of such a work shall be submitted in the form of a Project

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10.2. The project is aimed to train a postgraduate student in methods and techniques of imaging technology. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, collection of data, critical analysis, comparison of results and drawing conclusions.

10.3. Every candidate shall submit to the Registrar (Academic) of the university in the prescribed proforma, two hard copies of synopsis containing particulars of proposed project work within six months from the date of commencement of the course on or before the date notified by the university .The synopsis shall be sent through proper channel.

10.5. The project should be written under the following headings:

i) Introduction
ii) Aims or Objectives of study
iii)Review of Literature
iv)Material and Methods Results
vi)Discussion
vii)Conclusion
viii)Summary
ix)Reference
x) Tables
xi) Annexure

10.6. The written text of project shall not be less than 50 pages and shall not exceed 100 pages. It should be neatly typed in double line spacing on one side of the

A4 size paper and bound properly. Spiral binding should not be done. A declaration by the candidate that the work was done by him/her shall be included. The guide, head of the department and head of the institution shall certify the dissertation. No marks shall be awarded for project

11. Guide

The academic qualification and teaching experience required for recognition as Guides by the RGUHS

a) Age:

The age of guide shall not exceed 65 years.

b) Student-Guide Ratio: 3:1

A recognized guide shall supervise dissertation work for note more than three students per academic year. In any given college the maximum number of seats shall not exceed 6.

12. Schedule of Examination:

12.1 The university conducts two examinations in a year at an interval of not less than four to six months.

12.2 The number of examiners for practical and viva-voce shall be two, comprising of one internal and one external examiner appointed by the university.

12.3 A failed candidate needs to appear for both theory and practical examination in the failed subject/s only in the subsequent examination.

13. Scheme of Examination:

There shall be two university examinations, one at the end of the first year and the other at the end of second year, respectively.

A candidate shall be eligible to appear for the first year M.Sc., Radio diagnosis examination at the end of one year from the commencement of the course. He/She should have satisfactorily completed the prescribed course and fulfilled the prescribed attendance.

Written Examination: Shall consist of theory papers each of three hours duration. Each paper shall carry 80 marks.

Practical Examination: There shall be one practical examination at the end of each year in each of the designated subject. Each examination carries 80 marks. The duration of practical is three hours.

Records to be assessed by the external examiners during university practical examination.

Viva Voce: This shall aim at assessing: depth of knowledge, logical reasoning, confidence and oral communication skills. Each viva carries 20 marks.

Both internal and external examiners shall conduct the practical and viva-voce examination.

The particulars of subjects for examination and distribution of marks are shown in the table V and VI.

Table V. Main subjects for examination and distribution of marks for first year

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Sl. No	Subjects	Theory		Practical			Grand Total
		Written	IA	Expt	Viva	Total	
1.	Radiographic procedure &principles	80	20	80	20	100	200
2.	Instrumentation of conventional x-Ray & specialized radiology equipments	80	20	80	20	100	200
3.	Advanced Technique and Instrumentation of ultrasonography	80	20	80	20	100	200
4.	Advanced Technique and instrumentation of computed tomography	80	20	80	20	100	200
	Subsidary subjects (Secondary subjects)						
	Surface Anatomy Surface Physiology			50 50	--	50 50	100
	TOTAL						900

Table VI. Main subjects for examination and distribution of marks for Second year

Sr. No	Subjects	Theory		Practical			Grand Total
		Written	IA	Expt	Viva	Total	
1.	Advanced Technique and instrumentation of MRI	80	20	80	20	100	200
2.	Interventional Radiology Techniques	80		80	20	100	200
3.	Care of patients in Diagnostic Radiology	80	20	80	20	100	200
4.	Radiation Evaluation& Protection in Diagnostic radiology	80	20	80	20	100	200
5	Nuclear Medicine Imaging Technniques	80	20	80	20	100	200
	TOTAL						1000

14. Criteria for Pass.

For declaration of pass in any subject in the university examination, a candidate shall pass both in theory and practical components separately as stipulated below:

Theory component consists of marks obtained in university written paper. For a pass in the theory subject, a candidate shall secure not less than 50% of maximum marks in each paper and an aggregate of 50% marks per subject prescribed for the university examination separately. For pass in practical examination, the candidate has to secure 50% marks in aggregate, i.e. marks obtained in the practical and viva-voce examination added together provided the candidate has secured 40% marks in practical experiment. A failed candidate is required to appear for both theory and practical in the subsequent examination in that subject.

The subsidiary subjects(secondary subjects) class examination will be conducted in the Institute and the marks will be included in the marks card under the practical. The aggregate marks required for passing is 50%(25% in Anatomy & 25%

in Physiology.)

To consider as pass in first or second year, a candidate has to appear in all the papers prescribed for each subject and has to pass in all the prescribed subjects of the university examination for the concerned year.

15. Carry over

A candidate who has appeared in all subjects of first year in the university examination is eligible to go to second year provided he/she has passed in any two subjects. However, failed candidate has to pass in all the prescribed subjects of the university examination for the concerned year.

16. Declaration of Distinction:

A candidate securing total aggregate marks of 75% or more in the first attempt shall be declared as passed with distinction. Distinction will not be awarded for candidates passing the examination in more than one attempt. A candidate securing total aggregate marks of 60% till 74% shall be declared as passed with first class. A candidate securing total aggregate marks of 50% to 59% shall be declared as passed.

17. Number of attempts

A candidate is permitted not more than **three** attempts (actual appearance) to pass the first year examination or within two academic years from the year of admission, whichever is earlier. No candidate would be allowed to continue the course if this stipulation is not complied with.

18. Maximum duration for completion of course

A candidate shall complete the course within three years from the date of admission. Failing which the candidate would be discharged.

19. Eligibility for award of degree

A candidate shall have passed in all the subjects of first and second year to be eligible for the award to degree.

20. Field training

Before final year examination, every student will be posted, as observer, in various hospitals , for a period of 2 months. Successful completion of this field training is a pre-requisite to appear in the final year examination.

Chapter II

GOALS AND GENERAL OBJECTIVES OF POSTGRADUATE PROGRAM

The programme is designed for Radiographers wishing to explore, reflect upon and develop the individual learning achieved through the day to day activities in radiographic professional practice.

To explore the foundation science and safety principles in Medical Imaging Technology.

Enhance knowledge from clinical experience, interactions & discussions and research to improve the quality of training and education in Medical Imaging.

Explore the subject in depth and develop high degree of expertise to contribute to advancement of knowledge in Medical Imaging.

Develop teaching and presentation skills necessary to become efficient teachers utilizing state-of-the art facilities and equipments.

Build Up leadership qualities in education, practice and administration

Contribute to emerging and vitally important industry through research.

To provide with the skills and knowledge to apply for critical appraisal of day to day practice.

SCOPE OF THE PROGRAME

- On completion of the programme, Technologists can advance to supervisory position in Diagnostic Centers and hospitals.
- They can also earn key posts in academic institutions including teaching and research.
- In industry, Imaging technologists are needed for Application and Software development for Medical Imaging equipment.
- Military and public health service.
- Medical Imaging Technology is one of the fastest growing professions & it offers tremendous opportunity abroad.

COURSE DESCRIPTION ;

- This course provides medical imaging technologists with an understanding of the physical principles as well as theories involved in diagnostic imaging modalities.

- For each imaging modality, the image formation process along with image quality metrics and their relationship to the image appearance are also discussed.

- The course objective is also to provide the imaging technologist and understanding of current technologies as well as the physical principles that drive image quality and radiation dose.

Chapter III

COURSE

CONTENT

M.Sc. (M.SC. MEDICAL IMAGING TECHNOLOGY) FIRST YEAR

Paper 1:
RADIOGRAPHICPROCEDURE & PRINCIPLES OF RADIOGRAPHIC EXPOSURE (130 hours)

THEORY:

UNIT 1
Basic review of all Radiographic Technique

UNIT 2
Contrast Media- Application, types, safety aspects, mode & volume of administration, administration techniques

UNIT 3
Digestive System
Anatomy and physiology
Associated pathology and radiographic appearance
Plain radiography
Barium swallow
Barium meal
Barium meal follow through
Enteroclysis
Barium enema

UNIT 4
Genito urinary system
Anatomy and physiology
Associated pathology and radiographic appearance
Plain radiography
Intravenous urogram (IVU)
Micturating Cystourethrogram (MCU)
Ascending Urethrogram (ASU)
Hysterosalpingography (HSG)
Fallopian Tube Recanalisation (FTR)

UNIT 5
Cardio - Respiratory system
Anatomy and physiology
Associated pathology and radiographic appearance
Chest radiography

UNIT 6
Mammography
Anatomy and physiology
Indications, contraindications and techniques
ICRP guidelines, BIRADS

UNIT 7
Skull
Related anatomy of facial and cranial bones
Associated pathology and radiographic appearance
Radiographic projections

UNIT 8
Vertebral Column
Related anatomy
Associated pathology and radiographic appearance
Radiographic projections

UNIT 9
Upper limb
Related anatomy
Associated pathology and radiographic appearance
Radiographic projections

UNIT 10
Lower limb
Related anatomy
Associated pathology and radiographic appearance
Radiographic projections

UNIT 11
Pelvis
Related anatomy of pelvic bones and hip joint
Associated pathology and radiographic appearance
Radiographic projections
Pelvimetry

UNIT 12
Hepatobiliary system
Related anatomy
Associated pathology and radiographic appearance
ERCP/ PTBD, T – tube cholangiography

UNIT 13
Dental Radiography
Related anatomy
Associated pathology and radiographic appearance
Intraoral, Extraoral and Occlusal views
General precautions
OPG

UNIT 14
Other procedures
Sialography , Dacrocystography, Sinography, Fistulography
Related anatomy
Associated pathology and radiographic appearance
Indications, contraindications and technique

UNIT I5
X-ray production
Interaction of radiation with matter- Compton effect, photoelectric effect, pair production, coherent scattering.
Useful range
Clinical application

UNIT 16
The Photographic process
Introduction
Basic review of photographic emulsions
Photographic latent image
Film materials
Spectral sensitivity of film material
Speed and contrast of photographic materials
Intensifying screens and cassettes
Film processing

UNIT 17
Sensitometry
Photographic density
Opacity

Transmission
Production of Characteristic curve
Features of Characteristic curve
Variation in the characteristic curve with development
Comparison of emulsions by their characteristic curve
Application of Characteristic curve
Information from the Characteristic curve

UNIT 18
Radiographic Image
Radiographic Density
Acceptable range
Factors influences density.
Radiographic Contrast
Components
Factors influences contrast
Management of Radiographic Image quality

UNIT 19
Resolution
Line spread function & Modulation transfer function
Unsharpness in the Radiographic image and various factors contributing towards
Unsharpness
Types of Unsharpness
Radiographic mottle

UNIT 20
Geometry of the radiographic image
Magnification / Distortion -Types and factors
Micro / Macro radiography

UNIT 21
Instrumentation of Processing Equipment
Automatic film processor (AFP)
Maintenance and Quality control tests in AFP
Layout and planning of Darkroom
Viewing accessories: viewing boxes
Magnifiers and viewing conditions

Referral books

1. Radiographic positioning – Clarke's
2. Radiographic positioning – Merriil's

3. Diagnostic Radiography – Glends Bryan
4. Christensen's Physics of Diagnostic radiology
5. Radiographic Imaging – Chesney & Chesney
6. Anatomy & Physiology-Ross and Wilson
7. Normal Radiation Anatomy-Meschan
8. Human anatomy – Chaurasia.
9. Atlas of Human anatomy – Antunez
10. Basic anatomy and Physiology for radiographers – Dean.M.R.E

Paper 2: INSTRUMENTATION OF CONVENTIONAL X-RAY EQUIPMENTS & INSTRUMENTATION OF SPECIALIZED RADIOLOGY EQUIPMENTS (P-II)

(Class room: 130 hours)

THEORY:

UNIT 1

Generation of electrical energy
AC/DC
Polyphase supply
Distribution of electrical energy
Use of electrical energy
Current loads & power loss
Uses of electricity in Hospitals
Safety rules for Radiographers

UNIT 2
X ray Circuit components
High tension transformers
Main Voltage Compensation
High tension switches
Stabilizers and UPS

UNIT 3
Fuses
Switches
Earthing
High tension cables construction & design.
Rectification
Types of Rectifiers
X-ray circuits
Filament circuits
High voltage circuits

UNIT 4
Tube rating
Types of Generators
Capacitor discharge generator
Battery Powered generator
Medium frequency & High frequency generator.

UNIT 5
Switches
Circuit breakers
Primary & Secondary switches
Exposure switching and its application.
Interlocking Circuits
Regulating and safety devices
Magnetic relay
Thermal relay switches
Interlock in Tube Circuit and overload interlocks.

UNIT 6
Exposure timers
Timing systems
Electronic timer
Ionization timer

Photo timer
Synchronous timer and impulse timer.

UNIT 7
Devices improving radiographic quality
Cone
Cylinder
Collimator
Grid
Filter

UNIT 8
Portable & Mobile equipments
Mains requirements
Cable connections to wall plugs
Portable X-Ray Equipments
Mobile X-Ray Equipments
Capacitor Discharge Mobile Equipment
Cordless Mobile Equipments
X-Ray Equipments for the Operating Theatre
Mobile Image Intensifier units

UNIT 9
Fluoroscopy Equipments
Construction & Working principles of Image Intensifier
Viewing the Intensified image
Recording the intensified Image
Digital fluoroscopy
Panel type image intensifier

UNIT 10
Fluoroscopic / Radiographic Tables
General features of fluoroscopic / radiographic table
The serial changer
Remote control table
The spot film devices.

UNIT 11
Tomographic Equipment
Principles of tomography
Various types of tomographic movement
Equipment for linear tomography

UNIT 12

Equipment for Cranial and Dental radiography
The skull table
General Dental X-ray equipment
Pantomography equipment
Equipment for Cranial & skeletal radiography
Equipment for mammography

UNIT 13
Care, Maintenance and tests
General care
Functional tests
Quality assurance program
Acceptable limits of variation
Corrective action

References

1. X-ray Equipments for Radiographers – Noreen Chesney & Muriel Chesney
2. Christensen's Physics of Diagnostic Radiology
3. Text book of Radiology for Technicians – Bhargava.S.K
4. Practical approach to Modern X.ray equipment – Thompson Thomas

Paper 3: Advanced Technique & Instrumentation of Ultrasonography (P-III)

(Class room: 65 hours)

THEORY:

UNIT 1
Ultrasound
Properties of ultrasound
Interaction of ultrasound with matter

UNIT 2
Transducers
Types of transducer
Advances in the design of modern ultrasound transducers

UNIT 3
Image display
Display modes
Real time ultrasound
Pulse echo ultrasound instrumentation
Beam former
Pulse transmitter – receiver
Controls
CRT displays – television monitors
Image storage
Scan converter memory
Photographic film
Multiformat camera
Laser imager
Colour & video thermal printers
Computer storage
Pre and post processing techniques

UNIT 4
Doppler Imaging
Doppler principles
Continuous wave Doppler and Pulsed Doppler
Duplex scanning
Doppler spectral analysis & display
Color flow imaging
Power Doppler
Harmonic imaging
Real time compounding
Extended field of view

Doppler Instrumentation

UNIT 5
Ultrasound contrast agents

UNIT 6
Image characteristics and artifacts
Ultrasound tissue characterization and organ dynamics
Vascular, interventional, intra operative and ophthalmic Ultrasonography
3D & 4D ultrasound imaging
Acquisition, visualization and display methods

UNIT 7
Bio-effects and safety considerations in ultrasound
US system performance measurements
US equipment quality assurance - Conventional & Doppler system testing & documentation

UNIT 8
Ultrasound Protocols

Referral Books

1. Diagnostic Ultrasound by Carol M. Rumack
2. Color Doppler Ultrasound by Allen Paul
3. Basic physics and technology of medical diagnostic ultrasound – M.Hussey
4. Doppler ultrasound physics instrumentation and clinical applications – D.H.Evans.
5. The essential physics of medical imaging – Bushberg
6. Real time ultrasound manual for Physicians and Technical personnel – Bartrum.R.J

Paper 4: Advanced technique & Instrumentation of Computed Tomography (P-IV)

(Class room: 80 hours)

THEORY:

UNIT 1
Imaging principles in computed tomography
Instrumentation of CT scan
Advances in Detector technology
Slip ring technology
Helical CT
Single slice and Multi slice CT Scan system

UNIT 2
Isotropic imaging
Image display
Pre and Post Processing techniques
Image quality in single slice and multi slice helical CT scan
Patient radiation dose considerations in Helical CT

UNIT 3
Protocols for adult Whole Body CT
Protocols for pediatric Whole Body CT
Documentation
Common and specific artifacts in Helical CT images

UNIT 4
HRCT of Lungs
Technical aspects
Volumetric HRCT
Expiratory HRCT
HRCT protocols
Artifacts

UNIT 5
CT angiography
CT fluoroscopy
Multidimensional reformations
MPR, Curved MPR, MIP
3D imaging & 4D CT

UNIT 6
CT Perfusion scanning

CT colonoscopy
CT bronchoscopy

UNIT 7
CT coronary angiography
CT calcium scoring
Myocardial Imaging

UNIT 8
Care, Maintenance and tests
General care
Functional tests
Quality assurance program
Acceptable limits of variation
Corrective action

Referral books

1. Computed Tomography – Physical Principles , Clinical Applications & Quality Control by Euclid Seeram
2. Computed Tomography by Stewart C. Bushong
3. The essential physics of medical imaging – Bushberg
4. Clinical Computed Tomography for the Technologist – Chiu.L.C

Paper 5: BIO-STATISTICS (P-V)

(Class room: 80 hours)

UNIT 1
Introduction
Introduction to Biostatistics & research methodology, types of variables & scales of measurements, measures of central tendency and dispersion, rate, rate, ratio, proportion, incidence & prevalence

UNIT 2
Sampling
Random & non-random sampling, various methods of sampling-simple random, stratified, systematic, cluster and multistage. Sampling and non-sampling errors & methods of minimizing these errors.

UNIT 3
Basic probability distributions and sampling distributions
Concept of probability distribution. Normal, Poisson and Binomial distributions, parameters and applications. Concept of sampling distributions. Standard error and confidence intervals. Skewness an Kurtosis

UNIT 4
Tests of significance
Basics of testing of hypothesis-Null and alternate hypothesis, type I and type II errors, level of significance (parametric) and power of the test, p value. Tests of significance –t-test (paired & unpaired), Chi square test and test of proportion, one-way analysis of variance. Repeated measures analysis of variance. Repeated measures analysis of variance. Tests of significance (nonparametric) – Mann-Whitney u test, Wilcoxon test, Kruskal-Wallis analysis of variance. Friedmann's analysis of variance.

UNIT 5
Correlation and Regression
Simple correlation-Pearson's and Spearman's; testing the significance of correlation coefficient linear and multiple regression.

UNIT 6
Sample size determination
General concept. Sample size for estimating means and proportion, testing of difference in means and proportions of two groups.

UNIT 7
Study designs
Descriptive epidemiological methods- case series analysis and prevalence studies. Analytical epidemiological methods- case control and cohort studies. Clinical trials/intervention studies, odds ratio and relative risk, stratified analysis

UNIT 8
Multivariate analysis
Concept of multivariate analysis, introduction to logistic regression and survival analysis

UNIT 9
Reliability and validity evaluation of diagnostic tests

UNIT 10
Format of scientific documents
Structure of research protocol, structure of thesis/ research report, formats of reporting in scientific journals. Systematic review and meta analysis

Refferal Books:

1. Mathematical Physics -THE BASICS - S.D. Joglekar
2. A text book of Mathematical Physics - S. Chandra
3. Statistical Methods – An introductory text - J. Medhi
4. A text book of Engineering Mathematics - N.P. Bali & Dr. N.Ch. Srimannaray ana Iyergar

Chapter III COURSE CONTENT

M.Sc. (MEDICAL IMAGING TECHNOLOGY) SECOND YEAR THEORY

Paper 1: Advanced technique & Instrumentation of MRI (P-VI)

(Class room: 80 hours)

UNIT 1
Basic Principles
Spin
Precession
Relaxation time
Pulse cycle
T1 weighted image
T2 weighted image
Proton density image

UNIT 2

MR Instrumentation
Types of magnets
RF transmitter &receiver coils
Gradient coils
Shim coils
RF shielding
Computers

UNIT 3
Pulse sequences
Spin echo pulse sequence – turbo spin echo pulse sequence
Gradient echo sequence – Turbo gradient echo pulse sequence
Inversion recovery sequence – STIR sequence, SPIR sequence, FLAIR sequence
Echo planar imaging and Fast imaging sequences
Advanced pulse sequences.

UNIT 4
Image formation
2D Fourier transformation method
K-space representation
3D Fourier imaging
MIP

UNIT 5
MR contrast media
MR angiography – TOF & PCA
MR Spectroscopy

UNIT 6
Protocols in MRI for whole body
MRI artifacts
Safety aspects in MRI

UNIT 7
Cardiac MRI

UNIT 8
Musculoskeletal imaging protocols
Abdominal imaging protocols

UNIT 9
Functional MRI
BOLD Imaging

UNIT 10
Care, Maintenance and tests

General care
Functional tests
Quality assurance program
Acceptable limits of variation
Corrective action

References

1. MRI physics for Radiologist - Alfred Horowitz
2. Fundamentals of MRI – Stark & Bradley
3. MRI in Practice – Catherine brook
4. The essential physics of medical imaging – Bushberg

Paper 2: Interventional Radiology Techniques (P-VII)

(Class room: 60 hours)

THEORY :

UNIT 1

Introduction
Need for interventional procedures
Informed consent
DSA
Basic Principle
Types
Equipments
Basics of Angiographic equipments
Single and biplane angiographic equipment
Angiographic Table
Image intensifier
Flat panel detector
Recording systems
Pulseoximetry
Cardiac resuscitation measures - ECG
Pressure injector
Catheters, needles and other tools
3-D rotational angiography
Image processing
Patient monitor
ACT equipment
CO_2 angiography

UNIT 2

Patient care
Preparation for procedure

Post procedure care
Role of radiographer in interventional procedure
Crash trolley- Emergency drugs

UNIT 3
Procedures
Diagnostic & Therapeutic interventional procedures
PTC, PTBD, Stenting
Nephrostomy, ureteric stenting
Guided biopsies of different organs
Drainage of collections/abscesses
Angiograms, angioplasty, embolization
Venus access
Radiofrequency ablation
Image guided nerve blocks

UNIT 4
Neuro interventional procedures
Embolization of extra or intracranial tumors, vascular malformations
Vertebroplasty – direct puncture
Laser guided procedure

UNIT 5
Basics of cardiac catheterization

UNIT 6
Safety considerations in angiography room
Room design
Protective devices
Radiation monitoring

UNIT 7
Care, Maintenance and tests
General care
Functional tests
Quality assurance program
Acceptable limits of variation
Corrective action

References

1. Current Techniques in Interventional Radiology – Cope , Constantin
2. Interventional Radiology - A Practical Guide by Anthony Watkinson and Andreas Adam

Paper 3: Care of Patient in Diagnostic Radiology
(Class room: 50 hours)

UNIT 1

Introduction to Patient Care
Responsibilities of the Healthcare facility
Responsibilities of the Imaging Technologist

UNIT 2
General Patient Care
Patient transfer technique
Restraint techniques
Aspects of patient comfort
Specific patient conditions
Security of patient property
Obtaining vital signs
Laying up a sterile trolley
IV injection administration

UNIT 3
Nursing procedure in Radiology
General abdominal preparation
Clothing of the patient
Giving an enema
Handling the emergencies in Radiology
First aid in the X-Ray department

UNIT 4
Patient care during Investigation
G.I. Tract, Biliary tract, Respiratory tract, Gynecology, Cardiovascular, Lymphatic system, C.N.S. etc

UNIT 5
Infection Control
Isolation technique
Infection sources –
Transmission modes
Procedures
Psychological considerations
Sterilization & sterile techniques.

UNIT 6

Patient Education
Communication
Patient communication problems
Explanation of examinations
Radiation Safety / Protection
Interacting with terminally ill patient
Informed Consent

References

1. Care of Patients in Diagnostic Radiology – Chesney & Chesney
2. Care of Patients in Diagnostic Radiology – Gunn
3. Basic Medical Techniques and patient care for Radiologic Technologist – Torres.

Paper 4: Radiation Evaluation & Protection in Diagnostic radiology
(Class room: 60 hours)

THEORY:

UNIT 1
Introduction to Radiation protection
Need for protection
Aim of radiation protection
Basic radiation units and quantities
_ Exposure
_ Absorbed dose
_ Absorbed dose equivalent
_ Quality factor
_ Tissue weighting factor.

UNIT 2
Limits for Radiation exposure
Concept of ALARA (or ALARP)
ICRP regulation
Maximum permissible dose
Exposure in pregnancy, children

UNIT 3
Protection in Diagnostic Radiology
Protection for primary radiation
Work load
Use factor
Occupancy factor
Protection for scatter radiation and leakage radiation
X-Ray room design
Structural shielding
Protective devices
Radiation signages

UNIT 4
Technical protective consideration during Radiography
Evaluation of hazards
Effective communication
Immobilization
Beam limiting devices
Filtration
Exposure factors
Protection in :
- Fluoroscopy
- Mammography,
- Mobile radiography

- CT Scan
- Angiography room

UNIT 5

Radiation measuring instruments
Area monitoring
Personnel dosimeters
- Film badge
- Thermo luminescent dosimeter
- Pocket dosimeter.

UNIT 6

Biological aspects of Radiological protection
Biological effects of radiation
Direct & Indirect actions of radiation
Concept of detriment – Deterministic & stochastic effect of radiation – somatic and genetic effects
Dose relationship
Effects of antenatal exposure

References

1. Physics of Diagnostic radiology – Christensen
2. ICRP manual
3. Radiation protection measurement – Glenn F.Knoll
4. Radiation protection in hospitals – R.F.Mold
5. Advanced medical radiation dosimetry – Govinda Rajan
6. Radiation protection – Medical Radiography – Sherer
7. Radiation protection for radiologic technologist – Frankerl Robert

Paper 5: Nuclear Medicine Imaging Techniques (P-X)

(Class room: 65 hours)

UNIT 1

Basic atomic & nuclear physics
Quantities and Units
Atom composition and structure
Nucleus composition
Radioactivity
Exponential decay
Specific activity
Parent / Daughter decay
Modes of Radioactive decay.

UNIT 2

Radiation detectors
Gas filled detectors - Basic principles
Ionization chambers
Proportional counters
Geiger Muller counters
Semiconductor detectors
Scintillation detectors – basic principles

UNIT 3

Production of Radio nuclides
Reactor produced radionuclide
Reactor principles
Accelerator produced radionuclide
Radionuclide generators

UNIT 4

Instrumentation
The Anger Camera
Basic principle
System components
Detector system and electronics
Collimators
Image display and recording systems
Scanning camera

UNIT 5

Radio pharmacy
Radiopharmaceuticals
General principle of tracer technique
Preparation of different labeled compounds with technetium-99m isotope
Cold kit

UNIT 6

In vivo technique
Static and dynamic studies
Thyroid imaging
Imaging of bone
Respiratory system
Urinary system
G.I. system
Cardiovascular system
Iodine131 uptake studies
Iodine 131 therapy for thyrotoxicosis and thyroid ablation

UNIT 7

Image quality in Nuclear medicine
Spatial resolution
Contrast
Noise
Types of noise
Quality assurance of imaging equipments
Variation in Image perception – with physician, within technologist & technical parameter

UNIT 8

SPECT imaging

UNIT 9

PET imaging

UNIT 10

Radiation safety in Nuclear medicine
Radiation units and quantities
MPD
Safe handling of Radioactive materials
Storage of radioactive materials
Procedures for handling spills
Disposal of Radioactive waste
Radiation monitoring
Survey meters
Personnel dosimeters
Wipe testing
Contamination monitor
Isotope calibrator
Area monitor
Inventory of isotopes

References

1. Nuclear Medicine basics – Chandra.R
2. Principles & practice of Nuclear medicine – Early.P.J
3. Physics and Radiobiology of Nuclear Medicine – Gopal.
4. Essentials of Nuclear Medicine Imaging – Mettler
5. Radionucleid Imaging artifacts – Wells & Bernier

SHCEME OF EXAMINATION

THEORY
Duration: 3 hours Max. marks: 100

Type of questions	No. of questions	No. of question and marks for each question	Total marks
Long essay	2 either/or questions	2 x 10 marks each	20
Descriptive	6 out of 8 questions	8 x 5 marks each	40
Brief	10 out of 12 questions	10 x 2 marks each	20

PRACTICAL
Experiment: Duration: 3 hours Max. marks: 80
Viva voce: Duration: as stipulated Max. marks: 20

SECTION-IV

MONITORING LEARNING PROGRESS

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 the 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 in this chapter, which may be copied and used.

The learning out comes to be assessed should include:

i) Acquisition of knowledge: The methods used comprise of 'Log Book' which records participation in various teaching/learning activities by the students. The number of activities attended and the number in which presentations are made are to be recorded. The log book should periodically be validated by the supervisors. Some of the activities are listed. The list is not complete. Institutions may include additional activities, if so desired.

   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 Cheklist I, Section IV)

   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 using a check list (see Model Checklist II, Section IV)

ii) Teaching Skills: Candidates should be encouraged to teach undergraduate paramedical students, if any. This performance should be based on assessment by

the faculty members of the department and from feedback from the undergraduate students (See Model Checklist III, Section IV)

iii) Project: Please see Checklist IV in Section IV.

iv) Work diary / Log Book – Every candidate shall maintain a work diary and record his/her presentation in the training programmes conducted by the department such as journal reviews, seminar, etc. Special mention may be made of the presentations by the candidate as well as details of experiments or laboratory procedures, if any conducted by the candidate.

Log Book

The log book is a record of the important activities of the candidates during his training, internal assessment should be based on the evaluation of the log book. Collectively, log books are a tool for the evaluation of the training program of the institution by external agencies. The record includes academic activities as well as the presentations and procedures carried out by the candidate.

Format of the log book for the different activities is given in Tables 1 and 2 of Section IV. Copies may be made and used by the Institutions.

Procedure for defaulters: Every department should have a committee to review such situations. The defaulting candidate is counseled by the guide and head of the department. In extreme cases of default the departmental committee may recommend that defaulting candidate be withheld from appearing the examination, if she/he fails to fulfill the requirements in spite of being given adequate chances to set himself or herself right.

Format of Model Checklists

Checklist-I: MODEL CHECKLIST FOR EVALUATION OF JOURNAL REVIEW PRESENTATIONS

Name of the student: Date:

Title of the topic:

Name of the faculty/observer:

Sl. No	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Article chosen was					
2.	Extent of understanding of scope & objectives of the paper by the candidate					
3.	Whether cross- references have been consulted					
4.	Whether other relevant references have been consulted					
5.	Ability to respond to questions on the paper/subject					
6.	Audio visuals aids used					
7.	Ability to defend the paper					
8.	Clarity of presentation					
9.	Any other observation					
	Total Score					

Checklist-II: MODEL CHECKLIST FOR EVALUATION OF SEMINAR PRESENTATIONS

Name of the student: Date:

Title of the topic:

Name of the faculty/observer:

Sl. No	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Article chosen was					
2.	Extent of understanding of scope & objectives of the paper by the candidate					
3.	Whether cross- references have been consulted					
4.	Whether other relevant references have been consulted					
5.	Ability to respond to questions on the paper/subject					
6.	Audio visuals aids used					
7.	Ability to defend the paper					
8.	Clarity of presentation					
9.	Any other observation					
	Total Score					

Checklist-III: MODEL CHECKLIST FOR EVALUATION OF TEACHING SKILLS

Name of the student: Date:

Title of the topic:

Name of the faculty/observer:

Sl. No		Strong Point	Weak Point
1.	Communication of the purpose of the talk		
2.	Evokes audience interest in the subject		
3.	The introduction		
4.	The sequences of ideas		
5.	The use of practical examples and/or illustrations		
6.	Speaking style (enjoyable, monotonous, etc. specify)		
7.	Summary of the main points at the end		
8.	Ask questions		
9.	Answer questions asked by the audience		
10.	Rapport of speaker with his audience		
11.	Effectiveness of speaker with his audience		
12.	Uses of AV kids appropriately		

Checklist-IV: MODEL CHECKLIST FOR EVALUATION OF THE SEMINAR PRESENTATIONS

Name of the student: Date:

Title of the topic:

Name of the faculty/observer:

Sl. No	Points to be considered during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Interest shown in selecting topic					
2.	Appropriate review					
3.	Discussion with guide and other faculty					
4.	Quality of protocol					
5.	Preparation of proforma					
	Total Score					

Checklist-V: MODEL CHECKLIST FOR CONTINUOUS EVALUATION OF PROJECT WORK BY GUIDE/CO-GUIDE

Name of the student: Date:

Title of the topic:

Name of the faculty/observer:

Sl. No	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Periodic consultation with guide/co-guide					
2.	Depth of Analysis/ discussion					
3.	Department presentation of findings					
4.	Quality of final output					
5.	Others					
	Total Score					

OVERALL ASSESSMENT SHEET

Date:

Check List No.	Name of the Students			
	A	B	C	D
1				
2				
3				

Signature of HOD Signature of the Principal

The above overall assessment sheet used along with logbook should form the basis for certifying satisfactory completion of course of study, in addition to the attendance requirement.

KEY:
Main Score: Is the sum of all the scores of checklists 1 to 5
A, B, C: Name of the students.

LOG BOOK

Table 1: Academic activities attended

Name:
Admission Year:
College:

Date	Type of activity, specific seminar, journal club, presentation, UG teaching	Particulars

Table 2: Academic activities attended

Name:
Admission Year:
College:

Date	Topic	Type of activity, specific seminar, journal club, presentation, UG teaching

MANAGEMENT INFORMATION SYSTEM REPORT

1. Name of the college imparting M.Sc. Medical Imaging Technology PG Program:
2. Details of M.Sc. Medical Imaging Technology program

Sl. No	Name of the Branch & Teaching faculty	Sanctioned strength	Admitted	Name of the subjects to be studied at 1st year

3. No. of experiments/assignments conducted for 1st year M.Sc. Medical Imaging Technology

students

Sl. No	Branch		Subject	Assigned by RGUHS	Conducted	%	Remarks
1		No	Name				

4. No. of theory classes conducted for 1st year M.Sc. Medical Imaging Technology students

Sl. No	Branch		Subject	RGUHS Norms (25)	Conducted	%	Remarks
1		No	Name				

5. Number of theory and practical classes taken by 2nd year M.Sc. Medical Imaging Technology students for under graduate program (Optional)

6. No. of Journal clubs (department wise) for the 1st and 2nd year M.Sc. Medical Imaging Technology students

Total No. of students year wise	Norms for half yearly report	Achieved Number	% Achievement	Remarks
1st year No=	2 per candidate per year			
2nd year No=	2 per candidate per year			

7. Number of seminars for the 1st and 2nd year M.Sc. Medical Imaging Technology students

Total No. of students year wise	Norms for half yearly report	Achieved Number	% Achievement	Remarks
1st year No=	2 per candidate per year			
2nd year No=	2 per candidate per year			

8. Number of interdepartmental meetings

Norms for half yearly report	Achieved Number	% Achievements	Remarks
1	2	200%	Interactive and productive

9. Number of visits to other hospital and related institutes for the 1st and 2nd year M.Sc. Medical Imaging Technology students

Norms for half yearly report	Achieved Number	% Achievements	Remarks
1	2	200%	Educative & informative

10. Number of guest lectures for postgraduate program

Norms for half yearly report	Achieved Number	% Achievements	Remarks
2	3	150%	Need focused and educative

11. Number of research papers published in the year in the college
12. Any other additional information such as consultancy/collaboration/conducing seminars & workshops or attending seminar & workshops or conference.

Section VI

MINIMUM REQUIREMENT OF INFRASTRUCTURE, LABORATORY FACILITIES AND STAFF FOR M.Sc, Medical Imaging Technology COURSE

Institute should have its own hospital with full-fledged Department of Radiodiagonsis with facilities mentioned hereunder.

1. Teletherapy machine (atleast one unit of the below)
   Essential: Linear Accelerator with Multi Leaf Collimator (MLC)
   IMRT capabilities
   Desirable: Linac with IGRT capabilities
   Tele cobalt machine
2. Brachytherapy machine (atleast one unit of the below)
   Essential: High Dose Rate machine
   Desirable: Manual after loader
3. Independent Diagnostic Department
   a. Essential: X-ray, CT Scan, MRI, Mammography, Ultrasonography
   b. Desirable: PET and/or PET-CT, angiogram, Nuclear Medicine facilities
4. Treatment Planning system capable of performing:
   Essential: CT Scan based treatment planning
   Associated contouring workspace
   Teletherapy plans including 3D-CRT and IMRT
   Brachytherapy planning (HDR)

   Desirable: IGRT planning; Virtual simulation
5. Beam verification devices (atleast any two of the below)
   a. Electronic Portal Imaging Device
   b. Film dosimetry with appropriate phantom
   c. 2D array
   d. TL Dosimetric system
6. Physics Dosimetry equipments
   a. Radiation Field Analyzer
   b. Ion chambers (cylindrical and parallel plate)
   c. Well type chamber
   d. Jig and associated gadgets.
   e. Electrometers
   f. Water Phantoms
   g. Survey Meter
   h. Zone Monitor
7. Immobilization devices
8. Mould Room facilities
9. Library with Internet facility for educational purpose

Laboratory space: 800 sq.ft

Seminar room: 250 sq.ft

Class room: 250 sq.ft (2 numbers)

Audio-Visual aids: LCD projector, Slide projector, Over Head Projector and associated computers

Principals room, student's common room, staff room, office room store room.

Staff Requirement:

Teaching Staff (minimum requirement)

Head the Department :

One should have atleast 12 years of experience in the field of Radio diagnosis after qualifying degree/diploma in the field of Radio diagnosis

Senior Professor: One

Should have atleast 5 years of experience in the field of Radio diagnosis after qualifying degree/diploma in the field of Radio diagnosis

Topics for seminar

First year

1. Various radiographic techniques and their applications.
2. Safety aspects in the administration of contrast media.
3. Radiographic procedures and their associated pathology for the following system.
    a. Digestive system.
    b. Genito urinarty system
    c. Respiratory system.
    d. Urinary system.
    e. GI system.
    f. Cardiovascular system.
4. Procedures and techniques involved in mammography.
5. Dental Radiographic procedures and their precautions.
6. Production of X-rays and their clinical application in radio-diagnosis.
7. Various process involved in photographic process.
8. Application of electrical energy in radiology and safety rules for radiographers.
9. The components of X-ray circuit.
10. Construction and working principle of image intensifies.
11. General features of radiographic / fluoroscopic tables.
12. Interaction of ultrasound with matter and advancement in the design of transdusers.
13. Analysis on continuous wave Doppler and pulsed Doppler.
14. Image characteristics and artifacts in ultrasonography.
15. The imaging principles involved in computed tomography.
16. Design and description of CT scan system.
17. The difference in image quality in single slice and multi slice helical CT scan.
18. The common and specific artifacts observed in helical CT.
19. The concept of standard errors and confidence intervals.
20. Systematic review and meta analysis involved in thesis / research reports.

Topics for seminar

Second year

1. Basic principles of magnetic resonance imaging and its instrumentation.
2. Various advanced pulse sequences of MRI.
3. Angiography and spectroscopy of MR.
4. Different protocols followed for whole body MRI.
5. Musculoskeletal and abdominal imaging protocols.
6. Quality assurance of functional tests and acceptable limits.
7. Basic principles of single and biplane angiographic equipments.
8. The major role of radiographers in interventional procedures.
9. Radio-frequency ablication and image guided nerve blocks.
10. Embolization of extra (or) intra cranial tumors.

11. Room design of angiography room and their safety considerations.
12. Responsibilities of the health care faculty and the imaging technologists.
13. Basic radiation quantities and units.
14. Acceptable limits of radiation exposure and the concept of alara.
15. Room design shielding and protection of X-ray.

16. Significance of immobilization and beam limiting devices.
17. Biological effects of radiation.
18. Basic principle of gas filled and scintillation detectors.
19. Anger camer description and merits and demerits.
20. Preparation involved in labeled compounds with Tc 99m.
21. Quality assurance test of imaging equipments in nuclear medicine.
22. Procedures for safe handling of radioactive materials and desposal of radioactive waste.
23. Description and application of radiation monitoring equipments.
24.