

National Commission for Allied and Healthcare Professions

COMPETENCY BASED CURRICULUM

"MEDICAL RADIOLOGY AND IMAGING TECHNOLOGY"



As per NCAHP Act-2021

APPROVED SYLLABUS AHCHREPROFESSIONS . 2025

Ministry of Health & Family Welfare

Since-2021

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

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List of Abbreviations

2D	Two Dimensional
3D	Three Dimensional
AC	Alternate Current
ALARA	"As Low As Reasonably Achievable"
AEC	Automatic Exposure Control
AED	Automated External Defibrillator
AERB	Atomic Energy Regulatory Board
AHP	Allied and Healthcare Professional
BLS	Basic Life Support
BSc. MRIT	Bachelor of Science in Medical Radiology and Imaging Technology
BMW	Bio Medical Waste
BVM	Bao-Valve-Masks
CATS	Credit Accumulation and Transfer System
CBCS	Choice Based Credit System
ChD	Case based Discussion
CBSE	Cast-Dased Discussion
CEV	Mini Crea Exploration Expression
	Mini Case Evaluation Exercise
COPD	chronic obstructive pulmonary disease
CPR	Cardiopulmonary Resuscitation
	Computerized Tomography
DC	Direct Current
DMRIT	Diploma in Medical radiology and Imaging Technology
DOPs	Direct Observation of Procedures
DRR 🦾	Digitally Reconstructed Radiographs
ECG	Electrocardiogram
ECTS	European Credit Transfer System
EEG 💫	Electroencephalography
ERCP	Endoscopic Retrograde Cholangio Pancreatography 🛛 🥂
FW	Full wave
GI	Gastro Intestinal
HRCT 🚫	High-resolution computed tomography
HSSC	Healthcare Sector Skill Council
HU	Heat Unit
HVT	Half Value Thickness INCO-2021
HW	Half Wave
ICRP	International Commission on Radiological Protection
JCI	Joint Commission International
LDR	Low Dose-Rate
MIP	maximum intensity projection
MLC	Medico Legal Case
MLC	Multi Leaf Collimator
MSc MRIT	Master of Science in Medical Radiology and Imaging Technology
MoHFW	Ministry of Health and Family Welfare
MPR	Multiplanar reconstruction
MDI	Magnatia Peropanga Imaging
MC -	Magnetic Resonance Intaging
IVISC	Master of Science

NAAC	National Assessment and Accreditation Council				
NABH	National Accreditation Board for Hospitals & Healthcare Providers				
NCRC	National Curricula Review Committee				
NIAHS	National Initiative for Allied Health Sciences				
NSDA	National Skills Development Agency				
NSQF	National Skills Qualification Framework				
OSCE	Objective Structured Clinical Examination				
OSLER	Objective Structured Long Examination Record				
OSPE	Objective Structured Practical Examination				
PACS	picture archiving and communication system				
PCA	Phase contrast angiography ED A				
PET	Positron Emission Tomography				
PhD	Doctor of Philosophy				
PPE	Personal Protective Equipment				
PTBD	Percutaneous transhepatic biliary drainage				
QA	Quality Assurance				
QC	Quality Control				
RBC	Red Blood Cells				
RIAHS	Regional Institute of Allied Health Sciences				
RPP	Radiation Protection Programme				
SCA	Sudden Cardiac Arrest				
SDL >	Self –Directed Learning				
SPECT	Single-Photon Emission Computed Tomography				
TLD	Thermoluminescent Dosimeter				
TSU	Technical Support Unit				
TVT 🚬	Tenth Value Thickness				
UGC —	University Grants Commission				
US	Ultrasonography				
UHC	Universal Health Coverage				
sWBC	White Blood Cells				
WHO 🦳	World Health Organization				
WWW	World Wide Web				
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Chapter 1: Introduction to the Handbook

The report 'From Paramedics to Allied Health Professionals: Landscaping the Journey and Way Forward' that was published in 2012, marked the variance in education and training practices for the allied and healthcare courses offered by institutions across the country. This prompted the Ministry of Health and Family Welfare to envisage the creation of national guidelines for education and career pathways of allied and healthcare professionals, with a structured curriculum based on skills and competencies. Thus, this handbook has been designed to familiarize universities, colleges, healthcare providers as well as educators offering allied and healthcare courses with these national standards.

Individually, created for different professional groups of allied and healthcare, this hand book aims to reduce the variation in education by comprising of a standardized curriculum, career pathways, nomenclature and other details for each profession. The change from a purely didactic approach will create better skilled professionals and improve the quality of overall patient care. In the absence of a national standard-setting authority, this handbook can also guide the thousands of young adults who choose healthcare as a profession – not as doctors or nurses but to play several other critical roles – on the appropriate course of action to enable them to be skilled allied and healthcare professionals of the future.

Who is an Allied and Healthcare Professional?

The Ministry of Health and Family Welfare, accepted in its entirety the definition of an allied and healthcare professional based on the afore-mentioned report, though the same has evolved after multiple consultations and the recommended definition is now as follows-

'Allied and healthcare professionals (AHPs) includes individuals involved with the delivery of health or healthcare related services, with qualification and competence in therapeutic, diagnostic, curative, preventive and/or rehabilitative interventions. They work in multidisciplinary health teams in varied healthcare settings including doctors (physicians and specialist), nurses and public health officials to promote, protect, treat and/or manage a person('s) physical, mental, social, emotional, environmental health and holistic well-being."

Since the past few years, many professional groups have been interacting and seeking guidance on all those who would qualify under the purview of "allied and healthcare professionals". In the healthcare system, statutory bodies exist for clinicians, nurses, pharmacists and dental practitioners; but a regulatory structure for around 50 professions is absent in India. Currently, the Government is considering these professions under the ambit of the allied and healthcare system. However, this number is subject to changes and modifications over time, particularly considering how quickly new technologies and new clinical avenues are expanding globally, creating newer cadres of such professionals.

Scope and need for allied and healthcare professionals in the Indian healthcare system

The quality of medical care has improved tremendously in the last few decades due to the advances in technology, thus creating fresh challenges in the field of healthcare. It is now widely recognized that health service delivery is a team effort involving both clinicians and non-clinicians, and is not the sole duty of physicians and nurses.¹ Professionals that can competently handle sophisticated machinery and advanced protocols are now in high demand. In fact, diagnosis is now so dependent on technology, that allied and healthcare professionals (AHPs) are vital to successful treatment delivery.

Effective delivery of healthcare services depends largely on the nature of education, training and appropriate orientation towards community health of all categories of health personnel, and their capacity to function as an integrated team. For instance in the UK, more than 84,000 AHPs, with a range of skills

and expertise, play key roles within the National Health Service, working autonomously, in multiprofessional teams in various settings. All of them are first-contact practitioners and work across a wide range of locations and sectors within acute, primary and community care. Australia's health system is managed not just by their doctors and nurses, but also by the 90,000 university-trained, autonomous AHPs vital to the system.^{ii,iii}

As the Indian government aims for Universal Health Coverage, the lack of skilled human resource may prove to be the biggest impediment in its path to achieve targeted goals. The benefits of having AHPs in the healthcare system are still unexplored in India. Although an enormous amount of evidence suggests that the benefits of AHPs range from improving access to healthcare services to significant reduction in the cost of care, though the Indian healthcare system still revolves around the doctor-centric approach. The privatization of healthcare has also led to an ever-increasing out-of-pocket expenditure by the population. However, many examples assert the need of skilled allied and healthcare professionals in the system, such as in the case of stroke survivors, it is the support of AHPs that significantly enhance their rehabilitation and long term treatment ensures return to normal life. AHPs also play a significant role to care for patients who struggle mentally and emotionally in the current challenging environment and require mental health support; and help them return to well-being.ii Children with communication difficulties, the elderly, cancer patients, patients with long term conditions such as diabetes people with vision problems and amputees; the list of people and potential patients who benefit from AHPs is indefinite.

Thus, the breadth and scope of the allied and healthcare practice varies from one end to another, including areas of work listed below:

- Across the age span of human development from neonate to old age;
- With patients having complex and challenging problems resulting from systemic illnesses such
- as in the case of diabetes, cardiac abnormalities/conditions and elderly care to name a few;
- Towards health promotion and disease prevention, as well as assessment, management and evaluation of interventions and protocols for treatment;
- In a broad range of settings from a patient's home to community, primary care centers, to tertiary care settings; and
- With an understanding of the healthcare issues associated with diverse socio-economies and cultural norms within the society.

Learning goals and objectives for allied and healthcare professionals

The handbook has been designed with a focus on performance-based outcomes pertaining to different levels. The learning goals and objectives of the undergraduate and graduate education program will be based on the performance expectations. They will be articulated as learning goals (why we teach this) and learning objectives (what the students will learn). Using the framework, students will learn to integrate their knowledge, skills and abilities in a hands-on manner in a professional healthcare setting. These learning goals are divided into nine key areas, though the degree of required involvement may differ across various levels of qualification and professional cadres:

- 1. Clinical care
- 2. Communication
- 3. Membership of a multidisciplinary health team
- 4. Ethics and accountability at all levels (clinical, professional, personal and social)
- 5. Commitment to professional excellence

- 6. Leadership and mentorship
- 7. Social accountability and responsibility
- 8. Scientific attitude and scholarship (only at higher level- PhD)
- 9. Lifelong learning

1. Clinical Care^{iv}

Using a patient/family-centered approach and best evidence, each student will organize and implement the prescribed preventive, investigative and management plans; and will offer appropriate follow-up services. Program objectives should enable the students to:

- Apply the principles of basic science and evidence-based practice
- Use relevant investigations as needed
- Identify the indications for basic procedures and perform them in an appropriate manner
- Provide care to patients efficiently and in a cost-effective way in a range of settings, and maintain foremost the interests of individual patients
- Identify the influence of biological, psychosocial, economic, and spiritual factors on patients' well-being and act in an appropriate manner
- Incorporate strategies for health promotion and disease prevention with their patients

2. Communication iv^{,v}

The student will learn how to communicate with patients/clients, care-givers, other health professionals and other members of the community effectively and appropriately. Communication is a fundamental requirement in the provision of health care services. Program objectives should enable the students to:

- Provide sufficient information to ensure that the patient/client can participate as actively as
 possible and respond appropriately to the information
- Clearly discuss the diagnosis and options with the patient, and negotiate appropriate treatment plans in a sensitive manner that is in the patient's and society's best interests
- Explain the proposed healthcare service its nature, purpose, possible positive and adverse consequences, its limitations, and reasonable alternatives wherever they exist
- Use effective communication skills to gather data and share information including attentive listening, open-ended inquiry, empathy and clarification to ensure understanding
- Appropriately communicate with, and provide relevant information to, other stakeholders including members of the healthcare team
- Use communication effectively and flexibly in a manner that is appropriate for the reader or listener
- Explore and consider the influence that the patient's ideas, beliefs and expectations have during interactions with them, along with varying factors such as age, ethnicity, culture and socioeconomic background
- Develop efficient techniques for all forms of written and verbal communication including accurate and timely record keeping
- Assess their own communication skills, develop self-awareness and be able to improve their relationships with others
- Possess skills to counsel for lifestyle changes and advocate health promotion

3. Membership of a multidisciplinary health team^{vi}

The student will put a high value on effective communication within the team, including transparency about aims, decisions, uncertainty and mistakes. Team-based health care is the provision of health services to individuals, families, and/or their communities by at least two health providers who work collaboratively to accomplish shared goals within and across settings to achieve coordinated, high quality care. Program objectives will aim at making the students being able to:

- Recognize, clearly articulate, understand and support shared goals in the team that reflect patient and family priorities
- Possess distinct roles within the team; to have clear expectations for each member's functions, responsibilities, and accountabilities, which in turn optimizes the team's efficiency and makes it possible for them to use division of labor advantageously, and accomplish more than the sum of its parts
- Develop mutual trust within the team to create strong norms of reciprocity and greater opportunities for shared achievement
- Communicate effectively so that the team prioritizes and continuously refines its communication channels creating an environment of general and specific understanding
- Recognize measurable processes and outcomes, so that the individual and team can agree on and implement reliable and timely feedback on successes and failures in both the team's functioning and the achievement of their goals. These can then be used to track and improve performance immediately and over time.

4. Ethics and accountability

Students will understand core concepts of clinical ethics and law so that they may apply these to their practice as healthcare service providers. Program objectives should enable the students to:

- Describe and apply the basic concepts of clinical ethics to actual cases and situations
- Recognize the need to make health care resources available to patients fairly, equitably and without bias, discrimination or undue influence
- Demonstrate an understanding and application of basic legal concepts to the practice
- Employ professional accountability for the initiation, maintenance and termination of patientprovider relationships
- Demonstrate respect for each patient's individual rights of autonomy, privacy, and confidentiality

5. Commitment to professional excellence^{vii}

The student will execute professionalism to reflect in his/her thought and action a range of attributes and characteristics that include technical competence, appearance, image, confidence level, empathy, compassion, understanding, patience, manners, verbal and non-verbal communication, an antidiscriminatory and non-judgmental attitude, and appropriate physical contact to ensure safe, effective and expected delivery of healthcare. Program objectives will aim at making the students being able to:

• Demonstrate distinctive, meritorious and high quality practice that leads to excellence and that depicts commitment to competence, standards, ethical principles and values, within the legal boundaries of practice

- Demonstrate the quality of being answerable for all actions and omissions to all, including service users, peers, employers, standard-setting/regulatory bodies or oneself
- Demonstrate humanity in the course of everyday practice by virtue of having respect (and dignity), compassion, empathy, honour and integrity
- Ensure that self-interest does not influence actions or omissions, and demonstrate regards for service-users and colleagues

6. Leadership and mentorship^{viii}

The student must take on a leadership role where needed in order to ensure clinical productivity and patient satisfaction. They must be able to respond in an autonomous and confident manner to planned and uncertain situations, and should be able to manage themselves and others effectively. They must create and maximize opportunities for the improvement of the health seeking experience and delivery of healthcare services. Program objectives should enable the students to:

- Act as agents of change and be leaders in quality improvement and service development, so that they contribute and enhance people's wellbeing and their healthcare experience
- Systematically evaluate care; ensure the use of these findings to help improve people's experience and care outcomes, and to shape clinical treatment protocols and services
- Identify priorities and effectively manage time and resources to ensure the maintenance or enhancement of the quality of care
- Recognize and be self-aware of the effect their own values, principles and assumptions may have on their practice. They must take charge of their own personal and professional development and should learn from experience (through supervision, feedback, reflection and evaluation)
- Facilitate themselves and others in the development of their competence, by using a range of professional and personal development skills
- Work independently and in teams. They must be able to take a leadership role to coordinate, delegate and supervise care safely, manage risk and remain accountable for the care given; actively involve and respect others' contributions to integrated person-centered care; yet work in an effective manner across professional and agency boundaries. They must know when and how to communicate with patients and refer them to other professionals and agencies, to respect the choices of service users and others, to promote shared decision-making, to deliver positive outcomes, and to coordinate smooth and effective transition within and between services and agencies.

7. Social Accountability and Responsibility^{ix}

The students will recognize that allied and healthcare professionals need to be advocates within the health care system, to judiciously manage resources and to acknowledge their social accountability. "They have a mandate to serve the community, region and the nation and will hence direct all research and service activities towards addressing their priority health concerns. Program objectives should enable the students to:

• Demonstrate knowledge of the determinants of health at local, regional and national levels and respond to the population needs

- Establish and promote innovative practice patterns by providing evidence-based care and testing new models of practice that will translate the results of research into practice, and thus meet individual and community needs in a more effective manner
- Develop a shared vision of an evolving and sustainable health care system for the future by working in collaboration with and reinforcing partnerships with other stakeholders, including academic health centres, governments, communities and other relevant professional and non-professional organizations
- Advocate for the services and resources needed for optimal patient care

8. Scientific attitude and Scholarship^x

The student will utilize sound scientific and/or scholarly principles during interactions with patients and peers, educational endeavors, research activities and in all other aspects of their professional lives. Program objectives should enable the students to:

- Engage in ongoing self-assessment and structure their continuing professional education to address the specific needs of the population
- Practice evidence-based by applying principles of scientific methods
- Take responsibility for their educational experiences
- Acquire basic skills such as presentation skills, giving feedback, patient education and the design and dissemination of research knowledge; for their application to teaching encounters

9. Lifelong learning^{xi}

The student should be committed to continuous improvement in skills and knowledge while harnessing modern tools and technology. Program objectives will aim at making the students being able to:

- Perform objective self-assessments of their knowledge and skills; learn and refine existing skills; and acquire new skills
- Apply newly gained knowledge or skills to patient care
- Enhance their personal and professional growth and learning by constant introspection and utilizing experiences
- Search (including through electronic means), and critically evaluate medical literature to enable its application to patient care
- Develop a research question and be familiar with basic, clinical and translational research in its application to patient care
- Identify and select an appropriate, professionally rewarding and personally fulfilling career pathway

Introduction of new elements in allied and healthcare education Competency-based curriculum

A significant skill gap has been observed in the professionals offering healthcare services irrespective of the hierarchy and level of responsibility in the healthcare settings. The large variation in the quality of services is due to the diverse methodologies opted for healthcare education and the difference in expectations from a graduate after completion of a course and at work. What one is expected 'to perform' at work is assumed to be learned during the course, however, the course design focuses on what one is expected 'to know'. The competency-based curriculum thus connects the dots between the 'know what' and 'do how'.

The efficiency and effectiveness of any educational programme largely depends on the curriculum design that is being followed. With emerging medical and scientific knowledge, educators have realized that learning is no more limited to memorizing specific lists of facts and data; in fact, by the time the professional aims to practice in the healthcare setting, the acquired knowledge may stand outdated. Thus, competency-based education is the answer; a curricular concept designed to provide the skills that professionals need. A competency-based program is a mix of skills and competencies based on individual or population needs (such as clinical knowledge, patient care, or communications approaches), which is then developed to teach relevant content across a range of courses and settings. While the traditional system of education has a focus on competencies, outcomes, performance and accomplishments. In such a case, teaching activities are learner-centered, and evaluation is continuous and formative in structure. The competency-based credentials depend on the demonstration of a defined set of competencies which enables a professional to achieve targeted goals. Competency frameworks comprise of a clearly articulated statement of a person's abilities on the completion of the credential, which allows students, employers, and other stakeholders to set their expectations appropriately.^{xixii}

Considering the need of the present and future healthcare delivery system, the curriculum design depicted in this handbook thus will be based on skills and competencies.

Promoting self-directed learning of the professionals

The shift in the focus from traditional to competency-based education has made it pertinent that the learning processes may also be revisited for suitable changes. It is a known fact that learning is no more restricted to the boundaries of a classroom or the lessons taught by a teacher. The new tools and technologies have widened the platform and introduced innovative modes of how students can learn and gain skills and knowledge. One of the innovative approaches is learner-centric and follows the concept of **self-directed learning**.

Self-directed learning, in its broadest meaning, describes a process in which individuals take the initiative with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and implementing learning strategies and evaluating learning outcomes (Knowles, 1975).^{xin}

In self-directed learning, learners themselves take the initiative to use resources rather than simply reacting to transmissions from resources, which helps them learn more in a better way.^{xv} Lifelong, self-directed learning (SDL) has been identified as an important ability for medical graduates (Harvey, 2003)^{xvi} and so is applicable to other health professionals including AHPs. It has been proven through many studies worldwide that the self-directed method is better than the teacher-centric method of learning. Teacher-directed learning makes learners more dependent and the orientation to learning becomes subject-centred. If a teacher provides the learning material, the student is usually satisfied with the available material, whereas if a student is asked to work on the same assignment, he or she invariably has to explore extensive resources on the subject.^{xv}

Credit hours vs traditional system

Recently the National Assessment and Accreditation Council (NAAC) and the University Grants Commission (UGC) have highlighted the need for the development of a Choice-Based Credit System (CBCS), at par with global standards and the adoption of an effective grading system to measure a learner's performance.^{xvii} All the major higher education providers across the globe are operating a system of credits. The European Credit Transfer System (ECTS), the 'National Qualifications Framework' in Australia, the

Pan-Canadian Protocol on the Transferability of University Credits, the Credit Accumulation and Transfer System (CATS) in the UK as well as the systems operating in the US, Japan, etc. are examples of these. Globally, a need now exists for the use of a fully convertible credit-based system that can be accepted at other universities. It has now become imperative to offer flexible curricular choices and provide learners mobility due to the popularity of initiatives such as 'twinning programmes', 'joint degrees' and 'study abroad' programmes.^{xviii}

In order to ensure global acceptability of the graduates, the current curriculum structure is divided into smaller sections with focus on hours of studying which can be converted into credit hours as per the international norms followed by various other countries.

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Integrated structure of the curriculum

Vertical integration, in its truest sense, is the interweaving of teaching clinical skills and knowledge into the basic science years and, reinforcing and continuing to teach the applications of basic science concepts during the clinical years. (Many efforts called 'vertical integration' include only the first half of the process).

Horizontal integration is the identification of concepts or skills, especially those that are clinically relevant, that cut across (for example, the basic sciences), and then putting these to use as an integrated focus for presentations, clinical examples, and course materials. e.g. Integration of some of the basic science courses around organ systems, e.g., human anatomy, physiology, pathology; or incorporating ethics, legal issues, finance, political issues, humanities, culture and computer skills into different aspects of a course like the Clinical Continuum.

The aim of an integrated curriculum is to lead students to a level of scientific fluency that is beyond mere fact and concept acquisition, by the use of a common language of medical science, with which they can begin to think creatively about medical problems.^{xix}

This innovative new curriculum has been structured in a way such that it facilitates horizontal and vertical integration between disciplines; and bridges the gaps between both theory & practice, and between hospital-based practice and community practice. The amount of time devoted to basic and laboratory sciences (integrated with their clinical relevance) would be the maximum in the first year, progressively decreasing in the second and third year of the training, making clinical exposure and learning more dominant.^{xi} However it may differ from course to course depending on the professional group.

Introduction of foundation course in the curriculum

The foundation course for allied and healthcare professions is an immersive programme designed to impart the required knowledge, skills and confidence for seamless transition to the second semester of a professional allied and healthcare course. Post admission, the foundation course is designed for a period of 6 months to prepare a student to study the respective allied and healthcare course effectively and to understand the basics of healthcare system. This aims to orient the student to national health systems and the basics of public health, medical ethics, medical terminologies, communication skills, basic life support, computer learning, infection prevention and control, environmental issues and disaster management, as well as orientation to the community with focus on issues such as gender sensitivity, disability, human rights, civil rights etc. Though the flexibility to the course designers have been provided in terms of – modifying the required numbers of hours for each foundation subject and appropriate placement of the subject across various semesters.

Learning methodologies

With a focus on self-directed learning, the curriculum will include a foundation course that focuses on communication, basic clinical skills and professionalism; and will incorporate clinical training from the first year itself. It is recommended that the primary care level should have sufficient clinical exposure integrated with the learning of basic and laboratory sciences. There should also be an emphasis on the introduction of case scenarios for classroom discussion/case-based learning.

Healthcare education and training is the backbone of an efficient healthcare system and India's education infrastructure is yet to gain from the ongoing international technological revolution. The report 'From Paramedics to Allied Health: Landscaping the Journey and way ahead', indicates that teaching and learning of clinical skills occur at the patient's bedside or other clinical areas such as laboratories, augmented by didactic teaching in classrooms and lecture theatres. In addition to keeping up with the pace of technological advancement, there has been a paradigm shift to outcome-based education with the adoption of effective assessment patterns. However, the demand for demonstration of competence in institutions where it is currently limited needs to be promoted. The report also mentions some of the allied and healthcare schools in India that have instituted clinical skill centres, laboratories and high-fidelity simulation laboratories to enhance the practice and training for allied and healthcare students and professionals. The report reiterates the fact that simulation is the replication of part or all of a clinical encounter through the use of mannequins, computer-assisted resources and simulated patients. The use of simulators addresses many issues such as suboptimal use of resources and equipment, by adequately training the manpower on newer technologies, limitations for imparting practical training in real-life scenarios, and ineffective skills assessment methods among others. i The table mentioned below lists various modes of teaching and learning opportunities that harness advanced tools and technologies.

Teaching modality	Learning opportunity examples
Patients	Teach and assess in selected clinical scenarios
13	Practice soft skills
	Practice physical examination
1P7 X41	Receive feedback on performance
Mannequins	Perform acquired techniques
R	Practice basic procedural skills
	Apply basic science understanding to clinical problem solving
Simulators	Practice teamwork and leadership
A A	Perform cardiac and pulmonary care skills
	Apply basic science understanding to clinical problem solving
Task under trainers	Practice phlebotomy, lumbar puncture, etc.

Table 1	Clinical learning	opportunities	imparted	through the us	se of advanced	techniquesi,"
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Assessment methods

Traditional assessment of students consists of the yearly system of assessments. In most institutions, assessments consist of internal and external assessments, and a theory examination at the end of the year or semester. This basically assesses knowledge instead of assessing skills or competencies. In competency-based training, the evaluation of the students is based on the performance of the skills as per their

competencies. Hence, all the three attributes - knowledge, skills, and attitudes - are assessed as required for the particular competency.

Several new methods and tools are now readily accessible, the use of which requires special training. Some of these are given below:

- Objective Structured Clinical Examination(OSCE), Objective Structured Practical Examination • (OSPE), Objective Structured Long Examination Record(OSLER) AND HEALTHCAR
- Mini Case Evaluation Exercise(CEX)
- Case-based discussion(CBD) .
- Direct observation of procedures(DOPs) •
- Portfolio .
- Multi-source feedback
- Patient satisfaction questionnaire

An objective structured clinical examination (OSCE) is used these days in a number of allied and healthcare courses, e.g. Optometry, Physiotherapy, and Radiography. It tests the performance and competence in communication, clinical examination, and medical procedures/prescriptions. In physiotherapy, orthotics, and occupational therapy, it tests exercise prescription, joint mobilization/manipulation techniques; and in radiography it tests radiographic positioning, radiographic image evaluation, and interpretation of results. The basic essential elements consist of functional analysis of the occupational roles, translation of these roles ("competencies") into outcomes, and assessment of trainees' progress in these outcomes on the basis of demonstrated performance. Progress is defined solely by the competencies achieved and not the underlying processes or time served in formal educational settings. Most methods use predetermined, agreed assessment criteria (such as observation check-lists or rating scales for scoring) to emphasize on frequent assessment of learning outcomes. Hence, it is imperative for teachers to be aware of these developments and they should suitably adopt them in the allied and healthcare education system.^{xxi}





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Chapter 2 Background of the profession

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Chapter 2: Background of the profession

Statement of Philosophy- Why this profession holds so much importance

Medical Radiology and Imaging Technology is the health profession concerned with the direct administration of radiation, primarily x-rays, in disease diagnosis and injury assessment and treatment. From the humble beginnings of plain film techniques, we are now with a wide array of imaging methods using Conventional and Digital X-rays, ultrasound, magnetic resonance and Radionuclide. Modern diagnostic radiography and Medical Imaging forms an integral part of medical practice, both in making diagnosis and also in treatment. The term "diagnostic radiography" is used to describe a variety of radiographic or x-ray examinations. These simple procedures as well as those which require the use of contrast agents, make it possible to study organs that otherwise cannot be seen. These professionals are at the heart of modern medicine.

Diagnostic radiographers employ a range of different imaging techniques and sophisticated equipment to produce high quality images of an injury or disease. They take the images using range of techniques including: X-rays, Mammography, Fluoroscopy, CT (computed tomography), MRI (magnetic resonance imaging), Nuclear medicine, Angiography etc. Medical imaging studies have been a cornerstone in medical diagnosis for decades; however, technological advances and the addition of new imaging modalities now place medical imaging among the most dynamic, expanding and high demand fields in clinical medicine.

About Medical Radiology and Imaging Technology

Radiology is a branch of medicine that uses radiation and imaging technology to diagnose and treat disease. It allows the radiologic technologist to produce images of various internal parts of the body, to aid in the detection of injury or disease by using radiations. Radiology is central to the clinical practice of medicine across a wide range of disciplines. It is the best practical way to diagnose, monitor treatment and detect progression or relapse of many important and common diseases in a minimally invasive and anatomically precise manner. As a consequence of the increasing sophistication and accuracy of clinical imaging, the utilization and importance of radiology has increased dramatically and consistently over the last 20 years. In recent years, the increasing complexity of radiologic procedures has made Medical Radiology and Imaging technology a highly specialized and sophisticated science requiring competently trained personnel to maintain a high degree of accuracy in radiographic positioning and exposure technique. A qualified Medical Imaging Technologist is skilled in both interventional and Diagnostic Radiology.

Since-2021

Scope of practice

Diagnostic Radiographers/technologists possess, utilize and maintain knowledge of radiation protection and safety. Radiographers have an extremely thorough understanding of the structure of the body, how the body can be affected by injury, and causes and effects of disease when taking X-ray images. Their work does include a wide range of different imaging modalities radiographers are the primary liaison between patients, radiologist and other members of the support team. They remain sensitive to needs of the patient through good communication, patient assessment, patient monitoring and patient care skills. As members of the health care team, diagnostic radiographer /technologist participate in quality improvement processes and continually assess their professional performance. They engage in continuing education to include their area of practice to enhance patient care, public education, knowledge and technical competence. Diagnostic radiographers use a range of imaging technology:

- X-ray Penetrate through the body to examine and view internal structures •
- Fluoroscopy uses X-rays to obtain real-time moving images of the internal parts of the body.
- CT (Computed Tomography) provides cross-sectional views / images of the body using computer with the help of X-Rays.
- MRI (Magnetic Resonance Imaging) images of the different tissue types within the body using strong magnet and RF waves
- Ultrasound –uses high frequency sound waves to produce images of the structure within the body. ٠ It is well known for its use in obstetrics and gynecology. Also used to check circulation and examine the heart
- .004 EALTHCAR Angiography -radiological study which is used to investigate blood vessels. ٠
- Mammography-Imaging of the soft tissue breast •
- DEXA—Bone Densitometry.

Recognition of Title and qualification

The practice of medical radiography is performed by health care professionals responsible for the administration of ionizing radiation for diagnostic purposes. In addition to medical radiology and imaging technologists, they are also known as Diagnostic Radiographers/ Imaging Technologist/ Radio-Diagnosis Technologist.

The recommended title thus stands as the Medical Radiology and Imaging Technologists for this group of professionals.

A medical radiology and imaging technologist performs radiographic procedures at the request of practitioner. They form an indispensable part of the medical team.

Definition of Medical Radiology and Imaging Technology professionals

A radiographer or medical imaging technologist is a trained health professional who performs medical imaging by producing high quality X-ray pictures or images used to diagnose and treat injury or disease. **TODIT**

VIC 되는다 It is an important part of medicine and a patient's diagnosis and treatment is often dependent on the Xray images produced.^{xxiii}They are responsible for producing high quality medical images that assist medical specialists and doctors to diagnose or monitor a patient's injury or illness treatment. They operate extremely technologically advanced equipment such as CT (computed tomography), MRI (magnetic resonance imaging) DSA, DEXA, mammography, CR, DR, fluoroscopy and digital mobile X-ray machines. Their roles are diverse and challenging, as radiographers are often trained in several specialist areas such as trauma radiography, mobile radiography, CT, MRI, Fluoroscopy, angiography, intervention and operation theatre mammography DEXA etc.

Education of these professionals

When developing any education program it is necessary that program planning should be outcome-based, meeting local and national manpower requirements, personal satisfaction and career potential for the professionals with supporting pathway in the development of the profession. One of the major changes is the shift from a focus based on traditional theoretical knowledge and skills to competency based education and training. Optimal education/training requires that the student is able to integrate knowledge, skills and attitude in order to be able to perform a professional act adequately in a given situation.

Thus the following curriculum aims to focus on skills and competencies based approach for learning and is designed accordingly. The curriculum is prescriptive and is designed with an aim to standardize the content across the nation.

Course duration

It is recommended that any programme developed from this curriculum should have a minimum of the following duration to qualify as an entry level professional in Medical Radiology and Imaging Technology.

- 4 year programme (including 1 year of clinical training /internship)- Bachelor's degree level
- 2 year programme Master's level

The emphasis during the initial year should be on the academic content establishing a strong scientific basis and engagement with the course principles. During the second and third years of training, emphasis should be laid on process to refine the acquired theoretical knowledge and its application to clinical/reflective practice. In Bachelor degree programme minimum one year should be devoted to clinical practice and this should be on a continuum of rotation from theory to practice over the programme. The aim of the 4 year degree programme is to enable the development of the medical radiology and imaging technologist as a key member of the multidisciplinary team and to enable him/her to execute advanced preparation/ planning/delivery as well as quality assurance.

With the change in the disease dynamics and multifold increase in the cases needing diagnostic medical imaging and evaluation, it is imperative that a well-structured programme of postgraduate education is also encouraged so as to enhance research capacity within the country to widen the scope of clinical practice for the profession. Thus, a master's degree programme is recommended with minimum of two years of education in specialized field of Medical Radiology and Imaging Technology. The post graduate students can contribute significantly in research and academics.

PhD also play a significant role in the academic system, research and innovation. However as per ICAHP Committee - 3 (Minimum Standards and Procedures for Award of Ph.D. Degree in MRIT in the related special fields) to be followed as per UGC Guidelines has also been incorporated in this curriculum

Teaching faculty and infrastructure (minimum standard to start the programmes)

One of the important recommendation of the task force members should be associated with the state medical colleges whereby they can make use of the available patient load and medical infrastructure as a part of their training curriculum (May be through MOU).

- Standalone institutions must have an MoU with either a medical college or hospital or healthcare facility as per the guidelines (desired number of Radiology equipment/beds/OPD etc.) defined in the curriculum to
- ensure practical exposure to the students.
- The MOU must be done with either a medical college or hospital or healthcare facility having minimum of 100 investigation per day includes of x-rays, Radiological imaging procedures, CT and MRI includes advance imaging techniques.
- MoU to also define the radiology clinical supervision of the students –institutional staff or clinical preceptors can be considered.

For the institutes to be capable of providing high quality training to the student and exposure to all the related modalities, it should have the following:xxiii

- Conventional X-ray Unit for routine X-ray and IVU
- Mobile X-ray unit
- Fluoroscopic unit •
- Ultrasonography, Color Doppler Equipment
- Multi-slice C.T. Scan, •
- Mammography •
- MRI •
- DSA(preferably)

The teaching faculty for the department should have a minimum of (for the 20 intake) . DE PROFESSIONS

- 1 Professor
- 1 Assoc. Professor
- 3 Asst. Professor
- 2 demonstrators

Method of teaching and learning-

- Lecture
- Tutorial •
- Problem based learning •
- Small group teaching and learning •
- Continuous interactive learning •
- Case-based
- Project based •
- Research project- Research was considered by the group to be very important in order to keep pace with other professions and to generate a research background for our own profession.
- Seminars
- Clinical conferences
- E-learning
- Skills laboratory •

Job availability-

Diagnostic radiography is a fast-moving and continually changing profession, and long-term career prospects include: management, research, clinical work, teaching etc.

Since-2021

Employment opportunities available in a variety of settings in both rural and urban areas include:

- More generalized practice in medium to small hospitals; •
- Specialized clinical practice in large academic medical hospitals and trauma centers,
- Clinics and free-standing imaging centers which may offer both special and general practice • opportunities; or
- Clinical practice coupled with expanded responsibilities in quality control, education, data management and supervision, particularly in large hospitals.
- Research Scholar/ Research Assistant

• Medical imaging professionals are usually employed in the medical imaging/radiology departments of large teaching hospitals, private and country hospitals, and private radiological clinics. Graduates may work in the field of teaching, Research, Application Specialist, Radiology Technologist, Clinical Supervisor and even as a clinical research consultant. Professionals may eventually specialise in particular areas of practice, or in specific techniques such as computed tomography, ultrasound, magnetic resonance imaging or picture archiving and communication systems (PACS). Graduates may also pursue more technical careers in medical physics or biophysics, quality control, radiation health, or with equipment manufacturers. Managerial careers within medical imaging service departments are also possible, as is pursuing further education or research. The medical imaging graduates are highly regarded and employment opportunities are readily available, in both metropolitan and rural and regional areas. There is high industry demand, and you will be qualified to work anywhere in India and in many locations internationally.

The demand for qualified radio-imaging technologist is on the rise and such jobs come with well-paid salary packages. The job profile may vary according to the modality and scope of practice.

The program aims to train human resources with requisite skills in the area of medical radiology & imaging technology who can be hired in all kinds of healthcare settings including:

- Hospitals
- Diagnostic centers
- Medical Records and Transcription organizations
- Clinical and Medical Research organisations
- Pharma and Bio-Tech companies
- Medical equipment and device companies

Diagnostic radiographers provide a service for most departments within the hospital including, accident and emergency, outpatients, operating theatres and wards. Close liaison and collaboration with a wide range of other health care professionals is therefore vital. After completion of this curriculum, a Medical Radiology &Imaging Technologist gets opportunities to work at various health care institutes under designations as:

- Radiographer
- Radiological Technologist
- X-ray Technologist
- CT scan Technologist
- MRI Technologist

- Mammography Technologist •
- Cathlab Technologist
- **Applications Specialist**
- Radiological Safety Officer •
- Interventional Technologist •
- Quality control Technologist •
- PACS manager •

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- Sales and marketing of radiology industry •
- Diagnostic Manager, etc. •
- AND HEALTHUR WE hospital. Other Administrative posts in Medical Imaging department & hospital. •
- Teaching & research faculty in Medical colleges •
- Research Scientists in Medical imaging industry •

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

AND HEALTHCAPE PROF Chapter 3 Model Curriculum of Medical **Radiology and Imaging Technology Courses**

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

Chapter 3: Model Curriculum

Background

This curriculum document outlines the structure of the Medical Radiology and Imaging Technology training program, the knowledge and skills expected from the graduates at various levels. It also enumerates the nature of the various examinations and assessments that planned throughout the training program.

The aims of the recommended curriculum are to produce MRIT'S who are

- Technically and clinically competent;
- Aware of radiation safety issues and the importance of quality assurance;
- Understand the theoretical basis for evidence based practice;
- Effective members of the multidisciplinary team;
- Prepared to participate in or initiate research into practice;

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- Can work according to registration requirements on the respective continents.

All aspects of medical radiological and imaging technology have been considered in the development of this curriculum together with the identification of the roles expected for different levels of MRIT'S based on their qualification and experience. The need for connecting the dots between the education and employment practices has been the road map for devising this curriculum.

Foundation course has also been designed to bring all the students at the same level of understanding with respect to basic healthcare related norms before the start of a career in a healthcare professional course. The foundation course is mandatory for all the allied and healthcare professional courses and for both entry level courses – diploma as well as degree. If a diploma holder has completed the foundation course and is willing to pursue the degree course, the candidate will directly get entry for next semester, however a pre- qualifier skill test will have to be satisfactorily completed, if not, then the candidate will have to undergo the first semester of foundation course again.

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3.1 Bachelor in Medical Radiology and Imaging Technology (BMRIT)

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Introduction:

Learning Objectives:

Bachelor in Medical Radiology and Imaging Technology (BMRIT) program is to provide students with a high quality, well-rounded educational experience which results in graduates who possess the knowledge, skills and abilities to enter the field of diagnostic imaging as entry-level MRITs. Graduates of the BMRIT program will be able to demonstrate the necessary skills to integrate the theoretical knowledge and essential clinical skills to perform radiography, radiological and imaging procedures including interventional procedures with utmost radiation safety measures as well as to provide exemplary patient care in a variety of healthcare settings with diverse patient populations.

The objectives of the program are to:

- Provide the profession and community with trained qualified MRITs.
- Provide education a comprehensive program that promotes problem solving, critical thinking and communication skills in the clinical environment.
- Students will demonstrate quality patient care skills including professionalism and ethical behaviors as specified in the code of ethics.
- Provide graduate students with specific skills necessary making them to be competent at entry level.

Expectation from the future graduate in the providing patient care.

- Should be able to undertake all radiological and imaging procedures independently or as a key team member wherever required.
- Able to do the image processing.
- Should be able to handle all radiological and imaging equipment independently.
- Should ensure radiation protection and quality assurance.
- Undertake care and maintenance of all radiological and imaging equipment.
- Able to evaluate images for technical quality.
- Able to identify and manage emergency situations.
- Able to receive and document verbal, written and electronic orders in the patient's medical record.
- Should have computer skills.
- Should be able to provide empathetic professional patient care.
- Able to demonstrate professional growth, sense of professionalism and desire to learn.
- Able to demonstrate the core values of caring, integrity and discovery.
- To exhibit keen interest, initiative & drive in the overall development of the Department and 'Leadership Qualities' for others to follow.
- He / She is expected to be confident and to perform all the duties diligently with utmost sincerity and honesty.

Teaching faculty and infrastructure (minimum standard to start the programmes):

Institute should mandatorily be associated with the state medical colleges whereby they can make use of the available patient load and medical infrastructure as a part of their training curriculum (May be through MOU).

• Standalone institutions must have an MoU with either a medical college or hospital or healthcare facility as per the guidelines (desired number of Radiology equipment/beds/OPD etc.) defined in the curriculum to ensure practical exposure to the students.

MoU to also define the radiology clinical supervision of the students --institutional staff or clinical • preceptors can be considered.

For the institutes to be capable of providing high quality training to the student and exposure to all the related modalities, it should have the following:

- X-ray Unit (CR, DR)
- Mobile X-ray unit •
- Fluoroscopic unit
- Ultrasonography, Color Doppler Equipment •
- Multi-slice C.T. Scan,
- Mammography
- DEXA
- MRI
- DSA .

HEALTHCAR The teaching faculty (with annual intake of up to 20 students or students staffs ratios must be 5:1 to be maintained) for the MRITs should have a minimum of Master in the MRIT or MRIT with PhD in relevant subject.

- 1 Professor .
- 1 Assoc. Professor
- 3 Asst. Professor •
- 2 demonstrators •

Method of teaching and learning-

- Lecture
- Tutorial
- Problem based learning
- Small group teaching and learning
- Continuous interactive learning •
- Case-based •
- Project based
- Research project- Research was considered by the group to be very important in order to keep pace with other professions and to generate a research background for our own profession.

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- Seminars
- Clinical conferences
- E-learning •
- Skills laboratory
- Industrial visit

Infrastructure requirements (with annual intake of up to 20 students):

- Minimum 4 classrooms with minimum seating capacity of 30 students
- Faculty rooms, Common rooms for students •
- Auditorium/Conference room with minimum seating capacity of 150 students.
- A minimum 2000 sqft library area •

- Student canteen/cafeteria
- Office rooms for staff

Eligibility for admission

Selection procedure:

He/she has passed the Higher Secondary (10+2) or equivalent examination recognized by any Indian University or a duly constituted Board with Physics, Chemistry, Biology

OR

Candidates who have studied abroad and have passed the equivalent qualification as determined by the University will form the guideline to determine the eligibility and must have passed in the subjects: Physics, Chemistry, Biology and English up to 12th Standard level.

OR

Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.

English, Physics, Chemistry, Botany, Zoology

English, Physics, Chemistry, Biology and any other language

- He/she has attained the age of 17 years as on or before the 31st December of the year of admission) & maximum age limit is 30 years.
- He/she must furnish at the time of submission of application form, a certificate of Physical fitness from a registered medical practitioner and two references from persons other than relatives testifying to satisfactory general character.

Admission to Bachelor Medical Radiology and Imaging Technology course shall be made based on eligibility and an entrance test to be conducted for the purpose.

Selection of eligible candidates:

Selection to the BMRIT course shall be based on merit obtained in the National Entrance and Eligibility Test (NEET) conducted by the central government or its authorized agency.

In accordance with NCAHP regulations Institution/university having hospital setup shall be permitted an annual intake capacity of 20 admissions annually apart from inservice /Govt.Sponsored Candidates as per NCIAHP Act. Thereafter these can be increased to 40/60 BMRIT admissions annually. The phase-wise requirements to be fulfilled by the applicant colleges after obtaining letter of intent and Letter of Permission for establishment of new college or increase in annual intake for 40/60 BMRIT admissions annually as per ICAHP regulations.

Admission of Lateral Entry candidates:

Number of intake: lateral entry admission must not be more than 10% of the annual intake.

Lateral entry to second year for allied and healthcare science courses for candidates who have passed diploma program from the Government Boards and recognized by State/Central University, fulfilling the conditions specified and these students are eligible to take admission on lateral entry system only if the same subject have been studied at diploma level.
There may be need of deliberation on the inclusion of a few bridging courses are advisable for those having less qualified subjects.

A candidate with a minimum 2 years full-time diploma in Medical Imaging Technology/Radiography recognized by a Government Body is eligible for lateral entry to the 3rd semester.

Note: Candidates with minimum 2 years full-time diploma in Medical Imaging Technology/Radiography from a recognized Government Body shall have passed 'plus-two' [10+2] with Physics, Chemistry and Biology as subjects with minimum 1 years of radiology working experience in hospital/academic institution or

Candidates with minimum 3 years full-time diploma in Medical Imaging Technology/Radiography from a recognized Government Body shall have passed 'plus-two' [10+2] with Arts/Commerce as subjects, should have studied Physics, Chemistry and Biology as principal subjects during the tenure of the Medical Imaging Technology course with minimum 1 years of radiology working experience in hospital/academic institution. Eligibility of the lateral candidates based on examination conducted by NCAHP.

Foreign nationals and candidates who have qualified from a foreign University/Board should obtain permission from the NCAHP commission prior to the admission for equivalence of the qualification.

Note: Curriculum task force members decided not to submit the Diploma of MRIT curriculum and requested NCAHP to phase out the course within five years. (As it was decided during the previous meeting).

Duration of the course

Duration of the course: 3 years (6 semesters) + 1 year (7th and 8th semester) internship. Total 4 years or 8 semesters programme. (per semester 640 hours of Theory & Practical hours) and 2400 hours of internship.

Total hours of the course: 6240 hours.

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Maximum period for completion of the course:

- The maximum period for completion of BMRIT is 7 years.
- If a candidate does not complete within the 6years, he/she should re-register.

Attendance and Monitoring progress of studies:

- A candidate shall study in concerned department of the Institute for the entire period as a full time student.
- A candidate who has a minimum of 75% attendance in theory and practical separately and who has fulfilled other requirements of the course shall be permitted to appear for examination.
- A candidate having shortage of attendance shall repeat the exam when it is offered next.

Assessment and Evaluation

Scheme of Evaluation

The academic performance is assessed on the basis of both Continuous Internal Evaluation (CIE) assessment and End Semester Examination (ESE) in each semester.

ESE weightage will be in the ratio of 30 % for CIE and 70 % for ESE.

Continuous Internal Evaluation (CIE)

- 30% of the total marks is allotted for CIE in each course.
- 50% of CIE shall be based on the average of marks obtained in two notified formative written tests. Absence without prior permission for a formative test shall result in scoring of the test as zero.
- The remaining 50% of CIE will be based on internal assessments in the form of evaluation seminars, journal club presentations, case presentations, completion of assignments etc. which will be specified in the individual course curricula.
- CIE will be conducted for theory and practical for each course wherever applicable.
- A Candidate must secure at least 40% of total marks fixed for CIE in the particular subject in order to be eligible to appear for the End Semester Examination (ESE) for that subject.

End semester examination (ESE)

- There shall be a University Examination at the end of each semester.
- To be eligible to appear for University examination a candidate should fulfill all the following conditions
 - Undergone satisfactorily the approved program of study in the course/courses for the prescribed duration
 - 75% attendance separately in theory and in practical/hospital postings, in each course
 - Shall have the minimum attendance requirement in all courses of that semester for the first appearance
 - Secure at least 50% of total marks fixed for CIE in a particular course; and
 - Fulfill any other requirement that may be prescribed by the University from time to time.
- The End semester examination will consist of Theory examination for all courses and in addition, Practical examination for specified courses.
- Theory examination
 - Written tests with question types, pattern, duration and weightage as specified in the Course-wise curricula
 - Setting of question papers and evaluation of answer scripts as per University regulations
- Practical examination
- Broad outline would be in the form of Spotters, Demonstration of equipment handling, Case based discussions.

Criteria for pass:

A Candidate must score 50% separately in theory and practical wherever applicable to be declared as pass. In case of fail, subsequently a candidate has to appear for both theory and practical examination of the university in that particular course.

Attendance and appearance for Exam:

Candidates not possessing required attendance in a particular course as prescribed by University will not be allowed to take up examinations and has to appear for supplementary examination whenever board conducts exam for the particular course very next time.

Stipend: All students shall be paid a minimum amount of Rupees 7000/- per month as stipend during internship or at par with other streams as per Consumer Price Index as per NCIAHP Act.

Structure of the program

Overview

Foundation courses	1. Human Anatomy
	2. Physiology
(12 credits)	3 Pathology
	4 Basics of Microbiology
	5 Basics of Biochemistry
	3. Dasies of Dioenennistry
Core courses	1. Basics of Radiation Physics
$(100 \text{ and } d; t_2)$	2. Conventional Radiography and Equipment
(109 credits)	3. Clinical Radiography Positioning (Part 1)
	4. Clinical Radiography Positioning (Part 2)
	5. Radiography and Image Processing Techniques
	6. Contrast Media and Special Radiological procedures
	7. Cross Sectional Anatomy
	8. Modern Radiological Imaging Equipment and Physics
	9. Interventional Radiology Techniques
	10. Patient Care in Radiology
	11. Basics Techniques in CT Technology
	12. Radiation safety in Diagnostic Radiology
	13 Quality Assurance in Diagnostic Radiology and Regulatory Requirements
	14 Basics Techniques in MRI Technology and regulatory requirements
	15. Introduction to Nuclear Medicine Techniques
	16. Ultrasound Techniques
	10. Ontasound Teeninques
Programme Courses	1. Introduction to Healthcare
(09 Credits)	2. Medical Terminology and Record Keeping
	3. Basic Computers and Information Science
	4. Medical Law and Ethics
	5. Professionalism and Values
	6. Principals of Management
	7. English and Communication Skills
	8. Biostatistics and Research Methodology
40 Credits	Internship
Total credits: 170	
	ach and stell
Distribution of Credits:	TOTAL JUCIER
	· · P BEFEY T'
L – Lectures- 1 hour: 1 cree	dit

Distribution of Credits:

- L Lectures- 1 hour: 1 credit
- T Tutorial- 1 hour: 1 credit
- P Practical- 2 hours: 1 credit

Clinical (Studentship)- 3 hours: 1 credit

Curriculum Outline

	Teaching and Examination Scheme															
Coι	u rse Name : Bac	helor in M	edical R	adiolo	ogy ar	nd Imag	ging Techno	logy								
Du	ration of Progra	ım: Four Y	lears (I	Eight	Sem	esters)	Pattern : H	full Tim	e	Dı	iration	:18 W	eeks			
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1	Human Anatomy	RI'T- 001	3			3	2.5	30	70	100	50	$\mathcal{C}_{\mathcal{A}}$				100
1.		BM							X				K			
2	Physiology	RIT -002	3			3	2.5	30	70	100	50		PP			100
2.		BM											Ć	2		
3.	Basics of Radiation	ARIT -003	2		6	5	2.5	30	70	100	50	30	70#	100	50	200
	Physics	BN												S		
4.	Introduction to Healthcare	IRIT -004	1		-	1		30	70*	100	50			0		
	4 P	BN		4										4		
5	Medical Terminology	RIT- 005	1			1	-	30	70*	100	50				-	
0.	and Record keeping	BM												1		
	Basic Computers	RIT- 006	1			1		30	70*	100	50		- 2	-		
6.	and Information	BMI	रन्ट		9	यम	न स	वोश	र्थस	I ST	-	T	A			
	science Medical Law		1			1	ic	30	70*	100	50		.9			
7.	and Ethics	IRIT- 007					A J V	30	10	100	50	8				
		BN	50			3	Since	-202	21		~	30				
8	Professionali sm and	RIT -008	1	5		1		30	70*	100	50	/				
0.	Values	BM			7	15	FD-Y	PS	25	51						
9.	Principals of Management	BMR IT- 009	1			1		30	70*	100	50					
	English &	TT- 110	1			1		30	70*	100	50					
10.	on skills	BMRJ 0														

11.	BMRIT Radiology Clinical Education – part I (studentship)				15	5								-		-
	Total		13	2	21	23				300				100		400
Stuc	dent Contact Ho	urs Per We	eek: 36 I	Hrs.'T	heor	y and p	ractical pe	riods of	60 minu	ites eac	:h.	Mediu	m of Inst	ruction	Englis	sh Total

Marks: 400

Abbreviations: ESE- End Semester Exam, CIE- Continuous Internal Evaluation, L – Lectures ((hrs/week), T - Tutorial, P – Practical {Clinical / Practicals (hrs/week)}

*Internal Assessment, # External Assessment.

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Weeks												
Course Name :Bachelor in Medical Radiology and Imaging Technology												
WEEKS												
al Grand												
Min Marks												
Basics of Microbiology BMRIT -011 2 2 2.5 30 70 100 50 100 Basics of Microbiology -011 2 2 2.5 30 70 100 50 100												
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*Internal Assessment # External Assessment												

	Teaching and Examination Scheme															
Cou	Course Name: Bachelor in Medical Radiology and Imaging Technology Duration of Program: Four Vears (Fight Semesters) Pattern : Full Time Duration : 18															
Dura Weel	ation of Prog ks	ram: l	Four Yo	ears	(Eight	Semest Semest	ters) P er : Thi	attern rd	: Full	Tim	e		Du	ratior	ı : 18	
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S.N.	Course	e Code	eek)		sek)	ts -P)	ation .	CIE	ESE	То	tal	CIE	ESE	То	tal	Gran Total
	Title	Cours	L (hrs/w	T	C/ C/	Credi (L+T+	Exam Dur in Hr	Max Marks	Max Marks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks	
1.	Pathology	BMRIT -015		6		2	2.5	30	70	100	50	ΓHζ	1			100
2.	Clinical Radiography Positioning (Part II)	2 1 6 6 2.5 30 70 100 50 30 70# 100 50 200														
3.	Radiography and Image Processing Techniques	BMRIT- 017	2	2 3 2.5 30 70 100 50											100	
4.	Contrast Media& Special Radiological procedures	BMRIT-018	2	1	6	6	2.5	30	70	100	50	30	70#	100	50 NS	200
5.	BMRIT Radiology Clinical Education – part III (studentship)															
	Total		6	4	26	21	<u>L</u> A			400		5	P	200		600
Stude	Student Contact Hours Per Week: 36 Hrs.Theory and practical periods of 60 minutes each. Medium of															
Abbr	uction: Engli eviations: ES	sn To E-En	otal Ma d Seme	rks : (ster F	bUU Fxam (TE- Co	ntinuo	is Inte	rnal F		tion	T _ T 4	ctures	Т-	Tut	orial P -
Pract	ical	L- LH	u seine	Ster I	Jain, C		minuot			Salua		L - L		, 1 -	iuu	Jiiai, I -
*Inte	rnal Assessme	ent, #	Externa	al Ass	sessmer	it.	414	eq	4							
*Inte	*Internal Assessment (Institutional Level examination) marks are not to be counted for the grade at the end of															
the se	ne semester.															

Teaching and Examination Scheme

Course Name :Bachelor in Medical Radiology and Imaging Technology

Duration of Program :Four Years (Eight Semesters) Pattern : Full Time Semester : **Fourth**

Duration: 18 Weeks

			Te	eachii	ng Sche	eme]	Exam	inatio	n Scheme	e		
		ode						ſ	heory				Practi	ical		
S.N	Course Title	Course Co	L week)	r	/P week)	L week)	tion in	CI E	ES E	Tot	al	CI E	ESE	Tot	tal	l Total
			(hrs/	14	(hrs/	(hrs/	Exam Dura Hrs.	Max Marks	<mark>Max Ma</mark> rks	Max Marks	Min Marks	Max Marks	Max Marks	Max Marks	Min Marks	Grand
1.	Cross sectional anatomy	BMRIT- 019	2		6	5	-		K	-	7	70#	30	100	50	100
2.	Modern Radiological Imaging Equipment and Physics	BMRIT-020	2	1	2	3	2.5	70	30	100	50			0	NEESS	100
3.	Interventional Radiology Techniques	BMRIT- 021	2	1	4	4	2.5	70	30	100	50	70#	30	100	10 MS	200
4.	Patient Care in Radiology	BMRIT- 022	1	1	4	4	2.5	70	30	100	50	70#	30	100	50	200
5.	BMRIT Radiology Clinical Education – part IV (studentship)		F Ico		12			1 d Ał e-2	थि - P 021	Ŧ	e la	न - ्	F. K	40 -		
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Inter	nal Assessment ester.	t (Institi	utiona	l Lev	el exa	minatio	on) m	arks ar	e not t	to be o	coun	ted for	r the gra	ide at 1	the er	nd of the

	Teaching and Examination Scheme															
Co	urse Name :Bac	chelor in	Medic	al Ra	diolog	y and I	maginę	g Tech	nolog	у						
Du	ration of Progra	am :Fou	ır Year	s (E	ight S	emeste	ers) P	attern	: Full	l Tin	ne		D	uratio	n : 18	
we	eks			Те	achina	Scheme	Semes	ster : I	riitn		Ex	aminat	ion Sch	eme		
				10	ø	Scheme						ammat	DII 301			Grand
		ode			tical:		8		heory	T	4.01	CIE	Prac	tical To	401	Total
Ż	Course Title	se C	ory	rial	Prac veek	lits '+P)	ratio s.	on CIE	ESE ø	0		UIE 0	ESE ø	0	iai	
S		Cour	The (hrs/w	Tuto	nical /] (hrs/w	Cred (L+T	am Du in Hr	x Marks	x Marks	x Marks	n Marks	x Marks	x Marks	x Marks	1 Marks	
					Cli		E	Ma	Ma	Ma	Mii	Ma	Ma	Ma	Min	
1.	Basics Techniques in CT Technology	BMRIT- 023	4	F10	P ₈		ED 2.5	A 30	1270	10 0	50	30	70#	100	50	200
2.	Radiation Safety in Diagnostic Radiology	BMRIT- 024	LINN 2 1 4 5 2.5 30 70 10 0 50 30 70# 100 50 200													
3.	Quality Assurance in Diagnostic Radiology and Regulatory Requirements	BMRIT-025	1	1 1 2 3 30 70# 100 50										100		
4.	BMRIT Radiology Clinical Education – part V (studentship)				12	4			5	-					SNOI	
	Total 7 3 26 21 20 0 300 500															
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Ab	breviations: ESP	E- End S	emeste	r Exa	am, Cl	E- Cor	ntinuou	ıs Inte	ernal E	Evalu	ation	1, L - I	Lectur	es, T	- Tuto	orial, P -
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the	the semester.															

Teaching and Examination Scheme Course Name: Bachelor in Medical Radiology and Imaging Technology																
Course Name: Bachelor in Medical Radiology and Imaging Technology Duration of Program: Four Years (Eight Semesters) Pattern : Full Time Duration : 18 Weeks																
Durat	tion of Program	n: Fo	ur Ye	ars (Eight	Semes	ters)	Pattern	: Full '	Time			Durati	on : 18	Weel	<u>s</u> s
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1.	Techniques In MRI	1.1-0	-3	1	8	8	2.5	30	70	100	50	30	70#	100	50	200
	Technology															
	Introduction															
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2.	Techniques	3MRI	1	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$											100	
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	BMRIT Radiology												-	FL		
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Abbre	eviations: ESE-	End	Seme	ster	Exam,	CIE- (Contin	uous Ir	ternal l	Evalua	tion	, L - L	ectures	, Т-	Tutori	al, P -
Practie	cal nal Assessment	# F.	ternal	Acc	essmen	ht										
*Inter	nal Assessment	(Insti	tution	al Le	evel exa	iminatio	on) ma	rks are	not to b	be cou	nted	for the	grade	at the e	nd of 1	the
semes	semester.															

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters. •
- Provide simulation and skill labs for practising skills specific to the program in the initial years of • observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check • annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the • students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after • the completion of the internship.

skills to be RELEALE NATIONAL Cn. HE AR 31 देखान्देखी

Teaching and Examination Scheme
Course Name: Bachelor in Medical Radiology and Imaging Technology
Duration of Program: Four Years (8 Semesters)
Pattern: Full Time Rotatory Internship
Semester: Seventh & Eighth (4 th year)
Internship: minimum 2400 hours (calculated based on 8 hours per day for one year of internship)

Every candidate after passing all semesters examination is required to undergo compulsory internship to the satisfaction of the college authorities and University for a period of 1 year as to be eligible for the award of the degree. The internship is partial fulfillment of the requirements for the graduation and no candidate shall be declared to have completed the program otherwise. The internship shall be completed within 18 months of the date of passing final examination.

Students must undertake the rotational postings during which students have to work under supervision of an experienced staff in the following areas:

2		Postings	Duration
00	1	Conventional Radiography, Mammography, CR, DR and PACS	4 months
NAL	2	Radiological Imaging & Special Procedures and Advanced Equipments	2 months
0	3	Ultrasonography & Doppler Imaging	1 month
AT	4	Interventional Radiology	1 month
Z	5	Computed Tomography	2 months
	6	Magnetic Resonance Imaging	2 months
A			

Assessment of Internship

The intern shall maintain a record of work which is to be verified and certified by the faculty under whom he/she works. Apart from scrutiny of the record of work, assessment and evaluation of training shall be undertaken by an objective approach using situation tests in knowledge, skills and attitude during and at the end of the training. Based on the record of work and date of evaluation, the Head of the Institution/hospital will issue a certificate of satisfactory completion of training, following which the University will award the BMRIT degree or declare him eligible for it.

Guideline for Internship

1. RATIONALE

The Clinical Education, is designed for the students to familiarize them with the applications of radiography, mammography, radiological special procedures, CT, MRI and advanced imaging techniques etc. Student should be able to reliably perform all non-contrast plain radiography as well as contrast radiological and imaging procedures along with Radiologist.

2. COMPETENCY

Identify the Anatomy to be imaged, properly position the patient for Imaging, Correctly select appropriate projection/projections to demonstrate the area of interest Use appropriate radiographic/radiological and imaging parameters.

3. COURSE OUTCOMES

On completion of this subject, the student should be able to:

- Correctly Identify the Anatomy to be imaged
- To properly position the patient for radiography/Radiological and Imaging procedures
- Correctly select appropriate projection/projections to demonstrate the area of interest
- Use appropriate radiographic parameters to produce a radiographic image with satisfactory results
- Should be able to differentiate a properly positioned and exposed radiographic image from a wrongly positioned and over or underexposed radiographic image
- Should be able to correctly identify anatomical features displayed in radiographic image obtained.

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			× .				NI									
			20	-	100 50 100 50											100

4. TEACHING AND EXAMINATION SCHEME

Note: ESE^* will be conducted immediate after end of the 7th & 8th semester at the institutional level.

Legends: L-Lecture, T – Tutorial/Teacher Guided Theory Practice, P – Practical, ESE -End Semester Examination, CIE- Continuous Internal Evaluation

	Students have to do hands on practice on following Techniques:										
Exp. No.	Name of Practical/ Exercise/ Assignment/ Case Study										
	Seventh Semester										
1	Radiation Physics										
2	Radiographic Positioning										
3	Conventional Radiography and Equipment										
4	Contrast Media& Special Radiological/ imaging procedures										
5	Interventional Radiology/ imaging techniques										
6	Patient Care in Radiology										
	Eighth Semester										
7	Basics Techniques in CT Imaging Technology										
8 5	Radiation Safety in Diagnostic Radiology										
9	Quality As <mark>surance in</mark> Diagnostic Radiology and Regulatory Requirements										
10	Basics Techniques in MRI Imaging Technology										
11	Introduction to Nuclear Medicine Techniques* (if facility available)										
12	Ultrasound Techniques										
7											

LIST OF PRACTICALS/ EXERCISES/ASSIGNMENTS/CASE STUDIES

5. GENERAL GUIDELINES FOR CLINICAL EDUCATION (INTERNSHIP)

The Institutes/Hospitals/Diagnostic Centers can be Government, Public limited, private enterprises or ownership.

- Training Area: Students should be trained in Large and Medium scale Hospitals/Diagnostic Centers. • However, despite the best efforts by the Institute, if large and medium scale Hospitals/Diagnostic Centers are not available to all students then, students can also be placed in Small scale Institutes/Hospitals/Diagnostic Centers approved by the NCAHP competent body.
- Skill Knowledge Partner (SKP) : To be identified by the Institute as per their programme areas like Since-2021

201-200

- 1. Government Hospitals.
- 2. Corporate Hospitals
- 3. Private Hospitals
- 4. Diagnostic Centers
- 5. Any other relevant industry

Note: All these needs to be approved by the NCAHP competent body.

6. EXPECTATIONS FROM Skill Knowledge Partner (SKP)

Helping institute in developing the following competencies among students

- Soft Skills i.e. Communication, Presentation and others.
- Life Skills i.e. Time management, Safety, Innovation, Entrepreneurship, Team building and others
- Hands-on Practices i.e. Patient Safety, Radiography/Radiological and Imaging and Quality Assurance aspects.

7. ROLE OF PARENT DEPARTMENT OF THE INSTITUTE

1. Identify Hospitals/Diagnostic Centers available for training along with capacity.

2. Institutions have to enter in to MOU with number of SKPs (Institutes/Hospitals/Diagnostic Centers) for accommodating all the enrolled students for the mandatory internship

3. Student and mentor allocation as per the slots available for Hands on training (Desirable mentorstudent ratio is 1:10).

4. Communication with Institutes/Hospitals/Diagnostic Centers available for training along with capacity and its confirmation.

5. Student enrollment for training.

6. Issuing letter to the Institutes/Hospitals/Diagnostic Centers for the training along with details of students and mentors.

7. Principal/ HOD/ Faculty should address students about safety norms, rules and discipline to be maintained in the Institutes/Hospitals/Diagnostic Centers during the training before relieving students for training.

8. The designated faculty member would visit the Institutes/Hospitals/Diagnostic Centers periodically to check the progress of the student in the training, his/ her attendance, discipline, log book preparation & project report preparation

9. Mentors to carry out progressive assessment of the students during the training through Continuous Internal Evaluation (CIE), End Semester Examination (ESE) assessment by mentor along with Institutes/Hospitals/Diagnostic Centers expert as external examiner

8. ROLES AND RESPONSIBILITIES OF THE STUDENTS

Following should be informed to students in the letter deputing them for the training; an undertaking for this should also be taken from them

- Students would interact with the mentor to suggest choices for suitable Institutes/Hospitals/Diagnostic Centers. If students have any contact in Institutes/Hospitals/Diagnostic Centers (through their parents, relatives or friends) then same may be utilized for securing placement for themselves and their peers.
- Students have to fill the forms duly signed by authorities along with training letter and submit it to training officer in the Institutes/Hospitals/Diagnostic Centers on the first day of training. Student should also carry with him/her the Identity card issued by institute during training period.
- He/she will have to get all the necessary information from the training officer regarding schedule of the training, rules and regulations of the Institutes/Hospitals/Diagnostic Centers and safety procedures to be followed. Student is expected to observe these rules, regulations, procedures.

- Students should know that if they break any rule of Institutes/Hospitals/Diagnostic Centers or do not follow the discipline then Institutes/Hospitals/Diagnostic Centers can terminate the training and send back the student.
- It is the responsibility of the student to collect information from Institutes/Hospitals/Diagnostic Centers about Radiography/Radiological & Imaging procedures/ Patient Safety /work ethics/professional practices/organizational structure etc.
- During the training period students have to keep daily record of all the useful information in Log book along with the time and date and type of Radiography/Radiological & Imaging procedures, how it was performed with patient's history any difficulty encountered.
- Maintain the Diary/Logbook and get it signed from mentor as well as Institutes/Hospitals/Diagnostic Centers Training in-charge.
- In case they face any major problem in industry such as an accident or any disciplinary issue then they should immediately report the same to the institute.
- Prepare final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from mentor as well as Institutes/Hospitals/Diagnostic Centers training incharge.

9. FORMAT FOR TRAINING REPORT

Following is the suggestive format for the training report; actual format may differ slightly depending upon the nature of Institutes/Hospitals/Diagnostic Centers. The training report may contain the following

- Title page
- Certificate
- Abstract
- Acknowledgement
- Content Page with date and time start and end
- Chapter 1. Organizational structure of Institutes/Hospitals/Diagnostic Centers and General Lay Out
- Chapter 2. Introduction of Institutes/Hospitals/Diagnostic Centers (History, Facilities available. Specialization and number of employees etc.)
- Chapter 3. Types of major equipment/instruments/ machines used in Radiology with their specification, approximate cost and specific use and their routine maintenance.
- Chapter 4. Standard Operating procedures.
- Chapter 5. Quality assurance and radiation safety procedures
- Chapter 6. Equipment handling and procedures.
- Chapter 7. Safety procedures followed
- Chapter 8. Particulars of Practical Experiences in Radiology and Imaging
- Chapter 9. Short report/description of the project (if any done during the training)
- Chapter 10. Special/challenging experiences encountered during training if any (may include students liking & disliking of work places)

References /Bibliography

10. SUGGESTED LEARNING STRATEGIES

Students should visit the website of the Institutes/Hospitals/Diagnostic Centers where they are undergoing training to collect information about Facilities, Specialization, capacity, number of employees, etc. They should also refer the operating manuals of the major machines and operation, testing, quality control and standard operating procedures and practices used in the Radiology. Students may also visit websites related to other similar industries as their learning resource. The training activity may vary according to nature and size of Institutes/Hospitals/Diagnostic Centers. The details of activities to be completed during 6 months should be planned appropriately. The evaluation of Clinical Education (Internship)will be done on the basis of skills acquired by the student during this 6 months period.

ASSESSMENT SCHEME FOR CLINICAL EDUCATION (INTERNSHIP)

Training	CONTINUOUS		END SEMESTER		Tota	al marks
duration	INTERNAL		ASSESSMENT		C	
	EVALUATION		(Practical and Oral)		TPA I	
	(Weekly report of all 6					
	months and attendance)		X			P
	2			Min.	Max.	2
6 months	Max. marks	Min. marks	Max. marks	marks	marks	Min. marks
6	100	50	100	50	200	100

EVALUATION SHEET FOR CONTINUOUS INTERNAL EVALUATION

Sr. No.	Enrollmen t Number	Name of Student	Seminar/presentation in workshop or conference	Marks by Supervisor	Marks by Mentor Faculty	Total Marks
	8		Out of 40	COut of 30	Out of 30	Out of 100
	EST /	स्वार	श्यम् _(A) सवाश्	(B)	म्(c) 🍾	(A+B+C)

Marking criteria for seminar/presentation at workshop/conference and marking criteria for supervisor/mentor faculty mentioned in the log book template.

DISTRIBUTION OF END-SEMESTER-EXAMINATION (ESE*) MARKS

Marks for Training Report	Marks for Practical's	Marks for Oral/Viva-voce	Total ESE marls
25	25	50	100

Practical (25 marks) must include minimum two practical related demonstration infront of the internal examiners.

Board of examiners for 7th & 8th semester:

• HOD of Radiology: Chairperson

NATIONAI

- Programme Co-ordinator/Course Co-ordinator/Chief of MRIT/Incharge of MRIT: Cochairperson
- Subject Experts: Internal examiners (two) members.

9 8 31



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PROFESSIONS

Logo Book Template:

Cover Page

Institute/University Logo



Name of the Student:

Name of the Under Graduate degree:

USN:

Batch:

PARTICULARS OF STUDENT



CERTIFICATE

This	is	to	certify	that
Mr/Ms				has
satisfactorily com	pleted the trai	ning requirements for	the programme of Bache	lor in Medical
Radiology and In	maging Techr	ology (BMRIT) from	(name of the Institute/	'University &
address). She/He	e has com <mark>ple</mark>	ted all the clinical r	esponsibilities during he	er/his Under-
graduation trainin Signa Head/Programm	ng from	स्वास्थ्य	to	ROFESSIONS





SECTION I: CLINICAL POSTINGS

SECTION II. SEMINARS PRESENTED/ATTENDED

S1. No.	Date	Topic of the Seminar	Signature of the Moderator
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	H.S.	Since-2021	A.C.
		क अरेर स्वास्थ्य देखाँ	ter.

Content of the Presentation Aesthetic of slides preparation Oratory & Presentation Skills Audio- visual aids used Clarity of presentation Critical Analysis Ability to respond to questions on the subject Ability to defend the topic Referencing Implementation recent	Excellent	Good	Average	Below Average	Poor
Content of the Presentation Aesthetic of slides preparation Oratory & Presentation Skills Audio- visual aids used Clarity of presentation Critical Analysis Ability to respond to questions on the subject Ability to defend the topic Referencing Implementation recent	IED A	ND HE,	AL THOM		
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SEMINAR EVALUATION FORM **Evaluation of Seminar**

SEMINAR SCORE SHEET

Sl. No.	Date	Topic	Total Marks (Max.50)	Evaluations Signature	Co- ordinator Signature
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		B ALLIEU	ANDA		
		FUILT	- /	EAL.	
			A	KTL,	
		SID		170	
				5	
	R				$\langle \rangle$
1	Z				0
Supervis	or/mentor	shall be determined the marks basis	of the follow	ving:	ROF
Supervis	or/mentor	shall be determined the marks basis	of the follow	ving:	K X

S.No. Parameter	Score
1. Proficiency of knowledge required for each radiological imaging procedures	0-5 0
2. The competency in skills expected to manage each radiological imaging procedures	0-5 5
3. Responsibility, punctuality, work up of case, involvement in follow-up reports	0-5
4. Capacity to work in a team (Behaviour with colleagues, technologist and relationship with other healthcare workers)	0-5
5. Initiative, participation in discussions, research aptitude	0-5
SCORING SCALE: Since-2021	
2 Below Average	
3 Average	
4 Good	
5 Excellent	

Note: A score of less than 2 in any of above items will represent unsatisfactory completion of internship.

SECTION III. EXTENSION/EXTRA CURRICULAR ACTIVITIES (CONFERENCES/CME/WORKSHOP/TRAININGS)

S1. No.	Date	Event (Institution/Place)	Achievements	Signature of the Faculty
		JON FOR ALLIED AN	DHEALTH	
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	IONZ			SSIC
	NA			SN
	215		P	atty.
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		Since-2021	Totel of	
		जार स्वास्थ्य	देखाः	

DETAILS OF ABSENCE

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EVALUATION OF THE LOGBOOK

Sl. No.	Items of observation during presentation	Ι	II	III	IV	V	VI	Internship
1	Organization of the log book							
2	Adequacy of Content/ Information in the log book							
3	Punctuality							
4	Relevance of Content/ Information in the log book							
5	Shows professional conduct during the Teaching Learning session	HE	AL,	T.L.				
6	Timely submissions of Projects/Synopsis/Seminar effectively				10			
7	Work Relationship & Frequency of consulting faculty				1	D		
8	Overall quality of department work					2		
	Total Score					2	h	
	Signature of the Co-ordinator					T	SSIO	
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Grading and Classification

Grading system

Letter grades and CGPA

The performance of a candidate shall be evaluated according to a Letter Grading System, based on the both CIE and ESE. The letter grades (O, S, A+,A, B, C, F and I) indicate the level of academic achievement assessed on a 10 point scale (0 to 10).

Marks Range(%)	Grade Point	Letter Grade	Descriptor	Classification	CGPA	
90 & above	10	Ο	Outstanding	Eirst Class with		
80 -89	9	S	Excellent	distinction	7.00 and Above	
70-79	8	A+	Very Good	distilicuon		
60-69	7	А	Good	First Class	6.00-6.99	
55-59	6	B+	Average		5.50-5.99	
				Second Class		
50-54	5	В	Pass	Pass Class	5.00-5.49	
Below 50	0	F	Fails	Fail	Less than 4.0	
Absent	0	Ι	Absent			

For non-credit courses 'Satisfactory' (P) or 'Unsatisfactory' (F) shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

- A candidate shall be considered to have completed a course successfully and earned the credits assigned, if he secures an acceptable letter grade in the range O-C. Letter grade 'F' in any course implies failure in that course and no credit is earned.
- A candidate having satisfactory attendance at classes and meeting the passing standard at CIE in a course, butremained absent from SEE shall be awarded 'I' grade in that course.

Grade Point Averages:

The overall performance of a candidate will be indicated by Grade Point Average (GPA). For each course grade points will be awarded as per a letter grading system.

Semester Grade Point Average (SGPA) is computed as follows:

 \sum [(course credit) X (Grade point)] for all courses with Letter grades, including F

SGPA = -----

 \sum [(course credits)] for all courses with Letter grades, including F

Cumulative Grade Point Average (CGPA) is computed as follows:

 $\sum\limits_{\rm F}$ [(course credit) X (Grade point)] for all courses for all semesters with, Letter grades excluding

CGPA = -----

 \sum [(course credits)] for all courses for all semesters with Letter grades, excluding F

Conversion of Grades into Percentage

Formula for conversion of GPA into percentage: CGPA earned X10 = Percentage of marks scored

Illustration: (CGPA Earned 8.18 X 10) = 81.80 %

Award of Class:

The candidate, who has passed all the courses prescribed, shall be declared to have passed the program. Class will be awarded only to those who pass the entire examination in the first attempt and on the basis of the aggregate of marks scored in individual semester.

- A candidate who secures GPA ≥ 7.00 and above in first attempt shall be declared to have passed in 'First Class with Distinction'.
- A candidate who secures GPA ≥ 6.00 or more but less than 7.00 in the first attempt shall be declared to have passed in 'First Class'.
- A candidate who secures GPA ≥ 5.00 or more but less than 6.00 in the first attempt shall be declared to have passed in 'Second Class'.
- A candidate who secures $GPA \ge 4.00$ or more but less than 5.00 in the first attempt shall be declared to have passed in 'Pass Class'.
- Candidates who pass the examinations in more than one attempt shall be declared as passed in Pass' class irrespective of the percentage of marks secured.
- An attempt means the appearance of a candidate for one or more courses either in part or full in a particular examination. If a candidate submits application for appearing for the examination but does not appear for any of the courses either in full or part in the university examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessment marks, etc. are fulfilled and his appearing in the supplementary examination shall be considered as the first attempt.

Carry over benefit:

A candidate shall appear for all the subjects of that particular semester in the University examinations but failed in that semester can avail this benefit, provided:

- A candidate who fails in not more than 2 subjects in I semester is allowed to move to II semester. The candidate with back log subjects shall take both I semester backlog subjects as well as II semester subjects. The candidate with a backlog of not more than 2 subjects in II semester is allowed to go to the III semester till he/she clears all I semester subjects.
- The candidate with a backlog of not more than 2 subjects in III semester is allowed to go to the IV semester till he/she clears all II semester subjects.
- The candidate with a backlog of not more than 2 subjects in IV semester is allowed to go to the V semester till he/she clears all III semester subjects.
- The candidate with a backlog of not more than 2 subjects in V semester is allowed to go to the VI semester till he/she clears all IV semester subjects.
- Results of candidates will be declared at the end of VI semester only when the all backlog subjects are cleared by the candidates.

Maximum attempt: No more than three attempts shall be allowed for the candidate to pass the any subjects. If he/she fails to clear the any subjects within three attempts will be considered as withdrawal of the course.

Re-totaling:

Re-totaling of marks is permitted only for theory papers. The University/board, on application within the stipulated time and remittance of a prescribed fee, shall permit a re-totaling of marks for the course/s applied. The marks obtained after re-totaling shall be the final marks awarded. There is no facility provided for repeat paper valuation of any subjects.

Supplementary Examinations:

Supplementary examination shall be conducted by the university for the benefit of unsuccessful candidates. Lower semester examinations shall be conducted by the University along with current semester examinations for the benefit of unsuccessful candidates.

- A Candidate detained for lack of attendance will be barred from appearing in any one or all course/s for the supplementary examination.
- A candidate permitted to appear for the supplementary examination can improve his internal assessment marks before he takes the supplementary examination by subjecting himself to internal assessment.

Conduct and discipline:

Candidates shall conduct themselves within and outside the premises of the Institute in a manner befitting the student of an educational institution.

As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

The following act of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

Ragging as defined and described by the Supreme court/Government Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus. Willful damage or stealthy removal of any property/belongings of the Institute/Hostel or of fellow candidates/citizens. Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs. Mutilation or unauthorized possession of library books. Noisy or unseemly behavior, disturbing studies of fellow candidates. Hacking in computer systems (such as entering into other person's domain without prior permission, manipulation and/or damage to the computer hardware and software or any other cybercrimes.) Plagiarism of any nature. Any other act of gross indiscipline as decided by the Board of Management from time to time.

Commensurate with the gravity of offense, the punishment may be: reprimand, fine, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the Institution, rustication for a specific period or even outright expulsion from the Institution, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

For any offence committed in (i) a hostel (ii) a department or in a classroom and (iii) elsewhere, the Chief Warden, the Head of the Department and the Head of the Institution, respectively, shall have the authority to reprimand or impose fine.

All cases involving punishment other than reprimand shall be reported to the Vice-Chancellor.

Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

Graduation requirements:

Candidate shall be declared eligible for the award of the degree if he or she has:

- Fulfilled all degree requirements.
- No dues to the University, Institution, departments, hostels, library etc.
- No disciplinary action pending against him.

The award of degree must be recommended by the Board of Management.

Convocation:

Degrees will be awarded in person to all eligible students who have graduated during preceding academic year at the annual convocation.

Board of examiners for each semester (except 7th & 8th semesters):

The Examination Committee shall recommend in such manner as may be determined by the State Board, names of suitable experts as the chairman of panels of Board of examiner for setting and moderating the question papers and arrange the panels of moderators, senior examiners and examiners prepared in such manner as per the guidelines of the NCAHP.

HOD of Radiology: Chairperson

Programme Co-ordinator/Course Co-ordinator/Chief of MRIT/Incharge of MRIT: Cochairperson

Subject Experts:

External examiner (two):



The examiner must be subject expert.

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Internal examiner (two):

The examiner must be subject expert

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

HEALTHCARE PROFESSIONS First First First Semester

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Subject: Human Anatomy

Subject Code: BMRIT - 001

RATIONALE

Anatomy is a key component of all education programmes for MRITs and should have a strong focus on organ position, orientation and relationships. The topics provide the student with an understanding of the structure and relationships of the systems and organs of the body which is essential in patient preparation and positioning. The radiographic anatomy component will enable MRITs to evaluate images prior to reporting by the radiologist.

COURSE OUTCOMES

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

CO1: Describe the general anatomy of human body

D HEALTHC CO2: Explain normal disposition of various structures and organs in the body and its clinical correlation PROFESSIO.

CO3: Describe the microscopic structure of various tissues

CO4: Determine the topography of various structures on the surface of the body

CO5: Identify and locate structures of the body

CO6: Identify organs and tissues under microscope

CO7: Point out various features of appearance of normal body in skiagrams

Teaching Scheme (In Hours)			Total Credits	Examination Scheme			N N			
			(L+T+P)	Theory Marks		Practical Marks		Total Marks		
L	T	Р		С	CIE		ESE	CIE	ESE	5
3	-52		4-0	3 422	30	Y	70 27	निधन	म् ,	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction: Human Body as a Whole Definition of anatomy and its subdivisions, Terms of location, positions and planes, Cell and its organelles, Epithelium – definition, classification, describe with examples, functions, Glands – classification, describe serous and mucous glands with examples, Basic tissues – classification with examples	08	14
	Locomotion and Support		
----	--	---------------	--------
	Cartilage – types, examples and histology		
	Bone – classification, examples and histology. Parts of long bone, names of all bones, vertebral column and intervertebral disc. Fontanel's of fetal skull.		
II	Joints – classification of joints with examples, typical synovial joint (in detail). Muscular system – classification of muscular tissue and histology	08	14
	Important muscles of the body- Sternocleidomastoid, Trapezius, Muscles of tongue, Deltoid, Biceps brachii, Intercostal muscles, Thoracic diaphragm, Rectus abdominis, External oblique, Internal oblique, Transversus abdominis, Pelvic diaphragm, Gluteus maximus, Gluteus medius, Gluteus Minimus, Quadriceps femoris, Soleus.		
	Cardiovascular System		
ш	Heart – size, location, chambers, exterior and interior, Blood supply of heart, Pericardium, Systemic and pulmonary circulation, Branches of aorta - common carotid artery, subclavian artery, Axillary artery, brachial artery, radial artery, superficial palmar arch, femoral artery, popliteal artery, dorsalis pedis artery., Peripheral pulse, Inferior venacava, portal vein, portosystemic anastomosis, Great saphenous vein, median cubital vein, Dural venous sinuses, Lymphatic system – cisterna chyli and thoracic duct, Lymphatic tissues and its histology, Regional lymph nodes – cervical, axillary and inguinal lymph nodes.	OF PROFESSION	20
	Respiratory System		N
	Parts of RS – nose, nasal cavity, paranasal air sinuses, larynx, trachea, lungs, pleura, bronchopulmonary segments, Histology of trachea and lungs.		N N
	Gastro-Intestinal System Theory	F	u.
IV	Parts of GIT- oral cavity (lip, cheek, tongue, salivary glands, palate, dentition) pharynx (Waldeyer's ring) esophagus, stomach, small and large intestine and appendix, Liver, gall bladder, pancreas and spleen, Histology of esophagus, stomach, small and large intestine, liver, gall bladder and pancreas.	12/08	14
	Peritoneum NCATP	- /	
	Description of reflection, folds and pouches in brief.		
	Urinary System		
	Kidney, ureter, urinary bladder, male and female urethra, Histology of kidney, ureter and urinary bladder.		
	Reproductive System		• •
V	Parts of male reproductive system- testis, vas deferens, epididymis, prostate, Parts of female reproductive system- uterus, fallopian tubes, ovary, mammary gland, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary.	US	20
	Endocrine Glands		

Total		48	96
	Spermatogenesis and oogenesis, Ovulation, fertilization, Placenta	PRS	
VI	Sensory Organs Skin and its appendages, Eye – parts of eye ball and lacrimal apparatus, Extra- ocular muscles, Histology of cornea and retina, Ear – parts of ear- external, middle and inner ear and contents Embryology	08	14
	Nervous System Neuron, Classification of nervous system, Cerebrum, cerebellum, brain stem, spinal cord & spinal nerve, Meninges, ventricles and cerebrospinal fluid, Blood supply of the brain, Cranial nerves (in brief), Nerve plexus (Brachial & lumbar)		
	Names of all endocrine glands, describe in detail on pituitary gland, thyroid gland and parathyroid gland, suprarenal gland, Histology of pituitary, thyroid, parathyroid, suprarenal gland.		

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Demonstration of Histology of types of epithelium, Histology of serous, mucous and mixed salivary gland, Surface marking of the body region wise.	
2.	Demonstration of Histology of hyaline, elastic and fibrocartilage, Demonstration of all bones showing parts, radiographs of normal bones and joints, Histology of compact bone (TS and LS), Demonstration of all muscles of the body, Histology of skeletal, smooth and cardiac muscle.	them
3.	Demonstration of heart, pericardium and vessels of the body, Histology of large artery, medium sized artery and large vein, Histology of lymph node, spleen, tonsil and thymus, Normal chest radiograph showing heart shadows, Normal angiograms. Demonstration of parts of respiratory system, Normal radiographs of chest, Histology of lung and trachea.	1
4.	Demonstration of parts of GIT, liver, gall bladder, pancreas and spleen, Histology of tongue, salivary glands, esophagus, stomach, small and large intestine, liver, gall bladder, pancreas and spleen, Radiographs of abdomen plain and contrast. Demonstrations of reflections, folds and pouches.	1

Sr. No		Hours
	Demonstration of parts of urinary system, Histology of kidney, ureter, urinary bladder, Radiographs of abdomen – IVP, retrograde cystogram.	
5.	Demonstration of section of male and female pelvis with organs in situ, Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube and ovary, Radiographs of pelvis – Hysterosalpingogram.	1
	Demonstration of the glands, Histology of pituitary, thyroid, parathyroid, suprarenal glands.	
6.	Demonstration of Histology of peripheral nerve and optic nerve, Demonstration of major nerves in the body, Demonstration of cranial cavity and parts of brain, Histology of cerebrum, cerebellum, spinal cord	1
	Demonstration of Histology of thin and thick skin, Demonstration of histology of cornea and retina.	
	Total	6
Demons practical	tration will be part of theory/tutorial classes. There is in separate credit for the s/demonstrations.	OFE

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			F
	Two Written tests	c		5
	Same pattern as Summative test	H 50	ाम् ह	
	Average of two to be considered	D		
	Absence without prior permission to be marked as 0		2C	/
	Total SINCE-202	50	0.3	15
2.	Continuous assessment	रेखाँ		
	Seminars/Case presentations/ Logbook/ Case			
	records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

С С

Written Paper

Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks	LLIED AND	Hr	70
Duration (minutes)		"EALT,	150

Question Paper Blueprint

Question	Paper Blueprint	
Unit	N.	Marks (± 5%)
1.	Introduction Human Body as a Whole	14
2.	Locomotion and Support	14
3.	Cardiovascular System, Respiratory System	(20
4. LV	Gastro-Intestinal System, Peritoneum	14
5. Z	Urinary System, Reproductive System, Endocrine Glands	20
6.	Nervous System, Sensory Organs, Embryology	14
	Total Marks (including optional questions)	596
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SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Human Anatomy, Vol.1,2 &3, 5th edition, 2010,	B.D. Chaurasia	CBS publishers & distributors Pvt. Ltd.
2	Physiology & Anatomy with Practical Considerations	Ester. M. Grishcimer	J.P. Lippincott. Philadelphia
3	Manipal Manual of Anatomy, 2nd edition, 2012	Sampath Madhyastha	CBS publishers & distributors Pvt. Ltd
4	Text Book of General Anatomy, 2nd edition, 2013	Shobha Rawlani and Shivlal Rawlani	Jaypee brothers
5	Langman's Medical Embryology, 11th edition, 2009	T.W Sadler	Wolters Kluwer



Subject: PHYSIOLOGY

Subject Code: BMRIT - 002

RATIONALE

Physiology provides the students with knowledge of the function of systems and organs and their relationships and underpins the understanding of how various imaging modalities are to be selected HEALTHCA, depending upon the clinical history

COURSE OUTCOMES

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

CO1: Explain the normal functioning of organs and systems.

CO2: Understand the interrelationships and interactions among various organs and systems for maintaining homeostasis.

CO3: Assess the relative contribution of each organ systems toward the maintenance of constant internal environment

CO4: Differentiate between normal and abnormal functioning of organs and systems,

CO5: Understand physiological basis of pathogenesis and treatment of diseases and disorders.

CO6: Apply the physiological basis in the field of allied health care

Teaching Scheme	Total Credite	Examination Scheme		
(In Hours)	(L+T+P)	Theory Marks	Practical Marks	Total Marks
LTP	रदास्थ	CIE ESE	ESECIE	Like Contraction
3	3	30 70		100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
	General physiology		
	Introduction to Physiology, Concept of Homeostasis, cell – Morphology – Functions of organelles and Cell membrane, Transport mechanisms, Body fluid compartments.		
	Muscle nerve physiology		
	Neurons: Morphology, Action Potential, Neuroglia: Types & functions, Muscles: Types, structure of sarcomere. Neuromuscular junction, sliding filament mechanism of contraction.		
	Blood		
I	Composition, properties, functions. Plasma proteins: Concentrations and functions, RBC: Morphology, functions, count, physiological variations and life span Erythropoiesis – stages, essential factors, regulation of Erythropoiesis, Hemoglobin – Jaundice, types, Color index, MCH, MCV, MCHC, PCV – normal values, WBC: Morphology, functions of all types including T & B lymphocytes, total and differential counts, physiological variations, Platelets: Morphology, count, functions, thrombocytopenia & bleeding time, Blood groups: Basis of blood grouping. Landsteiner's laws, ABO system, determination of blood groups, blood transfusion, complications of incompatible blood transfusion, Rh group, erythroblastosis foetalis, prevention and treatment, Blood bank.	10	PROFESSIONS
	Haemostasis: Mechanisms. Clotting mechanism: factors, intrinsic and extrinsic pathways.		
	Disorders of clotting – hemophilia, vitamin K deficiency. Anticoagulants – mechanism of action and their uses, Anemia: Classification – Morphological and Etiological, Blood volume: normal values.	म्	whath
	Cardiovascular system	A	
п	Organization of cardiovascular system, greater and lesser circulation, Physiological anatomy of the heart, nerve supply, Junctional tissues of heart (pacemaker), Cardiac cycle: Mechanical events, Heart sounds, causes, characteristics and significance, Normal ECG, clinical significance of ECG, Heart rate – Physiological variations, Cardiac output: Definitions, normal values, physiological variations, Arterial blood pressure: Definitions, normal values, physiological variations, factors maintaining blood pressure. Role of baroreceptors in regulation of blood pressure.	10	10
	Respiratory system		
III	Respiratory and Non-respiratory function of respiratory system. Physiological anatomy of respiratory system Functions of respiratory	8	10

	tract. Respiratory membrane. Respiratory muscles. Surfactant:		
	Definitions of terms used in respiratory physiology: Eupnea, Hyperpnoea, Tachypnea, Apnea, Dyspnea.		
	Mechanics of breathing – intrapulmonary and Intrapleural pressure changes during a respiratory cycle.		
	Spirometry – Lung volumes and capacities. Vital capacity.		
	Oxygen transport: Role of hemoglobin, factors affecting, oxygen carrying capacity. Carbon dioxide transport: forms, chloride shift (Hamburgers phenomenon).		
	Respiratory centers. Role of chemo receptors in regulation of respiration. Pulmonary ventilation and alveolar ventilation.	HCA	
	Partial pressure of gases, Calculation of partial pressure of gasses in mixture. Arterial and venous blood gas concentrations and contents.	P	
/	Hypoxia: Types and effects Cyanosis, Asphyxia, Periodic Breathing, Acclimatization.		RO
	Hyperbaric O2 therapy, Artificial respiration and Ventilators.		E
	Excretory system		ls,
	Functions of kidneys. Nephrons – Juxta glomerular apparatus – functions, Steps in Urine formation – Ultrafiltration, Tubular Reabsorption, Tubular Secretion, GFR.		SND
IV	Definition, normal values, factors affecting GFR, measurement of GFR, Renal threshold for glucose, tubular load for glucose, Role of aldosterone and ADH in urine formation, Micturition, Innervation of bladder. Diuresis, Renal functions tests – Based on analysis of urine and analysis of blood, Skin: Functions of skin. Sweat glands.	4	05 Leftell
	Digestive system	~	D
V	Introduction, structure of alimentary canal, Saliva: Composition, functions, Stomach: Functions. Gastric Juice: composition, functions, Pancreatic Juice: Composition and functions, Liver: Functions, Bile: composition, functions, Gall bladder: functions, Succusentericus: Composition, functions. Functions of large intestine, Movements of small intestines, Deglutition.	4	05
VI	Major endocrine glands- Hormone: Definition, Anterior pituitary: hormones and their functions, disorders – Giganitism, acromegaly, dwarfism, Posterior pituitary:	8	15
	Hormones – diabetes insipidus, Thyroid: Hormones, normal values, functions, role of TSH. Disorders: simple goitre, myxoedema,		

Suggested Practicals/Demonstration NCAHP

SUGGESTED PRACTICALS/DEMONSTRATION	Hours
Study of Microscope and its uses Collection of blood and study of hemocytometer	
Hemoglobinometry	
Determination of RBC count	8
Determination of WBC count	
Determination of blood groups	
Determination of bleeding time	

SUGGESTED PRACTICALS/DEMONSTRATION	Hours
Determination of clotting time	
Recording of Arterial Blood Pressure,	
Clinical examination of Radial pulse	
Recording of spirogram and determination of vital capacity	
Artificial respiration, CPR	
Demonstration of ECG recording ED AND	
Total	8
Demonstration will be part of theory/tutorial classes. There is in separate	1 Ka
credit for the practicals/demonstrations.	C

Evaluation System

Continuous Internal Evaluation (CIE)

			-YA	
Evalua Continu	tion System		- AL	0
Contin	dous internai Evaluation (CIE)			2
Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			SS.
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		V SNO!
	Total	50	0.3	15
2.	Continuous assessment	साधन	रम् ४	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment Since-202		ALL ALL	
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

Written Paper

Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks	IED AND	Hr	70
Duration (minutes)		EALT	150

Question Paper Blueprint

uestion	Paper Blueprint	CAP
Unit	N.	Marks (± 5%)
1.	General physiology, Muscle nerve physiology, Blood	18
2. <	Cardiovascular system	14
3.	Respiratory system	14 0
4. K	Excretory system	9 2
5. Z	Digestive system	9 0
6.	Endocrine system, Nervous system	18
7.	Special senses, Reproductive system	14
	Total Marks (including optional questions)	96

Suggested Learning Resources

S.No.	Title of Book	Author	Publication
1	Foundation of Anatomy Rearry and Physiology	Ross Wilson	Churchill Livingstone.
2	Physiology & Anatomy with Practical Considerations	Ester. M. Grishcimer	J.P. Lippincott. Philadelphia
3	Text Book of Physiology	A. P. Krishna	Suman Publication
4	Text Book of Physiology	A.K. Jain	Avichal Publishing Company;

Subject: Basics of Radiation Physics

Subject Code: BMRIT - 003

RATIONALE

, the pracu. IT become be. AND HEALTHCAMP TO FOOT STORE Radiation physics is one of the primary pillars underlying the practice of radiology technology and understanding the principles of radiation physics helps BMRIT become better technologist.

COURSE OUTCOMES

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

CO1: Describe general physics related to imaging

CO2: Differentiate between within general radiation

CO3: Identify construction of radiology equipment's

CO4: Interpret quality of control of radiology equipment's

CO5: Differentiate between x-ray equipment's and other radiology related equipment's

CO6: Describe production of x-rays

CO7: Describe circuit system of radiology equipment's

	Total			Examinati	on Scheme	S
Teaching Scheme (In Hours)	Credits (L+T+P)	The	ory Marks	Practic	al Marks	Total Marks
LTP	C	CIE	ESE	CIE	ESE	5
2 6	रनारश	30	रग्व	30	270 H	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

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TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
I	Basic concepts : Units and measurements-Force, work, power and energy- Temperature and heat-SI units of above parameters. Atomic structure-atom model-Nucleus-electronic configuration-periodic table-Isotopes-Ionization- excitation-Binding energy-electron volt-Electromagnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum.	5
п	Electricity and magnetism : Electric charges, Coulomb's law-Unit of charge- Electric potential, unit of potential-Electric induction, capacitance and Capacitors, series and parallel connection-electric current, unit, resistance, ohm's law, electric power, Joule's law. Varying currents-Growth and decay of current in LR circuit time constant, charge and discharge of a Capacitor through a resistance and inductance. Oscillations in an LC circuit. Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits, DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Kirchhoff's law, heating effect of current. Electromagnetic waves : Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and	6
	radiation in Atmosphere.	1
ш	Electronics Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers. Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply. Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers.	ESSION'S • 14
IV	Discovery of x-rays-X-ray production and properties : Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.	5
V	Heat Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer-conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling, Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).	4
VI	Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.	5

	Total	36
	Physical quantity, its unit and measurement : Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit.	
VII	LE1, range of energy relationship for alpha, beta particles with X-Rays.	6
	Radiation intensity and exposure, photon flux and energy flux density.	
	atomic number.	
	Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and	
	Exponential attenuation (linear/mass attenuation coefficients), Half Value	

SUGGESTED PRACTICALS/DEMONSTRATION

		
Sr. No	SSION CIA	Hours
1.	Basic concepts	12
2.	Electricity and magnetism, Electromagnetic waves	'P
3.	Electronics	20
4.~~	Discovery of x-rays-X-ray production and properties	108
5.	Heat	SS
6.	Interaction of ionizing radiation with matter-	10
7.5	Exponential attenuation, Physical quantity, its unit and measurement	Z
Total		108

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		2E	
	 Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0 	2 c50 2 c	di l	
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

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End Semester Evaluation (ESE)

Written Paper

Ty	pe of quest	ion	No. of questions	Marks per question	Total
Essay Question (EQ)		3 (to answer 2)	10	20
Short Essay Que	stion (SEQ)		9 (to answer 7)	5	35
Short Answer Qu	uestion (SAQ))	7 (to answer 5)	3	15
Total marks					70
Duration (minute	es)		I IED AND		150
There shall be pra	actical examin	nation for 70 m	arks in the subject.	HC	AD AD
There shall be pra	arks for ESE	nation for 70 m E p <mark>ractical exam</mark>	arks in the subject. s:	Grand total	RPE PR
There shall be pra	actical examinarks for ESE	nation for 70 m E practical exam CIE	arks in the subject.	Grand total	ARE PROF
There shall be pra	arks for ESE ESE Practical	nation for 70 m E practical exam CIE Viva	arks in the subject. s: Sub Total	Grand total	ARE PROFE
There shall be pra	actical examinates for ESE ESE Practical 50	nation for 70 m E practical exam CIE Viva 20 30	arks in the subject. s: Sub Total 100	Grand total	ARE PROFES
There shall be pra	arks for ESE ESE Practical 50 Blueprint	nation for 70 m E practical exam CIE Viva 20 30	arks in the subject. s: Sub Total 100	Grand total 100	WRE PROFESSION:

End Semester Evaluation (ESE)

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

Question Paper Blueprint

Unit	Marks $(\pm 5\%)$
Basic concepts	10
Electricity and magnetism, Electromagnetic waves	10
Electronics	06
Discovery of x-rays-X-ray production and properties	25
Heat	06
Interaction of ionizing radiation with matter-	25
Exponential attenuation, Physical quantity, its unit and measurement	14
Total Marks (including optional questions)	96
गण्डे हिस्ताहम् मारु	

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SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Basic radiological physics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2	Christensen's physics of diagnostic radiology	Curry and Dowdey	Wolters Kluwer
3	X-Ray Equipment for Student	D.N. And M.O. Chesney	Blackwell Science Ltd
4	A Textbook Of Radiation Physics For Radiologic Technology	Surendra Suraj Sah Maharjan,	Samiksha Publications
5	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications
	भूम स्वास्थ्यम् स्रिहे ब्रुहे अग्रेर स्व	सर्वार्थसाध CAHP ce-2021 बारथ्य देखा-रे	राणाऽ म्राज्य स्र

Subject: Introduction to Healthcare

Subject Code: BMRIT - 004

RATIONALE

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world.

Teac	hing S	cheme	Total	Examination Scheme
(In H	Iours)		Credits	Institute level exam only:
			(L+T+P)	The Institute level examination will be held before the
-	Т	Р	C. FU	commencement of the University examinations. A Pass in the
	-	-	N	subject with a minimum of 50 marks (50% of the total 100 marks)
			101	is compulsory in order to be eligible for the award of degree. These
		6	2	marks will not be considered for the award of class. Supplementary
1	/	_ P	1	examination shall be conducted by the Institute for the benefit of
_		L'		unsuccessful candidates. Supplementary examinations will be
		Z		conducted within six weeks/six months from the date of
		.0.		announcement of results.

L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Topic and contents	Hours
Introduction to Health:	S
Definition of Health, Determinants of Health, Health indicators of India, Health team	
concept	E
National Health Policy	5
National Health Programs (Brief objectives and scope)	
Family welfare programs in India	
Introduction to Nursing:	
Nursing and Nursing principles, Interpersonal relationships, Bandaging basic turns,	18
Bandaging extremities, Triangular bandages and their applications	
Nursing position, bed making, prone, lateral, dorsal, dorsal re-cumbent, Fowler's position,	
comfort measures, Aids, rest and sleep	
Lifting and transporting patients, Transferring patients to wheel chair, transferring from	
bed to stretcher	
Bedside Management: Proper usage of bed pan, Observation of stools, urine, sputum.	
Understand the use and care of catheters. Enema procedures	
Method of giving nourishment: Feeding, tube feeding, drips, transfusion	

Monitoring and recording of vitals

Simple aseptic techniques, sterilization and disinfection

Observation of surgical dressings

Concepts of First Aid

SUGGESTED LEARNING RESOURCES

1Principles and Practice of Nursing Management and AdministrationJogindra VatiJaypee Ltd2Textbook of Preventive and Social MedicineK ParkBanarsidas Publishers3Introduction to HealthcareDakota Mitchell and Lee HarounDelmar4Introduction to Healthcare and CareersRoxann DelaetJoanes Bartlett Lee	S.No.	Title of Book	Author	Publication
2Textbook of Preventive and Social MedicineK ParkBanarsidas Publishers3Introduction to HealthcareDakota Mitchell and Lee HarounDelmar4Introduction to Healthcare and CareersRoxann DelaetJoanes Bartlett Lee	1	Principles and Practice of Nursing Management and Administration	Jogindra Vati	Jaypee Brothers Ltd
3Introduction to HealthcareDakota Mitchell and Lee HarounDelmar4Introduction to Healthcare and CareersRoxann DelaetJoanes Bartlett Let	2	Textbook of Preventive and Social Medicine	K Park	Banarsidas Bhanot Publishers
4 Introduction to Healthcare and Careers Roxann Delaet Joanes Bartlett Lee	3	Introduction to Healthcare	Dakota Mitchell and Lee Haroun	Delmar
	4	Introduction to Healthcare and Careers	Roxann Delaet	Joanes and Bartlett Learning
	ATIC			101

स्वास्थ्यम् सर्वार्थसाधनम् NCAHP Since-2021 अरेर स्वास्थ्य देखान्रेखा

Subject: Medical Terminologies and Record Keeping

Subject Code: BMRIT - 005

RATIONALE

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes.

Teaching Scheme	Total	Examination Scheme
(In Hours)	Credits	Institute level exam only:
	(L+T+P)	The Institute level examination will be held before the
T P	CNFU	commencement of the University examinations. A Pass in the
	10,	subject with a minimum of 50 marks (50% of the total 100 marks)
	5	is compulsory in order to be eligible for the award of degree. These
		marks will not be considered for the award of class. Supplementary
1	1	examination shall be conducted by the Institute for the benefit of
2.		unsuccessful candidates. Supplementary examinations will be
O.		conducted within six weeks/six months from the date of
\bigcirc		announcement of results.
L, lecture; T, Tutori	al; P, Practical	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.



SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Medical Terminology, Documentation, and Coding	Anne P. Stich	Routledge Publisher
2	Medical Terminology for Health Professions	Ann Ehrlich, Carol L. Schroeder	Cengage Learning
3	Medical Terminology OR ALLIED	M. Mastenbjörk M.D. S. Meloni M.D. Medical Creation David Andersson	Medical Creations
4	Medical Records: Organization and Management	GD Mogli (Author)	Jaypee Brothers Medical Publishers



Subject: Basic Computers and Information Science

Subject Code: BMRIT - 006

RATIONALE

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation.

Teaching Scheme T	otal	Examination Scheme	
(In Hours) Credits Insti		Institute level exam only:	
(L+	-T+P)	The Institute level examination will be held before the	
- T P	C	commencement of the University examinations. A Pass in the	
	U	subject with a minimum of 50 marks (50% of the total 100 marks)	
5		is compulsory in order to be eligible for the award of degree. These	
, L'		marks will not be considered for the award of class. Supplementary	
1	1	examination shall be conducted by the Institute for the benefit of	
6		unsuccessful candidates. Supplementary examinations will be	
S		conducted within six weeks/six months from the date of	
	5	announcement of results.	

L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Topic and contents	
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Topics to be covered under the subject are as follows:

- 1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
- 2. Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).
- 3. Processor and memory: The Central Processing Unit (CPU), main memory.
- 4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic 18 disk, optical disk, mass storage devices.
- 5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).
- 6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
- 7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.

Hours

- 8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
- 9. Introduction of Operating System: introduction, operating system concepts, types of operating system.
- 10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
- 11. Internet and its Applications: definition, brief history, basic services (E-Mail, File stor, (WWW),. AND HEAL Tycel. Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
- 12. Application of Computers in clinical settings.

Practical on fundamentals of computers -

- 1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
- 2. To install different software.
- 3. Data entry efficiency

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication			
1	Basic of Com <mark>puter and Information</mark> Technology	Ashok Arora	Vikas			
	Computer and Information Science	Roger Lee (editor)	Springer			
3	3 Computer and Information Sciences Tadeusz Czachórski , Erol Gelenbe, Krzysztof Grochla, Ricardo Lent (Editor					
4	4 Information science and computer basics: An introduction Clive Bingley					
	NCA Broger Since- Since-	HP 2021 2021 रखा-रखा				

Subject: Medical law and ethics

Subject Code: BMRIT – 007 RATIONALE

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum.

Teaching Scheme	Total	Examination Scheme
(In Hours)	Credits	Institute level exam only:
~	(L+ <mark>T+P</mark>)	The Institute level examination will be held before the
T T P	С	commencement of the University examinations. A Pass in the
		subject with a minimum of 50 marks (50% of the total 100 marks)
0		is compulsory in order to be eligible for the award of degree. These
		marks will not be considered for the award of class. Supplementary
1	1	examination shall be conducted by the Institute for the benefit of
		unsuccessful candidates. Supplementary examinations will be
2		conducted within six weeks/six months from the date of
		announcement of results.

L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Topic and contents				
The in	portant and relevant topics that need to focus on are as follows:			
1.	Medical ethics - Definition - Goal - Scope			
2.	Introduction to Code of conduct			
3.	Basic principles of medical ethics – Confidentiality			
4.	Malpractice and negligence - Rational and irrational drug therapy			
5.	Autonomy and informed consent - Right of patients	18		
6.	Care of the terminally ill- Euthanasia			
7.	Organ transplantation			
8.	Medico legal aspects of medical records – Medico legal case and type- Records and			
	document related to MLC - ownership of medical records - Confidentiality			
	Privilege communication - Release of medical information - Unauthorized			
	disclosure - retention of medical records - other various aspects.			

- Professional Indemnity insurance policy 9.
- 10. Development of standardized protocol to avoid near miss or sentinel events
- 11. Obtaining an informed consent.
- 12. Medical ethics Definition Goal Scope
- 13. Introduction to Code of conduct
- 14. Basic principles of medical ethics Confidentiality
- 15. Malpractice and negligence Rational and irrational drug therapy
- 16. Autonomy and informed consent Right of patients
- 17. Care of the terminally ill- Euthanasia
- 18. Organ transplantation
- 19. Medico legal aspects of medical records Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
- 20. Professional Indemnity insurance policy
- 21. Development of standardized protocol to avoid near miss or sentinel events
- 22. Obtaining an informed consent.

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
	Medical Law and Ethics	Bonnie F. Fremgen	Pearson
2 2	Medical Law and Ethics	Jonathan Herring	OUP UK 🔨
3	Medical Law and Ethics	Purosottam Behera	Mittal Publications
4	Reflections on Medical Law and Ethics in India	Bismi Gopalakrishnan, Mercy Khaute, B. Sandeepa Bhat	Eastern Law House
	NCA Since- Since-	HP 2021 रुख देखा-रेखा	

Subject: Professionalism and Values

Subject Code: BMRIT - 008

RATIONALE

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

Teaching Scheme Total		Examination Scheme
(In Hours)	Credits	Institute level exam only:
	(L+T+P)	The Institute level examination will be held before the
т Т Р С	С	commencement of the University examinations. A Pass in the
		subject with a minimum of 50 marks (50% of the total 100 marks)
N.	N/N	is compulsory in order to be eligible for the award of degree. These
N.		marks will not be considered for the award of class. Supplementary
		examination shall be conducted by the Institute for the benefit of
		unsuccessful candidates. Supplementary examinations will be
		conducted within six weeks/six months from the date of
M		announcement of results.
L, lecture; T, Tutorial	; P, <mark>Practica</mark> l	

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

	Topic and contents	Hours
1.	Professional values- Integrity, Objectivity, Professional competence and due care,	
	Confidentiality	
2.	Personal values - ethical or moral values - C	
3.	Attitude and behavior- professional behavior, treating people equally	18
4.	Code of conduct, professional accountability and responsibility, misconduct	10
5.	Differences between professions and importance of team efforts	
6.	Cultural issues in the healthcare environment 2021	

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Medical Ethics	Erich H Loewy	Springer
2	Professionalism, Professional Values and Ethics in Nursing	Suresh K Sharma, Asha P Shetty	Jaypee Brothers Medical Publishers

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S.No.	Title of Book	Author	Publication
3	Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students	Varinder Kaur	CBS Publishers and Distributors Pvt. Ltd
4	Textbook of Professional Ethics and Human Values	R S Naagarazan	New age International Publishers



Subject: Principals of Management

Subject Code: BMRIT - 009

RATIONALE

The course is intended to provide a knowledge about the basic principles of Management.

Teac	hing Sc	heme	Total	Examination Scheme			
(In Hours) Credits			Credits	Institute level exam only:			
(L+T+P)				The Institute level examination will be held before	e the		
	commencement of the University examinations.						
L	1	1	FOI	subject with a minimum of 50 marks (50% of the total 100 r	narks)		
			OR	is compulsory in order to be eligible for the award of degree.	These		
		C		marks will not be considered for the award of class. Supplem	entary		
1	/	- 2	1	examination shall be conducted by the Institute for the ben	efit of		
		R.		unsuccessful candidates. Supplementary examinations w	ill be		
		Z		appoincement of results	10 01		
L	lecture	T Tutorial	· P. Practical				
г,	iceture,	1 , 10011a1	, I, I lactical				
TH	EORY	COMPON	IENTS	i i i i i i i i i i i i i i i i i i i			
The	followi	ng topics/si	ubtopics shoul	d be taught and assessed in order to attain the identified			
com	petency						
	peteney	•					
	pic and	contents		Hours			
	1. Int	roduction t	o management	S S S S S S S S S S S S S S S S S S S			
	2. Str	ategic Mana	igement				
	3. For	undations o	of Planning				
	4. Pla	nning Tool	s and Techniq	ues			
	5. De	cision Maki	ing, conflict an	d stress management			
	6. Ma	naging Cha	nge and Innov	ration Judi 91 June 18			
	7. Un	derstanding	g Groups and T	Teams .			
	8. Lea	dership					
	9. Tir	ne Manager	nent	NUARE $q \mathcal{E}$			
	10. Co	st and effici	iency	Since-2021			
	Ser all Aler						
			y vy	The state of the s			
				1 म्वरिश्य प			

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Essentials of Professionalism, Professional Values & Ethics for BSc Nursing Students	Varinder Kaur	CBS Publishers and Distributors Pvt. Ltd
2	Professionalism Professional Values and Ethics in Nursing	Suresh K Sharma	Jaypee Brothers
3	Professionalism, Professional Values & Ethics	Shama Lohumi and Rakesh Lohumi	CBS publishers and Distributers PVT Ltd



Subject: English and Communication skills

Subject Code: BMRIT - 010

RATIONALE

Patients need to feel safe enough to communicate honestly and openly with their care providers to receive effective treatments. Providers need to convey treatment plans and health education clearly, accessibly, and empathetically so that patients can receive optimal care.

Teaching Scheme Tota		Total	Examination Scheme			
(In Hours)		Credits	Institute level exam only:			
(L+T+P)			(L+T+P)	The Institute level examination will be held before the		
-	Т	Р	0	commencement of the University examinations. A Pass in the		
				su <mark>bject w</mark> ith a minimum of 50 marks (50% of the total 100 marks)		
		LIS.		is compulsory in order to be eligible for the award of degree. These		
	-			marks will not be considered for the award of class. Supplementary		
1		1	1	examination shall be conducted by the Institute for the benefit of		
-		Z	-	unsuccessful candidates. Supplementary examinations will be		
		2		conducted within six weeks/six months from the date of		
				announcement of results.		

L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Topic and contents	Hours
Language-Basic	
Content: Review of grammar, Remedial study of grammar, building vocabulary Introduction Parts of speech	Letter .
Exercise on use of grammar Tense, NCAHP	
Number, Gender Since-2021	
Content: Read and comprehend prescribed course books Reading, Summarizing, Comprehension	18
Assessment methods: Fill in the blanks and one-mark questions	
Content: Various Forms of Composition Letter writing	
Note taking Precise	

writings Diary writing Reports on health problem etc. Official correspondence: Outgoing correspondence, replying incoming correspondence, writing circulars, notices, charge memos, note taking, writing summaries, observation reports. Teaching learning activities: Exercise on writing: Letter writing, resume/CV Essay writing. Assessment methods: Applications, short reports to be written. NRE PROFESSIONS Content: English-Spoken mode, Debates, Telephonic conversion, formal & informal conversation: Agreeing emphasizing, interrupting, politely, opinions, interviews, visual presentation. Teaching learning activities: Participating in seminar, Telephonic conversion, conversation in different situations, practice in public speaking Assessment methods: Assessment of the skills based on the checklist. Content: Listening to comprehension media, audio, video, speeches, definition of listening, types of listening, purposes of listening, obstacles for listening, contexts of listening, to be a good listener, listening to a lecture etc. Teaching learning activities: Listening to audio, video tapes and identify the key points. Assessment methods: Practical test of listening and filling out the blanks, essay type.

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Communicative English for General Nursing Students	Tom Koorkkakala	K.J. Publications
3	How to write and speak Better, Reader's	John Ellison Kahn	Reader's Digest Association
4	Communication and Soft Skill Development	Ashwini Deshpande	Career Publications

BMRIT Radiology Clinical Education - part I (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.





"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

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RELEALE NATIONAL CO.

"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

देखान्हेखा में

Subject: Basics of Microbiology

Subject Code: BMRIT - 011

RATIONALE

Basics of Microbiology helps students to gain information about structure, metabolism reproduction, function and diseases caused by bacteria, viruses, bacterial viruses, animal viruses, archaea, mycoplasma and Phytoplasma. It also makes students aware of the nature and other important aspects of the D HEALTHCARD microorganisms.

COURSE OUTCOMES

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

CO001: Describe the structure, classification, morphology and growth of bacteria

CO002: Describe the methods sterilization and disinfection and its applications

CO003: Explain the concepts of immunity, hypersensitivity and immunization

CO004: Describe Nosocomial infections and methods for prevention of Hospital acquired infections

CO005: Describe the management of biomedical waste

CO006: List the common fungi and viruses and explain their importance

Т	eaching Scheme	Total	Examination Scheme				
(In Hours)		Credits (L+T+P)	Theory Marks		Practical Marks		Total Marks
L	ТР	स्वर्श्व	CIE	ESE 2	CIE	ESE	Lis
2		2	70	30			100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours
	Morphology of Bacteria: (Structure, size, shape, arrangement cell wall, flagella,	
	spore, capsule, fimbria)	
I	Physiology of Bacteria: (Bacterial growth curve, Temp, O2, Co2, micro and macro nutrient growth requirements)	9
	Culture Media	

	Culture Methods	
	Antimicrobial sensitivity tests	
	Sterilization and Disinfections: Definition, Dry heat Sterilization, Moist heat Sterilization, Chemical disinfectants, Gaseous disinfection, Test for disinfection	
	/ Sterilization control	
	Infection: Classification, Sources of infection, Modes of transmission	
II	Nosocomial infection including biomedical waste management: Definition,	
	Classification, Significance, Prevention and control	8
	Biomedical waste management	
III	Immunology: Immunity, Antigen, Antibody, Hypersensitivity	5
	General Properties of fungi. (General characters, classification, Morphology,	
137	Reproduction)	
IV	General Properties of Viruses. (General character, classification based on Genome,	
	Capsid, Envelope & replication and cultivation of virus).	
	Applied Microbiology: Pyrexia of unknown origin, Meningitis, Zoonotic infections,	5
v	Hepatitis, HIV infection and AIDS, Food poisoning, Diarrhea, Urinary tract	7
	infections, Pulmonary Tuberculosis	S
		NO
Total	Ž – L	36

Evaluation System Continuous Internal Evaluation (CIE)

Evolue	tion System			
Contin	uous Internal Evaluation (CIE)			1
Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	राष्ट्र	नम /	5
	Two Written tests	50	1	5
	• Same pattern as Summative test	D		
	Average of two to be considered		80	
	• Absence without prior permission to be marked	1	10	
	as 0	×2		
	Total	50	0.3	15
2.	Continuous assessment	4		-
	Seminars/Case presentations/ Logbook/ Case			
	records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

Written Paper

Type of question	No. of questions	Marks per question	Total	
Essay Question (EQ)	3 (to answer 2)	10	20	
Short Essay Question (SEQ)	9 (to answer 7)	5	35	
Short Answer Question (SAQ)	7 (to answer 5)	3	15	
Total marks			70	
Duration (minutes)	150			
Question Paper Blueprint FOR ALLIED AND HEAD				

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Unit	Marks (± 5%)
Unit I	26
Unit II	20
	13
Unit IV	22
Unit V	15
	0
Total Marks (including optional questions)	96

SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Text book of Microbiology	Ananthnarayana&Panikar	University Press
2	Text book of Microbiology	Baveja	Arya Publications
3	Text book of Microbiology	Sathish Gupte	ЈРВ
4	Textbook of Microbiology	Dr Arora	CBS Publishers & Distributors Pvt. Ltd

SN
Subject: Basics of Biochemistry

Subject Code: BMRIT - 012

RATIONALE

Biochemistry is a key component of all education programmes for MRITs and should have a strong focus on laboratory investigation with radiological procedures. The topics provide the student with an understanding of the blood investigation and relationships of the systems which are essential in patient preparation and procedures. D HEALTHCA.

COURSE OUTCOMES

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

- **CO1:** Understand the responsibility of health care personals and hazards faced in the clinical laboratory
- **CO2:** Explain the different types, use, care and maintenance of laboratory apparatus and instruments.
- **CO3:** Understand the fundamental chemistry and knowledge of different solutions

н

CO4: Understand what acids, bases, salts and indicators are and also know about acid base balance

CO5: Describe the sample collection procedure to analyse various biochemical parameters

CO6: Describe assimilation of nutrients and consequences of malnutrition

CO7: Understand the different functional tests like LFT (Liver function test), RFT (Renal function test)

CO8: Understand the overview of tumor markers, cardiac markers, blood sugar and GTT, lipid profile and diagnostic enzymology

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tet

CO9: Describe the applications of radioisotopes

Тс			Total	Examination Scheme			
Teaching Scheme		Credits	Theory Marks		<i>S</i> (1	
(In Hours)		(L+T+P)			Practical Marks	Total Marks	
		1.		21	ICE-ZUZ	1 10	
т	Т	Р	C DY	CIE	FSF	CIE ESE	
			· Wi	1	LUL	A TC	
2			2	30	70	<u>qo</u> .	100
ĺ					11,09		

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

THEORY COMPONENTS

Unit	Topic and contents	Hours
	Nutrition	
I	Calorific value Nitrogen Balance Respiratory quotient BMR	9
	Nutritional importance of carbohydrate, lipids, proteins, vitamins and minerals	
	Emphasis on parenteral nutrition	
	Acid-Base Balance	
	Henderson Hassel Bach equation	i
	Buffers of the body fluids	S S
	Ph regulation	Б
	Disturbance in acid base balance	S
II	Anion gap	9
	Basic principles & estimation of blood gases and ph.	- /
	Water & Electrolyte balance	
	Over view of water and electrolyte balance	
	Basic principles in estimation of Electrolyte	
	Normal values and interpretation	
	Clinical chemistry	
	Brief over view of normal values and interpretation of results	
	Renal function tests	
	Liver function tests	
III	Tumor markers	9
	Cardiac markers	
	Diagnostic Enzymology	
	Lipid profile	

	Blood sugar and GTT Normal &Abnormal urine analysis	
IV	Radioisotopes: Definition, Application &Hazards Normal and abnormal urine analysis Clinical charts on LFT, RFT, and diagnostic enzymology	9
Total	COR ALLIEU AND HE	36

Evaluation System

Continuous Internal Evaluation (CIE)

Total	FOR ALLIES AN	UHE.		36
Evaluat Continu	tion System uous Internal Evaluation (CIE)	- AL	THCAP	
Sl. No.	Component	<u>Marks</u>	Weightage	IA marks
1.	Sessional test(s)			
	 Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0 	50		OFESSI
ŀ	Total	50	0.3	
2.	Continuous assessment			20
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks	<u> </u>		30
End Se	mester Evaluation (ESE)	मिष	नम् त	5

End Semester Evaluation (ESE)

Written Paper

Written Paper	ICAHP	de	5
Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	2 10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks			70
Duration (minutes)			150

Question Paper Blueprint

Unit		Marks (± 5%)
1.	Introduction to Clinical Biochemistry, Chemicals & Reagents, Preparation of solution, Specimen collection and handling	25
2.	Nutrition	20
3.	Acid–Base Balance; Water & Electrolyte balance	22
4.	Clinical chemistry; Brief over view of normal values and interpretation of results	14
5.	Radioisotopes: Definition, Application & Hazards	15
6.	- CIU	
	Total Marks (including op <mark>tional questions)</mark>	96
SUGGES	TED LEARNING RESOURCES	TD.

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication		
1	Text Book of biochemistry for dental students	Vasudevan, Sreekumari, Kannan Vaidyanathan	Jaypee Brothers		
2	Biochemistry for Physiotherapy and allied health sciences students.	Nandini M, Beena V Shetty, Vinitha Ramanath Rai	Jaypee Brothers Medical Publisher (India)		
3	Clinical chemistry	Varley	CBS Publishers & Distributors		
4	Textbook of biochemistry for paramedical students	P Ramamoorthy	Jaypee Brothers Medical Publishers		
Since-2021 में जिस्ता आदित के दिखान्स्टिंग के दिखान्स्टि					

Subject: Conventional Radiography and Equipment

Subject Code: BMRIT -013

RATIONALE

Conventional Radiography and Equipment provide the students' knowledge about the x-ray equipment working and also about how x-rays are produced.

COURSE OUTCOMES

At the end of the course students will be able to						
CO001: Describe the structure and working of x-ray tube, production of x-rays						
CO002: Describe the types of x-ray tube and heat dissipation methods						
CO003:Explain the x-ray generator circuits						
CO004: Describe the different circuit types						
CO005: Describe the meters and exposure timers						
CO006: List the control of scattered radiation						
CO007: Describes about the fluoroscopy						
CO008: Explains about the care and maintenance of x-ray equipment's						
Teaching Scheme Total Examination Scheme						
(In Hours)Credits (L+T+P)Theory MarksPractical MarksTotal Marks						
L T P C CIE ESE CIE ESE						
4 2 5 30 70 100						

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

THEORY COMPONENTS

Unit	Topic and contents	Hours
I	X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays-factors influencing them.	10
	Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, methods of cooling the anode, rating chart and cooling chart;	oRO
Π	 Rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum. Grid controlled and high speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation).Interlocking and X-ray tube overload protection. Heat dissipation methods, tube rating, heat units, operating conditions and maintenance and Q.A procedures. 	ESSIONS - Lyke
III	Filament current and voltage, X-ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-high frequency generators-falling load generators, Capacitors discharge and grid control systems. X-ray generator circuits: Vacuum tube diodes-semi-conductor diodes-transistor-Rectification-half and full wave-self rectification-X-ray generator; filament circuit-kilo Voltage circuit-single phase generator-three phase generator-constant potential generator-Fuses, switches and interlocks-Exposure switching and timers-HT cables-earthing.	10
IV	High tension circuits: H.T. generator for x-ray machines, three phase rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high and medium frequency circuits; capacitance filter control and stabilizing equipment;	10

	mains voltage compensator, mains resistance compensator, compensation for			
	frequency variation, control of tube voltage, kV compensator; high tension			
	selector switch, mament circuit, control of tube current, space charge			
	compensation.			
	diagnostic machines for over load protection circuit diagram: simplified circuit			
	and block diagrams illustrating accurate of events from mains supply to			
	and block diagrams indstrating sequence of events from mains supply to			
	controlled emission of x-rays.			
	Meters and exposure timers: Moving coil galvanometer: construction and			
	working/conversion to millimeter, ammeter and voltmeter, meters commonly			
	used in diagnostic x-ray machines, pre reading kV meter and millimeter, digital			
V	panel meters. Clockwork timers, synchronous motor timer, electronic timers,	10		
	photo metric timers (fluorescent and photoelectric effect as applied in timers), ion			
	chamber-based timers, integrated timer.			
	Control of control radiation, Been limiting devices, disphereme	0		
	Light beam collimator, beam contaring devices, matheds to verify beam contaring	P		
	and field alignment: Eilters, inherent filters, added filters, heavy metal filters, grids:	0		
	design and control of scattered radiation grid ratio grid cut off parallel grid	TI		
VI	focused orid crossed orid orided cassettes stationary and moving orid potter			
	bucky diaphragms various types of grid movements; single stroke movement	S		
	oscillatory movement and reciprocatory movement	ō		
		N		
	Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent	S		
	materials used in fluoroscopic screens, construction of fluoroscopic screen and			
	related accessories, tilting table, dark adaptation. Image intensifier - Construction			
	and working, advantages over fluoroscopic device, principles and methods of	R		
VII	visualising intensified image, basic principles of closed circuit television camera	8		
	and picture tube. Vidicon camera, CCD. Automatic brightness control, automatic			
	exposure control, chamber selection during fluoroscopy. Serial radiography:			
	Manual cassette changer, rapid automatic film changer, basic principles of cine			
	fluoroscopy and angiography use of grid controlled x-ray tube.			
	Care and Maintenance of X-ray equipment;			
	General care; functional tests; testing the performance of exposure timers,			
VIII	assessing the MA settings, testing the available KV, measurement of focal spot of	6		
V 111	an x-ray tube, testing the light beam diaphragm, practical precautions pertaining	U		
	to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as			
	well as accessory equipment.			
Total		72		

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	X-ray tube; Production of x-rays	5
2.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	4
3.	Filament current and voltage; X-ray generator circuits	5
4.	High tension circuits; Interlocking circuits; Relays	5
5.	Meters and exposure timers	5
6.	Control of scattered radiation: Beam limiting devices	4
7.	Fluoroscopy	pp ⁴
8.	Care and Maintenance of X-ray equipment	OF F
	Total	36
5		IS
		$\underline{\circ}$

Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	_		A
	 Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0 	साध- ⁵⁰	तम् हि	2/4
	Total	50	0.3	15
2.	Continuous assessment	TELEV		
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	q0.		
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

Written Paper

Type of question	No. of questions	Marks per question	Total			
Essay Question (EQ)	3 (to answer 2)	10	20			
Short Essay Question (SEQ)	9 (to answer 7)	5	35			
Short Answer Question (SAQ)	7 (to answer 5)	3	15			
Total marks			70			
Duration (minutes)			150			
Question Paper Blueprint FOR ALLIED AND HEAL						

Cint	TOPICS	Marks (± 5%)
1.	X-ray tube; Production of x-rays	16
2.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	15
3.	Filament current and voltage; X-ray generator circuits	10
4.	High tension circuits; Interlocking circuits; Relays	10
5. <	Meters and exposure timers	9
6.	Control of scatter <mark>ed radia</mark> tion: Beam limiting devices	16
7.	Fluoroscopy	210
8.	Care and Maintenanc <mark>e of X-ray equipment</mark>	_10
4	Total Marks (including optional questions)	96

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	D.N. Chesney & M.O Chesney	CBS Publishers & Distributors
2	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
3	Radiological Science for technologists	Stewart C Bushong	Mosby
4	Equipment for Diagnostic Radiography	E. Forster	Springer Dordrecht
5	The Physics Of Radiology And Imaging	K Thayalan	Jaypee

Subject: Clinical Radiography Positioning (Part I)

Subject Code: BMRIT - 014

RATIONALE

Clinical Radiography Positioning Part- 1 provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken.

COURSE OUTCOMES

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

CO1: Understand the basic patient positioning during radiographic investigation.

CO2: Apply special positioning skills for different pathological and physical conditions.

CO3: Application of equipments while working in radiology departments.

CO4: Choose proper position during radiography.

CO5: Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.

CO6: Explain the use of accessories.

CO7: Explain the anatomic and physiological basis of the procedure to be undertaken.

CO8: Explain the radiographic appearances of both normal and common abnormal conditions.

Teaching Scheme	Total	Examin	ation Scheme			Z
(In Hours)	Credits	Theory Marks		Practical Marks		Total Marks
	(L+T+P)					
LTP	С	CIE	ESE	CIE	ESE	E
4 1 6	8	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

THEORY COMPONENTS

Unit	Topic and contents	Hours
	Principles of Radiography:	
Ι	Preparation of the Room, Apparatus and Instruments Positions of the Patient: Erect, Sitting, Supine, Prone, Lateral, Oblique, Decubitus Etc. Relative position	8
	of X-Ray tube and patient, relevant exposure factors. Use of accessories such as	
	radiographic cones, grid and positioning aids. Anatomic and Physiological basis	

	of the procedure, Association with theory with practical work. Radiographic appearances, both normal and common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique. Modifications in technique for various disabilities and types of subject. Radiation protection, use of gonad shield, practical methods of reducing radiation dose to the patient.	
	Upper limb:	
II	Routine projections for the whole hand, fingers, wrist joint, forearm, elbow joint and humerus. Supplementary projections for Scaphoid, Carpal tunnel, Ball Catchers projections, Head of the Radius, Supracondylar fracture and Olecranon process	10
ш	Lower limb: Routine projections for the whole foot, toes, calcaneum, ankle joint, leg, knee- joint, patella and femurs. Supplementary projections for Talo-Calcaneal joint, Forced projections for torn ligaments, Flat Feet, Club Feet, Intercondylar projections for loose bodies in the knee, Axial projection for Patella.	10
IV	Shoulder Girdle and Thorax: Routine projections for the shoulder joint, Scapula, Acromio-Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs.	SSI01
N	Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.	S
v	Vertebral Column: Routine projections for Atlanto -Occipital joint, cervical spine, Cervico- thoracic Junction, thoracic Spine, lumbar Spine, Lumbo Sacral Region, Sacrum and Coccyx. Supplementary projections for the intervertebral foramina, posterior arch of Atlas, Flexion and Extension of Cervical Spine, Scoleosis and Kyphosis, Sacro Ileac Joint.	12
VI	Skull: Routine projections for cranium and facial bones; Supplementary projections for trauma, Towne's method, Sellaturcica, Optic foramina, Jugular foramina, Temporal bones, Mastoids, Petrous bone, Zygomatic arches, Orbits, Maxillae, Nasal bones, Mandible, Temporomandibular joints. Nasal Sinuses: Techniques for Frontal, Maxillary, Ethmoidal and Sphenoid Sinuses, erect and horizontal projections for fluid levels.	12
VII	Pelvic girdle and hip region: Routine projections for the whole pelvis, Sacro-Ileac joints, hip joint and Neck of Femur.	10

	Supplementary projections for the greater and lesser trochanters of Femur.	
	Frog leg projection, Ischeum, Symphysis Pubis, Ileum, Acetabulum and	
	Congenital Dislocation of Hip, Arthrodesis.	
	Skeletal survey: Skeletal survey for metabolic bone disease, metastases,	
	hormonal disorder, renal disorders.	
-		
Total		72

SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	NP	Hours
1.	Principles of Radiography	15
2.	Upper limb	17
3.	Lower limb	17 P
4.	Shoulder Girdle and Thorax	14
5.	Vertebral Column	15
6.	Skull	15
7.4	Pelvic girdle and hip region, Skeletal survey	15
	Total	108

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Evaluation System

Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		de	
	 Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0 	50 7 2 201-22	ET OF	
	Total	50	0.3	15
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

Written Paper

Type of question			No. of questions	Marks per question	Total	
Essay Question (E	Q)			3 (to answer 2)	10	20
Short Essay Quest	ion (SEQ)			9 (to answer 7)	5	35
Short Answer Que	estion (SAQ)		7 (to answer 5)	3	15
Total marks						70
Duration (minutes))					150
Distribution of ma	rks for ESF	practica	l <mark>exams:</mark>			Np.
0	ESE		CIE		Grand total	P
9	Practical	Viva		Sub Total		Ó
47	50	20	30	100	100	m
Question Paper E	Blueprint					OISS

End Semester Evaluation (ESE)

ESE		CIE		Grand total
Practic <mark>al</mark>	Viva		Sub Total	
50	20	30	100	100

Question Paper Blueprint

Unit	TOPICS	Marks (± 5%)
1.	Principles of Radiography	13
2.	Upper limb	15
3.	Lower limb स्वास्थ्यम् सवाथसाधनम् क्र	13
4.	Shoulder Girdle and Thorax	13
5.	Vertebral Column Since-2021	15
6.	Skull 37 January Light	13
7.	Pelvic girdle and hip region, Skeletal survey	14
	Total Marks (including optional questions)	96

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Atlas of Radiographic Positioning and Radiological Procedures	PhilipWBallinger,Eugene D.FrankImage: Constraint of the second	Mosby
2	Clarks Positioning In Radiography	Ra Swallow, E Naylor	Lippincott Williams and Wilkins
3	Merrill's Atlas of Radiographic Positioning and Procedures	Bruce W. Long &Jeannean Hall Rollins & Barbara J. Smith	Mosby
4	Bontrager's Textbook Of Radiographic Positioning And Related Anatomy	John Lampignano and Leslie E Kendrick	Elsevier Science
5	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	Garkal Gs	Jaypee Brothers Medical Publishers
6	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

BMRIT Radiology Clinical Education – part II (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.



"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

AND HEALTHCARE PROFESSIONS **Third Semester**

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Subject: Pathology

Subject Code: BMRIT -015

RATIONALE

Pathology helps students to learn about the advances in basic science and clinical pathology. And help students learn and classify the type of diseases, to help learn about the mechanism of action of various diseases and to gain knowledge on lab tests.

COURSE OUTCOMES

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

CO1: Define the term "Disease" or concepts of Diseases.

CO2: Define, classify diseases and the medical terms used.

AND HEALTHCA CO3: Describe the cause and mechanism of a few common diseases they come across during their routine work.

CO4: Common these diseased changes seen in persons different organs/tissues/bodyfluids.

CO5: Names of the common laboratory tests done to diagnose the diseases like examination of urine, blood, other body fluids and tissues.

CO6: Enumerate the proper methods of collection, preservation and delivery of the samples to the respective laboratories.

CO7: Describe the procedures of procuring the whole blood or blood components from blood bank and the complications of blood transfusion.

	Teaching	Total Credits		Examination Scheme	F
	Scheme	(L+T+P)	Theory Marks	Practical Marks	Total Marks
	(In Hours)				P
L	Τ	4 CI tec	CIE ESE	CIE ESE	5
2		2	30 70- D		100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

Unit	Topic and contents	Hours	Marks
I	 Introduction to Pathology, Cell membrane, Cytoplasm, contents and nucleus Various injuries – Cell changes – Reversible changes, fatty liver, hydropic changes and Irreversible changes Irreversible changes – Necrosis. Types with examples. Apoptosis Pigments – Classification. Bilirubin, melanin, pathological calcification Inflammation – Definition, classification, signs, vascular & cellular events in acute inflammation Repair and wound healing, fracture healing, complications, factors influencing healing Infectious diseases – Tuberculosis, leprosy, fungal diseases, malaria 	THEAPE	10
II NATION	 Oedema – Definition, classification, causes, pathogenesis. Pulmonary oedema, cardiac oedema, Renal oedema, Lymphedema Thrombosis – Definition, classification, pathogenesis, venous and arterial thrombosis, fate of thrombus Embolism – Definition, classification and clinical manifestations – Infarction, gangrene Cellular adaptations and Growth disorders: Atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia and neoplasia Neoplasia (Tumors) – Definition, nomenclature, differences between benign and malignant tumors metastasis Causes (carcinogens), clinical features and lab diagnosis of cancers Genetics – Genetic diseases, cause, Common cytogenic diseases – Klinefelter, Downs and Turners syndrome. Complete urine examination – physical, chemical, microscopy of sediment Liver function tests, Renal function tests Cytology, FNAC, Surgical pathology, biopsy, resected specimen preservation, fixation and filling of request forms 	FT S	ISIONS ISIONS

III	 Blood collection for investigations, anticoagulant. Sample collection, labeling, transportation to labs Common hematological tests – Peripheral blood smear, Haemoglobin, Packed cell volume, WBC count – variation of total and differential leukocyte count, Platelet count Bone marrow Aspiration and biopsy; Indications, procedure, contraindications and complications Anemias – Definition, classification, Iron deficiency anemia, causes, clinical features and lab diagnosis Megaloblastic anemia – cause, classification, diagnosis. Briefly hemolytic anemia Leukemia – Definition, classification, lab diagnosis of Acute Leukemias (AML & ALL) and Chronic Leukemias (CML & CLL) Bleeding disorders – Classification, Vascular, Platelet and coagulation factors contribution in clotting. Common Platelet disorders Common coagulation disorders (Hemophilia, DIC). BT, CT, Prothrombin time and APTT for diagnosis Blood grouping, cross matching, collection of blood from blood donors. Mandatory tests done in blood bank, blood components, complications Diseases of joints – Osteoarthritis and Rheumatoid arthritis – causes, aetiopathogenesis, pathology, complications Metabolic disease of bones – Osteoporosis, Osteomalacia, Rickets Cardiovascular diseases – Introduction, Atherosclerosis – definition, risk factors, sites/ organs, pathology manifestations Ischemic heart disease (IHD) – Types, Pathogenesis of Angina, Myocardial infarctions and its complications Rheumatic heart disease – etiology, pathogenesis and morphology of the heart Hypertension – definition, causes, complications 	THE AREA	15 DODEESSIONS 15
v	Respiratory diseases – Chronic obstructive pulmonary airway diseases – causes, pathology and complications of	7	15

each (asthma, chronic bronchitis, emphysema,		
Broncheictasis in brief).		
Pneumonia – classification, clinical features and		
morphology		
Pulmonary tuberculosis – classification/ types, primary,		
complex, miliary TB and cavitatory TB, complications		
Pleural effusion - definition, causes, clinical features and		
diagnosis		
Renal system; Glomerulonephritis, nephritic and nephrotic		
syndrome. Tubulointerstitial diseases, Renal failure – Acute		
and chronic CONTRACTOR		
Pyelonephritis – Types, causes, organ changes and	T_{I}	
complications.	NO	
Renal stones – Causes, pathogenesis, clinical features.	40	
Hydronephrosis – causes, clinical features and diagnosis	7	
		5
0.		P
Total	36	70
	·	T
SUGGESTED PRACTICALS/DEMONSTRATION		0,

SUGGESTED PRACTICALS/DEMONSTRATION

Sr.No	Hours
 Sr.No Fatty liver – Gross & Microscopy T.B. Lymphadenitis – Gross & Microscopy Acute Appendicitis – Gross & Microscopy Granulation tissue – Microscopy Mechanism of thrombosis, Sites & complications and clinical features (effects) Atrophy & Hypertrophy (Heart). Benign tumors - Squamous papilloma – Gross & Microscopy, Adenoma Colon Gross & Microscopy, Leiomyoma uterus – Gross & Microscopy, Adenocarcinoma colon – Gross & Microscopy; Malignant tumors - Squamous cell carcinoma – Gross & Microscopy, Osteosarcoma bone – Gross & Microscopy Metastasis – Lung, liver, lymph nodes (specimens) Blood collections – Containers, Anticoagulants Hb%, PCV, ESR, Peripheral smear and Bone marrow aspiration 	Hours
 Cytology – Body fluids, FNAC. Histopathology – Specimens, biopsies, fixatives. Request form writing. 	

Sr.No			Hours
	• Blood grouping, Transfusion complications, components.		
	• Anemias – Microcytic hypochromic, Megaloblastic (slides)		
	• Leukemia – AML & CML (Slides)		
	• Atherosclerosis, MI, Rheumatic valvular lesions		
	• Renal stones, hydronephrosis, chronic pyelonephritis (specimens)		
	• 18. Lung – Pneumonias, pulmonary tuberculosis cavitatory lung abscess (specimens).		
	Total	THA	6
Evaluation Continuou	n System us Internal Evaluation (CIE)	AP	r. Pl
SINO	Component	Weightage	IA marks

Evaluation System

Continuous Internal Evaluation (CIE)

Sl.No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			T
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50	<u>~</u>	ESSIO
<	Total	<i>50</i>	0.3	15
2.	Continuous assessment			0,
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			Et l
	Total	50	0.3	15
	Total CIE marks	48		30

End Semester Evaluation (ESE)

Written Paper

NCAHP Since-2021

Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks			70
Duration (minutes)			150

Question Paper Blueprint

Unit	Marks (± 5%)
Unit I	16
Unit II	20
Unit III	20
Unit IV	20
	20
OR ALLILD ANU HA	
Total Marks (including optional questions)	96
SUGGESTED LEARNING RESOURCES	Pr
No. Title of Book Author	Publication

SUGGESTED LEARNING RESOURCES

14.2 7.4. HE CORE 377.

S.No.	Title of Book	Author	Publication
1	Textbook of Pathology with Pathology	Harsh Mohan	Jaypee Brothers Medical Publishers (P) Ltd
2	Pathology Basis of Disease	Robbins and Cotran	Saunders Elsevier
3	Text book on Pathology for DMLT & Paramedical Courses	Dr. I Clement	Emmess medical publishers
4	Text book of Pathology & Microbiology for Paramedical Students	Aruna Singh	Notion Press

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

Subject: Clinical Radiography Positioning (Part- II)

Subject Code: BMRIT - 016

RATIONALE

, e of. , patient 1 on radiograph. .anagement of pa. ination. Clinical Radiography Positioning Part-2 provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken. To improve skills and knowledge on patient positioning for students' MRIT and to identify radiological pathologies and to gain knowledge on radiographic anatomy. They also gain knowledge of image quality in radiological images and management of patients in emergency situations.

COURSE OUTCOMES

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

CO1: Prepare management and positioning of patients

CO2: Correlate of indications, contraindications of the patient

CO3: Understand the patient preparations needed before any radiological examination.

CO4: Generalize knowledge of post procedural care.

CO5: Students will be able position the patients for radiological procedures.

CO6: Knowledge of image quality in radiological images.

CO7: Management of patients in radiology department for various procedures.

CO8: Ability to handle emergency situations in radiology department.

Teaching Scheme Total		Total	Examination Scheme		
(In Hours) Credits		Credits	Theory Marks Practical Marks Total Marks		
		E.	(L+T+P)		
L	Т	PK	С	CIE ESE CIE ESE	
2	1	6	6	30 70 -202 30 70 200	

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

THEORY COMPONENTS

Unit	Topic and contents	Hours	Marks
	Dental Radiography Technique for intra oral full mouth Occlusal projections Extra oral projections including orthopantomography		
I	Supplementary techniques. Upper respiratory system Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva maneuver Phonation.	5	10
пли	LungandMediastinum:Supplementaryprojections:Antero-posterior,obliques,lordotic, apical projection, use of penetrated postero-anteriorprojection Expiration technique Technique for pleural fluidlevels and adhesions.Abdominal viscera-Technique for plain film examination Projection for acuteabdomen patients Technique to demonstrate: Foreign bodies,Imperforate anus.	6	PROFESSIO
	RadiographyusingmobileX-rayequipment-Radiography in the ward:Radiography in the specialized unit, such as: Intensive care unit,Coronary care, Neonatal unit Radiography in the operatingtheatre.Mammography:Basic views, special views, wire localization.Localization of foreign bodies.Various techniques	5 FT	DNS 10
IV	Ward /mobile radiography – electrical supply, radiation protection, equipment and instructions to be followed for portable/ward radiography. Operation theatre techniques: General precautions, Asepsis in techniques - Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques. Trauma radiography/Emergency radiography	5	10
V	Neonatal and Pediatric Radiography, Forensic Radiography Microradiography: General principles, Requirement, Equipment, Technique.	5	10

	Soft Tissue Radiography:		
	High and low kilo voltage technique; differential filtration.		
	Non - screen technique - simultaneous screen and non -screen		
	technique.		
	Multiple radiography.		
	Uses of soft tissue radiography.		
VI	High kV Radiography:	5	10
	General principles MILED AND	5	10
	Relation to patient dose		
	Change in radiographic contrast.	7.	
	Scatter elimination; beam collimation; grid ratio.	HAN	
	Speed and type of grid movement.	C.	
/	Radiographic factor; application and uses.	12	
	N	<u></u>	
	Localization of foreign bodies:	1	5
	General location principles.		5
	Ingested; inhaled; inserted; embedded foreign bodies.		TI
	Foreign bodies in eye.	5	10
~~~<	Preparation of the area to be investigated.	5	010
0	Appropriate projection for all	<b>•</b>	03
	Techniques to locate non-opaque foreign body.		0
$\leq$			Z
Total		36	70

# SUGGESTED PRACTICALS/DEMONSTRATION

		F
Sr. No	क स्तारश्यम सत्विभाषानम	Hours
1.	Dental Radiography; Upper respiratory system	20
2.	Lungs and Mediastinum; Abdominal viscera	20
3.	Radiography in the ward; Mammography_2021	20
4.	Operation theatre techniques; C-arm	20
5.	Neonatal and Paediatric Radiography; Forensic Radiography	
	Microradiography	10
6.	Soft Tissue Radiography	
	Multiple radiography	
	High kV Radiography	
	Scatter elimination; beam collimation; grid ratio	10
	Speed and type of grid movement	
	Radiographic factor; application and uses	

Sr. No		Hours
7.	Localization of foreign bodies	8
	Total	108

# **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	·LA	7.	_
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior p <mark>ermission to be marked as 0</mark>	50	HCARK	
	Total	<u>50</u>	0.3	15
2.	Continuous assessment			3
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			FES
	Total	<u>50</u>	0.3	15
-	Total CIE marks			-30

# End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	3 (to answer 2)	10	<b>2</b> 0
Short Essay	8 (to answer 6)	5	30
Short Answer	12 (to answer 10)	3	30
T STATE	5 TEPTT	ELEC	80
Duration (minutes)	41704		150

# End Semester Evaluation (ESE)

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

Distribution of marks for ESE practical exams:

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

# **Question Paper Blueprint**

Unit	FOR ALLIED AND HEAD	Marks (± 5%)
1.	Dental Radiography; Upper respiratory system	14
2.	Lungs and Mediastinum; Abdominal viscera	14
3.	Radiography in the w <mark>ard; Mammography</mark>	14
4.	Operation theatre tech <mark>niques;</mark> C-arm	14
5.	Neonatal and Paediatric Radiography; Forensic Radiography; Macroradiography	14
	Soft Tissue Radiography	E
$\geq$	Multiple radiography	5
9	High kV Radiography	5
6	Scatter elimination; beam collimation; grid ratio	14
$\triangleleft$	Speed and type of g <mark>rid movement</mark>	2
4		S
	Radiographic factor; application and uses	
7.	Localization of foreign bodies	12
	Total Marks (including optional questions)	96

# suggested Learning Resources ALLD

S.No.	Title of Book	Author	Publication
1	Radiological positioning	Merils	Mosby
2	A guide to radiological R R-q	Clarks	CBS publishers and distributors pvt. Ltd
3	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	GarkalGs	Jaypee Brothers Medical Publishers
4	Bontrager's Textbook of Radiographic Positioning and Related Anatomy	John Lampignano), Leslie E. Kendrick	Mosby

S.No.	Title of Book	Author	Publication
5	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications



# Subject: Radiography and Image Processing Techniques

# Subject Code: BMRIT -017

# RATIONALE

Radiography and Image processing techniques provides construction and working of film, intensifying screen, cassette, dark room and automatic processor.

# **COURSE OUTCOMES**

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

At the end of the course students will be able to... **CO1:** Know basic physics of radiography processing system **CO2:** Describe construction and working of film, intensifying screen, cassette, dark room and automatic processor

CO3: Explain radiographic film Processing chemistry

**CO4:** Discuss the factors affecting image quality in radiographic image and their application

**CO5:** Operate the workflow in x-ray imaging

**CO6:** Apply knowledge for the use of radiation factors

**CO7:** Demonstrate process the radiographic film in different systems

**CO8:** Prepare care and maintenance of radiographic films, cassettes, intensifying screens, darkroom accessories and X-ray equipment

Total			Total		E	xamination S	Scheme	
Teaching Scheme (In Hours)		Credits (L+T+P)	Theory Ma	urks	Practical	l Marks	Total Marks	
L	T	Р	qicec	CIE	ESE	CIE	ESE	5
2		2	3	<b>30</b>	-70 🗩		75	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

# THEORY COMPONENTS

Unit	Topic and contents	Hours	Marks
I CO.	<ul> <li>Photographic Principles:</li> <li>Radiographic film- construction and types; Photographic effect and latent image formation; Film density and log relative exposure; Characteristic curve – its formation and features; Spectral response; Film faults and Artifacts</li> <li>Intensifying Screens: Luminescence-fluorescence and phosphorescence; Construction and types of Intensifying Screens; Intensification Factor, quantum detection and conversion efficiency; Film screen matching; Resolving power of Intensifying Screens; Speed of intensifying screen; Screen film contact tests; Advantages and limitations of Intensifying Screens</li> <li>X-ray Cassette: Construction of X-ray cassettes; Types of cassettes; Mounting Intensifying Screens on cassettes; Care and maintenance of cassettes</li> </ul>	THE 9	20
I NATIO	Dark Room – Planning & Construction: Planning for a small & large Hospital; Location of Dark Room; Construction of Dark Room; Ventilation; Wall Protection; Entrance to Dark Room - Single Door, Double Door, Labyrinth Dark Room Accessories: Dry bench; Hopper, Drawer, Cupboard; Loading and unloading cassettes; Hangers, types of hangers and storage of hangers; Wet bench; Cleanliness, control of dust, dark room sinks; Hatches; Drier; Safe Lights-types and uses, factors affecting safelight performance, safelight Tests; Viewing room, Film dispensing	न मि क	SIONS 15
III	<ul> <li>Film Processing: Photochemistry;</li> <li>Developer; Rinsing; Fixer; Washing and drying;</li> <li>Preparation of processing solutions; Manual processing apparatus; Effect of temperature in processing; Rapid processing</li> <li>Automatic processor: Principle of working and features, thermal regulation and replenishment system; Care and maintenance of automatic processor; Advantages and limitations of automatic processor</li> </ul>	7	15

IV	Day Light Film handling; Xeroradiography, Stereoscopy	5	5
v	The Radiographic Image: The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness Resolution: Factors affecting resolution, choice of Kilovolt age and Mill amperage, Choice of Short Focus and Broad Focus, selection of Focus to Film Distance and Object to Film Distance selection of cassettes, Avoiding scatter radiation, magnification, distortion, penumbra	5 7 H C	5
	Magnification and Minification Radiography Radiography	Pr	$\mathbf{i}$
ŝ	Imaging Communication: Hospital Information System, Radiology Information System, PACS, DICOM	X	P
Total Z		36	70

# SUGGESTED PRACTICALS/DEMONSTRATION

1.Radiographic film; IntensifyingScreens; X-ray Cassette202.Dark Room – Planning & Construction63.Film Processing; Photochemistry;53.The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs54.Total36	Sr. No		Hours
2.       Dark Room – Planning & Construction       6         3.       Film Processing; Photochemistry;       5         4.       The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs       5         7.       Total       36	1.2	Radiographic film; IntensifyingScreens; X-ray Cassette	20
3.Film Processing; Photochemistry;54.The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs5Total36	2.	Dark Room – Planning & Construction	6
4.       The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs       5         Total       36	3.	Film Processing; Photochemistry;	5
4.       Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs       5         Total       36		The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast-	SIL
Total Since-2021 36	4.	Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs	5
9 24		Total Since-2021	36
ALT THE TOP TOP		8 BY THE FEELS	

# **Evaluation System**

# **Continuous Internal Evaluation (CIE)**

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	_	_	-
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment	HEN		
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	1	THCAD	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30
E. 1 C.	Endland (ESE)			

End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questions	Marks per question	Total
Long Essay	3 (to answer 2)	10	20
Short Essay	8 (to answer 6)	5	305
Short A <mark>ns</mark> wer	12 (to answer 10)	3	30
Y			80
Duration	n (minutes)	TTOTAL	2150
TX ryred	7 7997		

# **Question Paper Blueprint**

N

Unit	Since-2021	Marks (± 5%)
1.	Radiographic film; IntensifyingScreens; X-ray Cassette	25
2.	Dark Room – Planning & Construction	20
3.	Film Processing; Photochemistry;	20
4.	Day Light Film handling; Xeroradiography, Stereoscopy	10
5.	The emergent beam related to densities on film contrast – objective and subjective Radiation contrast, film contrast and Radiographic contrast- Density, Sharpness, Unsharpness; Factors affecting resolution; Reproduction of Radiographs	21
	Total Marks (including optional questions)	96

# SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	D.N. Chesney & M.O Chesney	Blackwell Scientific
2	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry & Dowdey	Lea & Febiger
3	Radiological Science for technologists	Stewart C. Bushong	Mosby
4	A Concise Guide on Basic Radiographic Physics Darkroom Procedures, Radiographic Positioning & Techniques	Lalit Agarwal	JBD Publications



# Subject: Contrast and Special Radiological Procedures

#### Subject Code: BMRIT - 018

# RATIONALE

Contrast & Special Radiological Procedures are diagnostic procedures usually performed by giving contrast through oral or intravenous to diagnose the disease. These imaging procedures are done under the guided of fluoroscopy or c-ram equipment.

# **COURSE OUTCOMES**

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

D AND HEAL , **CO1:** Prepare management and positioning of patients while performing radiological procedures.

**CO2:** Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and

radiation safety measures for different radiological procedures.

**CO3:** Understand the patient preparations needed before any radiological examination.

**CO4:** Generalize knowledge of post procedural care.

**CO5:** Students will be able position the patients for radiological procedures.

**CO6**: Knowledge of image quality in radiological images.

**CO7**: Management of patients in radiology department for various procedures.

**CO8:** Ability to handle emergency situations in radiology department.

CO9: Precautions and care required in interventional suits.

Teaching Scheme Total Credits				गम्	सवाथः	xamination	Scheme	5
(In Hours)		urs)	(L+T+P)	The	eory Marks	Practica	ıl Marks	Total Marks
L	T	Р	С	CIE	ESE 21	CIE	ESE	
2	1	6	86	30	70	30	<b>70</b>	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

PROFESSIONS (

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# THEORY COMPONENTS

Unit To	pic and contents	Hours	Marks
Introduction: General procedures, Responsibili radiological procedures, procedures, Room lay fluoroscopy. Contrast Media: Positiv Adverse Reactions to con Emergency Equipment in	approach to Special Radiographic ty of Radiology Technologist during Preparation of patient for different out in interventional radiology and e and Negative, Ionic & Non Ionic, trast media and patient management.	8	10
Gastro Intestinal Tract: B Double Contrast; Bariur Enema (Enteroclysis); B Loopogram Biliary Tract: Oral & Intra Transhepatic Cholengiog Drainage; Endoscopic Re	arium Swallow; Barium Meal - Single and n Meal Follow Through; Small Bowel arium Enema - Gastrograffin Enema; avenous Cholecystography; Percutaneous raphy; Percutaneous Transhepatic Biliary trograde Cholengiopancreatography	10	20 ESS
III Urinary System: IVU Pyeloureterography (RG Ascending Urethrography Reproductive System: F Tube Recanalization)	(Intravenous Urography), Retrograde U), Micturating Cysto Urethrography, Y IysteroSalpingogram, FTR (Fallopian	8	
IV       Central Nervous System         Puncture and Lateral Co       Myelography with water s         IV       Respiratory System: Bron         Other procedures in       Lymphography, Sinograp         Embolization & embolic       Embolization	n: Cervical Myelography - Cisternal ervical Puncture, Lumbar Myelography, oluble and oily contrast media chography, Percutaneous Lung Biopsy radiology: Arthrography, Sialography, hy & Fistulography, Dacryocystography, agents	F. 10	20
	Total	36	70

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures Contrast media and their adverse reactions to contrast media and patient management	25
2.	Procedures for gastrointestinal tract including barium studies Procedures for biliary tract	LTHC 29
3.	Procedures for urinary system and reproductive system	29
4.	Procedures for central nervous system and respiratory system	25
N	Total	108
Evaluation Continuou	s Internal Evaluation (CIE)	NOIS

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0		नाम 🍐	Lefter.
	Total	50	0.3	15
2.	Continuous assessment	)	A	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	1	ET AL	
	Total	50	0.3	15
	Total CIE marks	4		30

End Semester Evaluation (ESE)
### Written Paper

Long Essay Short Essay			3 (to answer 2)	10	20
Short Essay					
			8 (to answer 6)	5	30
Short Answer			12 (to answer 10)	3	30
			IED AND		80
Duration (minutes)	, FO	RAL		HEAL	150
Distribution of marks	for ESE pract	ical exams:	KS III IIIC SUDJECI.		E PRO
	ESE	CIE		Grand total	TE
Z P	ractical Viva		Sub Total		S

### End Semester Evaluation (ESE)

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

### **Question Paper Blueprint**

Unit		Marks (± 5%)
1.	General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures Contrast media and their adverse reactions to contrast media and patient management	15
2.	Procedures for gastrointestinal tract including barium studies Procedures for biliary tract	27
3.	Procedures for urinary system and reproductive system	27
4.	Procedures for central nervous system and respiratory system	27
	Total Marks (including optional questions)	96

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### SUGGESTED LEARNING RESOURCES

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

### BMRIT Radiology Clinical Education - Part III (studentship)

9 EF 37

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

### Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

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# HEALTHCARE PROFESSIONS Fourth Semester

For For ME STER 31 देखान्रेखा र्खे

### Subject: Cross Sectional Anatomy

### Subject Code: BMRIT - 019

### RATIONALE

Cross sectional anatomy provides the students with Skills that are important to help the technologist in MRI and CT to identify the anatomy being imaged and to communicate effectively with the radiologist and physicians.

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### **COURSE OUTCOMES**

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

CO1: Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR images.

**CO2:** Describe anatomical structural relationships.

**CO3:** Recognize normal anatomy and build a personal resource system for future study.

RALI

CO4: Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy.

**CO5:** On CT and MR images, identify anatomical structures of the body and of the head.

**CO6:** Distinguish between arterial and venous anatomy of the entire body's vascular system.

CO7: Classify the various sections of anatomical regions and their associated parts.

F			T	1				
Teachin	ıg Schen	ne	Total	Examin	ation Scheme			F
In Hou	irs)		Credits	Theory	Marks	Practical N	Aarks	Total Marks
	42	7-0	(L+T+P)	मर	वर्धिर	नाः	म	E
L	T	Р	С	CIE	ESE	CIE	ESE	p.
2		6	5	NO	АПГ	30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels.	12	

	Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus		
II	CT/MRI Images of the Thorax - Normal and abnormal imaging Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels CT/MR Images of Abdomen – Normal and pathologic anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems Reproductive Organs - Normal and abnormal imaging	12	
ATIONAL CO.	CT/MR Images of the Male/Female Pelvis- Normal and pathologic Neuro Anatomy-Scan planes Brain – Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves Spine- Vertebra and disc, Spinal cord and meninges Neck-Arterial/venous systems, Muscles, Glands and pharynx	12	ROFESSION
Z			S
Total 🖂		36	E

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	NCAHP	Hours
1.	Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology Anatomy of the upper thorax-Surface anatomy relationships, Bony structures and muscles, Blood vessels. Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus	36
2.	CT/MRI Images of the Thorax - Normal and abnormal imaging Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels CT/MR Images of Abdomen –	36

	Normal and pathologic anatomy of the Pelvis- Bony structures and	
	associated muscles, Digestive and urinary systems	
	Reproductive Organs - Normal and abnormal imaging	
3.	CT/MR Images of the Male/Female Pelvis- Normal and	
	pathologic	
	Neuro Anatomy-Scan planes	
	Brain –Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves	36
	Spine- Vertebra and disc, Spinal cord and meninges	
	Neck-Arterial/venous systems, Muscles, Glands and pharynx	
	Total	108
	Z.	0

**Evaluation System** 

### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		2	5
	Two practical tests	50		0
<	Same pattern as Summ <mark>ative t</mark> est			2
	Average of two to be considered			S
	Absence without prior permission to be marked as 0			
	Total	50	0.3	15
2.	Continuous assessment			F
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	साध	तम 🏾	ku
	Total	50	0.3	15
	Total CIE marks		Xc	30
	End Semester Evaluation (ESE) CO-202	1	1 2	
No theo	ory paper for this subject.	देखान्रेर	91	

### End Semester Evaluation (ESE)

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

Distribution of marks for ESE practical exams:

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

### SUGGESTED LEARNING RESOURCES

ATTAC THE AREA 34

S. No.	Title of Book	Author HEALT	Publication
1	Cross Sectional Anatomy CT & MR	G Bhavin Jhankaria	Jaypee Brothers Medical Publishers;
2	Step by step Cross-sectional Anatomy	D Karthikeyan	Jaypee brother medical publishers
3	Atlas of Cross Sectional Anatomy and Radiological Imaging	Dr David J. Jackowe	Anshan Ltd
4	Fundamentals of Sectional Anatomy: An Imaging Approach	Denise L. Lazo	Cengage Learning

"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

न देखान्हर्ग्धा मु

### Subject: Modern Radiological Imaging Equipment and Physics

### Subject Code: BMRIT - 020

### RATIONALE

Modern radiological Imaging Equipment and Physics provides the students knowledge about the modern x-ray equipment and working principle. Modern imaging techniques - including X-rays, , rea in an c ou get clean ultrasound, CT scans and MRI - can show structures inside your body in great detail. Radiologic Physics is the study of medical imaging components, technology, and parameters in an effort to produce optimal imaging results. The goal with studying radiologic physics is to ensure you get clear images while ensuring the patient is safe from radiation.

### **COURSE OUTCOMES**

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

**CO001:** Describe the special radiological equipments **CO002:** Describe the digital and computed radiography

CO003: Describe PACS, RIS and HIS

								-
Teachir	ng Schen	ne	Total	Examin	ation Scheme			0
(In Hours)		Credits	Theory	Marks	Practical I	Marks	Total	
Z	2		(L+T+P)					Marks
	-	·						
T	T	P	C	CIE	DOD	ESE	CIE	
					ESE			
2	1	2	3	30	70			100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum. Since-201-200

31/2

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stitch radiography, Dual energy x-ray absorptionometry (DEXA) scan.	9	20
п	Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.	THOMPS	20
шS	Modern dental equipments. Cone beam dental CT.	9	20
IV	Picture archiving and communication system (PACS), RIS and HIS.	9	10
VO		•	S
T/	Total	36	70

### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionometry (DEXA) scan. Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.	9
3.	Modern dental equipments. Cone beam dental CT.	9
4.	Picture archiving and communication system (PACS), RIS and HIS.	9
	Total	36

### **Evaluation System**

### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment	NAHU		-
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	-47	THICA	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30

### End Semester Evaluation (ESE)

### Written Paper

Type of question	No. of questions	Marks per qu <mark>estion</mark>	Total S
Essay Question (EQ)	3 (to answer 2)	10	20 5
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15 <b>()</b>
Total marks			70
Duration (minutes)			150

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### **Question Paper Blueprint**

Unit		Marks (± 5%)
1.	Modern x-ray tube. Digital Mammography and Tomosynthesis, Stich radiography, Dual energy x-ray absorptionometry (DEXA) scan.	25
2.	Computed radiography: its principle, physics & equipment. Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units.	25
3.	Modern dental equipments. Cone beam dental CT.	25
4.	Picture archiving and communication system (PACS), RIS and HIS.	21
	Total Marks (including optional questions)	96

### SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Textbook of Radiology: Physics	Amol Sasane, Hariqbal Singh , Roshan Lodha	Jaypee Brothers Medical Publishers
2	The Physics Of Radiology And Imaging	THAYALAN K	Jaypee Brothers Medical Publishers
3	Christensen's Physics of Diagnostic	Thomas S. Curry, James E.	Lea &
	Radiology	Dowdey, Robert E. Murry	Febiger,U.S
4	Textbook Of Radiology For Residents And Technicians	BHARGAVA S. K (Author	CBS; publishers
5	Concise Text Book on Imaging	Lalit Agarwal,	JBD Publications
	Modalities & Recent Advances In Diagnostic Radiology	Dr. K.B. Gehlot	PR

गणमा स्वास्थ्यम् सर्वार्थसाधनम् NCAHP Since-2021 संस्था स्वास्थ्य देखान्स्टा

VESSIONS -

### Subject: Interventional Radiology Techniques

### Subject Code: BMRIT -021

### RATIONALE

Interventional radiology (IR) helps student MRIT to gain about the basics diagnostics and interventional procedures and to learn procedures in modalities like digital radiography CT and MRI and nuclear medicine and to increase the level of understandings and knowledge required to meet current radiologic procedures and to understand the physical principles of radiography and basic radiography positioning to perform the procedures. it a medical specialty that performs various minimally-invasive procedures using medical imaging guidance, such as x-ray fluoroscopy, computed tomography, magnetic resonance imaging, or ultrasound. IR performs both diagnostic and therapeutic procedures through very small incisions or body orifices

### **COURSE OUTCOMES**

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

CO1: Know the basic principle and physics of interventional equipment.

CO2: Know the management and positioning of patients while performing interventional radiological procedure.

**CO3:** Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.

CO4: Understand the patient preparation needed before any interventional radiological procedures.

**CO5**: Have knowledge about the post procedural care and safety.

Teachin	g Schen	ne	Total	Examination Sche	me		4
(In Hou	ırs)	रन्व	Credits (L+T+P)	Theory Marks	Practical	Marks	Total Marks
L	Т	P	С	CIE	CIE	ESE	
2	1	4 6	4	Since 70/2021	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
	Introduction to interventional procedures		
	DSA: basic principles and types		
I	<b>Equipment:</b> Basics of angiographic equipment, single and biplane angiographic equipments, angiographic table, image intensifier, flat panel detectors, recording systems, pulse oximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography	6 THCARS	15
/	Interventional procedures: Catheter- classification, types and	· T	2
п	applications, Guide Wire-Classification, types and applications, Pressure Injector and Accessories, Percutaneous catheterization, Digital Subtraction Angiography, Catheterization Sites, Asepsis	9	20
TI TITI	Arteriography: Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography Venography: Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography	9	20
IV	Safety considerations in angiography room; room design, protective devices, radiation monitoring		10
v	Care and maintenance tests: General care, functional test Quality assurance program: Acceptable limits of variation, corrective action	6	05
	जार स्वास्थ्य देखा		
Total	·	36	70

### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Basics of angiographic equipments	18
2.	Catheter and guide wires	4.0
		18
3.	Arteriography and venography procedures	
	NEUNI	18
4.	Safety considerations in angiography room	HO
	153.	18
	Total	72

**Evaluation System** 

### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			ō
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		<ul> <li>SNG</li> </ul>
	Total	50	0.3	15
2.	Continuous assessment		<u>.</u>	4
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	रसाधन	नम्	214
	Total NCAH	50	0.3	15
	Total CIE marks	à		30

## Written Paper

End Semester Evaluation (ESE Written Paper	202-2021	ETREE	
Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks			70
Duration (minutes)			150

End Semester Evaluation (ESE)

OFE

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

Distribution of marks for ESE practical exams:

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

### **Question Paper Blueprint**

Question ]	Paper Blueprint COR ALLIED AND HEA	
Unit		Marks (± 5%)
1.	Basics of angiographic equipments	13
2.	Catheter and guide wires	20
3.	Arteriography and venography procedures	20
4.	Safety considerations in angiography room	610
5. 7	Care and maintenance tests and quality assurance program	20
NO	Total Marks (including optional questions)	96 S

### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	The practice of interventional radiology	Karim valji	RL
2	Interventional radiology: a survival guide	EBIR Kessel, David, Robertson, Iain	Elsevier Health Sciences
3	Handbook of Interventional Radiologic Procedures	Krishna kandarpa, lindsay machan, janettedurham	Lippincott Williams and Wilkins
4	Interventional Radiology: A Survival Guide	David Kessel , Iain Robertson	sevier Health Sciences
5	A Guide on Special Radiographic Investigations & Techniques	Lalit Agarwal	JBD Publications

### Subject: Patient Care in radiology

Subject Code: BMRIT - 022

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### RATIONALE

Patient management is based on team work, it is essential that the student should appreciate the technologist's role and that the importance of co-operation with wards and other departments. The students should be attached to wards or the accident and emergency department for a definite training period.

### **COURSE OUTCOMES**

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

**CO1**: Understand the responsibility of the imaging technologist and other health care facility.

**CO2**: Understand the management and care of patient during different procedures and emergency situations.

**CO3**:Know about different patient transfer techniques and to restrain the uncooperative patients during radiological examination

**CO4**: Differentiate the types of consent forms

CO5: Know about infection control, infection source and isolation techniques

**CO6:** Describe sterilization techniques

**CO7**: Understand the radiation safety and protection

, r	Teaching So	heme	Total		Examination Scheme			
	(In Hou	rs)	Credits	Theory	Marks	Practical N	Marks	Total Marks
	$\leq$		(L+T+P)					Z
L	T	Р	С	CIE	ESE	CIE	ESE	S
1	1	4	4	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum. 11 

### **THEORY COMPONENTS**

Since-2021 The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	<ul> <li>Introduction to Patient Care: Responsibilities of Medical Imaging Technologist, Obtaining Consents and history for different radiological examinations, Patient transfer and Restraining techniques, Obtaining vital signs, Ergonomics and body mechanism</li> <li>Communication: Patient education, Communication with the patient, Professional role and behavior</li> </ul>	2	10

II	<ul> <li>Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.</li> <li>Care of the patient : FIRST contact with patients in the department; management of chair and stretcher patients and aids</li> </ul>	2	10
III	for this, management of the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients.	3	10
IN 1001	Nursing procedures in Radiology: Injection- methods and their routes of administration, Clothing of patient, Administering rectal enema. First aid: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons.	3	10 DEESSIO
v	Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc. <b>Principles of asepsis:</b> Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study by radio imaging students only)	3 12/20	
VI	<ul> <li>Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control</li> <li>Departmental procedures: Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department; appointments; organisations; minimizing waiting time; out-patient and follow-up clinics; stock taking and stock keeping.</li> </ul>	2	10

	Drugs in the department and Storage: classification; labelling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-		
VII	hypertensive etc. crash cart. <b>Medical ethics and records:</b> Medico legal implication of MLC cases, Importance of consent, Consent in detail, Precaution while dealing with female patient, Medical records	3	10
Total	D NI LIED AND U	18	70
Iotal	OR ALLIES ANU HE	18	70

## SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	153°	Hours
1.	Introduction to Patient Car and Communication	10
2. TVNO	Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out- patient and follow-up clinics; stock-taking and stock keeping.	ROFESS
3.	Care of the patient	10 9
4.2	Nursing procedures in Radiology and first aid	11 5
5.	Infection and Principles of asepsis	10
6.	Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.	10
6. 7.	<ul><li>Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control.</li><li>Drugs in the department and Storage and medical ethics and records</li></ul>	10
6.	Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control. Drugs in the department and Storage and medical ethics and records Total	10 10 72
6.	Patient care in following investigations: GIT, Respiratory system, Cardiovascular system, CNS; Sterilization; Infection control. Drugs in the department and Storage and medical ethics and records Total	10 10 72

### Evaluation System Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Written tests	50		
	<ul> <li>Same pattern as Summative test</li> </ul>			
	• Average of two to be considered			
	• Absence without prior permission to be marked			
	as 0			
	Total RALLILD AN	50 11	0.3	15
2.	Continuous assessment	"LA	1	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment		HC	
			Yp,	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

### Written Paper

Type of question	No. of questions Mark ques	tion per Total
Essay Question (EQ)	3 (to answer 2) 10	20
Short Essay Question (SEQ)	9 (to answer 7) 5	35
Short Answer Question (SAQ)	7 (to answer 5) 3	15
To <mark>t</mark> al marks		70
Duration (minutes)		150

### End Semester Evaluation (ESE)

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

Distribution of marks for ESE practical exams:

7		0.11		
ESE 💜	324	CIE		Grand total
Practical	Viva	i fo	Sub Total	5
50	20	30	100	100

### **Question Paper Blueprint**

Unit		Marks (± 5%)
1.	Introduction to Patient Car and Communication	10
2.	Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologist to patients and other members of the staff; medico- legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.	14
3.	Care of the patient	10
4.	Nursing procedures in Radiology and first aid	14
5.	Infection and Principles of as <mark>epsis</mark>	14
6.	Patient care in following inve <mark>stigations: GIT, Resp</mark> iratory system, Cardiovascular system, CNS; Steriliza <mark>tion; Infe</mark> ction control.	20
7.	Drugs in the departme <mark>nt an</mark> d Storage and medical ethics and records	14
	Total Marks (incl <mark>uding op</mark> tional questions)	96

# SUGGESTED LEARNING RESOURCES

	SUGGESTED LEARNING RESOURCES						
S.No.	Title of Book	Author	Publication				
	Patient care in radiography	Ruth Ann Ehrlich, Dawn M Coakes	Mosby OS				
2	Concise Textbook on Hospital Management & Patient Care in Diagnostic Radiology	N.K.Kardam,, <u>Lalit</u> <u>Agarwal</u>	JBD Publications				
3	Patient care in radiography: with an introduction to medical imaging	Ruth Ann Ehrlich and Joan A. daly	St. Louis, Mo. : Mosby Elsevier				
4	Introduction To Radiologic And Imaging Sciences And Patient Care	Adler A M	<u>Elsevier</u>				
5	Concise Text Book on Hospital Management & Patient Care In Diagnostic Radiology	Lalit Agarwal , Dr. N.K. Kardam	JBD Publications				

### BMRIT Radiology Clinical Education - part IV (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

### Studentship or observership must include:

E 9 4 31

NATIONA STACK

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# AND HEALTHCARE PROFESSIONS Fifth Fifth Faresa For any Fifth Semester

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### Subject: Basics Techniques in CT Technology

### Subject Code: BMRIT - 023

### RATIONALE

. cT protocols Basics techniques in CT Technology provide the students with knowledge of the basic physics of CT. It creates relationship between scan and patient with various CT protocols for better representation of images.

### **COURSE OUTCOMES**

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

**CO1:** Define basic principle and physics of Computed Tomography scan

**CO2:** Recognize protocols needed for Computed Tomography examination

**CO3:** Prepare and positioning for Computed Tomography examination

**CO4:** Interpret post processing of raw Computed Tomography images

**CO5:** Prepare and position the patients for Computed Tomography examination

**CO6:** Categorize knowledge of improving image quality in Computed Tomography images

**CO7:** Plan of scanning with various Computed Tomography protocols for better representation of images

CO8: Systematize post processing for Computed Tomography scan

CO9: Management of patient for any post contrast reactions

1				Sin	<u> </u>		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
Teaching Scheme Tota		Total	Examina	ation Scheme	XJ	0		
(In Hours)		Credits	Theory Marks Practical Marks		Total Marks			
		(L+T+P)	r t-d	ITEST O				
L	Т	Р	C	CIE	ESE	CIE	ESE	
4	1	8	9	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	15/CAD	20
п	Dataacquisition,Imagepre-processing/reconstruction techniques,Algorithms for image reconstruction, Image display, Imagepost-processing techniques, CT artifacts, Image quality	14	10
ATION,	<b>CT Protocols for different body parts &amp; Dental scan,</b> CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	14	SSIONS
IV	Multi-detector CT Isotropic imaging, Cardiac CT, Flash CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CT- fluoroscopy	15	15
v	Safety consideration, Hole of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	म् <u>क्र</u>	10
Total	Ker 22	72	70

### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	30
2.	Image post-processing techniques, CT artifacts	20

Sr. No		Hours
3.	CT Protocols for different body parts & Dental scan,	
	CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	54
4.	Multi-detector CT	20
5.	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	20
	Total	144
	M	

### **Evaluation System**

### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			ŝ
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		SNO
	Total	50	0.3	15
2.	Continuous assessment			4
	Seminars/Case presentations/ Logbook/ Cas records/Record book/assignment		नम	141
	Total	50	0.3	15
	Total CIE marks		dD	30
Writter	End Semester Evaluation (ESE) n Paper	1	el de	

### Written Paper

winten Tuper		120.	
Type of question	No. of questions	Marks per question	Total
Long Essay	3 (to answer 2)	10	20
Short Essay	8 (to answer 6)	5	30
Short Answer	12 (to answer 10)	3	30
			80
Duration (minutes)			150

### End Semester Evaluation (ESE)

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

Distribution of marks for ESE practical exams:

42 7411-. Hoder 37/2

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100
Blueprint	FOR	ALL	IEU AND	HEALT

### Question Paper Blueprint

Unit	15510 CAS	Marks (1 5%)
1.	Introduction and hi <mark>story, CT principle, CT generations, CT</mark> Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology	20
2.	Image post-processing techniques, CT artifacts	Q 19
3. <b>VOI</b>	CT Protocols for different body parts & Dental scan, CT Protocols for Angiography & Perfusion, CT contrast media and administration, CT guided interventional procedures	ESIS IO
4. Y	Multi-detector CT	
5.	Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT	19
P	Total Marks (including optional questions)	96

म् सर्वार्थसाधनम् NCAHP Since-2021 स्वाज्य देखान्रखे



### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders
2	Computed Tomography for Technologists: A Comprehensive Text Computed Tomography: Physics and Technology. A Self Assessment Guide	Lois Romans Euclid_Seeram	Lippincott Williams and Wilkins; Wiley-Blackwell
4	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	<u>Timothy P.</u> <u>Szczykutowicz</u>	Medical Physics Publishing Corporation
5	CT PROTOCOLS	Manjot Ka <mark>ur,</mark> Maajid Mohi Ud Din Malik	JBD Publications

स्वास्थ्यम् सर्वार्थसाधनम् NCAHP Since-2021 अरेर स्वास्थ्य देखान्रेखा

### Subject: Radiation Safety in Diagnostic Radiology

### Subject Code: BMRIT - 024

### RATIONALE

Radiation protection aims to reduce unnecessary radiation exposure with a goal to minimize the harmful effects of ionizing radiation. In the medical field, ionizing radiation has become an inescapable tool used for the diagnosis and treatment of a variety of medical conditions .to study radiation physics relevant to radiation protection to gain information on radiation types and does receive to study the molecular and cellular effects of radiations and to know the radiation quantities units dose limits and regulatory bodies to know about equipment design for radiation protection and to implement patient and personnel THCAPES radiation protection practices for radiological procedures

### **COURSE OUTCOMES**

At the end of the course, students will be able to learn:

CO1: Aim and need of radiation protection

CO2: Introduction to Radiation units and quantities

CO3: Understanding of various Radiation protection regulations and the dose limit

CO4: Radiation protection to patients, occupational workers and general public in

**Diagnostic Radiology** 

CO5: Layout of Radiology department

CO6: Use of protective devices and awareness of radiation with radiation signages

CO7: Dose reduction measures with technical protective considerations during radiology

CO8: Different radiation measuring devices

CO9: Effects of radiation on biological tissue

Teaching Scheme		Total Credits		Examination S	Scheme
(In Hours)		(L+T+P)	Theory Marks	Practical	Marks Total Marks
L	ТР	IT C Y	CIE ESE	CIE	ESE
2	1 4	5	30 70	30	70 200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Radiation Quantities and Units: Radiation- Radioactivity- Sources of radiation - natural radioactive sources -cosmic rays terrestrial radiation man made radiation sources. Units of radiation - Quality factor - Flux- Fluence-Kerma- Exposure- Absorbed dose- Equivalent Dose- Weighting Factors-Effective Dose - Occupational Exposure Limits - Dose limits to public.	7	15
п	Biological Effects of radiation: Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus -Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.	APE PROFES	15
III	Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence -Effects on photographic emulsion. Ionization Chambers – proportional counters- G.M counters- scintillation detectors – liquid semiconductor detectors – Gamma ray spectrometer. Measuring systems – free air ionization chamber – thimble ion chamber – condenser chamber – Secondary standard dosimeters – film dosimeter – chemical dosimeter- Thermoluminescent DosimeterPocket dosimeter-Radiation survey meter- wide range survey meter -zone monitor-contamination monitor -their principle function and uses. Advantages & disadvantages of various detectors & its appropriateness of different detectors for different type of radiation measurement. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography Artificial Intelligence in Radiation Safety	-the man	15
IV	Radiation protection: Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey –ALARA- personnel dosimeters (TLD and film batches) - occupational exposure.	7	10

Total	material.	36	70
v	Radiation Hazard evaluation and control: Philosophy of Radiation protection, effects of time, Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding	7	15

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	SION	Hours
1.	Radiation Quantities and Units	15
2.	Biological Effects of radiation	15 8
3. <b>TOTOLOGICAL STREET, STREET</b>	Radiation detection and Measurements Survey meter and personal dosimeter Artificial Intelligence in Radiation Safety	15 FESSIO
4.4	Radiation protection; Principles of radiation protection; ALARA	15 Z
5.	Radiation Hazard evaluation and control	12
	el l	72

### **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	NCAH	Marks	Weightage	IA marks
1.	Sessional test(s)	0	л		
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission	n to be marked as 0	50	el	
	Total		50	0.3	15
2.	Continuous assessment				
	Seminars/Case presentations/ records/Record book/assignmen	Logbook/ Case t			
	Total		50	0.3	15
	Total CIE marks				30

End Semester Evaluation (ESE)

### Written Paper

Type of question				No. of questior	nsMarks question	perTotal
Essay Question (E	Q)			3 (to answer 2)	10	20
Short Essay Quest	ion (SEQ)			9 (to answer 7)	5	35
Short Answer Que	stion (SAQ	)		7 (to answer 5)	3	15
Total marks						70
Duration (minutes)	)					150
Distribution of ma	rks for ESE	l practica	l <mark>exams:</mark>			TPP
0	ESE		CIE		Grand total	D
0	Practical	Viva		Sub Total		0
H H	50	20	30	100	100	TI
Question Paper B	Blueprint					0155

### End Semester Evaluation (ESE)

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

### **Question Paper Blueprint**

Unit		Marks (± 5%)
1.	Radiation Quantities and Units	18
2.	Biological Effects of radiation	20
3.	Radiation detection and Measurements Survey meter and personal dosimeter	20
4.	Radiation protection; Principles of radiation protection; ALARA	19
5.	Radiation Hazard evaluation and control _2021	19
	Total Marks (including optional questions)	96
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### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiation Protection In Diagnostic X-Ray Imaging	Euclid Seeram, Patrick C. Brennan	Jones and Bartlett Publishers
2	Development of Radiation Protection in Diagnostic Radiology	Stewart C. Bushong	CRC Press Inc.,U.S.
3	Textbook of adiological Safety	Thayalan K	Jaypee Brothers Medical Publishers
4	Radiation Protection in Medical Radiography	Statkiewicz Sherer	Elsevier Health - US;
5	Basics of Radiation, Hazards and Prevention In Diagnostic Radiology	Prashant <mark>Kuma</mark> r Jha	JBD Publications
	भू स्वास्थ्यम् स NCA	र्वार्थसाधनम् HP	W WHYT SNO

### Subject: Quality Assurance in Diagnostic Radiology and Regulatory Requirements

### Subject Code: BMRIT -025

### RATIONALE

Quality assurance testing includes the monitoring, evaluation and maintenance of equipment for optimal performance and stability. It is essential that radiological technologists recognize, record and report, AND HEALTHCARE according to policy, when a significant increase or underexposure in radiation exposure occurs.

### **COURSE OUTCOMES**

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

- CO1: Aim and need of radiation protection
- CO2: Introduction to quality assurance
- CO3: Understanding of regulatory requirements
- CO4: Follow radiation protection regulations and apply practically

Teach	ing Schen	Examin	ation Scł	neme			0		
(In Hours)		Credits	Theory Marks Practical Ma		Marks	Total Marks			
	2		(L+T+P)						S.
L	Ŧ	Р	С	CIE	ESE		CIE	ESE	610
1	1	2	3		/		30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

### **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	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. Quality assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance. Quality assurance programme at the radiological faculty level: Responsibility; Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing; Quality assurance practical	4	

	exercise in the X ray generator and tube; Image receptors from		
	processing; 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. LASER printer calibration		
	QA in Diagnostic Radiology		
	filtration		
	Contact between film and intensifying screen		
	Contrast Verification of Optical and Radiation field congruence		
	Beam alignment	70	
	Focal spot size		
	Linearity of tube current mA and Timer	P	
11	Applied potential	4 0	2
	HVT and total tube	1	SI
	Resolution		IS 1
H	Grid alignment		9
	QA in mammography		S
	QA in CT		
	QA in Digital Radiography	A	
	Regulatory requirements in Diagnostic Radiology	R	-
	National Regulatory Body	S	
	Responsibilities and organization	A	
III	Safety Standards Since-2021	4	
	Codes and Guides		
	Care and maintenance of diagnostic equipment: General principles and		
	annually: care in use, special care of mobile equipment		
	Responsibilities of licensees, registrants and employers		
	Enforcement of Regulatory requirements		
IV	Role of technologist in radiology department Maintenance and care of	3	
	equipment and instruments; Cassette, screen maintenance; Maintenance		
	of automatic processor and manual processing units; Routine		
	annually: care in use, special care of mobile equipment.		
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v	Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly,	3	
	maintenance of equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.		

# SUGGESTED PRACTICALS/DEMONSTRATION

. No	ISSID TO TO	Hours
	Quality assurance programme at 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 from processing; 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. LASER printer calibration <b>QA in Diagnostic Radiology</b> filtration Contact between film and intensifying screen Contrast Verification of Optical and Radiation field congruence Beam alignment Focal spot size Linearity of tube current mA and Timer	PROFESSIONS - Lefter
	Applied potential	8
	Resolution	
	Grid alignment	
	QA in mammography	
	QA in CT	

Sr. No		Hours					
3.	Regulatory requirements in Diagnostic Radiology						
4.	Responsibilities of licensees, registrants and employers						
	Enforcement of Regulatory requirements						
5.	Care and maintenance of diagnostic equipment: General principles and						
	preventive maintenance for routine - daily, Weekly, monthly, quarterly,	7					
	annually: care in use, special care of mobile equipment.						
	Total	36					
Evaluation	s Internal Evaluation (CIE)						
Sl. No. Co	mponent Marks Weightage	IA marks					

# Evaluation System

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	<mark>Marks</mark>	Weightage	IA marks
1.	Sessional test(s)			0
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as	50		FESSI
	Total	50	0.3	15 📿
2.	Continuous assessment			2
	Seminars/Case presentations/ Logbook/ Ca records/Record book/assignment	se		7.
	Total	50	0.3	15
	Total CIE marks	<u> </u>		30
	भेट्रे स्वास्थ्यम् सवाः NCAH Since-202 के और स्वास्थ्य	यसाध P 21 देखाँ	रानम्	3
End Se	emester Evaluation (ESE)			

# End Semester Evaluation (ESE)

There is no theory examination for this subject.

End Semester Evaluation (ESE)

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

Distribution of marks for ESE practical exams:

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

# SUGGESTED LEARNING RESOURCES

p			
S. No.	Title of Book	Author	Publication
1	Quality Assurance and Control in Diagnostic Radiology and Imaging	Bhargava	CBS Publishers and Distributors
2	Quality Assurance	Dr. R. Sundhararajan, M.V.Kumudhavalli, Minal T. Harde	Thakur Publications Pvt Ltd
3	Quality Assurance in Diagnostic Radiology	J. McLemor <mark>e (A</mark> uthor	Imprint unknown
4	An Introduction to Quality Assurance in Radiology	Zafar Neyaz	JBD Publications

# BMRIT Radiology Clinical Education – part V (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

# Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in every semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have seminars/workshops on new developments/ technologies. Check annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after the completion of the internship.



"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# FOR ALLIED AND HEALTHER SIXTH Semester

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देखान्रेखा री

# Subject: Basics Techniques in MRI Technology

# Subject Code: BMRIT - 026

# RATIONALE

Magnetic Resonance Imaging (MRI) is a non-invasive imaging technology that produces three dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction . MRI exar of the rotational axis of protons found in the water that makes up living tissue. The student learn to Recognize and planning different protocols and prepare and position patients for MRI examination. To gain knowledge on Management of patients, contrast reactions MRI Safety.

# **COURSE OUTCOMES**

At the end of the course students will be able to... **CO1:** Define basic principle and physics of Magnetic Resonance Imaging.

**CO2:** Recognize protocols needed for Magnetic Resonance Imaging examination.

**CO3:** Prepare and positioning for Magnetic Resonance Imaging examination.

**CO4:** Interpret post processing of Magnetic Resonance Imaging images.

**CO5:** Prepare and position the patients for Magnetic Resonance Imaging examination.

**CO6:** Categorize knowledge of improving image quality in Magnetic Resonance Imaging .

**CO7:** Scanning of patient with various Magnetic Resonance Imaging protocols for better representation of images.

**CO8:** Plan of post processing for Magnetic Resonance Imaging data.

**CO9:** Management of patient for any post contrast reactions.

Teachin	g Schen	ne <b>T</b>	Total	Examin	ation Scheme	-131-	म	5
(In Hou	irs) 🔰		Credits	Theory	Marks	Practical N	Marks	Total Marks
		B	(L+T+P)	NC	АПР		2E	
L	Т	POO	С	CIECE	ESE 21	CIE	ESE	
3	1	8	8 37	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	Introduction to MRI; Basic principle; Image weighting and contrast in MRI; Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding	12	15
II	Encoding and Image formation-Encoding, K-Space; Parameters and Trade-offs; MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences	12	15
III	Flow phenomena; Flow phenomena compensation; Vascular Imaging- Digital Subtraction MRA, TOF-MRA, PC-MRA, Velocity Encoding, MR-Angiogram, MR- Venogram	10	10
IV	Cardiac Imaging; Whole body MRI Protocols; MRI Artifacts and their compensation; MRI contrast agents-T1 contrast agent, T2 contrast agent	10	15
v	MRI safety- Implants and pace-makers, Electrical safety, Metallic safety, Instrumental safety, Bio-effects of MRI; Documentation; Quality assurance in MRI	10	S G ON
			SI
	Total	54	70

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	रे स्वास्थ्यम सर्वार्थसाधन	Hours
1.	Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding	30
2.	MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences	30
3.	Flow phenomena; Flow phenomena compensation	24
4.	Whole body MRI Protocols; MRI Artifacts and their compensation	30
5.	MRI safety and Quality assurance in MRI	30
lotal		144

# **Evaluation System**

# **Continuous Internal Evaluation (CIE)**

Sl. No.	Component	Marks	Weightage	IA marks		
1.	Sessional test(s)					
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50				
	Total	50	0.3	15		
2.	Continuous assessment					
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	-47	THCA			
	Total	<i>50</i>	0.3	15		
	Total CIE marks			30		

# End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questions	Marks per	Total
0		qu <mark>estion</mark>	S.
Essay Question (EQ)	3 (to answer 2)	10	20 5
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15 <b>()</b>
Total marks			70
Duration (minutes)			150

# End Semester Evaluation (ESE)

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

# Distribution of marks for ESE practical exams:

0.2		Sin	$c_{0} - 2021$	10
ESE	X	CIE		Grand total
Practical	Viva		Sub Total	CI-
50	20	30	100	100

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# **Question Paper Blueprint**

Unit		Marks (± 5%)
1.	Instrumentation of MRI-Magnets- classification, types, advantages, disadvantages, Gradient & Body Coils, RF coils, Shim coils, Ramping, Cryogen, RF shielding	19
2.	MRI Pulse sequences-Spin Echo pulse sequence, Gradient Echo pulse sequence; Fast imaging sequences	20
3.	Flow phenomena; Flow phenomena compensation	19
4.	Whole body MRI Protocols; MRI Artifacts and their compensation	19
5.	MRI safety and Quality assurance in MRI	19
	Total Marks (including optional questions)	96

# SUGGESTED LEARNING RESOURCES

	Total Marks (including optional questions) 96				
SUGGE	UGGESTED LEARNING RESOURCES				
S.No.	Title of Book	Author	Publication		
1	Tomography and Magnetic Resonance Imaging of the Whole Body (Vol.1& II) (Saunders).	John R. Haaga, Daniel Boll	Elsevier		
2	MRI inPractice	Catherine Westbrook & Caralyn Kaut	Wiley-Blackwell		
3	Protocols inMRI	Catherine Westbrook	Wiley-Blackwell		
4	An Introduction to the Physics and Function of Magnetic Resonance Imaging	Dominik Weishaupt , Victor D. Koechli , Borut Marincek , J.M. Froehlich	Springer;		
5	Concise Textbook of MRI Physics & Concise Protocols	Maajid Mohi Ud Din Malik, Manjot Kaur	JBD Publications		

# Subject: Introduction to Nuclear Medicine Techniques

# Subject Code: BMRIT -027

# RATIONALE

It is thebranch of medicine that deals with the use of radioactive substances in research, diagnosis, and treatment disease. In this student will learn about the fundamentals of radioactivity and various interactions of radiation with matter, radiopharmaceuticals, instrumentations measuring radioactivity, PET imaging and patients care and safety.

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

**CO1:** Define basic principle and physics of nuclear medicine.

- **CO2:** Apply precautions while handling radiopharmaceuticals.
- **CO3:** Recognizing the artefacts associated with nuclear medicine.
- **CO4:** Assess the knowledge of improving image quality in nuclear medicine.

**CO5:** Management of patient for any late reactions associated with radiotracers in nuclear medicine.

Teaching Scheme	Total	Examinatio	n Scheme			S
(In Hours)	Credits	Theory Mar	·ks	Practical N	Iarks	Total
A	(L+T+P)					Marks
L T P	С	CIE E	SE C	CIE	ESE	4
1 1 2	3424	30 70	124	121	म्	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

Since-2021

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	7	25
ш	Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI	THCARE	25
ш	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	4	20
Total 🚬		18	70

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr.No	Listom Isotome and Palionuslides Draductica of	Hours	SNO
, ki	Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	12	· /. /.
2.	Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET-MRI	12	
3.	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	12	
	Total	36	

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# **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	_		
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total DED AN	50	0.3	15
2.	Continuous assessment	HFA		
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	-42	THCAN	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30

# End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questions Mark	tion per Total
Essay Question (EQ)	3 (to answer 2) 10	20 Z
Short Essay Question (SEQ)	9 (to answer 7) 5	35
Sh <mark>o</mark> rt A <mark>ns</mark> wer Question (SAQ)	7 (to answer 5) $3$	15
Total marks		70
Duration (minutes)		150

# Question Paper Blueprint

Unit	NCAHP de	Marks (± 5%)
1.	History; Isotopes and Radionuclides- Production of Radionuclides, Transport of Radionuclides; Radio Activity- Radio Active transformations, Specific Activity; Radiopharmaceuticals- Preparation, Precautions while handling	32
2.	Gamma Camera instrumentation - Collimator- classification and types; Single Photon Emission Computed Tomography (SPECT); Positron Emission Tomography (PET); Advanced techniques in NM - SPECT-CT, PET-CT, PET- MRI	32
3.	Safety Considerations & Radiation Dose in Nuclear Medicine; Room layout in nuclear medicine	32
	Total Marks (including optional questions)	96

# SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Nuclear Medicine Textbook: Methodology and Clinical Applications	DuccioVolterrani , Paola Anna Erba , IgnasiCarrió , H. William Strauss	Springer;
2	Nuclear Medicine Instrumentation	Jennifer Prekeges (Author)	Jones and Bartlett Publishers
3	Nuclear Medicine Physics: The Basics	Ramesh Chandra & Arman Rahmim	Wolters Kluwer
4	Nuclear Medicine Technology: Procedures and Quick Reference	Pete Shackett BA CNMT ARRT(N) (Author)	LWW;
5	A Concise Guide on Basic Radiation Physics, radiotherapy Physics & Nuclear Medicine	Lalit Agarwal, Dr. Arvind Shukla	JBD Publications
VUTVN	स्वास्थ्यम् स भूह हात्व डांतटव	वर्धिसाधनम् AHP -2021 स्थ्य देखानरेखा	SIONS • Triply

# Subject: Ultrasound Techniques

# Subject Code: BMRIT -028

# RATIONALE

ples of s. To learn procedures equip. h matter Ultrasound techniques provide students knowledge on the basic principles of ultrasonography and how to prepare the patients for the scan and also to identify any artefacts. To learn about the physics behind ultrasound and to gain knowledge regarding various ultrasound procedures equipment used in ultrasound and patient care during ultrasound procedures

# **COURSE OUTCOMES**

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

**CO001:** Describe the Ultrasound properties, interaction of ultrasound with matter

**CO002**: Describe the transducer and types

**CO003:** Explain the concepts of image display

**CO004:** Describe Doppler imaging and ultrasound contrast agents

**CO005:** Describe the image characteristics and artefacts

**CO006:** explain the safety considerations in ultrasound and protocols

F
ical Marks Total Marks
नम 🔊
ESE
100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

**DIABLE** 

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
I	<b>Ultrasound:</b> Properties of ultrasound, interaction of ultrasound with matter	6	10
II	<b>Transducers:</b> Types of transducers, advances in the design of modern ultrasound transducers	6	15
ш	Image display: Display modes, ultrasound instrumentation, controls, image storage, scan converter memory, photographic film, multi format camera,laser imager, colour and video thermal printer, computer storage, pre and post processing techniques	T6HCARD	10
IV JW	<b>Doppler Imaging:</b> Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents	6	PR SEES
NATIO	<b>Image characteristics and artefacts:</b> vascular, interventional, intraoperative and ophthalmic ultrasonography, 3D and 4D ultrasound imaging Artificial Intelligence in Ultrasound	6	10NS
VI A	<b>Bio-effects and safety considerations in ultrasound</b> , ultrasound system performance measurements, ultrasound equipments quality assurance – conventional Doppler system testing and documentation	⁶ मि	10
	Total	36	70
SUGGESTEI	D PRACTICALS/DEMONSTRATION	SE.	

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	En 31/2 JUNT STELEVEL	Hours
1.	Ultrasound interaction of ultrasound with matter	6
2.	Types of transducers, advances in the design of modern ultrasound transducers	6
3.	Image display: Display modes, ultrasound instrumentation, controls	6

Sr. No		Hours
4.	<b>Doppler Imaging:</b> Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents	6
5.	Image characteristics and artefacts	6
6.	<b>Bio-effects and safety considerations in ultrasound</b> , ultrasound system performance measurements, ultrasound equipments quality assurance	6
	SION AC	
	Total	36
Evaluation	n System	OP
Continuou	is Internal Evaluation (CIE)	2

# Evaluation System

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			()
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		SNOI
	Total	50	0.3	15
2.	Continuous assessment		-	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	C		15
	Total	50	0.3	15
	Total CIE marks	5	de	30

### End Semester Evaluation (ESE)

Since-2021

# Written Paper

Type of question	No. of questions	Marks per question	Total
Essay Question (EQ)	3 (to answer 2)	10	20
Short Essay Question (SEQ)	9 (to answer 7)	5	35
Short Answer Question (SAQ)	7 (to answer 5)	3	15
Total marks			70
Duration (minutes)			150

# **Question Paper Blueprint**

Unit		Marks (± 5%)
	Ultrasound: Properties of ultrasound, interaction of ultrasound with matter	14
	<b>Transducers:</b> Types of transducers, advances in the design of modern ultrasound transducers	20
	<b>Image display:</b> Display modes, ultrasound instrumentation, controls, image storage, scan converter memory, photographic film, multi format camera, laser imager, colour and video thermal printer, computer storage, pre and post processing techniques	14
	<b>Doppler Imaging:</b> Doppler principles, continuous wave Doppler and pulsed Doppler, duplex scanning, colour flow imaging, power doppler, harmonic imaging, extended field of view Ultrasound contrast agents	20
	<b>Image characteristics and artefacts:</b> vascular, interventional, intraoperative and ophthalmic ultrasonography, 3D and 4D ultrasound imaging	PR 14
	<b>Bio-effects and safety considerations in ultrasound</b> , ultrasound system performance measurements, ultrasound equipments quality assurance – conventional Doppler system testing and documentation	F14
	questions)	96
SUGGE	STED LEARNING RESOURCES	SNI

# SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
2	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
3	Physics and Technical Aspects Diagnostic Ultrasound	202 DINESH K BAGHEL (Author	AITBS PUBLISHERS
4	Diagnostic Ultrasound	Carol M. Rumack (Author), Deborah Levine (Author)	Elsevier;
5	Ultrasound Imaging (1000 Multiple Choice Questions)	Yadav	JBD Publications

Subject: Biostatistics and Research Methodology

# Subject Code: BMRIT -029

# **RATIONALE:**

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

# **COURSE OUTCOMES**

At the end of the course students will be able to... CO1: Understand the Importance of statistics course in the curriculum

**CO2:** Understands Statistical Terms

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

Teaching	Tot <mark>al</mark>	Examination Scheme
Scheme	Credits	Institute level exam only:
(In Hours)	(L+T+P)	The Institute level examination will be held before the
	C	commencement of the University examinations. A Pass in
	<b>U</b>	the subject with a minimum of 50 marks (50% of the total
NOLLAN	2	100 marks) is compulsory in order to be eligible for the award of degree. These marks will not be considered for the award of class. Supplementary examination shall be conducted by the Institute for the benefit of unsuccessful candidates. Supplementary examinations will be conducted within six weeks/six months from the date of announcement of results.

L, lecture; T, Tutorial; P, Practical

# **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency. י ע רוו

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

	and Calculation of Mode; Comparison of the Mean, and Mode; Guidelines for the Use of Various Measures of Central Tendency.	
IV	Measure of Variability: Need For Measure of Dispersion. The Range, the Average Deviation, The Variance and Standard Deviation; Calculation of Variance and Standard Deviation, Ungrouped and Grouped.	3
V	Probability and Standard Distributions: Meaning of Probability of Standard Distribution, The Binominal Distribution. The Normal Distribution; Divergence from Normality - Skewness,Kurtosis	3
VI	Sampling Techniques: Need For Sampling - Criteria for Good Samples. Application of Sampling in Community, Procedures of Sampling and Sampling Designs Errors. Sampling Variation and Tests of Significance.	3
Total		18

# SUGGESTED LEARNING RESOURCES

S. No. Title of Book	Author	Publication
¹ Elements of Health Statistics	Rao. N.S	ION
² An introduction of Biostatistics	Sunder Rao	N
³ Methods in Bio-Statistics	B.K. Mahajan	4
4 Elementary Statistics in Medical Workers	Inderbir Singh	to a
5 An Introduction to. Statistical Methods, Ram Prasad &Sons	Gupta C.B	15

# BMRIT Radiology Clinical Education – part IV (studentship)

Students will gain additional skills in clinical procedures, interaction with patients and professional personnel. Students apply knowledge from previous clinical learning experience under the supervision of a senior technologist. Students are tested on intermediate clinical radio diagnosis skills.

# Studentship or observer ship must include:

- A minimum of 14 hours per week is considered as studentship in every semester.
- Provide simulation and skill labs for practicing skills specific to the program in the initial years of observer ship/studentship.

- Every semester must have seminars/workshops on new developments/ technologies. Check • annexure for marking criteria.
- If the clinical facility is not within the same campus, transportation should be provided to the • students and interns.
- All practical skills must be supervised and recorded in a Logbook and skills to be evaluated after

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S. no.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hour s
		Identify the area for treatment.	Determining x-ray, CT scan or MRI scan needs of patient	
1	Be able to interpret and evaluate a prescription	Quantify the practical problems associated with machine and accessory equipment limitations	Understand and interpret instructions and requirements documented by the physician in the patient's prescription	200
2	Operate and oversee operation of radiologic equipment	Selecting and performing basic views (projections) and conventional contrast studies using appropriate radiographic parameters and equipment Carrying out routine procedures for troubleshooting and maintenance of imaging and processing systems	Reliably perform all non- contrast plain Radiography, conventional contraststudies and non-contrast plain radiography in special situationsControl and manipulate parameters associated with exposure and processing to produce a required image of desirable qualityApply procedures for all radiologic equipment	200
3	Be able to transfer all relevant information and complete accurate documentation	Recognize the importance of accurate transfer of information to allow for accurate treatmentaccurate according to the treatment prescriptionset-up and prescriptionKnow includedwhat shouldbe beKnow to whom or where the documentation mation should be sentbeBe aware of the legal issues relating to documentationto the council to the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the the 	Construct the most appropriate device for the individual patient within the context of the protocol Apply the necessary precautions in production Implement correct QC, storage and handling procedures for shielding devices	100
4		Know the shielding devices/methods available	Construct the most appropriate device for the	100

Skills based outcomes and monitorable indicators for Medical Radiology and Imaging Technologist during internship:

S. no.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hour s
	Be able to prepare the diagnostic machinery		individual patient within the context of the protocol	
		Know how to use these devices	Apply the necessary precautions in production	
		Recognize the associated health and safety issues	Implement correct QC, storage and handling procedures for immobilization devices	
	Be able to carry out the daily	Recognize the importance of team interactions	Participate in the organization of the daily work schedule to maximize efficiency	
5	organization of the treatment unit	Explain the principles of effective communication	Inform the patient about the procedure	100
	IAL	Review the individual patient requirements	FES	
6	Be able to accurately and consistently set-up and produce a good quality radiological image	Able to interpret the set-up information	Interpret the diagnostic plan and set-up the patient accordingly	
		Apply knowledge of radiographic imaging to the production of radiographs and the assessment of image quality	Carrying out quality control tests on images obtained	200
	7 22	Be familiar with the treatment plan	Explain the anatomic and physiological basis of the procedure to be undertaken	
7	Be able to prepare and position the patient for the	Identify procedures	Identify and explain the possible side effects to each patient	200
	procedure	भवारथ्य ५	Check all preparatory procedures have been completed	
		Be familiar with the diagnostic plans for all patients on the treatment unit	Identify the patient in accordance with recognized procedures and consistent with the department protocol	

S. no.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hour s
		Recognize the signs and symptoms associated with treatment in different sites	Analyze the information and integrate to define the optimal patient position	
		Discuss the importance of patient identification and how it should be carried out	Interpret the diagnostic plan and use the equipment accordingly	
	/	Recognize the importance of accurate documentation	Complete the treatment documentation accurately	
	Be able to complete	Know what should be included	Ensure all legal requirements have been met	
8	treatment documentation	Be aware of the legal issues relating to treatment documentation	TPT PT	50
	107	List support groups that might benefit patients	20F	
9	Advise patient on appropriate nutrition, sexual function, rest, skin care, nausea and other symptoms	Explain the impact of nutritional status on patient tolerance of treatment	Assess the patient's nutritional status	50
	4	Monitor treatment process/outcomes	Identify needs and expectations of patient/health care professionals	
10	Monitor and assure quality	Identify problems in treatment process/outcomes	Solve treatment process/outcome problems	50
		Know what patient care is relevant for the procedure	Evaluate potential solutions thoroughly	
11	Be able to carry out the necessary data	Define and explain the data that must be transferred	Check and verify all parameters	100
	transfer checks		Confirm approval and signatures	
12	Be able to process radiographic images	Apply knowledge of radiographic imaging to the production of radiographs and the assessment of image quality	Perform X-ray film / image processing techniques (including dark room techniques)	100
		and the assessment of image quality		

S. no.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hour s
		Control and manipulate parameters associated with exposure and processing to produce a required image of	Acquire an appropriate image as per instructions	
		desirable quality		
1.0	Recognize contrast induced adverse reactions	Promptly recognize and assess the reactions	Know the correct medications and other treatment options	4.0.0
13		Taking precautionary measures to avoid the reactions	Recognise the contraindications of allergic reactions	100
14	Be able to carry out corrective actions as per instructions Be able to implement health and safety procedures	Recognize the critical structures on the verification images	Make corrections in accordance with the protocol	100
		Identify the correct imaging protocol	Record any corrections	
15		Explain the health and safety issues for patients and staff	Assess the safety features to ensure they are in place and adhered to	100
16	Be able to interpret, apply and disseminate information as a member of the medical imaging team	Define and explain the data that must be disseminated	Identify the appropriate personnel to whom specific information should be disseminated	100
		वास्थ्यम् सर्वार्थस	Communicate the correct, relevant and appropriate information	
17	Be able to demonstrate professional behaviour	Explain the legal and ethical guidelines related to the profession	Practice in accordance with legislation regulations and ethical guidelines	
		Be aware of your own competency levels	Promote collaborative practice	100
		Identify the elements that reflect professional appearance and manner		
18	Be able to demonstrate a sensitive and caring attitude to patients	Explain the components of good communication	Self-awareness of their own personality traits	100
		Describe the main personality types	Analyze how the differences in personality influence approach	100

S. no.	Learning outcomes	Knowledge/comprehension	Applications / synthesis /evaluation	Hour s		
		Be aware of the patient 'gender, age, cultural background, educational level and social situation				
19	Be able to ensure radiation protection legislation is adhered to	Describe the radiation hazards and how they are managed Explain the legislation relating to radiation protection	Routinely inspect the area to ensure that radiation protection measures are in place and functional	100		
20	Be able to carry out the daily/weekly Quality Control (QC) checks	Explain Quality Management System (QMS), Quality Assurance (QA) and Quality Control (QC	Perform the daily/weekly/monthly QC procedures	100		
21	Be able to review the literature	Define search terms for specific treatment sites	Identify the appropriate literature in the area of interest	100		
22	Be able to suggest implementation of research findings	Identify relevant sources of Research	Evaluate research with respect to current departmental practice	50		
23	Be able to suggest/ initiate topics for medical imaging researchIdentify literature to support research proposalDefine the necessary steps in preparing and carrying out research		Review the literature in the area Formulate a research question	. 50		
Total Hours-2400 स्वर्थ्यम स्वथसघनम						

अप्रियम् रापायसाधनम् अ NCAHP Since-2021 अप्रे स्वास्थ्य देखान्येख

#### Annexures

#### 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 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.

The learning out comes to be assessed should include:

a. Acquisition of knowledge: the methods used comprise of Log Book' which records participation in various teaching/ learning activities and mentoring of students. The number of activities attended and the number in which presentations are made are to be recorded. The log bookshouldperiodicallybe validated by the supervisors. Some of the activities are listed.

**b.** 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 checklist *(see Model ChecklistI)*.

c. Work diary/ Log Book- every candidate shall maintain a work diary and record his participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of experiments or procedures, if any conducted by the candidate.

d. Records: records, log books and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University.

# Log Book

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

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 he fails to fulfill the requirements inspite of being given adequate chances to set himself right.

# Checklist- I: MODEL CHECKLIST FOR THE EVALUATION OF THE SEMINAR PRESENTATIONS

Name of the student:

Date:

Name of the faculty/ observer:

Title of the seminar:

S1.	Items of observation during	Poor0	Below	Average	Good	Very
No	presentation		average			good 4
	AL CONTRACT	LIEU /		2	3	
1	Topic chosen was			FA.		
2	Extent of understanding of scope &			17		
	objectives of the paper by the			~//	$\forall \sim$	
	candidate				Ch	
3	Whether cross- references have been				YS	
	consulted				1	$\sim$
4	Whether other relevant r <mark>eferences</mark>					0
	have been consulted	1				D
5	Ability to respond to questions on the					0
	paper/ subject					T
6	Audio- visual aids used					
7	Ability to defend the topic					S
8	Clarity of presentation					S
9	Any other observation					0
	Total score					Ν
Remar	ks				•	$\overline{\Omega}$

Name and Signature of the Faculty .....

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ince-2021 नारच्य देखा-रेखी Model marking criteria for Supervisor/mentor faculty:

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S.No.	Parameter	Score
1.	Proficiency of knowledge required for each radiological imaging procedures	0-5
2.	The competency in skills expected to manage each radiological imaging procedures	0-5
3.	Responsibility, punctuality, work up of case, involvement in	0-5
	follow-up reports	
4.	Capacity to work in a team (Behaviour with colleagues,	0-5
	technologist and relationship with other healthcare workers)	
5.	Initiative, participation in discussions, research aptitude	0-5
SCORIN	IG SCALE:	
0 Dissati	sfied	D
1 Poor /		6
2 Below .	Average	T
3 Averag	e	T

- 1 Poor
- 2 Below Average
- 3 Average
- 4 Good
- 5 Excellent

Note: A score of less than 3 in any of above items will represent unsatisfactory completion of internship.

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# HEALTHCARE PROFESSIU 3.2 Master in Medical **Radiology and Imaging** Technology

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# Introduction:

# Learning Objectives:

Master in Medical Radiology & Imaging Technology is specifically aimed at those candidates pursuing a professional/academic career in Radiology &Imaging Technology. It is designed to provide specialized training in the scientific principles of modern imaging sciences and in the application of these principles in the field of Radiology & Imaging Technology. It is designed as a higher degree course suitable for graduates having experience in the technology of Radiology & Imaging Technology. The objective of the programme is to train students to be qualified, patient focused, compassionate, critical thinkers for the community who are engaged in lifelong learning.

Upon successful completion of the Master course, students will have developed a broad knowledge of the principles, technology, instrumentation, recent developments and proper handling of the modern radiological and imaging equipment's and proper execution of the various radiological procedures and be able to embark upon a successful career in their chosen direction of Imaging Science research.

# Expectation from the future post graduate in providing research/academics/patient care

Perform a range of radiographic/radiological examinations on patients to produce high quality images.

1. Verifying informed consent, assuming responsibility for patient needs during procedures.

2. Applying principles of ALARA to minimize exposure to patient, self and others. Starting and maintaining intravenous access as prescribed, Identifying, preparing and/or administering medications as prescribed

- 3. Evaluating images for technical quality, ensuring proper identification is recorded.
- 4. Performing diagnostic radiographic/radiological and non-interpretive fluoroscopic procedures
- 5. Assist radiologists and senior staff in complex radiological examinations.
- 6. Record imaging identification and patient documentation quickly and accurately and observes protocols.
- 7. Research and development of new techniques and procedures as assigned.

8. Promotes effective working relationships and works effectively as part of a department / unit / team inter and intra departmentally to facilitate the department/unit's ability to meet its goals and objectives.

9. Follows established safety practices including biohazards, exposure control plan

10. Demonstrates respect and regard for the dignity of all patients, families, visitors and fellow employees to ensure a professional, responsible and courteous environment.

11. Identifying and managing emergency situations.

12. Performing ongoing quality assurance activities.

13. Ensure safe custody of all the accessories of the X-ray/radiological unit of which he/she is in charge. Keeps the X-ray room locked when not in use.

14. Understands and observes health and safety regulations/precautions and instruction for self and others protection. He/she should wear a dosimeter during duty hours.

- 15. Attends all in service education program required as per hospital policy.
- 16. Providing education and monitoring students and other health care providers.
- 17. Orientation and teaching students and new employees.
- 18. Learns new technologies and technologies as required by the professional bodies.
- 19. Impart appropriate training to the students and other staff.

20. Should have management and research skills.

21. To exhibit keen interest, initiative & drive in the overall development of the Department and 'Leadership Qualities' for others to follow.

22. He / She is expected to be confident and to perform all the duties diligently with utmost sincerity and honesty.

23. Any other duty/task/work assigned by any higher authority like Director, Dean, Medical Superintendent, Head of the Department from time to time; either in "Public Interest" or in the interest of upkeep / development of the Department / Institutions.

# Minimum standard to start the MMRIT programmes:

Accordance with NCAHP regulations Institution/university with having medical college with hospital setup shall be permitted an annual intake capacity of 10 admissions (maximum) annually. No shall paramedical institutes/colleges having no own medical college shall permitted to start the Master degree programme. The phase-wise requirements to be fulfilled by the applicant colleges for obtaining letter of intent and Letter of Permission for establishment of new college or increase in annual intake MMRIT admissions annually from 10 to 15 intake. Maximum of intake in the Master degree programe is 15 candidates. No shall permission of the intake to be permitted more then 15 to any institute or college.

For the institutes to be capable of providing high quality training to the student and exposure to all the related modalities, it should have the following: ESSIO

- X-ray Unit (CR, DR)
- Mobile X-ray unit
- Fluoroscopic unit
- Ultrasonography, Color Doppler Equipment
- Multi-slice CT Scan
- Mammography
- DEXA
- MRI
- DSA

Note: Starting MMRIT program in CT, MRI and Breast Imaging apart from the above equipment's the institute must have state of art high end equipment in these specializations.

The teaching faculty (with annual intake of up to 10 students) for the MMRITs should have a minimum of Master in the MRIT or MRIT with PhD in relevant subject.

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- 1 Professor
- 2 Assoc. Professor
- 4 Asst. Professor
- 8 demonstrators

Method of teaching and learning-

- Lecture
- Tutorial
- Problem based learning
- Small group teaching and learning
- Continuous interactive learning
- Case-based
- Project based

• Research project- Research was considered by the group to be very important in order to keep pace with other professions and to generate a research background for our own profession.

- Seminars
- Clinical conferences
- E-learning
- Skills laboratory
- Industrial visit

Infrastructure requirements:

- Minimum 4 classrooms with minimum seating capacity of 10 students
- Faculty rooms, Common rooms for students
- Auditorium/Conference room with minimum seating capacity of 150 students.
- Minimum 2000 sqft Library
- Student canteen/cafeteria

# Eligibility for admission:

# Selection procedure:

Bachelor in Medical Radiology & Imaging Technology (3+1)/B.Sc. Medical Technology Radio diagnosis and Imaging/ B.Sc. Radiological Technology/B.Sc. in Radiography/B.Sc. Medical Technology (X-ray) or equivalent to BMRIT with a minimum 60% marks in Bachelor. Bachelor course must be three years course and one year of internship/one year of working experience must be considered for the Master degree admission.

HCAPE

The selection of the candidates for admission to the course is made on merit on the basis of combined entrance examination conducted by NCAHP/NEET. The admission notice is released in all leading English Newspaper. Only those candidates will be eligible who score minimum 60% marks in the entrance test for General Category candidates and 55% of for those belonging to SC/ST category.

Selection of the candidate on the basis of Entrance examination conducted by the national commission (NCAHP) norms.

# Elective specializations:

MMRIT course offers three elective broad specializations during the admissions. First and Second semesters will be having common core subjects to all the students. During the study of Third and Fourth semesters there will be a three elective broad specializations. Three elective broad specializations are as follows:

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- CT Imaging Technology
- MR Imaging Technology
- Breast Imaging Technology

Selecting of elective broad specializations must be done during the admission itself as per ranking. There will be no option to change the elective broad specializations after the start of the academic year.

# Selection of eligible candidates:

Every student, selected for admission to a MMRIT in any of the para medical institutions/university on acquiring BMRIT or an equivalent qualification thereto shall have obtained permanent registration with

the NCAHP, or any of the State Medical Council(s) or shall obtain the same within a period of three months from the date of his/her admission, failing which his/her admission shall stand cancelled.

Selection to the MMRIT course shall be based on merit obtained in the National Entrance and Eligibility Test (NEET) conducted by the central government or its authorized agency.

Accordance with NCAHP regulations Institution/university with having medical college with hospital setup shall be permitted an annual intake capacity of 10 admissions (maximum) annually. No shall paramedical institutes/colleges having no own medical college shall permitted to start the Master degree programme. The phase-wise requirements to be fulfilled by the applicant colleges for obtaining letter of intent and Letter of Permission for establishment of new college or increase in annual intake MMRIT admissions annually from 10 to 15 intake. Maximum of intake in the Master degree programe is 15 candidates. No shall permission of the intake to be permitted more then 15 to any institute or college.

Number of approved admission/seats will be distributed on elective subjects as follows: DE PROFESSIONS

Intake: 10 seats
MMRIT – Elective of CT
Imaging Technology: 4 seats
0
MMRIT – Elective of MR
Imaging Technology: 4 seats
M
MMRIT – Elective of Breast
Imaging Technology: 2 seats

# Duration of the course

Duration of the course: 4 semesters or 2 Years (640 hours of Theory & Practical Classes). Total - 2560 hours

# Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

# Maximum period for completion of the course:

The maximum period for completion of MMRIT is 4 years.

If a candidate does not complete within the 4 years, he/she should re-register.

# Attendance and Monitoring progress of studies:

A candidate shall study in concerned department of the Institute for the entire period as a full-time student. No candidate is permitted to work in any other laboratory/college/ hospital/pharmacy etc. while studying. A candidate who has a minimum of 80% attendance in theory and practical separately and who has fulfilled other requirements of the course shall be permitted to appear for the examination.

A candidate having a shortage of attendance shall repeat the exam when it is offered next.

Stipend: All students shall be paid minimum sum of Rupees 15000/- per month as stipend in all the four semesters or at par with other similar streams as per consumer price index as per NCIAHP Act.

# Assessment and Evaluation

### Scheme of Evaluation

The academic performance is assessed on the basis of both Continuous Internal Evaluation (CIE) assessment and End Semester Examination (ESE) in each semester. Weightage will be in the ratio of 30 % for CIE and 70 % for ESE.

# Continuous Internal Evaluation (CIE)

- 30% of the total marks is allotted for CIE in each course.
- 50% of CIE shall be based on the average of marks obtained in two notified formative written tests. Absence without prior permission for a formative test shall result in scoring of the test as zero.
- The remaining 50% of CIE will be based on internal assessments in the form of evaluation of seminars, journal club presentations, case presentations, completion of assignments etc. which will be specified in the individual course curricula.
- CIE will be conducted for theory and practical for each course wherever applicable.
- A Candidate must secure at least 40% of total marks fixed for CIE in the particular course in order to be eligible to appear for the End Semester Examination for that course.
- End Semester Examination (ESE)
- There shall be a University Examination at the end of each semester.
- To be eligible to appear for University examination a candidate should fulfil all the following conditions
- Undergone satisfactorily the approved program of study in the course/courses for the prescribed duration
- 80% attendance separately in theory and in practical/hospital postings, in each course
- Shall have the minimum attendance requirement in all courses of that semester for the first appearance
- Secure at least 40% of total marks fixed for CIE in a particular course; and
- Fulfil any other requirement that may be prescribed by the University from time to time.
- The End Semester Examination will consist of Theory examination for all courses and in addition, Practical examination for specified courses.
- Theory examination
- Written tests with question types, pattern, duration and weightage as specified in the Course-wise curricula
- Setting of question papers and evaluation of answer scripts as per University regulations
- Practical examination
- Broad outline would be in the form of Spotters, Demonstration of equipment handling, Case based discussions.

# Criteria for pass:

A Candidate has to score 50% each in theory and practical wherever applicable to be declared as pass. In case of fail, subsequently candidate has to appear for both theory and practical examination of the university in that particular course.

# Attendance and appearance for Exam:

Candidates not possessing required attendance in a particular course as prescribed by University will not be allowed to take up examinations and has to appear for supplementary examination whenever university conducts exam for the particular course very next time.

Overview

Overview		OR ALLIED AND HEA
Core courses	1.	Radiological and Medical Physics
	2.	Clinical Special Radiography Positioning
( credits)	3.	Modern Radiological Imaging - Equipment and Physics
	4.	Contrast Media and Interventional Radiology
	5.	Modern Imaging and Special Radiological Procedures
	6.	Biostatistics and Research Methodology
Broad specific core	1.	Principles of CT Imaging Technology
courses (CT	2.	CT Imaging Procedures and Scanning Protocols
Technology)	3.	Basic and Cross Sectional Anatomy in CT Imaging
	4.	Advancements in CT Technology
	5.	Quality Assurance, Radiation Protection and Patient care in CT
		Imaging
	6.	Basic Pathology and Image Interpretation in CT Imaging
Broad specific core	1.	Principles of MR Imaging Technology
courses (MRI	2.	MR Imaging Procedures and Scanning Protocols
Technology)	3.	Basic and Cross Sectional Anatomy in MR Imaging
	4.	Advancements in MRI Technology
	5.	Planning, Safety and Patient care in MR Imaging
	6.	Basics Pathology and Image Interpretation in MR Imaging
Broad specific core	1.	Principles of Breast Imaging Technology
courses (Breast	2.	Breast Imaging Procedures and Scanning Protocols
Imaging Technology)	3.	Basics and Cross sectional anatomy of Breast
	4.	Advancements in Breast Imaging Technology
	5.	Quality Assurance, Radiation Protection and Patient care in Breast
		Imaging
	6.	Basics Pathology and Image Interpretation in Breast Imaging

# **Distribution of Credits:**

- L Lectures- 1 hour: 1 credit
- T Tutorial- 1 hour: 1 credit
- P Practical- 2 hours: 1 credit

Clinical (Studentship)- 3 hours: 1 credit
					Teach	ing and	l Exan	nination	n Scher	ne					
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1.	MMRI'T01	Radiological and Medical Physics	2	1	6	6	2.5	30	70	100		1	TOP		100
2.	MMRIT02	Clinical Special Radiography Positioning	2	1	6	6	2.5	30	70	100	30	70#	100	50	200
3.	MMRIT03	Biostatistics and Research Methodology	3			3	2.5	30	70	100			SNI -	-	100
4.		MMRIT Radiology Clinical Education – part I (studentship) *	<del>,</del> स्	d <del>-</del>	15	Т N	स CA	र्ग भ	रिमा	হন	-30	70	100	50	100
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1.	MMRIT1 4	Principles of MR Imaging Technology	2	1	4	5	2.5	30	70	100	50	<	PRU			100
2.	MMRIT1	MR Imaging Procedures and Scanning Protocols	3	1	4	6	2.5	30	70	100	50	30	70#	100	50	200
3.	MMRIT1 6 ALA	Basic and Cross Sectional Anatomy in MR Imaging		2	4	4						30	70#	100	50	100
4.		MMRIT Radiology Clinical Education - part III (studentship)*	 स्वा	र्	15	5 [ <del>7</del>	q	- থি	स			30	70 10 10 10 10 10 10 10 10 10 10 10 10 10	100	50	100
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Abbreviations: ESE- End Semester Exam, CIE- Continuous Internal Evaluation, L - Lectures, T - Tutorial, P - Practical

*Internal Assessment, # External Assessment.

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

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*Inte	ernal	Ass	essment (Institu	tional L	evel	examir	nation) r	narks ar	e not t	to be c	ounte	d for	the gra	de at t	he en	d of t	he
seme	ester.																

					Te	aching a	nd Exa	mination	n Schem	e						
Cour	se Nan	ne: Master in Medic	al Radio	ology	and Im	aging Tec	hnology	7								
Dura	tion of	Program: Two Ye	ars (Fo	ur Se	mester	s) Patte	rn : Ful	l Time		Dura	tion :	18 Wee	ks			
Seme	ster . 11			each	ing feel	neme			Ex	amina	tion	Scheme				
								Т	heory				Practio	cal		
		itle					uc	CIE	ESE	To	tal	CIE	ES	Tot	al	-
Z.	le	se T	ory veek	rial	P veek	lits +P)	ırati rs.	D. 4					E			tota
S S	Coć	Cour	Theo rs/w	Tuto	C/ urs/w	Crec L+T	n Du in H	A	arks	larks	arks	larks	larks	larks	arks	rand
	urse		-f)	1F	US.	<u> </u>	Exar	ax M	ax M	ax M	W U	AX M	ax M	ax M	in M	G
	Cc		.0	1				M	Ŵ	W	W	Ŵ	W	Ŵ	Ŵ	
	21	Principles of Breast Imaging	5									1CA				
1.	IRI'I	Technology	2	1	4	5	2.5	30	70	100	50	'	RA-			100
	MN												10			
	Breast Imaging     Procedures and															
2.	RIT	Scanning	3	1	4	6	2.5	30	70	100	50	30	70#	100	50	200
	MM	Protocols												T		
	3	Basics and Cross												S S		
3.	RIT'2	sectional anatomy of		2	4	4		/				30	70#	100	50	100
	IMM	Breast												Z		
		MMRIT												5		
		Radiology														
4.		Education - part			15	5						30	70	100	50	100
		III (studentship)*											7			
			J		<b>L9</b> ]			al s	t J	тет	-	П	A		(	
	Tot		5	4	27	20	<u></u>	<u>4</u>	<u> 1 1</u>	200	1	<u> </u>	3	300		500
	ai						CA	HI	P			d	6	/		
Stude	nt Con	tact Hours Per Weel	k: 36 <b>Hr</b>	s.Th	eory an	d practic	al perio	ods of 60	minutes	each.	1	Medium o	of Instru	ction: 1	Engli	sh Total
Marks Abbr	s <b>: 500</b> eviation	s: ESE- End Semes	ter Exa	n. CI	E- Con	tinuous I	nternal	-202 Evaluatio	n. L - Leo	ctures	T-T	'utorial. F	- Pract	ical		
*Inter	rnal Ass	sessment, # Externa	l Assess	ment	1221			1		TR	J		<u> </u>			
*Inter	rnal Ass	sessment (Institution	nal Leve	l exai	mination	1) marks :	are not t	to be cou	nted for t	the gra	de at t	he end o	t the ser	nester.		

### Studentship or observership must include:

- A minimum of 14 hours per week is considered as studentship in very semesters.
- Provide simulation and skill labs for practising skills specific to the program in the initial years of observership/studentship.
- Every semester must have journal club/UG teaching/Mentoring/seminars/workshops on new developments/ technologies. Check annexure for marking criteria.

• All practical skills must be supervised and recorded in a digital Logbook and skills to be evaluated after the completion of the studentship.

### **Dissertation:**

A candidate is required to carry out a research study in select area of his/her subject, under the supervision of a faculty guide. The results of such a study shall be submitted to the University in the form a dissertation as per the prescribed format and within the date stipulated by the University.

The dissertation work is aimed at training a postgraduate candidate in research methodology and techniques. It includes identification of the problem, formulation of a hypothesis, review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

### Guide:

A Guide shall be a Post MD/PhD or MMRIT with atleast 2 years of teaching experience. Each guide can take up to a maximum of three students per academic year. However a co-guide can be opted wherever required with prior permission of the Institute and University. The co-guide shall also be a postgraduate teacher recognized by the University as a guide.

Candidate shall submit synopsis to the University through the Guide and Head of the Institute on or before end of first semester or within date notified by the University, whichever earlier.

Once the synopsis is approved and registered by the University no change in the topic or Guide shall be made without the prior approval of the University.

In the event of registered Guide leaving the Institute or in the event of the death of the Guide, a change of Guide shall be permitted by the University, on the specific recommendation of the Institute.

### Schedule

The following procedure and schedule shall be strictly followed:

### Ethical clearance

Ethical Clearance should be obtained for a study involving any procedure on human subject. The candidate should apply for the certificate to the Ethics Committee of the Institute/University, through the Guide and present the study before the Committee for clearance. A copy of the certificate should be attached along with the synopsis forwarded at the time of submission of synopsis. All such clearance should be sought within three months of the commencement of the I semester.

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### Submission of synopsis

Synopsis should be vetted by guide, HOD and departmental curriculum development cell and approved by the institutional ethics committee before submission to the university. The synopsis should be submitted as per the format on or before the end of first semester, or within the date notified by the University, whichever is earlier. Once the synopsis is approved and registered by the university no change in the topic or Guide shall be made without the prior approval of the University.

### Final submission of the dissertation

The dissertation complete in all respects and duly certified by the Guide/Co-guide, Course Coordinator/ HoD/ Director should be submitted it to the Controller of Examinations as per the date specified by the University, generally three month before commencement of University examinations.

### **Preparation of dissertation**

The written text of dissertation shall be as per the format, shall not exceed 100 pages (cover to cover). It should be neatly typed with 1.5 line spacing on one side of the paper (A4 size: 8.27" x 11.69") and properly bound. Spiral binding should be avoided. E-submission of the dissertation is mandatory.

### Scheme of evaluation

The dissertation will be evaluated at the time of university examination of IV semester by a panel of examiner (Internal and External) appointed as per guidelines of NCAHP.

### Evaluation format for dissertation

S1.	University Evaluation	Marks
No	0	Max Marks
1.	Objectives, Resea <mark>rch Ques</mark> tion, Literature Review	25
2.	Results and Discussion	25
3.	Viva voce	50
	Total	100

### Criteria for pass:

A candidate is declared to have passed the examination in a subject if he secures minimum 40% of marks separately and overall 50% marks separately in theory and practical including internal assessment.

A candidate who fails in any subject shall have to appear only in that subject in subsequent examination.

### Carry over benefit:

A candidate shall appear for all the subjects of that particular semester in the University examinations but failed in that semester can avail this benefit, provided:

- A candidate who fails in not more than 2 subjects in I semester is allowed to move to II semester. • The candidate with back log subjects shall take both I semester backlog subjects as well as II semester subjects. The candidate with a backlog of not more than 2 subjects in II semester is allowed to go to the III semester till he/she clears all I semester subjects.
- The candidate with a backlog of not more than 2 subjects in III semester is allowed to go to the IV semester till he/she clears all II semester subjects.
- Results of candidates will be declared at the end of IV semester only when the all backlog subjects are cleared by the candidates.

Maximum attempt: No more than three attempts shall be allowed for the candidate to pass the any subjects. If he/she fails to clear any subjects within three attempts will be considered as withdrawal of the course. Grading and Classification

### **Re-totalling:**

Re-totalling of marks is permitted only for theory papers. The University, on application within the stipulated time and remittance of a prescribed fee, shall permit a re-totalling of marks for the course/s applied. The marks obtained after re-totalling shall be the final marks awarded. There is no re-evaluation offered for any of the subjects in MMRIT.

### Supplementary Examinations:

Supplementary examination shall be conducted by the university for the benefit of unsuccessful candidates. Lower semester examinations shall be conducted by the University along with current semester examinations for the benefit of unsuccessful candidates.

- A Candidate detained for lack of attendance will be barred from appearing in any one or all course/s for the supplementary examination.
- A candidate permitted to appear for the supplementary examination can improve his internal assessment marks before he takes the supplementary examination by subjecting himself to internal assessment.

### Conduct and discipline:

Candidates shall conduct themselves within and outside the premises of the Institute in a manner befitting the student of an educational institution.

As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

The following act of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

Ragging as defined and described by the Supreme court/Government Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus. Willful damage or stealthy removal of any property/belongings of the Institute/Hostel or of fellow candidates/citizens. Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs. Mutilation or unauthorized possession of library books. Noisy or unseemly behaviour, disturbing studies of fellow candidates. Hacking in computer systems (such as entering into other person's domain without prior permission, manipulation and/or damage to the computer hardware and software or any other cyber crime etc.) Plagiarism of any nature. Any other act of gross indiscipline as decided by the Board of Management from time to time.

Commensurate with the gravity of offense, the punishment may be: reprimand, fine, expulsion from the hostel, debarment from an examination, disallowing the use of certain facilities of the Institution, rustication for a specific period or even outright expulsion from the Institution, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

For any offence committed in (i) a hostel (ii) a department or in a classroom and (iii) elsewhere, the Chief Warden, the Head of the Department and the Head of the Institution, respectively, shall have the authority to reprimand or impose fine.

All cases involving punishment other than reprimand shall be reported to the Vice-Chancellor.

Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

Grading system Letter grades and CGPA The performance of a candidate shall be evaluated according to a Letter Grading System, based on the both CIE and ESE. The letter grades (O, S, A+,A, B, C, F and I) indicate the level of academic achievement assessed on a 10 point scale (0 to 10).

Marks Range (%)	Grade Point	Letter Grade	Descriptor	Classification	CGPA
90 & above	10	0	Outstanding		
80-89	9	S	Excellent	First Class with	7.50 and above
75-79	8	A+	Very Good	VD HEA	
65-74	.71	A	Good	First Class	6.50 -7.49
60-64	56	В	Average		6.00 - 6.49
50-59	5	С	Pass	Second Class	5.00 - 5.99
Below 50	0	F	Fail	Fail	PR
Absent	0	Ι	Absent		Less than 5.00

For non- credit courses 'Satisfactory' (P) or 'Unsatisfactory' (F) shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

A candidate shall be considered to have completed a course successfully and earned the credits assigned, if he secures an acceptable letter grade in the range O-C. Letter grade 'F' in any course implies failure in that course and no credit is earned.

A candidate having satisfactory attendance at classes and meeting the passing standard at CIE in a course, but remained absent from

ESE shall be awarded 'I' grade in that course. म् सर्वार्थसाध

Grade Point Averages:

The overall performance of a candidate will be indicated by Grade Point Average (GPA). For each course grade points will be awarded as per a letter grading system.

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Semester Grade Point Average (SGPA) is computed as follows:

 $\sum$  [(course credit) X (Grade point)] for all courses with

Letter grades, including F

SGPA

 $\sum$  [(course credits)] for all courses with Letter grades, including F

Cumulative Grade Point Average (CGPA) is computed as follows:

 $\sum$  [(course credit) X (Grade point)] for all courses for all semesters

with, Letter grades excluding F

CGPA

 $\sum$  [(course credits)] for all courses for all semesters with

Letter grades, excluding F

Conversion of Grades into Percentage

HEALTHCA Formula for conversion of GPA into percentage: CGPA earned X10 = Percentage of marks scored Illustration: (CGPA Earned 8.18 X 10) = 81.80 %

### Award of Class:

The candidate, who has passed all the courses prescribed, shall be declared to have passed the program. Class will be awarded only to those who pass the entire examination in the first attempt and on the basis of the aggregate of marks scored in individual semester.

- A candidate who secures GPA  $\geq$  7.00 and above in first attempt shall be declared to have passed in 'First Class with Distinction'.
- A candidate who secures GPA  $\geq 6.00$  or more but less than 7.00 in the first attempt shall be declared to have passed in 'First Class'.

A candidate who secures GPA  $\geq$  5.00 or more but less than 6.00 in the first attempt shall be declared to have passed in 'Second Class'.

A candidate who secures  $GPA \ge 4.00$  or more but less than 5.00 in the first attempt shall be declared to have passed in 'Pass Class'.

Candidates who pass the examinations in more than one attempt shall be declared as passed in 'Pass' class irrespective of the percentage of marks secured.

An attempt means the appearance of a candidate for one or more courses either in part or full in a particular examination. If a candidate submits application for appearing for the examination but does not appear for any of the courses either in full or part in the university examination, he can appear for supplementary examination provided other conditions such as attendance requirement, internal assessment marks, etc are fulfilled and his appearing in the supplementary examination shall be considered as the first attempt.

### Graduation requirements:

Candidate shall be declared eligible for the award of the degree if he or she has:

- Fulfilled all degree requirements.
- No dues to the University, Institution, departments, hostels, library etc.
- No disciplinary action pending against him. ٠

The award of degree must be recommended by the Board of Management.

### **Convocation:**

Degrees will be awarded in person to all eligible students who have graduated during preceding academic year at the annual convocation.

### Board of examiners for each semester:

The Examination Committee shall recommend in such manner as may be determined by the State Board, names of suitable experts as the chairman of panels of Board of examiner for setting and moderating the question papers and arrange the panels of moderators and examiners prepared in such manner as per the guidelines of the NCAHP.

HOD of Radiology: Chairperson

Programme Co-ordinator/Course Co-ordinator/Chief of MRIT /Incharge of MRIT: Co-chairperson ...air.

Subject Experts:

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External examiner (one person):

The examiner must be subject expert.

Internal examiner (one person):

The examiner must be subject expert.

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# COMMISSION FOR AL HEALTHCARE PROFESSIONS . **First Semester**

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217

### Subject: Radiological and Medical Physics

### Subject Code: MMRIT01

### RATIONALE

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

### **COURSE OUTCOMES**

COURSE OUTCOM	IES	ALLIED	) A (		
At the end of the cour	se students wi	ll be able to		HEAL	
<b>CO1:</b> Describe general	l physics relate	ed to <mark>imaging</mark>		- H	2
<b>CO2:</b> Differentiate be	tween within §	gene <mark>ral radiati</mark> on			To
CO3: Identify constru	ction of ra <mark>dio</mark> l	logy equipment's			The second secon
CO4: Interpret quality	of control of	radiology equipm	ent's		P
<b>CO5:</b> Differentiate be	tween <mark>x-ray ec</mark>	uipment's and otl	ner radio	ology <mark>related equ</mark> ipm	ent's
<b>CO6:</b> Describe produc	ction of x-rays				ES
<b>CO7:</b> Describe circuit	syst <mark>em of rad</mark>	iology equipment'	S		S
<b>CO8:</b> Describe the str	ucture and wo	orking of x-ray tub	e, produ	iction of x-rays	0
<b>CO9:</b> Describe the typ	oes of x-r <mark>ay tu</mark> l	be and heat dissip	ation me	ethods	S
<b>CO10:</b> Explain the x-ra	ıy generator ci	rcuits			
<b>CO11:</b> Describe the di	fferent circuit	types			F
<b>CO12:</b> Describe the m	ieters and exp	osure timers	c .	<u> </u>	75
<b>CO13:</b> List the control	l of scattered 1	radiation	वाश्	।साधनम्	5
<b>CO14:</b> Describes abou	it the fluorosc	opy NCA	HF		12
Teaching Scheme	Total	Examination Sch	eme	1 8	
(In Hours)	Credits (L+T+P)	Theory Marks	- V - F	ractical Marks	Total Marks

	10013		(L+T+P)				VIAIKS	Total Walks
L	T	Р	С	CIE	ESE	CIE	ESE	
2	1	6	6	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Basic concepts</b> : Units and measurements-Force, work, power and energy-Temperature and heat-SI units of above parameters. Atomic structure-atom model-Nucleus-electronic configuration-periodic table- Isotopes-Ionization-excitation-Binding energy-electron volt- Electromagnetic radiation-Quantum nature of radiation-mass energy equivalence-Fluorescence-electromagnetic spectrum.	4	5
2.	<b>Electricity and magnetism</b> : Electric charges, Coulomb's law-Unit of charge-Electric potential, unit of potential-Electric induction, capacitance and Capacitors, series and parallel connection-electric current, unit, resistance, ohm's law, electric power, Joule's law. Varying currents-Growth and decay of current in LR circuit time constant, charge and discharge of a Capacitor through a resistance and inductance. Oscillations in an LC circuit. Alternating currents: Peak and RMS values and current and voltage, circuit containing LR, CR and LCR-Power factor, series and parallel LCR circuits, DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Kirchhoff's law, heating effect of current.	4	SSHOW
ŀ	<b>Electromagnetic waves</b> : Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atmosphere.		SNOI
3.	<b>Electronics</b> Semiconductors; Conduction in crystals, Energy bands. Intrinsic and Extrinsic semiconductors n-type and p-type semiconductors, majority and minority carriers. Semiconductor diodes: p-n junction-properties forward and reverse bias, characteristics of p-n junction Rectifiers-Half-wave and full wave, ripple factor, Efficiency of HW and FW rectifiers. Filter circuits; Zener diode, regulated power supply.		- LLb 11 5
	Transistors-Symbols, Transistor connections and characteristics, Transistor as an amplifier, load line analysis, operating point, types of amplifiers-voltage and power amplifiers. Feedback-negative feedback in amplifiers.	di	
4.	<b>Discovery of x-rays-X-ray production and properties</b> : Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X- ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.	4	5
5.	<b>Heat</b> Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer-conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling,	4	5

	Heat radiation, perfect black body, Stefan law, application in Diagnostic Radiology (Heat dissipation in both stationary and rotating X-ray tubes).		
	<b>Interaction of ionizing radiation with matter</b> -Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.		
6.	Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-photonuclear disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat- soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.	4	5
	<b>Exponential attenuation</b> (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.	CAPA	
7.	Radiation intensity and exposure, photon flux and energy flux density. LET, range of energy relationship for alpha, beta particles with X-Rays.	3	5
	<b>Physical quantity, its unit and measurement</b> : Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit.		FESS
8.	<b>X-ray tube:</b> historical aspects, construction of X-ray tubes, requirements for X-ray production(Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes(Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle-space charge effect, tube cooling-Modern X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-ray-factors influencing them.	4	IONS Lato
	<b>Production of x-rays:</b> X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, methods of cooling the anode, rating chart and cooling chart;	de le	
9.	<b>Rotating anode x - ray tube:</b> construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum.	4	5
	Grid controlled and high-speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection.		

	Heat dissipation methods, tube rating, heat units, operating		
	conditions and maintenance and QA procedures.		
	Filament current and voltage, X-ray circuits (primary circuit, auto		
	transformer), types of exposure switch and timers, principle of		
	automatic exposure control (AEC) and practical operation, filament		
	circuit, high voltage circuits, half wave, full wave rectification, three		
	phase circuits. Types of generators, 3 phase, 6 and 12 pulse circuits-		
	high frequency generators-falling load generators, Capacitors discharge		
10	and grid control systems.	1	5
10.	X-ray generator circuits: Vacuum tube diodes-semi-conductor	7	5
	diodes-transistor-Rectification-half and full wave-self rectification-X-		
	ray generator; filament circuit-kilo Voltage circuit-single phase		
	generator-three phase generator-constant potential generator-Fuses,	C	
	switches and interlocks-Exposure switching and timers-HT cables-	YS	
	earthing.		
	5	. <	2
	<b>High tension circuits:</b> H.T. generator for x-ray machines, three phase	-	2
	rectifier circuits, th <mark>ree phase</mark> six rectifier circuit, three phase 12 rectifier		2
	circuit, high and medium frequency circuits; capacitance filter control		m
11.	and stabilizing equipment; mains voltage compensator, mains	2	6
	resistance compensator, compensation for frequency variation, control	-	S
1	of tube voltage, kV compensator; high tension selector switch, filament		O
	circuit, control of tube current, space charge compensation.		Z
-			S
	Meters and exposure timers: Moving coil galvanometer:		
	construction and working/conversion to millimeter, ammeter and		
	voltmeter, meters commonly used in diagnostic x-ray machines, pre		F
12.	reading kV meter and millimeter, digital panel meters. Clockwork	3	5 5
	timers, synchronous motor timer, electronic timers, photo metric	t k	
	timers (fluorescent and photoelectric effect as applied in timers), ion	1 B	
	chamber-based timers, integrated timer.		
	Control of scattered radiation and Beam limiting devices: cones	XC	/
	diaphragms, light beam collimator, beam centering device, methods to	02	
	verify beam centering and field alignment; Filters- inherent filters.		
	added filters, heavy metal filters, grids; design and control of scattered		
13.	radiation grid ratio grid cut-off parallel grid focused grid crossed	2	5
	orid orided cassettes stationary and moving grid potter bucky		
	diaphragms various types of grid movements; single stroke movement		
	oscillatory movement and reciprocatory movement		
	security movement and reciprocatory movement.		
	Fluoroscopy: Fluorescence and phosphorescence - description,		
14	fluorescent materials used in fluoroscopic screens, construction of	4	F
14.	fluoroscopic screen and related accessories, tilting table, dark	4	5
	adaptation. Image intensifier - Construction and working, advantages		

		· · · · · · · · · · · · · · · · · · ·	
	over fluoroscopic device, principles and methods of visualising		
	intensified image, basic principles of closed circuit television camera		
	and picture tube. Vidicon camera, CCD. Automatic brightness control,		
	automatic exposure control, chamber selection during fluoroscopy.		
	Serial radiography: Manual cassette changer, rapid automatic film		
	changer, basic principles of cine fluoroscopy and angiography use of		
	grid controlled x-ray tube.		
	Care and Maintenance of X-ray equipment;		
15.	General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an x-ray tube, testing the light beam	2	3
	diaphragm, practical precautions pertaining to Brakes and locks, H.T.		
	cables, meters and controls, tub <mark>e stands and tracks as</mark> well as accessory	C.	
	equipment.	12	
	S		70
	Total	54	
	G		3
			T
SUCCI			T
30661	ESTED PRACTICALS/DEMONSTRATION		

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	Radiological physics	Hours 10
12	Discovery of X-ray production and properties	10 5
2.	Interaction of ionizing radiation with matters	10
3.	Exponential attenuation, Physical quantity, its unit and measurement	10
4	Medical Physics	
4.	X-ray tube; Production of x-rays	18
5.	Rotating anode x - ray tube; Grid controlled and high speed tubes; Heat dissipation methods	10
6.	Filament current and voltage; X-ray generator circuits	10
7.	High tension circuits; Interlocking circuits; Relays	10
8.	Meters and exposure timers	10
9.	Fluoroscopy	10
10.	Care and Maintenance of X-ray equipment	10
	Total	108

# **Evaluation System**

### **Continuous Internal Evaluation (CIE)**

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	-		-
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total RALLILD AN	50 1	0.3	15
2.	Continuous assessment	15A		
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment		HCAP	
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of question	ons M <mark>arks</mark> question	perTotal
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150



...नम् +HP 2021 2021 देखा-रेखा There shall be practical examination for 70 marks in the subject.

Distribution of marks for university examination practical exams:

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

### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Basic radiologicalphysics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2.	Christinsens physics of diagnosticradiology	Curry and Dowdey	Wolters Kluwer
3.	X-Ray Equipment for Student	D.N. And M.O. Chesney	Blackwell Science Ltd
4.	A Textbook Of Radiation Physics For Radiologic Technology	Surendra Maharjan,Suraj Sah	Samiksha Publcation
5.	Radiographic Imaging (Cbs)I.C.R.P.	D.N. Chesney & M.O Chesney	CBS Publishers & Distributors
6.	An Introduction Of Physics to Diagnostic Radiography	Christensen, Curry &Dowdey	Lea&Febiger
7.	Radiological Science for technologists	Stewart C Bushong	Mosby
8.	Equipment for Diagnostic Radiography	E. Forster	Springer Dordrecht

### SUGGESTED LEARNING RESOURCES

स्वास्थ्यम् सर्वार्थसाधनम् NCAHP Since-2021 अर्रेर स्वास्थ्य देखान्रेख

### Subject: Clinical Special Radiography Positioning

### Subject Code: MMRIT02

### RATIONALE

Clinical Radiography Positioning provides the students with knowledge of x-ray imaging, positioning and all the care that should be taken.

### **COURSE OUTCOMES**

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

**CO1:** Understand the basic patient positioning during radiographic investigation.

CO2: Apply special positioning skills for different pathological and physical conditions.

CO3: Application of equipments while working in radiology departments.

**CO4:** Choose proper position during radiography.

**CO5:** Explain relative positions of x-ray tube and patient relevant exposure factors during radiography.

**CO6:** Explain the use of accessories.

**CO7**: Explain the anatomic and physiological basis of the procedure to be undertaken.

CO8: Explain the radiographic appearances of both normal and common abnormal conditions.

**CO9:** Prepare management and positioning of patients

**CO10:** Correlate of indications, contraindications of the patient

**CO11:** Understand the patient preparations needed before any radiological examination.

**CO12:** Generalize knowledge of post procedural care.

**CO13:** Students will be able position the patients for radiological procedures.

CO14: Knowledge of image quality in radiological images.

CO15: Management of patients in radiology department for various procedures.

**CO16:** Ability to handle emergency situations in radiology department.

Tea	aching S	cheme	Total	Examination Scheme				
(In	Hours)		Credits (L+T+P)	Theory	Marks	Practical N	Marks	Total Marks
L	Т	Р	С	CIE	ESE	CIE	ESE	
2	2	6	7	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
ational of the second s	<b>Principles of Radiography:</b> Preparation of the Room, Apparatus and Instruments Positions of the Patient: Erect, Sitting, Supine, Prone, Lateral, Oblique, Decubitus Etc. Relative position of X-Ray tube and patient, relevant exposure factors. Use of accessories such as radiographic cones, grid and positioning aids. Anatomic and Physiological basis of the procedure, Association with theory with practical work. Radiographic appearances, both normal and common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique. Modifications in technique for various disabilities and types of subject. Radiation protection, use of gonad shield, practical methods of reducing radiation dose to the patient.	6 CHREPHO	5 DFESSION
2.	Upper limb: Special projections for the whole hand, fingers, wrist joint, forearm, elbow joint and humerus. Supplementary projections for Scaphoid, Carpal tunnel, Ball Catchers projections, Head of the Radius, Supracondylar fracture and Olecranon process	6	۶/۲۰ S
3.	Lower limb: Special projections for the whole foot, toes, calcaneum, ankle joint, leg, knee- joint, patella and femurs. Supplementary projections for Talo-Calcaneal joint, Forced projections for torn ligaments, Flat Feet, Club Feet, Intercondylar projections for loose bodies in the knee, Axial projection for Patella.	6	9
4.	Shoulder Girdle and Thorax: Special projections for the shoulder joint, Scapula, Acromio- Clavicular joint, Clavicle, Sternoclavicular joint, Sternum and Ribs. Supplementary projections for the axial projection of Clavicle, Bicipital groove, Coracoid process.	6	6

5.	Vertebral Column: Special projections for Atlanto -Occipital joint, cervical spine, Cervico- thoracic Junction, thoracic Spine, lumbar Spine, Lumbo Sacral Region, Sacrum and Coccyx. Supplementary projections for the intervertebral foramina, posterior arch of Atlas, Flexion and Extension of Cervical Spine, Scoleosis and Kyphosis, Sacro Ileac Joint.	6	6
6. 7ENOITEN	<ul> <li>Skull:</li> <li>Special projections for cranium and facial bones;</li> <li>Supplementary projections for trauma, Towne's method,</li> <li>Sellaturcica, Optic foramina, Jugular foramina, Temporal bones,</li> <li>Mastoids, Petrous bone, Zygomatic arches, Orbits, Maxillae,</li> <li>Nasal bones, Mandible, Temporomandibular joints.</li> <li>Nasal Sinuses: Techniques for Frontal, Maxillary, Ethmoidal and</li> <li>Sphenoid Sinuses, erect and horizontal projections for fluid levels.</li> <li>Pelvic girdle and hip region:</li> <li>Special projections for the whole pelvis, Sacro-Ileac joints, hip</li> <li>joint and Neck of Femur.</li> <li>Supplementary projections for the greater and lesser trochanters of Femur.</li> <li>Frog leg projection, Ischeum, Symphysis Pubis, Ileum,</li> <li>Acetabulum and Congenital Dislocation of Hip, Arthrodesis.</li> <li>Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.</li> </ul>	6	6 DEESSIONS
8.	Dental Radiography         Technique for intra oral full mouth Occlusal projections         Extra oral projections including orthopantomography         Supplementary techniques.         Upper respiratory system         Technique for postnasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre Phonation.         Lungs       and         Supplementary projections: Antero-posterior obliques lordotic	6 AL	6
9.	<ul> <li>apical projections. Antero-postenor, obliques, fordotic, apical projection, use of penetrated postero-anterior projection Expiration technique Technique for pleural fluid levels and adhesions.</li> <li>Abdominal viscera-</li> <li>Technique for plain film examination Projection for acute abdomen patients Technique to demonstrate: Foreign bodies, Imperforate anus.</li> </ul>	6	6

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

# SUGGESTED PRACTICALS/DEMONSTRATION

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

Sr No		Hours
01.140		
	Multiple radiography	
	High kV Radiography	
	Scatter elimination; beam collimation; grid ratio	
	Speed and type of grid movement	
	Radiographic factor; application and uses	
13.	Neonatal and Paediatric Radiography; Forensic Radiography	
	Macroradiography Localization of foreign bodies	5
	Total	108
Evaluation	n System	TREP
Continuo	is Internal Evaluation (CIE)	PO

### **Evaluation System**

### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			T
	Two Written tests	50		()
	Same pattern as Summative test			0
	• Average of two to be considered			9
	• Absence without prior permission to	be		2
	marked as 0			0,
	Total	50	0.3	15
2.	Continuous assessment	<u>.</u>	_	-
	Seminars/Case presentations/ Logbook/ C	Case		1
	records/Record book/assignment			N
	The pression of the	यसाध	194	i k
	Total	50	0.3	15
	Total CIE marks	11	dE	30
	Since-20	)21	A.	
	867 2-11		2201	
	WIR THE	T ZEP		
	, rd ker	1 4		

End Semester Evaluation (ESE)

### Written Paper

Type of questio	n			No. of questi	ons Marks question	perTotal
Long Essay				2	15	30
Short Essay				8	5	40
						70
Duration (minute	es)					150
Distribution of m	arks for univ	ersity ex		on practical exam	ns: Grand total	I PP
0	Practical	Viva		Sub Total		í ch
A	50	20	30	100	100	E.
SUGGESTED L	EARNING	RESO	URCES			1015
S. Tide of I	D 1-	>		Andrea		S

# End Semester Evaluation (ESE)

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

# SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Atlas of Radiographic Positioning and Radiological Procedures	Philip W Ballinger, Eugene D. Frank	Mosby
2	Clarks Positioning In Radiography	Ra Swallow, E Naylor	Lippincott Williams and Wilkins
3	Merrill's Atlas of Radiographic Positioning and Procedures	Bruce W. Long & Jeannean Hall Rollins & Barbara J. Smith	Mosby
4	Bontrager'S Textbook Of Radiographic Positioning And Related Anatomy	John Lampignano and Leslie E Kendrick	Elsevier Science
5	Radiology Of Positioning And Applied Anatomy For Students And Practitioners	GarkalGs	Jaypee Brothers Medical Publishers

### Subject: Biostatistics and Research Methodology

### Subject Code: MMRIT03

### **RATIONALE:**

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

### **COURSE OUTCOMES**

At the end of the course students will be able to... **CO1:** Understand the Importance of statistics course in the curriculum

**CO2:** Understands Statistical Terms

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

Tea	aching S	cheme	Total		Examin	ation Scheme		1	
(In	Hours)	52	Credits (L+T+P)	~	Theory	Marks	Practical N	Marks	Total Marks
L	47 A	Р	С	/	CIE	ESE	CIE	ESE	FE
2	M		3		30	70	-		100 5

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

# **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency. 

4 2

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

	Ungrouped and Grouped; Meaning Comparison of the Mean, and Mode Various Measures of Central Tenden	; and Calculation of M e; Guidelines for the Us cy.	lode; se of	
4.	Measure of Variability: Need For M Range, the Average Deviation, T Deviation; Calculation of Variance Ungrouped and Grouped.	Measure of Dispersion. he Variance and Stan e and Standard Devia	The dard tion, 6	15
5.	Probability and Standard Distribution Standard Distribution, The Binomin Distribution; Divergence from Norm	ns: Meaning of Probabili al Distribution. The No nality - Skewness,Kurtos	ty of rmal is 6	10
6.	Sampling Techniques: Need For Sa Samples. Application of Sampling in Sampling and Sampling Designs Errors. Sampling Variation a	mpling - Criteria for C Community, Procedur and Tests of Significance	Good es of 6	10
	C			2
Total	1		54	70
Evalua Continu	tion System uous Internal Evaluation (CIE)			NOISS
Sl. No.	Component	Marks	Weightage	e IA marks
1.	Sessional test(s)			
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be m	50 narked as 0		Irlik I
	Total	50	0.3 🔨	15
2.	Continuous assessment	AHP	d	
	Seminars/Case presentations/ Logbo	ok/ Case	X	-

End Semester Evaluation (ESE)

Total CIE marks

Total

records/Record book/assignment

50

15

30

0.3

### Written Paper

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

# SUGGESTED LEARNING RESOURCES

S. No	. Title of Book	Author	Publication
1	Elements of HealthStatistics	Rao.N.S	PR
2	An introduction ofBiostatistics	Sunder Rao	FE
3	Methods inBio-Statistics	B.K. Mahajan	S S.
4	Elementary Statistics in MedicalWorkers	Inderbir Singh	ION
5	An Introduction to. Statistical Methods, Ram Prasad &Sons	Gupta C.B	S

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

सिंह बहु अगेर र

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

Since-2021



"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# Som FOR AI HEALTHCARE PROFESSIONS . Second Semester

Since-2021

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### Subject Code: MMRIT04

# RATIONALE

Modern radiological Imaging Equipment and Physics provides the students knowledge about the modern x-ray equipment and working principle. Modern imaging techniques - including X-rays, ultrasound, CT scans and MRI - can show structures inside your body in great detail. Radiologic Physics is the study of opt. mages w medical imaging components, technology, and parameters in an effort to produce optimal imaging results. The goal with studying radiologic physics is to ensure you get clear images while ensuring the patient is safe from radiation.

# **COURSE OUTCOMES**

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

**CO001:** Describe the special radiological equipments

**CO002**: Describe the digital and computed radiography

# **CO003:** Describe PACS, RIS and HIS

Teaching Scheme	Total	Examination Scheme			S.	
(In Hours)	Credits	Theory Marks		Practical Marks		Total
(L+T+P)						Marks
L T P	C	CIE ES	SE	CIE	ESE	S
3 1 4	6	30 70		30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	Modern x-ray tube: its principle, physics & equipment	5	5
2.	Digital Radiography: its principle, physics & equipment. Flat panel digital fluoroscopy and radiography system, Direct and indirect digital radiography and fluoroscopy systems. Digital radiography and Computed radiography its advantages, disadvantages and applications. Digital Portable and mobile x-ray units	5	5

3.	Dual energy x-ray absorptionometry (DEXA) scan: its principle, physics & equipment	5	5
4.	Computed radiography: its principle, physics & equipment.	5	5
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5	5
6.	Modern dental equipments. Cone beam dental CT	5	5
7.	Bone mineral density test: its principle, physics & equipment	5	5
8.	Picture archiving and communication system (PACS), RIS, HIS and Teleradiology	5 THC	5
9.	Computed Tomography	7 7	5
10.	Magnetic Resonance Imaging	5	5
11.	Ultrasound Imaging	5	5
12.	Hybrid Imaging	5	5
13.	Smart Simulator/virtual imaging	5	50
14.	Artificial Intelligence in Modern Radiological Imaging	5	5 2
<b>F</b> otal		72	700

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Modern x-ray tube: its principle, physics & equipment	जि कि
2.	Digital Radiography NCAHP	5
3.	Dual energy x-ray absorptionometry (DEXA) scan: its principle, physics & equipment	2
4.	Computed radiography A Forces	3
5.	Mammography and Tomosynthesis: its principle, physics & equipment	5
6.	Modern dental equipments. Cone beam dental CT	3
7.	Bone mineral density test: its principle, physics & equipment	2
Sr. No		Hours
--------	-------------------------------------------------------------	-------
8.	Picture archiving and communication system (PACS), RIS, HIS	
	and	5
	Teleradiology	
9.	Computed Tomography	5
10.	Magnetic Resonance Imaging	5
11.	Ultrasound Imaging	5
12.	Hybrid Imaging	5
13.	Smart Simulator/virtual imaging	'IC
	AI Imaging	4 7 2
Total	No.	54

#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
	Sessional test(s)			0
4	Two Written tests	50 <		2
	Same pattern as Summative test			S
	Average of two to be considered			
	Absence without prior permission to be marke	ed as 0		
	Total	50	0.3	15
2.	Continuous assessment	6.6		4
	Seminars/Case presentations/ Logbook/ records/Record book/assignment	Case	वनम्	15
		ЦФ	1	
	Total	50	0.3	15
	Total CIE marks Since-	2021	30.	30
	के अर्थर स्वास	व्य देखाँ	Frei	

End Semester Evaluation (ESE)

#### Written Paper

Type of question			No. of questions	sMarks per question	rTotal	
Long Essay			2	15	30	
			8	5	40	
					70	
					150	
tical examina ks for unive:	ation for ersity exa	: 70 marl imination	ss in the subject. practical exams:	CALTHCA		
ESE		CIE		Grand total	$\sim$	
Practical	Viva		Sub Total		0	
50 20 30 100 100						
EARNING	<b>RE</b> SOI	JRCES		K	FESS	
	aluation (E tical examina ks for unive ESE Practical 50 CARNING	Aluation (ESE) tical examination for the for university examination ESE Practical Viva 50 20 CARNING RESOU	Aluation (ESE)         Sical examination for 70 marks for university examination         ESE       CIE         Practical       Viva         50       20       30         EARNING RESOURCES       CIE	No. of questions         2         8         Bluation (ESE)         ED AND         cical examination for 70 marks in the subject.         ks for university examination practical exams:         ESE       CIE         Practical       Viva       Sub Total         50       20       30       100	No. of questions       Marks question       perequestion         2       15         8       5         Aluation (ESE)         EDAtion of proton marks in the subject. ks for university examination practical exams:         ESE         CIE       Grand total         Practical       Viva       Sub Total         50       20       30       100	

11	ESE		CIE	2	<mark>Gran</mark> d total
1	Practical	Viva		Sub Total	
	50	20	30	100	100

#### SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication =
1 5	Textbook of Radiology: Physics	Amol Sasane, Hariqbal	Jaypee Brothers Medical
4	Textbook of Radiology. Thysics	Singh, Roshan Lodha	Publishers
2	The Physics Of Radiology And	THAVALANK	Jaypee Brothers Medical
	Imaging		Publishers
3	8	Thomas S.	R
	Christensen's Physics of Diagnostic	Curry (Author), James E.	Lea & Febiger U.S
	Radiology	Dowdey (Author), Robert	Lea eer conger, e.e
	NC NC	E. Murry (Author)	Æ
4	Textbook Of Radiology For	BHARGAVA S. K	CBS: publishers
	Residents And Technicians	x9	SEC, paralelle
5	Ultrasound physics and technology	Vivien gibbs, davidcole,	Churchill Livingstone
	citiasound physics and technology of	Antonio sassano	Citaterini Extingutorie,
6	Manual of Diagnostic Illtrasound	Philip E. S.	World Health
		Palmer (Author)	Organization
7	Physics and Technical Aspects	DINESH K	ATTRS DUBI ISHERS
	Diagnostic Ultrasound	BAGHEL (Author	ATTD3 T UDLISTIENS

#### Subject: Contrast Media and Interventional Radiology

#### Subject Code: MMRIT05

#### **RATIONALE**

Interventional radiology (IR) helps student MRIT to gain about the basics diagnostics and interventional procedures and to learn procedures in modalities like digital radiography CT and MRI and nuclar medicine and to increase the level of understandings and knowledge required to meet current radiologic procedures and to understand the physical principles of radiography and basic radiography positioning to perform the procedures. it a medical specialty that performs various minimally-invasive procedures using medical imaging guidance, such as x-ray fluoroscopy, computed tomography, magnetic resonance imaging, PR or ultrasound. IR performs both diagnostic and therapeutic procedures through very small incisions or body orifices

#### **COURSE OUTCOMES**

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

CO1: Know the basic principle and physics of interventional equipment.

CO2: Know the management and positioning of patients while performing interventional radiological procedure.

CO3: Have knowledge about the indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for the different interventional radiological procedure.

CO4: Understand the patient preparation needed before any interventional radiological procedures. CO5: Have knowledge about the post procedural care and safety.

Teaching Scheme	Total	Examin	ation Scheme			
(In Hours)	Credits	Theory	Marks	Practical N	Marks	Total Marks
4	(L+T+P)					F
L T P	С	CIE	ESE C	CIE	ESE	R
2 1 4	51142	30	70 9 9	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

Since-2021

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Contrast Media</b> : Positive and Negative, Ionic &Non Ionic, Adverse Reactions to contrast media and patient management.	8	10
2.	Introduction to interventional procedures <b>DSA:</b> principles and types <b>Equipment:</b> Basics of angiographic equipments, single and biplane angiographic equipments, angiographic table, image intensifier, flat panel detectors, recording systems, pulseoximetry, cardiac resuscitation measure-ECG, pressure injector, catheters, needle and other tools, 3D rotational angiography, image processing, patient monitor, CO2 angiography	THICAD	10
3.PM	Interventional procedures:Catheter- classification, typesand applications, Guide wire-classification, typesandapplications,PressureInjectorand Accessories,Percutaneouscatheterization,Digital SubtractionAngiography, Catheterization Sites, Asepsis	8	SSIONS
4.	<ul> <li>Arteriography: Head and Neck Arteriography, Pulmonary Arteriography, Coronary Arteriography, Ascending Aortography, Trans Lumbar Aortography, Renal Arteriography, Trans Femoral Arteriography</li> <li>Venography: Peripheral Venography- Lower Limb, Upper Limb, Central Venography, Superior Venacavography, Inferior Venacavography, Pelvic Venography</li> </ul>		20
5.	Safety considerations in angiography room; room design, protective devices, radiation monitoring	5	10
6.	<b>Care and maintenance tests:</b> General care, functional test <b>Quality assurance program:</b> Acceptable limits of variation, corrective action	5	10
Total		54	70

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
5.	Contrast Media	10
6.	Basics of angiographic equipments	10
7.	Catheter and guide wires ALLIED AND HEAT	10
8.	Arteriography and venography procedures	20
9.	Safety considerations in angiography room	12
10.	Care and maintenance tests Quality assurance program:	10
VO	Total	72 0
IL		01
Evaluation	System	SN

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	<u> </u>		A
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50 <b>4   &amp;   *</b> D		lho
	Total Since-202	50	0.3	15
2.	Continuous assessment	R	91	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	301-		
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

#### Written Paper

Type of question	on			No. of questi	onsMarks question	perTotal
Long Essay				2	15	30
Short Essay				8	5	40
						70
Duration (minute	es)	/	. 1			150
Distribution of m	arks for univ	ersity ex	xaminatio	on practical exar	ns:	NPT P
S	ESE		CIE		Grand total	R
~	Practical [Variable]	Viva		Sub Total		OT T
Z	50	20	30	100	100	E
0				-		S.
SUGGESTED I	LEARNING	RESO	URCES			NON
S. Z	Rook	-	Δ.,	thor		Publication

#### End Semester Evaluation (ESE)

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

#### SUGGESTED LEARNING RESOURCES

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

#### Subject: Modern Imaging and Special Radiological Procedures

#### Subject Code: MMRIT06

#### RATIONALE

Contrast & Special Radiological Procedures are diagnostic procedures usually performed by giving contrast through oral or intravenous to diagnose the disease. These imaging procedures are done under the guided of fluoroscopy or c-ram equipment.

#### **COURSE OUTCOMES**

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

**CO1:** Prepare management and positioning of patients while performing radiological procedures.

CO2: Correlate of indications, contraindications, contrast media, radiation dose, exposure timing and radiation safety measures for different radiological procedures. DROFESSIONS .

**CO3:** Understand the patient preparations needed before any radiological examination.

**CO4:** Generalize knowledge of post procedural care.

**CO5:** Students will be able position the patients for radiological procedures.

**CO6**: Knowledge of image quality in radiological images.

**CO7**: Management of patients in radiology department for various procedures.

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**CO8:** Ability to handle emergency situations in radiology department.

**CO9:** Precautions and care required in interventional suits.

Teaching Scheme Total			Examination Scheme					
(In Hours)			Credits	Theory Marks Practical Marks		Total Marks		
6			(L+T+P)	Sir	ice-2021	1	A AL	
L	Т	Р	C C 3X	CIE	ESE	CIE	ESE	
2	1	4	5	30	70 792	30	70	200

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CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

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

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
5.	General approach to special radiographic procedures, responsibility of radiology technologist during radiological procedures	10
	Contrast media and their adverse reactions to contrast media and patient management	
6.	Procedures for gastrointestinal tract including barium studies Procedures for biliary tract	1574
7.	Procedures for urinary system and reproductive system	15
8.	Procedures for central nervous system and respiratory system	15 Rof
9. 🤜	Other procedures in radiology: Arthrography, Sialography,	E
	Lymphograph <mark>y, S</mark> inography & Fistulograp <mark>hy,</mark>	
2	Dacryocystography, Embolization & embolic agents	17
<b>I</b> AT	Related Advanced procedures.	SNC
	Total	72

#### सर्वार्धसाधनम Continuous Internal Evaluation (CIE)

Evalua	tion System	<u>_</u>		*
Contin	uous Internal Evaluation (CIE)	रिसाध	नम् 🎖	
Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		98	
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50	et de	
	Total	50	0.3	15
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

#### Written Paper

Type of question				No. of questions	Marks p question	erTotal
Long Essay				2	15	30
Short Essay				8	5	40
						70
Duration (minutes)						150
There shall be pract Distribution of mar	tical examir ks for univ	nation for er <mark>sity exa</mark>	70 marl	ss in the subject. n practical exams:		IP.
00	ESE		CIE		Grand total	R
~	Practic <mark>al</mark>	Viva		Sub Total		T
A	50	20	30	100	100	E
SUGGESTED LE	CARNING	RESOL	JRCES			SION

#### End Semester Evaluation (ESE)

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

#### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Radiographic Imaging (Cbs)I.C.R.P.	Bhushan and Lakkhar	Arya Publications
2	A guide to radiological procedures	Chapman EFF	Elsevier

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

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



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# Elective – Specialization of CT Imaging Technology Third Semester

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

#### Subject: Principles of CT Imaging Technology

#### Subject code: MMRIT07

**Rationale:** It aims to provide knowledge related to the basic working principle and construction of CT scanners and the various hardware and software mechanisms required for obtaining the cross-sectional imaging. It also gives a brief review of the history and evolution of the CT scanners.

#### **Course Outcome**

#### At the end of the semester student must be able to:

**CO1:**Should gain a comprehensive understanding of the principles behind CT imaging, including the physics and technology involved in generating cross-sectional images.

**CO2:**Will learn the practical aspects of CT scanning such as patient positioning, selection of appropriate protocols and the use of contrast agents.

**CO3:**Students should be able to explain the process of image reconstruction in CT and understand how raw data is transformed into meaningful images.

**CO4:**Will learn to assess CT image quality and identify common imaging artefacts, as well as strategies to minimize or correct these artefacts.

Teaching Scheme Total			Examin	ation Scheme			9	
(In Hours)		Credits	Theory Marks		Practical Marks		Total	
			(L+T+P)					Marks
L	Т	Р	С	CIE	ESE	CIE	ESE	E
2	1	4	5	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content	Hours	Marks
1	Introduction to CT: Basic principle of tomography, definition of terms,	7	10
	Image reconstruction from projections. AI in CT		
2	Evolution of terms	3	3
3	Process: data acquisition and image reconstruction	6	10
	Image display, Processing, storage, Recording and communications		
4	Working of CT	10	15
	Basic principle of CT	P/	
	Instrumentation	0	
	Reconstruction algorithms	T	
	AI in CT	C	E \
5	History of CT:	3	2
	Early experiments by Godfrey Newbold Hounsfield, Allan Macleod		S
Ĩ	Cormack		9
6	Generations of CT	7	10
	Generation of CT /Geometry		
7	Fast scanner	7	7
	Helical/ Spiral scanner	T	
	Applications of volume scanning	R	
	AI in CT	<u></u> 5	
8	Image formation in CT	9	10
	Hounsfield unit, CT windowing, CT image quality		
	CT artifacts.		
	Quality assurance and control in CT		
	AI in CT		
9	Merits and demerits of Computed tomography	2	3
	Total	54	70

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Introduction and History CT and Evolution of terms	6
2.	Process and Working in CT	19
3.	Generations and Image formation in CT	25
4.	Fast scanner Merits and demerits of Computed tomography	20
	Total	72
		Tp.
Evaluatio Continuo	n System us Internal Eval <mark>uation (</mark> CIE)	EPROF

#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			S
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as (	50		SNOI
	Total	50	0.3	15
2.	Continuous assessment			F
	Seminars/Case presentations/ Logbook/ Cas records/Record book/assignment	^{se} श्रीसाध	अनम्	1A LA
	Total	50	0.3	15
	Total CIE marks	Γ	2E	- 30
End Se Writter	emester Evaluation (ESE) Since-202	21	stel al	

## End Semester Evaluation (ESE)

#### Written Paper

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

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#### End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100
EARNING	RESO	JRCES	IED AND	HEALT

#### SUGGESTED LEARNING RESOURCES

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S. No.	Title of Book	Author	Publication
1.	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid         Seeram         RT(R)           BSc         MSc           FCAMRT         (Author)	Saunders
2.	Computed Tomography for Technologists: A Comprehensive Text	Lois Romans	Lippincott Williams and Wilkins;
3.	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley-Blackwell
4.	The CT Handbook: Opt <mark>imizin</mark> g Protocols for Today's Feature-Rich Scanners	<u>Timothy P.</u> <u>Szczykutowicz</u>	Medical Physics Publishing Corporation

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#### Subject: CT Imaging Procedures and Scanning Protocols

#### Subject code: MMRIT08

#### Rationale

CT Procedures and Scanning Protocol course is to provide participants with a comprehensive understanding of the various procedures involved in computed tomography (CT) imaging and the principles of selecting appropriate scanning protocols for different clinical scenarios. AND HEALTH,

#### Outcome

At the end of the semester student must be able to:

**CO1:**CT procedures and scanning protocols result in high-quality images that allow radiologists and healthcare professionals to make accurate and precise diagnoses. Clear and detailed CT images aid in identifying and characterizing various medical conditions, such as tumors, fractures, infections, and other abnormalities.

**CO2**: Will be able to acquire Accurate CT imaging helps healthcare providers create effective treatment plans for patients. The information obtained from CT scans can guide surgical procedures, radiation therapy, and other interventions, leading to improved patient outcomes.

**CO3:**Must follow appropriate scanning protocols and employ dose reduction techniques to minimize the amount of radiation the patient receives during the scan. This ensures that the benefits of the CT scan outweigh any potential risks associated with radiation exposure.

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Teac	hing Sch	neme	Total	Examin	ation Scheme			P
(In F	Iours)	$\langle \mathcal{H}$	Credits	Theory	Marks 💛	Practical N	Marks	Total
		2	(L+T+P)	NIC				Marks
L	Т	P	С	CIE	ESE	CIE	ESE	
2	1	4	5	30	9 ₇₀ 2021	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

S. No	Торіс	Hours	Marks
1	CT Head and Neck: CT Brain, Cerebral Angiography, CT orbit,	10	10
	CT face with 3D post-processing, CT temporal bone, CT PNS, CT		
	neck, neck angiography, Head and neck venography, CT cisternography		
2	CT Thorax: CT thorax (Supine, prone, Expiratory), HRCT	8	8
	thorax, CT pulmonary angiog <mark>raphy, CT aortograp</mark> hy.	Ca	
3	CT Abdomen and Pelvis: CT KUB, CT abdomen (Dual and triple	12	15
	phase), Liver, pancreas and renal protocol, CT enterography, CT	1	
	pelvis, CT abdominal angiography, CT renal angiography, CT	1	8
-	urography, CT cystogram		T
4 3	CT Musculoskeletal System: CT shoulder, elbow, wrist, hand,	8	10
G	hip, femur, k <mark>nee, tib</mark> ia & fibula, ankle, foot. CT p <mark>eripher</mark> al		S
	angiography/Venography.		9
5 Z	CT Spine: CT whole spine, CT cervical, thoracic, lumbar and LS	9	15
	spine, CT sacrum & coccyx, CT Myelography. Lumbar Puncture,		
	CSF Aspiration.		1
6	Miscallaneous: Paediatric CT, Adult Whole-body CT, CT	7	12
	fluoroscopy, Breast CT Imaging	T Á	
	Total	54	70
SUGGES	TED PRACTICALS/DEMONSTRATION	S.E.	

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	86° 374	Hours
1.	CT Head and Neck	10
2.	CT Thorax	10
3.	CT Abdomen and Pelvis	10
4.	CT Musculoskeletal System	10
5.	CT Musculoskeletal System	10
6.	CT Spine	10

Sr. No		Hours
7.	Miscallaneous	12
	Total	72

#### **Evaluation System**

## Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks CA	Weightage	IA marks
1.	Sessional test(s)	14	· / Ka	
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50	CAPK	0
	Total	50	0.3	15
2.	Continuous assessment		2	2
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			ESS
i	Total	50	0.3	15 🔵
<	Total CIE marks			30 Z
End Se	mester Evaluation (ESE)			S

Written	Paper
	1

Type of question	No. of questions	Marks per	Total
	5 5	question	R
Long Essay	2सवाशर	15 <b>894</b>	30
Short Essay	<b>SAHP</b>	5	40
Sin	ce-2021	A.	70
Duration (minutes)		261	150
अर स्ट	TS REFE	GIA	

#### End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

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

# SUGGESTED LEARNING RESOURCES IED AND HE

-			
S. No.	Title of Book	Author	Publication
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders
2	Computed Tomography for Technologists: A Comprehensive Text	Lois Romans	Lippincott Williams and Wilkins;
3. OITA	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley- Blackwell
4. Z	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	<u>Timothy P.</u> <u>Szczykutowicz</u>	Medical Physics Publishing Corporation

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#### Subject: Basic and Cross Sectional Anatomy in CT Imaging

#### Subject code: MMRIT09

#### Rationale

CT Cross Sectional Anatomy course typically aims to provide participants with a comprehensive understanding of the anatomical structures as visualized in computed tomography (CT) images. The course focuses on developing the necessary knowledge and skills to accurately interpret CT cross-sectional images of the human body. AND

At the end of semester student must be able to:

**CO1:**Participants should be able to identify and label major anatomical structures in CT cross-sectional images, including organs, bones, blood vessels, nerves, and other relevant tissues.

HFA

**CO2**: Will learn to interpret CT images in different planes (transverse, sagittal, and coronal) to gain a complete understanding of the spatial relationships and dimensions of anatomical structures.

**CO3:**Will become proficient in recognizing normal anatomy across various body regions, enabling them to distinguish variations from pathology.

**CO4:**Will develop the ability to identify and describe common pathological conditions and abnormalities seen in CT cross-sectional images, such as tumors, inflammation, fractures, and vascular anomalies.

Teaching Scheme	Total	Examination Scheme		
(In Hours)	Credits	Theory Marks	Practical Marks	Total Marks
4	(L+T+P)			*
		CIE ESE	CIE ESE	R
6	3		30 70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### PRACTICAL COMPONENTS

Unit	Topic and content	Hours	Marks
1	Cross Sectional Anatomy of: Head	20	14
	Vascular supply of brain		
	Venous supply of brain		
	Cranial nerves		
2	Neck cross sectional anatomy	14	8
	Vascular supply of neck		
	Venous supply of neck	<u> </u>	
3	Thorax cross sectional anatomy	18	12
	Vascular supply of thorax		
	Venous supply of thorax	$H_{\Delta}$	
4	Abdomen cross sectional anatomy	20	12
	Vascular supply of adomen	12	
	Venous supply of abdomen	N.	
5	Pelvis cross sectional anatomy (male and female)	16	6
	Vascular supply of pelvis		2
	Venous supply of pelvis	<u>^</u>	2
6	Vertebral body and extremities	8	5
7 >	Muscles, ligaments and tendons	6	5 0
8	Upper and low <mark>er limb b</mark> lood supply	6	8 5
	Total	108	70
A			Ζ
E-al.	Current and Current an		S
Evaluation	n System		
There will	be no Theory examination at university level for this subject.		
Continuo	us Internal Evaluation (CIE)	3	F

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component J-dly 214 Hdy	Marks	Weightage	IA marks
1.	Sessional test(s)		1	5
	Two Practical tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50 1	ALC ALC	
	Total	50	0.3	15
2.	Continuous assessment	90.		
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			
	Total	50	0.3	15
	Total CIE marks	•	•	30

End Semester Evaluation (ESE)

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

Distribution	of marks	for	university	examination	n practical	exams:

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

### SUGGESTED LEARNING RESOURCES

SUGGE	ESTED LEARNING RESOURCES	AND HEAL	
S. No.	Title of Book	Author	Publication
1	Cross Sectional Anatomy CT and MRI	Govind Chavhan, Bhavin Jankharia	Jaypee Brothers Medical Pub.
2	Cross-Sectional Anatomy for Computed Tomography	Michael L. Farkas	Springer New York
3.	Sectional Anatomy by MRI and CT	Mark W. Anderson, Michael G Fox	Elsevier Health Sciences
4.	Atlas of Human Cross-Sectional Anatomy With CT and MR Images	Donald R. Cahill, Matthew J. Orland, Gary M. Miller	Wiley

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

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

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# Composition FOR AL HEALTHCARE PROFESSIONS **Fourth Semester**

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#### Subject: Advancements in CT Technology

#### Subject code: MMRIT10

#### Rationale

Advances Techniques in Computed Tomography Technology aims to provide participants with specialized knowledge and skills related to the latest advancements and cutting-edge techniques in the field of Computed Tomography (CT) imaging. AND HEALTH,

#### Outcome

At the end of the semester student must be able to:

**CO1:**Will gain a comprehensive understanding of the latest advancements and cutting-edge techniques in CT imaging. This knowledge may include advanced imaging protocols, reconstruction methods and clinical applications.

**CO2:**Will give a deeper understanding of advanced CT techniques, participants can potentially improve diagnostic accuracy, leading to better patient outcomes and more effective treatment planning.

**CO3:**Involved in research and development, the course may inspire new ideas and insights that contribute to the ongoing advancement of CT technology and medical imaging.

**CO4:**Completion of this advanced course may provide continuing education credits or professional development recognition for individuals in the medical field.

CO5: Acquiring knowledge and skills in advanced CT techniques could lead to expanded career opportunities or increased responsibilities within their respective workplaces.

Teac	hing Sch	ieme	Total	Examin	ation Scheme			
(In H	Iours)	RS.	Credits	Theory	Marks	Practical N	Marks	Total Marks
		100	(L+T+P)	Sinc	e-2021		30	
L	Т	Р	C 31	CIE	ESE	CIE	ESE	
2	1	4	5	30 g	7022 4	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

#### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content	Hours	Marks
1	Advanced CT Imaging Techniques: Dual-Energy CT	4	3
	Dynamic CT, and iterative reconstruction algorithms. Role of these		
	techniques enhance image quality and improve diagnostic accuracy		
2	CT Angiography (CTA): principles and applications of CT	8	10
	angiography, including vascular imaging, cardiac CTA, CTPA and		
	peripheral CTA.		
	Role of CTA in diagnosing vascular diseases and assessing blood		
	flow.		
3	CT Perfusion Imaging: CT perfusion imaging and its use in	4	5
	assessing tissue perfusion, blood flow, and detecting cerebral or	Yn	
	abdominal ischemia.	4	
4	<b>Dual-Source CT and Multidetector CT (MDCT):</b> benefits of	4	5
	dual-source and MDCT scanners, such as reduced scan times,	<	
	improved spatial resolution, and decreased radiation dose		2
5	Cardiac CI Imaging: cardiac CI imaging, including coronary	4	10
	artery assessment, cardiac function evaluation, and the role of CI	·	T
	in cardiac disease diagnosis, Calcium Scoring.		- 11
6	Radiation Dose Optimization: advanced techniques for	2	3 'v
	optimizing CI scanning protocols to reduce radiation dose while		S
7	Maintaining image quality	2	- 0
	Advanced Post-processing Techniques: advanced image post-	3	° –
-	processing techniques, such as 5D volume rendering, maximum		$\overline{\mathbf{a}}$
0	CT mided Interventions: CT mided proceedures and	4	5
0	interventions including biopsy drainage and ablation techniques	4	5
	incrventions, including biopsy, dramage and ablation teeningues		
9	Virtual CT: Colonoscopy: the techniques used in virtual CT	4	5
	colonoscopy, a non-invasive method for imaging the colon and		A
	detecting polyps and other abnormalities	H	
	Bronchoscopy: technique, post processing and applications.		5
10	Advanced Image Reconstruction: advanced image	3	5
	reconstruction techniques such as iterative reconstruction	20	
	algorithms which improve image quality while reducing radiation	0	
	dose.		_
11	Artifact Reduction Strategies: techniques to minimize and	4	5
	correct artifacts that can arise in advanced CT imaging, ensuring		
10	accurate diagnosis and interpretation	2	
12	<b>Radiation Dose Management:</b> strategies for optimizing CI	2	2
	protocols to reduce radiation dose while maintaining diagnostic		
12	Contract Modio Innovational and a state of the state of the	2	2
15	contrast vieula innovations: new contrast media agents and	4	2
	protocols used in C1 imaging to enhance image contrast and		
	visualization of specific ussues or pathologies, automatic contrast		
14	Quality Assurance and Image Quality Assessments and	4	2
14	assurance protocols specific to advanced CT technology and the	7	5
	assessment of image quality		
	assessment of image quanty.		

15	Emerging Trends in CT: latest developments and emerging	2	2
	trends in CT technology, including artificial intelligence		
	applications and new imaging advancements.		
		E 4	70
	Total	54	/0
	1 otal	54	70

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Dual-Source CT and Multidetector CT (MDCT	
	Advanced CT Imaging Techniques	8
2.	Radiation Dose Management	40
	Radiation Dose Optimization	640
3.	Contrast Media Innovations	4
4.	Advanced Post-processing Techniques	R
	Advanced Image Reconstruction	8
5.	Quality Assurance and Image Quality Assessment	4
6. 2	Emerging Trends in CT	4
7. K	Artifact Reduction Strategies	8
8	Virtual CT	6.
	CT-guided Interventions	10
9.	CT Angiography (CTA)	4
	Cardiac CT Imaging	14 <b>H</b>
10.	CT Perfusion Imaging	6
	Total	72
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#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightag	IA marks		
			e			
1.	Sessional test(s)					
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50				
	Total OR ALLIEU AN	50 JA	0.3	15		
2.	Continuous assessment					
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment		HCA			
	Total	50	0.3	15		
	Total CIE marks			30		

End Semester Evaluation (ESE)

#### Written Paper

Type of question	No.	of Marks per o	<mark>jues</mark> tion Total
	questions		
Long Essay	2	15	30
Short Essay	8	5	40
			70
Duration (minutes)			150

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End Semester Evaluation (ESE)

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

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

Distribution of marks for university examination practical exams:

# SUGGESTED LEARNING RESOURCES ED AND HE

S. No.	Title of Book	Author	Publication						
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders						
² TKNO	Computed Tomography for Technologists: A Comprehensive Text	Lois Romans	Lippincott Williams and Wilkins;						
3.11 <b>X</b>	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley-Blackwell						
4.2	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	Timothy P. Szczykutowicz	Medical Physics Publishing Corporation						
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#### Subject: Quality Assurance, Radiation Protection and Patient care in CT Imaging

#### Subject code: MMRIT11

#### Rationale

Radiation Protection and Patient Care in CT course aims to provide participants with essential knowledge and skills related to ensuring patient safety and implementing radiation protection measures during computed tomography (CT) examinations.

#### **Course Outcome**

At the end of semester student must be able to:

**CO1:**Should gain a comprehensive understanding of the principles of ionizing radiation, its interaction with human tissues, and the potential risks associated with radiation exposure.

**CO2:**Will be familiarized with the ALARA (As Low As Reasonably Achievable) principle and learn techniques to minimize radiation dose to patients while maintaining image quality.

**CO3**:Should learn strategies for optimizing CT scanning protocols and adjusting parameters to achieve appropriate image quality with the lowest possible radiation dose.

**CO4:**Radiation Protection Guidelines: Participants will be introduced to national and international radiation protection guidelines specific to CT imaging.

**CO5:**Will learn proper patient positioning and centering techniques to ensure accurate imaging and reduce the need for repeat scans.

**CO6:** Should be aware of the unique considerations and radiation protection protocols when imaging paediatric and pregnant patients.

**CO7:** Will understand the use of contrast agents in CT imaging, their potential risks, and the importance of proper patient screening for allergies and contraindications.

**CO8:** Should understand the importance of infection control practices in the CT environment, including equipment cleaning and proper hygiene measures.

**CO9:** Will become aware of ethical and legal responsibilities in providing radiation protection and patient care in CT imaging.

**CO10:** Will be educated on safety measures and protocols to protect healthcare professionals and staff working in the CT department.

Teaching Scheme Total			Examination Scheme					
(In F	lours)		Credits (L+T+P)	Theory Marks Practical Marks		Theory Marks I		Total Marks
L	Т	Р	С	CIE	ESE	CIE	ESE	
2	1	4	5	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.
THEORY COMPONENTS
The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content	Hours	Marks
1	Introduction of Radiation Protection: Principles of radiation protection, ALARA/ALARP, MPD, The Role of the CT Technologist, Radiation in Pregnancy and children.	10	15
$\begin{array}{c} 2 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\$	<b>Radiation quantities and units:</b> Factors Affecting Dose in CT, CT Dosimetry – MSAD, Bed Index, CTDIw, CTDIvol, DLP.	6	10 S
3 IN	<b>Biological units of radiation</b> : Radiation detection and measurements, LET, OER, survey meters, Geiger muller counter, ionisation chambers.	6	
4	Radiation Hazard evaluation and control: Scatter and Leakage radiation, ICRP guidelines for CT room design, Radiation Signage, Protective devices.	10 T	10-11-2-12-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2
5	AERB and ICRP guidelines: Limits for radiation exposure	4	5
6	<b>Contrast media in CT</b> : ionic and non-ionic agents, lethal dose, contrast administration techniques, contrast tracking techniques.	4	5
7	<b>Radiation protection</b> : Radiation protection for patient and staff, personnel protective apparel. AI in radiation safety.	6	5
8	Pre and post-procedural care in CT:	8	10
	Patient transfer and Restraining techniques, Infection control and		
	sterilization, Medical ethics and records, Patient care in special		
	cases: Spinal injuries, Trauma, Stroke, Burns, Cardiac emergency.		
	Total	54	70

#### SUGGESTED PRACTICALS/DEMONSTRATION

1.       2.       3.       4.       5.	Introduction of Radiation Protection AERB and ICRP guidelines Radiation quantities and units Biological units of radiation Pre and post-procedural care in CT ED AA Radiation protection	Пир	20 20	
2. 3. 4. 5.	AERB and ICRP guidelines Radiation quantities and units Biological units of radiation Pre and post-procedural care in CT ED AA Radiation protection	Пиг	20 20 5	
2. 3. 4. 5.	Radiation quantities and units Biological units of radiation Pre and post-procedural care in CT ED AA Radiation protection	ID Hr	20	
3. 4. 5.	Biological units of radiation Pre and post-procedural care in CT ED AA Radiation protection	ID Hr	20	
3. 4. 5.	Pre and post-procedural care in CT ED AA Radiation protection	DHA	5	
4. 5.	Radiation protection	U NP		
5.		IE,	10	
	Radiation Hazard evaluation and control		12	
6.	Contrast media in CT		5	
	Total		72	0
0				B
Evaluation Continuous	System s Internal Evaluation (CIE)			0155
Sl <mark>.</mark> No. Con	nponent	Marks	Weightage	IA marks
. Sess	sional test(s)			S
Two Sam Ave Abs	O Written tests ne pattern as Summative test rage of two to be considered sence without prior permission to be marked as 0	50		- Left
Tot	a उताउँकाम स्तिश	50	0.3	15
2. Con	ntinuous assessment	1 Allo		5
Sem	ninars/Case presentations/ Logbook/ Case ords/Record book/assignment	2	SE .	
	Since-202	50	10.2	15
	ai	50	20.5	20

End Semester Evaluation (ESE)

#### Written Paper

Type of questio	n			No. of questi	onsMarks question	perTotal
Long Essay				2	15	30
Short Essay				8	5	40
						70
Duration (minute	es)					150
Distribution of m	arks for univ	ersity exa	aminatio	n practical exan	ns:	- PR PR
0	Practical	Viva	0111	Sub Total		en la
M	50	20	30	100	100	E
0				-		S
SUGGESTED I	EARNING	RESOU	JRCES			0/
S						0

#### End Semester Evaluation (ESE)

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

#### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Computed Tomography: Physical Principles, Clinical Applications, and Quality Control	Euclid Seeram RT(R) BSc MSc FCAMRT (Author)	Saunders
2	Computed Tomography for Technologists: A Comprehensive Text	Lois Romans	Lippincott Williams and Wilkins;
3.	Computed Tomography: Physics and Technology. A Self Assessment Guide	Euclid Seeram	Wiley-Blackwell
4.	The CT Handbook: Optimizing Protocols for Today's Feature-Rich Scanners	Timothy P. Szczykutowicz	Medical Physics Publishing Corporation

#### Subject: Basic Pathology and Image Interpretation in CT Imaging

#### Subject code: MMRIT13

#### Rationale

Imaging pathology and image interpretation in computed tomography (CT) is to facilitate accurate and early detection, characterization, and evaluation of various medical conditions and abnormalities within the body. CT imaging is a non-invasive, widely available, and valuable medical imaging modality that provides detailed cross-sectional images of the internal structures of the body. IEALTHCA.

#### Outcome

#### At the end of the semester the student must be:

**CO1:** To Identify diseases and abnormalities at an early stage often leads to better patient outcomes.

**CO2:**Learn the extent and location of pathologies, aiding in precise diagnosis and treatment planning.

**CO3**: Will learn CT guide certain medical procedures such as biopsies, drainages, and needle aspirations.

0						0.
Teaching Schem	ne Total	Examin	nation Scheme			0
(In Hours)	Credi	ts Theory	Marks	Practical N	Marks	Total
Z	(L+T	'+P)				Marks
				OTE	DOD	
LIP	C	CIE	ESE	CIE	ESE	6
6	3			30	70	100
	C					R

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CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical
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#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignments minimum one per unit based on the curriculum.

## PRACTICAL COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content	Hours	Marks
1.	Basic pathologies and general interpretations of Head, Face&Neck	15	10
2.	Basic pathologies and general interpretations of Vascular imaging	5	5
3.	Basic pathologies and general interpretations of Spine	15	10
4.	Basic pathologies and general interpretations of Brachial	10	5
	plexus,Chest, Heart and great vessels		
5.	Basic pathologies and general interpretations of Breast	5	5
6.	Basic pathologies and general interpretations of Kidney, Pancreas,	13	5
	Liver and biliary system		

7.	Basic pathologies and general interpretations of Abdomen and Pelvis	10	5
8.	Basic pathologies and general interpretations of Upper limb	10	5
9.	Basic pathologies and general interpretations of Lower Limb	10	5
10.	Basic pathologies and general interpretations of Peripheral vascular	5	5
	system		
11.	Basic pathologies and general interpretations of Pediatric imaging	10	10
	Total	108	70

Evaluation System There will be no Theory examination at university level for this subject.

SI No	Component	Marks	Weightage	IA mortes
51. INO.	Component	IVIAIRS	weiginage	ITT IIIaIKS
1.	Sessional test(s)		<i></i>	0
	Two Practical tests	50		2
	Same pattern as Summative test			2
	Average of two to be considered			T
	Absence without prior permission to be marked as 0			°.
	Total	50	0.3	<i>15</i> ()
2.	Continuous assessment			0
×	Seminars/Case presentations/ Logbook/ Case			$\sim$
-	records/Record book/assignment			S
	Total	50	0.3	15
	Total CIE marks	•	-	30

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End Semester Evaluation (ESE)
There shall be practical examination for 70 marks in the subject.

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

Distribution of marks for university examination practical exams:

# SUGGESTED LEARNING RESOURCES

GGESI	ED LEARNING RESOURCES	AND	
S. No.	Title of Book	Author	Publication
1	CT & MRI Pathology: A Pocket Atlas, Third Edition	Michael L. Grey, Jagan Mohan Ailinani	Snippet view
2	Normal Findings in CT and MRI	Torsten Bert Moeller, Emil Reif	PROF
3.	Neurological Practice: An Indian Perspective	Wadia	ES
0			S

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

E 9 8 31

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

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."



"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# Elective – Specialization of MR Imaging Technology Third Semester स्वास्थ्यम् सर्वार्थसाधनम्

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स्वास्थ्यम् सर्वार्थसाधनम् NCAHP Since-2021

"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# Subject: Principles of MR Imaging Technology

#### Subject Code: MMRIT14

#### RATIONALE

The basic working principles of Magnetic resonance imaging along with the construction and equipments necessary for the image formation, processing, encoding, storage and display. To comprehend the image quality parameters, identify artifacts and assure image quality with the aid of quality assurance tests and tolerance limits.

# **COURSE OUTCOMES**

COURSE OUTCOMES ALLIED AND HE								
At the end	At the end of the course students will be able to							
<b>CO1:</b> Identify the basic physical concepts involved in MRI								
<b>CO2:</b> Understand the various imaging parameters that determine image contrast.								
CO3:Desc	<b>CO3:</b> Describe the various image weighting techniques and its application							
CO4:To c	omprel	nend princi	i <mark>ples of g</mark> radier	nts and sp	oatial encoding.			OF 1
CO5:Cond	cept of	K- space a	nd its traversa	l involved	l in MR image f	formation.		ES
CO6: Kno	wledge	e of image o	quality in MRI	images.				OIS
<b>СО</b> 7: Арр	ly MR	imaging pa	rameters in th	e clinical	setting and its t	rade-off to	optimize im	age quality.
CO8: Abil	ity to n	ninimize in	nage artifacts a	nd under	stand various Q	Quality assur	ance tests.	
CO9: Prec	aution	s and care	required during	g MR Ima	aging			F
	कि स्वास्थ्यम सर्वार्थसाधनम							
Teachi	ng Sch	eme	Total	Examina	ation Scheme			2
(In Ho	urs)	R	Credits	Theory I	Marks	Practical N	1arks	Total
(L+1+P) Since-2021					Marks			
	Г	Р	C	CIE	ESE	CIE	ESE	
2 1	l	4	5 417	30 	70य दे	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Introduction and Basic principles</b> : Atomic structure and motion, MR active nuclei, Hydrogen MRI, spin precession, Larmor equation, Resonance, Relaxation, T1 and T2 Times.	8	10
2.	<b>Image contrast and weighting</b> : Intrinsic and extrinsic parameters of MR Image contrast, T1, T2 and PD weighting and its applications, T2* decay, FID.	6	8
3.	<b>Spatial Encoding and K-Space</b> : Gradients, Slice selection, frequency and phase encoding, K space basic concept, its filling and traversal, Fast Fourier transform.	4	6
4.	MRI Pulse sequences: Spin echo sequences, Inversions recovery sequences, Gradient eco sequences, echo planar imaging, Parallel imaging.	10	10
5.LVN	MR Instrumentation and Safety: Magnets- types and application, Radio waves, Coils- types and functions, Shielding, Shimming, MR scanner Construction and components, MRI safety considerations, Signage, MR Compatible/conditional/non-compatible devices. AI in MRI.	10	ESSIONS
6.	Image Parameters and quality: SNR, CNR, Scan time, Spatial Resolution. Trade-offs between parameters.	4	8
7.	<b>MRI Contrast Agents</b> : Mechanism of action, T1 and T2 Agents, classification and applications of contrast agents, doses in adults and pediatrics, Safety considerations in pregnancy and lactation.	6	8
8.	MRI artifacts: Causes, appearance, remedy. Quality assurance tests and tolerance limits.	6	10
Total	1997	54	70
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# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Image contrast and distinction between differently weighted images.	10
2.	Manipulating TR and TE for T1, T2 and PD weighted images.	10
3.	Identifying and manipulating various image parameters to maintain image quality	10
4.	Identifying the various types of coils and their uses. Distinction between SE and GRE sequences.	12
5.	Understanding MRI safety principles and patient screening.	10
6.	Contrast agents and its uses, dosage and administration process, time-intensity curves.	10
7.	MRI artifacts	10
V	Total	72
5		S 3
Evaluation	n System	SNOL

# Evaluation System

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			4
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	⁵⁰ साध-	नम् हू	21h
	Total	50	0.3	<u>15</u>
2.	Continuous assessment SINCE-202	1	1 20	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	देखान्रेर		
	Total	50	0.3	15
	Total CIE marks			30

# End Semester Evaluation (ESE)

# Written Paper

Type of question	n			No. of questi	onsMarks question	perTotal
Long Essay				2	15	30
Short Essay				8	5	40
					D	70
Duration (minute	s)	-nF	AL		UHEA	150
Distribution of m	arks for univ	ersity ex	xaminatic	on practical exar	ns: Grand total	T PP
0	Practical	Viva		Sub Total		0
41	50	20	30	100	100	
SUGGESTED L	EARNING	RESO	URCES			NOISS

# End Semester Evaluation (ESE)

ESE		CIE		Grand total
Practic <mark>al</mark>	Viva		Sub Total	
50	20	30	100	100

# SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication				
1	Fundamentals of MRI	Stark &Bradely	Inf				
2		Catherine Westbrook, Carolyn	Wiley-				
14	MRI in practice, 4 th edition	Kaut Roth, and John Talbot	Blackwell				
3.	Magnetic Resonance Imaging,	Stewart Bushong and Geoffrey					
	Physical and Biological Principles	Clarke	C				
	4th edition. Sinc	e-2021					
के अर्भर स्वास्थ्य देखान्रेखी							

# Subject: MR Imaging Procedures and Scanning Protocols

#### Subject Code: MMRIT15

#### RATIONALE

To comprehend the indications, contraindications, patient preparation, positioning, coils used and other specific considerations while performing the different MRI scan Protocols. Basic understanding of Parameter manipulation and post procedural care.

# **COURSE OUTCOMES**

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

HEALTH **CO1:**Identify the indications and contraindications for various protocols

**CO2:**Understand the various patient preparation aspects, including history taking and screening.

**CO3:**Describe the parameters and sequences used to acquire necessary images.

**CO4:**To comprehend principles of image quality for each type of protocol and the trade-of

**CO5**: Types of coils used, positioning and landmark for each anatomical examination.

**CO6**: Knowledge of Post procedural care.

A T									NO
Teac	hing Sch	ieme	è	Total	Examin	ation Scheme			S
(In F	Iours)			Credits	Theory	Marks	Practical N	Aarks	Total
	N			(L+T+P)					Marks
L	T	Р		С	CIE	ESE	CIE	ESE	4
2	12	4	4d	1221	30	70 <b>2</b> <del>4</del>	30-	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

#### **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>MRI Brain:</b> Routine, stroke, epilepsy, MS, tumour protocols, MR Angiography (COW), MR Venography, CSF Flow analysis.	10	14

Total		54	70 00
7.	All special MRI procedures including MRCP, perfusion scan, ASL, FMRI, Cardiac MRI etc. Pediatric scan: Kitten MRI	5	ROFE
6.	MRI Thorax-Abdomen: Cardiac MR, routine Abdomen, MRCP, Fetal MRI, Fistulography, MR Prostate, MR Placenta, MR Urography, Enteroclysis. Respiratory and ECG Gating techniques	5	7
5.	MRI Spine: Cervical, Thoracic, Lumbo-sacral, Flexion- Extension, Whole spine screening.Composing, MR Cisternography, Myelography.	9	12
4.	MRI Lower limb Protocols: Pelvis- bony, male and female, hip joint, knee, ankle, foot. MR Cartigram. Lower Limb Angiography/Venography.	9	10
3.	<b>MRI Upper limb protocols:</b> Shoulder, elbow, wrist, hand. MR Upper limb angiography/venography. Shoulder Arthrography.	9	10
2.	MRI Face: Orbit, Cochlea, OSA, Pituitary, Neck, Brachial Plexus, Sialography, Dacrocystography	7	10

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	MRI Brain and special sequences acquired in different pathologic conditions.	10
2.	MRI Face and neck region, angiographies and various post- processing techniques involved.	10
3.	Upper and Lower limb MRI protocols for various anatomical structures.	10
4.	Fistulography, Sialography, Dacrocyctography, MRCP and the various contrasts, techniques and parameters of acquisition.	12
5.	Understanding MRI safety principles and patient screening prior to patient position in the clinical setting.	10
5.	Contrast agents and its uses, dosage and administration process, time-intensity curves.	10
7.	MR in Pregnancy	10
	Total	72

#### **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		-	-
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment R PPPPPP	UHE		-
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	-42	THCA	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questio	onsMarks qu <mark>estion</mark>	perTotal
Long Essay	2	15	30 0
Short Essay	8	5	40 5
			70
Duration (minutes)			150

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End Semester Evaluation (ESE)

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

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

Distribution of marks for university examination practical exams:

# SUGGESTED LEARNING RESOURCES

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GGEST	ED LEARNING RESOURCES	IED AND HEAL	
S. No.	Title of Book	Author	Publication
1.	Musculoskeletal MRI E-Book	Major, Nancy M., Anderson, Mark W	E PR(
2.	MRI in practice, 4 th edition	Catherine Westbrook, Carolyn Kaut Roth, and John Talbot	Wiley- Blackwell
3. <b>NIO</b>	Magnetic Resonance Imaging, Physical and Biological Principles 4th edition.	Stewart Bushong and Geoffrey Clarke	SION,

देखान्द्रखा सुरि

#### Subject Code: MMRIT16

# RATIONALE

To identify and understand the various anatomical structures, so that positioning and planning of protocols is performed proficiently. To also comprehend various pathological conditions and interpret images efficiently.

# **COURSE OUTCOMES**

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

AND HEALTHY **CO1:**Identify the cross –sectional anatomical structures with ease

CO2: Understand the various post processing techniques to optimize anatomical visualization. .

**CO3**:Identify the various blood vessels or nerves and its anatomical correlation.

**CO4:** To comprehend principles of image quality for each type of protocol based on anatomical structure

**CO5**: Types of coils used, positioning and landmark for each anatomical examination.

**CO6**: Knowledge of various pathological conditions and the special sequences used to optimize its visualization.

Teac	eaching Scheme Total Examination Scheme							
(In Hours) Credits		Theory Marks		Practical Marks		Total Marks		
(L+T+P)					5			
L	ТР	F	<b>दास्थ्य</b>	CIE	ESE	CIE	ESE	4
	- 6		3	<b>N</b> ÌC	ΛLD	30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# PRACTICAL COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Basic Anatomy:</b> Anatomical Terminologies, Sectional planes, movements, Joints, surface anatomy.	12	6
2.	<b>Brain</b> : Cross-sectional Anatomy, lobes, ventricles, Brainstem, blood supply, venous sinuses, cranial nerves. Paranasal sinuses, orbits, pituitary gland.	16	10
3.	Neck: Major vessels – carotids, aorta, pulmonary vessels, Brachial plexus, Thyroid, cartilages, salivary glands and duct system, muscles of the back.	14	8
4.	Upper limb: Shoulder- rotator cuff, elbow, wrist, hand, metacarpals, carpals, phalangs, related muscles and tendons. Arterial supply and venous drainage.	14	80RO
5. 70	Lower limb: Pelvis- bony, male and female, hip joint, knee, ankle, foot, metatarsals, tarsals, ligaments, tendons, muscles,popliteal fossa, arterial supply and venous drainage.	14	10 FESS
6.	Spine: Cervical, Thoracic, Lumbar, sacrum, coccyx, ribcage, muscles attached. Spinal cord, meninges, nerve roots, vertebral disc.	12	10 <b>ONS</b>
7.	Thorax: Lungs, Heart, Mediastinum, Respiratory volumes, Esophagus, Trachea, Bronchial tree, Bronchopulmonary segments, Diaphragm.	12	8
8.	Abdomen: Stomach, Small and Large Intestines, Liver, pancreas, Biliary tree, Spleen, Kidneys and renal vasculature, excretory system, reproductive system (male and female), Aorta and its		3 10
Total	branches. Since-2021	108	70
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#### **Evaluation System**

There will be no Theory examination at university level for this subject.

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)			
	Two Practical tests Same pattern as Summative test	50		
	Average of two to be considered Absence without prior permission to be marked as 0			
	Total	50 6	0.3	15
2.	Continuous assessment	0	$\Lambda_{1}$	
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment		SSIN	
	Total	50	0.3	15
	Total CIE marks		•	30

# End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

Ď	ESE		CIE		Grand total
	Practical	Viva	1	Sub Total	
	50	20	30	100	100

# SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Cross Sectional Anatomy CT and MRI	Govind Chavhan, Bhavin Jankharia	Jaypee Brothers Medical Pub.
2	Cross-Sectional Anatomy for Computed Tomography	Michael L. Farkas	Springer New York
3.	Sectional Anatomy by MRI and CT	Mark W. Anderson, Michael G Fox	Elsevier Health Sciences
4.	Atlas of Human Cross-Sectional AnatomyWith CT and MR Images	Donald R. Cahill, Matthew J. Orland, Gary M. Miller	Wiley

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

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

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"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# COMPOSION FOR AL HEALTHCARE PROFESSIONS . Fourth Semester

Since-2021

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देखान्रेखा स्

#### Subject: Advancements in MR Imaging Technology

#### Subject Code: MMRIT17

# RATIONALE

To Stay abreast of the advancements and special procedures performed Using MRI in various conditions. The innovation in Hardware, software and post-processing techniques available for advanced image acquisition and diagnosis.

# **COURSE OUTCOMES**

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

AND HEALTH, **CO1:**Understand the basic principles of advanced techniques of MRI

CO2: To constantly stay abreast of the latest advancements and innovations in the field of MRI

**CO3:**Identify the various Diffusion related processes and its applications.

**CO4:**To comprehend principles of magnetic susceptibility and its uses.

**CO5**: Advancement in the hardware, software and post-processing techniques.

**CO6**: Knowledge of various pathological conditions and the special sequences or protocols/procedures performed to optimize its visualization.

Teaching Scheme	Total	Examination Scheme			
(In Hours)	Credits	Theory Marks	arks Practical Marks		Total
13	(L+T+P)				Marks
	-			ř	Ar
	स्थि	CIE ESE	CIE	ESE	
2 1 4	5	30 70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical Since-2021

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
1.	<b>Flow Phenomenon:</b> Types of flow, mechanisms, Compensation, CSF Flow Analysis.	10	10
2.	<b>MRA:</b> Conventional Vascular imaging techniques, DSA, TOF- MRA, Phase Contrast MRA, Velocity encoding MRA	10	10
3.	Diffusion and its advancements: DWI, Diffusion Tensor Imaging, White matter Tractography. Physics, protocol and its applications.	4	10
4.	<b>MR Spectroscopy:</b> Metabolites, hunters angle, CHESS, STEAM, PRESS, MRS in Breast and Prostrate. Related pathologies and protocol.	10	10
5.	<b>fMRI:</b> Paradigms, Hemodynamic response function,Perfusion Imaging - DSC, DCE, ASL and its types. Protocols, Principles and applications.	6	10 FES
6.VI	Iron and Fat quantification: Fat suppression techniques, Elastography, Quantification techniques, parameters and applications.	6	10 SIONS
7.	Miscallaneous advancements: Sodium MRI, Portable MRI Systems, Ultra-high Magnetic field systems, MR Mammography, Synthetic MRI, Interventional MRI techniques.	6	10
Total	ि स्तास्थ्यम स्तर्शिसाधन	54	70

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	Sinco 2021	Hours
1.	Flow Phenomenon and MRA	20
2.	Diffusion and its advancements	12
3.	MR Spectroscopy and fMRI	20
4.	Iron and Fat quantification	10
5.	Miscallaneous advancements	10
	Total	72

#### **Evaluation System**

# **Continuous Internal Evaluation (CIE)**

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	-		-
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment R PPPPP	UHE		-
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	- AL	THCA	
	Total	<u>50</u>	0.3	15
	Total CIE marks			30

End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questio	nsMarks qu <mark>estion</mark>	perTotal
Long Essay	2	15	30 0
Short Essay	8	5	40 5
			70
Duration (minutes)			150

# End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

ESE 💊	1251	CIE		Grand total
Practical	Viva	i fo	Sub Total	5
50	20	30	100	100

Since-

# SUGGESTED LEARNING RESOURCES

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PER 31

S. No.	Title of Book	Author	Publication
1.	Tomography and Magnetic Resonance Imaging of the Whole Body (Vol.1&II) (Saunders)	John R. Haaga (Author), Daniel Boll (Author)	Elsevier
2.	MRI inPractice	Catherine Westbrook &CaralynKaut	Wiley–Blackwell
3.	Protocols inMRI	Catherine Westbrook	Wiley-Blackwell
4.	An Introduction to the Physics and Function of Magnetic Resonance Imaging	Dominik Weishaupt , Victor D. Koechli , Borut Marincek , J.M. Froehlich	Springer
<ul> <li>NATIONAL</li> </ul>			OFESSIONS .



nce-2021

देखान्हेखा वृष्टि

# Subject: Planning, Safety and Patient care in MR Imaging

#### Subject Code: MMRIT18

# RATIONALE

Students comprehend the effects of MRI on the human body, learn the safety aspects to prevent accidents and maintain high image quality while ensuring patient compliance and pleasant patient experience

# **COURSE OUTCOMES**

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

CO1:Understand the basic safety measures to be taken while performing MRI

CO2: To Ensure optimum patient care

**CO3:**Identify the various MRI compatible/conditional and non compatible devices and warn patients accordingly.

CO4: To comprehend the various hazards involved in MRI and to know how to prevent Accidents.

**CO5**: To learn the various MRI facility zones and other MRI Safety considerations.

Teaching Scheme Total		Examin	Examination Scheme			5
(In Hours)	Credits	Theory Marks		Practical Marks		Total
ZN	(L+T+P)					Marks
L T P	С	CIE	ESE	CIE	ESE	
$\frac{2}{2}$ 1 4	5	30	70	30	70	200
	C					

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and contents	Hours	Marks
	Bioeffects of MRI: Bio-effects of static and gradient magnetic		
1.	fields, Acoustic noise, Bio-effects of radiofrequency power		
	deposition and induced heating during MRI, SAR,	14	16
	Claustrophobia, anxiety and emotional distress in the MR		

2.	<b>MRI facility design:</b> Site selection, MRI safety zones, Scanner room layout. Shielding techniques, Faraday Cage.	10	14
3.	<b>Implants:</b> Materials used as implants and prosthesis, cardiac devices, Patient monitoring in the MRI environment, Managing Acute situations, Screening, History, Metal Detection.	10	14
4.	<b>MRI Contrast Safety:</b> Identification and management of acute reactions related to gadolinium based contrast agents, Contrast safety in pregnancy and lactation, nephrogenic systemic fibrosis, Extravasation.	10	16
5.	Miscallaneous Safety aspects: Quenching, Ambient temperature, cryogen levels, Safety issues for interventional MR Systems, MRI safety guidelines, policies and procedures.	10	10
Total		54	70

# SUGGESTED PRACTICALS/DEMONSTRATION

		· · · · · · · · · · · · · · · · · · ·
Sr. No		Hours
1.	Bioeffects of MRI	14
2.	MRI facility design	12
3.	MRI Contrast Safety	12
4.	Miscallaneous Safety aspects	16
5.	Implants	18
	Total	72
	<i>4</i> ेर स्वास्थ्यम सर्वार्थसा	धनम 👗
Evaluatio Continuo	n System	de

# CAHP Continuous Internal Evaluation (CIE)

Sl. No.	Component Since-202	Marks	Weightag e	IA marks
1.	Sessional test(s)	7.01-		
	Two Written tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50		
	Total	50	0.3	15
2.	Continuous assessment			
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			

Total	50	0.3	15
Total CIE marks			30

End Semester Evaluation (ESE)

# Written Paper

Type of question	No. of questions	Marks per	Total
		question	
Long Essay	2	15	30
Short Essay	SED AND	5	40
NEUM		EALT	70
Duration (minutes)		'HO	150

# End Semester Evaluation (ESE)

ESE		CIE		G <mark>rand</mark> total
Practical	Viva		Sub Total	
50	20	30	100	100

# SUGGESTED LEARNING RESOURCES

End Ser	nester Evaluation (ESE)		70				
There sh	There shall be practical examination for 70 marks in the subject.						
Distribut	ion of marks for university examination pra-	ctical exams:	PRO				
	ESE CIE	Grand total	TE				
ā	Practical Viva Sub	Total	S				
	50 20 30 100	100	0				
SUGGE	STED LEARNING RESOURCES		SN				
S.	Title of Book	Author	Publication				
No.							
1.	Tomography and Magnetic Resonance	John R.	15				
	Imaging of the Whole Body (Vol.1&II (Saunders)	Boll (Author), Daniel	Elsevier				
2.	MRI inPractice	Catherine Westbrook &CaralynKaut	Wiley–Blackwell				
3.	Protocols inMRI	Catherine Westbrook	Wiley-Blackwell				
4.	An Introduction to the Physics and Function of Magnetic Resonance Imaging	Dominik Weishaupt , Victor D. Koechli , Borut Marincek , J.M. Froehlich	Springer				

# Subject: Basics Pathology and Image Interpretation in MR Imaging

#### Subject Code: MMRIT19

# RATIONALE

Students comprehend the effects of MRI on the human body, learn the safety aspects to prevent accidents and maintain high image quality while ensuring patient compliance and pleasant patient experience

# **COURSE OUTCOMES**

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

- To Identify diseases and abnormalities at an early stage often leads to better patient outcomes.
- Learn the extent and location of pathologies, aiding in precise diagnosis and treatment planning.
- Will learn MR guide certain medical procedures such as biopsies, drainages, and needle aspirations.

Image-guided procedures improve accuracy, minimize risks, and reduce the need for exploratory surgeries.

Teaching S	cheme	Total	Examin	ation Scheme			0
(In Hours)		Credits (L+T+P)	Theory	Marks	Practical N	Marks	Total Marks
L T	Р	C	CIE	ESE	CIE	ESE	510
- LA	6	3	-		30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable assignmentsminimum one per unit based on the curriculum.

# PRACTICAL COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency.

Unit	Topic and content SINCE-2021	Hours	Marks
1.	Basic pathologies and general interpretations of Head, Face&Neck	15	10
2.	Basic pathologies and general interpretations of Vascular imaging	5	5
3.	Basic pathologies and general interpretations of Spine	15	10
4.	Basic pathologies and general interpretations of Brachial plexus,	10	5
	Chest, Heart and great vessels		
5.	Basic pathologies and general interpretations of Breast	5	5
6.	Basic pathologies and general interpretations of Kidney, Pancreas,	13	5
	Liver and biliary system		
7.	Basic pathologies and general interpretations of Abdomen and Pelvis	10	5
8.	Basic pathologies and general interpretations of Upper limb	10	5
9.	Basic pathologies and general interpretations of Lower Limb	10	5

10.	Basic pathologies and general interpretations of Peripheral vascular system	5	5
11.	Basic pathologies and general interpretations of Pediatric imaging	10	10
	Total	108	70

# **Evaluation System**

There will be no Theory examination at university level for this subject.

# Continuous Internal Evaluation (CIE)

Contin	uous Internal Evaluation (CIE)	DHE		
Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		HA	
	Two Practical tests Same pattern as Summative test Average of two to be considered Absence without prior permission to be marked as 0	50	APE	D
	Total	50	0.3	15
2.	Continuous assessm <mark>ent</mark>			T
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			ESSI
F	Total	50	0.3	15
V 1	Total CIE marks		•	30

# End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

ESE		CIE	AHP	Grand total
Practical	Viva	Sin	Sub Total	2
50	20	30	100	100
	M/	TT S	5 TEPTT	<u>Tel</u>

the list

# SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	CT & MRI Pathology: A Pocket Atlas, Third Edition	Michael L. Grey, Jagan Mohan Ailinani	Snippet view
2		Torsten Bert	
	Normal Findings in CT and MRI	Moeller, Emil Reif	
3.	Neurological Practice: An Indian	Wadia	
	Perspective	· LALT,	

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

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





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# HEALTHCARE Elective-specialization of Breast Imaging Technology **Third Semester**

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# Subject: Principle of Breast Imaging Technology

# Subject Code: MMRIT21

# RATIONALE

Mammography is a specialized imaging technique that uses low-dose X-rays to visualize and assess breast tissue. The role of imaging technologist specializing in mammography is crucial in the early detection and diagnosis of breast abnormalities, including breast cancer.

# **COURSE OUTCOMES**

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

- **C01:** Understand the various components of the mammographic equipment, properly operate it and demonstrate the correct use of compression devices, filtration devices, the magnification setup, exposure controls etc.
- **C02:** State the specifications and parameters of physical principles related to mammography (eg. half-valuelayer, focal spot size, heel effect, source-to-image distance and the minimum requirements).
- **C03:** Explain the significance of target/filtercombinations.
- **C04:** Differentiate between the various types of x-ray generators used inmammography.
- **C05:** Discuss and define digitalmammography.
- **C06:** Define compression, its usefulness and minimum and maximum requirements.
- **C07:** State the purpose of magnification.
- **C08:** Process digital images if available.
- **C09:** Describe a picture archiving and communications system (PACS) and itsfunction.
- **C010:** Define digital imaging and communications in medicine(DICOM).
- **C011:** Discuss the image storage and viewing capabilities related to digitalmammography.

Teac	hing :	Scheme	Total	Examin	ation Scheme			K
(In I	Iours	े उ	Credits	Theory	Marks	Practical I	Marks	Total Marks
	-	2	(L+T+P)		ммм	ЛМ		3
L	Т	Р	С	CIE	ESE	CIE	ESE	
2	1	4 6	5	30 inc	2021	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

# **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

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# THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Unit	Topic and contents	Hours	Marks
1.	<b>Basic Principles:</b> History, Xero-mammography, Screen film mammography, Physics of image formation, Mammography Instrumentation, Mammographic cassettes, X-ray tube, Filters, AEC & Console	6	10
2.	<b>Conventional Mammography Equipment:</b> C-arm x-ray tube stand, Mammography tube: Rotating vs. stationary anodes, Tube design, Anode design and configuration, Biangular targets, Focal spot: Standard sizes, Magnification size, Effective target angle, Filtration, Beam geometry, Heel effect.	8	10
3.	<b>Beam limiting devices:</b> Collimation, SID, OID, Generators: Three-phase, High-frequency and Constant potential, Homogenous x-ray beam, Ripple factor, Tube capacity (Ma output), Automatic exposure control(AEC), Grids, Compression devices, Magnification.	8	10
4. 20	<b>Digital mammography:</b> Detectors, Types of digital mammography systems, Image processing, CAD for mammography, technical considerations: Charged coupled device (CCD), Matrix/pixels, FOV, Resolution, SNR, CNR, AEC, Single-and Multiple exposure approach, Tele mammography.	8	10 SIO
5.	Other aspects of digital technology: Expense, Additional equipment, Review workstation, PACS, Laser printer, Computer- aided detection (CAD), Connectivity, Compatibility & Computer literacy of technologist, Digital imaging and communications in medicine (DICOM), HIS, RIS, EMR and HL7	10	
6.	<b>Sonomammography:</b> Physics of USG, Instrumentation & equipment, Image quality, Breast density and influencing factors	7	10
7.	Mammographic compression: Rationale for breast compression, Clinical image assessment for proper breast positioning, exposure, contrast, sharpness, and noise	750	10
Total	S.C. 20	54	70

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No		Hours
1.	Basic Principles	
2.	Conventional Mammography Equipment	10
3.	Beam limiting devices	10
4.	Digital mammography	10

Sr. No		Hours
5.	Other aspects of digital technology	10
6.	Sonomammography	12
7.	Mammographic compression	10
	Total	72
Evaluatio Continuo	n System us Internal Evaluation (CIE)	ALTHC
CINT C		

# **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)	1	1	
	Two Written tests	50		To \
	Same pattern as Su <mark>mmative te</mark> st			0
	Average of two to be considered			T
	Absence without prior permission to be marked as	; 0		T
	Total	50	0.3	15 0
2.	Continuous assessment			0
4	Seminars/Case prese <mark>ntations</mark> / Logbook/ C	ase		$\sim$
	records/Record book/assignment			S
	Total	50	0.3	15
	Total CIE marks			30
End Se	emester Evaluation (ESE)	शम्प्री	I I I	RI
Writter	Paper	9110		3
WIIIICI			人	

# Written Paper

Type of question	No. of qu	estions Marks	perTotal
Con	Since-20	21 question	30
Long Essay	2	15	30
Short Essay	रक्षास्थर	G 5	40
			70
Duration (minutes)			150

End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

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

# SUGGESTED LEARNING RESOURCES

SUGGE	ESTED LEARNING RESOURCES	) AND HEAL	
S. No.	Title of Book	Author	Publication
1.	Basic radiological physics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2.	Christinsens physics of diagnosticradiology	Curry and Dowdey	Wolters Kluwer
3. CIL	X-Ray Equipment for Student	D.N. And M.O. Chesney	Blackwell Science Ltd
4.	Digital Mammography	Ulrich Bick, Felix Diekmann	SI

"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

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# Subject: Breast Imaging Procedures and Scanning Protocols

# Subject Code: MMRIT22

# RATIONALE

Breast Imaging Procedures and Scanning Protocols provide the knowledge base in the type and application ities. of interventional procedures involving breast imaging modalities.

# **COURSE OUTCOMES**

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

- Illustrate the sterile technique. **C01**
- C02 Describe localization techniques.
- **C03** Describe biopsy techniques.
- **C04** Delineate galactography.
- C05 Describe specimen imaging guidelines.
- **C06** Describe specimen handling and record keeping for pathologic analysis.
- **C07** Describe continuous patient care from pre-biopsy topostbiopsy.
- **C08** Define patient transport requirements pre and post biopsy.

Teaching Scheme	Total	Examination Scheme		10
(In Hours)	Credits (L+ <mark>T+P)</mark>	Theory Marks	Practical Marks	Total Marks
	С	CIE ESE	CIE ESE	
2 1 4	6	30 70	30 70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

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# TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

# **THEORY COMPONENTS**

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Since-2021

Unit	Topic and contents	Hours	Marks
1.	<ul> <li>Sterile Techniques: Spread of infection: Exogenous, Endogenous, Iatrogenic and Nosocomial, Preparation of local anesthetics, contrast media, Patient allergies and alternative options.</li> <li>Proper glove use, hand washing technique, Skin preparation Sterile tray preparation, Disposal of items.</li> </ul>	8	10

2.	Localization Modalities Mammography localization: Stereotactic biopsy : Definition, Application & Technique Wire localization: Definition, Application & Technique Ultrasound Guidance: Definition, Application & Technique MR localization: Definition, Application, Technique.	8	10
3.	<b>Interventional Procedures:</b> Cyst aspirations, Fine-needle aspiration or biopsies, Core biopsy, Vacuum-assisted breast biopsy, Galactography, Specimen Imaging: Imaging Guidelines- Core Specimen and Surgical specimens.	6	10
4.	<b>Patient Positioning:</b> Foot Placement, Arm placement, Degree of obliquity- Size of breast, Lesion location, Patient comfort	10	10
5.	<b>Evaluation of Images</b> :Positioning , Compression, Exposure, Contrast, Sharpness, Noise, Artifacts, Motion, Labeling, Collimation	6	10
6.	Patients requiring modification of positioning techniques Males, Transgender patients, Kyphotic patients, Large breasts, Small breasts, Encapsulated implants, Pectus excavatum, Pectus carinatum, Protruding abdomens, Pacemaker, Wheelchair, Infuse- port (Port-A-Cath), Physically disabled, Mentally disabled, Frozen shoulder, Barrel chest, Thick axilla, Irradiated breast, Reduction mammoplasty, Postsurgical breast, Loop recorder	10	PROFESSIO
7.2	<b>Image Quality Problems and remedy:</b> Nipple not in profile, Skin folds or wrinkling, Difficulty compressing due to patient body habitus, Incorrect or uneven compression, Superimposition of extra anatomy, Drooping of breast, Motion, Artifact.	6	10 NS
Total	A	54	70
SUGGES	STED PRACTICALS/DEMONSTRATION	TT	R

# SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No	NCAHD	Hours
1.	Sterile Techniques	10
2.	Localization Modalities	12
3.	Interventional Procedures	-14
4.	Patient Positioning and Evaluation of Images	12
5.	Patients requiring modification of positioning techniques	14
6.	Image Quality Problems and remedy	10
	Total	72

# **Evaluation System**

# Continuous Internal Evaluation (CIE)

Sl. No.	Component		Marks	Weightage	IA marks			
1.	Sessional test(s)		<b>I</b>	•				
	Two Written tests		50					
	Same pattern as Summative test							
	Average of two to be considered							
	Absence without prior permission to be marked as 0							
	Total	ALLIED	AN 50 Hr	0.3	15			
2.	Continuous assessment							
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment			"HCAR				
	Total		<u>50</u>	0.3	15			
/	Total CIE marks				30			
End Se Writter	mester Evaluation (ESE)				FES			
Type o	of question	No. of q	uestions Marl q <mark>ues</mark>	<mark>ks</mark> per T tion	otal 0			
Long F	Essay	2	15	3	0 J			
Short F	E <mark>ssa</mark> y	8	5	4	0			
	K			70				
Duratio	on (minutes)	3	C C	1	50			

# SUGGESTED LEARNING RESOURCES

S. No.	Title of Book Since-2	Author	Publication
1.	Clarks Positioning In Radiography	Ra Swallow, E Naylor	Lippincott William and Wilkins
2.	Merrill's Atlas of Radiographic Positioning and Procedures	Bruce W. Long & Jeannean Hall Rollins & Barbara J. Smith	Mosby

# Subject: Basics and Cross Sectional anatomy of Breast

# Subject Code: MMRIT23

# RATIONALE

The knowledge of breast anatomy is of paramount importance for Imaging technology students, especially those specializing in mammography or breast imaging. Understanding breast anatomy is crucial for several reasons like proper positioning, differentiating normal and abnormal structure and image interpretation.

# **COURSE OUTCOMES**

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

**CO1**:Describe breast structure, developmental stages, and the differences between the male and female breast.

CO2:Identify and label external and internal anatomy of the breast.

**CO3:**Identify and label the breakdown of the single lobe.

**CO4:**Identify the three arterial branches supplying the breast and the three venous drainage channels. **CO5:**Describe the lymphatic system and lymphatic drainage.

**CO6:**Correlate breast anatomical structures to mammographic anatomical structures.

Z							S.
Teaching	Scheme	Total	Examin	ation Scheme			10
(In Hours)		Credits	Theory	Marks	Practical I	Marks	Total Marks
NA		(L+T+P)					S
L	Р	С	CIE	ESE	CIE	ESE	
- 4	6	3			30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

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# TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

# PRACTICAL COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Since-2021

Unit	Topic and contents	Hours	Marks
1.	<b>Definition of the Breast:</b> Male vs female, breast developmental stages: Fetal, Puberty, Menstruation, Pregnancy, Lactation, Menopause, Post menopause, Breast landmarks: Quadrants, Clock face references.	20	14
	Gross Anatomy of the Normal Breast, Nipple, Areola, Montgomery's		
---------	-------------------------------------------------------------------------------	--------	----------
	glands, Morgagni's tubercles, Skin: Sebaceous glands, Sweat glands, Hair		
2.	follicles, Axillary tail, Breast margins, Inframammary fold, Axilla, Internal	40	25
	Anatomy: Fascia, Layers, Retromammary(fat)space.		
	Breast parenchymal components, Lobes and ducts, Cooper's ligaments,		
	stroma, Lymphatic drainage, Breast Vasculature, Pectoral muscle.		
	Histology of the breast: Terminal ductal lobular unit, Extra lobular		
3.	terminal duct, Intra-lobular terminal duct, Ductal sinus(acinus), Cellular	20	16
	components: Epithelial cells, Myoepithelial cells, Basement membrane		
	Mammographic Appearance of Breast: Density variations, BIRADS,		
4.	Variances, Life cycle changes, lesions and characteristic features, lesion	28	15
	measurement.		
Total	5	108	70
		R	
Evalua	tion System	~	2
	G		3
There w	all be no Theory examination at university level for this subject.		TI
Contin	uous Internal Evaluation (CIE)		ES
SI No	Component	tago I	1 mortes

## **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks	Weightage	IA marks
1.	Sessional test(s)		•	0
	Two Practical tests	50		
	Same pattern as Summative test			S
	Average of two to be considered			
	Absence without prior permission to be marked as 0			
	Total	50	0.3	15
2.	Continuous assessment	C		5
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	साध	नम् 🏑	140
		Þ		
	Total	50	0.3	<u>15</u>
	Total CIE marks Since-202	1	100	30
	के अर्थर स्वास्थ्य	देखाँग्रे	SI	

#### End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

ESE		CIE		Grand total
Practical	Viva		Sub Total	
50	20	30	100	100
EARNING	RESOU	J <b>RCES</b>	IED AND	HEAL

# SUGGESTED LEARNING RESOURC

S. No.	Title of Book	Author	Publication
1.	Cross Sectional Anatomy CT and MRI	Govind Chavhan, Bhavin Jankharia	Jaypee Brothers Medical Pub.
2.	Cross-Sectional Anatomy for Computed Tomography	Michael L. Farkas	Springer New York
3. <b>OITA</b>	Sectional Anatomy by MRI and CT	Mark W. Anderson, Michael G Fox	Elsevier Health Sciences
4. ~	Atlas of Human Cross-Sectional Anatomy With CT and MR Images	Donald R. Cahill, Matthew J. Orland, Gary M. Miller	Wiley

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

The course may offer hands-on training or practical sessions, allowing participants to enhance their skills in teaching and research. Since-2021 की Since-2021 की सिंह के रिया की रिया क



"Curriculum Handbook of Medical Radiology and Imaging Technology (Intellectual Property of the National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare)."

# COMPOSION FOR AL HEALTHCARE PROFESSIONS . Fourth Semester

Since-2021

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#### Subject: Advancements in Breast Imaging Technology

#### Subject Code: MMRIT24

#### RATIONALE

Advances in breast imaging techniques have been instrumental in improving the early detection, diagnosis, and management of breast conditions, especially breast cancer. These advanced techniques offer several key benefits and rationale for their adoption

#### **COURSE OUTCOMES**

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

**CO1:**Describe the uses of computer-aided detection for mammography images.

**CO2**:Describe the basic theory of digital breast tomosynthesis including appropriate use.

**CO3:**Identify the value of biomarkers and those specific to breast imaging modalities.

**CO4:**Discuss dual energy contrast digital mammography and its appropriate use.

**CO5**:Describe the potential benefits and use of breast elastography.

**CO6**:Discuss the potential benefits and use of nuclear medicine studies.

**CO7:**Describe the use of 3-Dsonography.

**CO8:**Discuss the potential benefits and use of abbreviated breast MRI.

CO9:Discuss the use of computed tomography laser mammography (CTLM) and thermography

C									05
Teac	hing	Scheme	Total	Examin	ation Se	cheme			0
(In I	Iours	)	Credits	Theory	Marks		Practical I	Marks	Total Marks
2	-		(L+T+P)						0,
	т	D		CIE			CIE	FSE	
L		1			ESE		CIE	ESE	1
2	1	4	5	30	70		30	70	200
	A					c	• (		5

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

## TUTORIAL ASSIGNMENTS

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

## THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Unit	Topic and contents	Hours	Marks
1.	<b>Computer-Aided Detection</b> Define, Proper protocol for use, Tool for mammography interpretation	4	6
2.	<b>Digital Breast Tomosynthesis (DBT):</b> Define, physical principle and components of DBT, Personnel training requirements (MQSA), Potential benefits, Types of images: Projection images &Reconstruction images.	8	10

3.	Breast Imaging Biomarkers: Breast Density assessmen	4	6			
	Breast arterial calcification scoring, Cancer markers, MRM	А.				
4.	Dual Energy Contrast-enhanced Mammography		4	8		
	Define, Theory, Potential benefits					
5.	5. Breast Elastography: Ultrasound Imaging, Basic principle, types,					
	advantages, image interpretation.					
6	Nuclear Medicine Studies: Define, basic principle,	Potential				
0.	benefits, Types: Scintimammography, Lympho-scint	tigraphy.	10	8		
	Positron emission tomography.	01,,				
7	3-D Ultrasound Imaging: Concept, mechanism of	action.	Q	8		
<i>.</i>	advantages, indications.	1/ >.	0			
8.	Abbreviated Breast MRI: Define, Theory, Potential ber	nefits	6	6		
/		í C	2			
9.	Non-ionizing techniques: CTML, Thermal Imaging	, Breast	4	6		
	Imaging with EIS, Breast Photo Imaging	•	1.			
10.	indications pros and cons protective apparel	imation,	2	Do \		
	indications, pros and cons, protective apparei.					
Total			54	70		
Total			54	70		
Total	D PRACTICALS (DEMONSTRATION		54	TO TS		
Total	D PRACTICALS/DEMONSTRATION		54	70 ESS		
Total SUGGESTE Sr. No	D PRACTICALS/DEMONSTRATION	Hours	54	TESS 0		
Total SUGGESTE Sr. No	D PRACTICALS/DEMONSTRATION	Hours	54	TESSION:		
Total SUGGESTE Sr. No 1. (2) 2. []	D PRACTICALS/DEMONSTRATION	Hours 8	54	ESSIONS		
Total SUGGESTE Sr. No 1. ( 2. []	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT)	Hours 8 6	54	TESSIONS -		
Total           SUGGESTE           Sr. No           1.           2.           3.	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers	Hours           8           6           8	54	Terssions - L		
Total           SUGGESTE           Sr. No           1.           2.           3.           4.	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques	Hours 8 6 8 8 8	54	TAL SNOISST		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         E           4.         N           5.         I	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT	Hours 8 6 8 8 8 8	54	TESSIONS MUS		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         F           4.         N           5.         I	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT	Hours 8 6 8 8 8 8	54	TESSIONS .		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         H           4.         N           5.         I           6.         3	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging	Hours 8 6 8 8 8 8 8 8 8	54	TESSIONS - Laura		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         F           4.         N           5.         I           6.         3           7.         I	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography	Hours 8 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	54	TESSIONS . Laure		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         F           4.         N           5.         I           6.         3           7.         I           F         F	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography Breast Elastography	Hours 8 6 8 8 8 8 10	54	TESSIONS INDE		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         E           4.         N           5.         I           6.         3           7.         I           9.         A	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography Breast Elastography	Hours 8 6 8 8 8 8 10	54	TESSIONS MAL		
Total         SUGGESTE         Sr. No         1.       C         2.       I         3.       F         4.       N         5.       I         6.       3         7.       I         8.       A	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography Breast Elastography Abbreviated Breast MRI	Hours 8 6 8 8 8 8 10 6	54	TESSIONS - LALA		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         H           4.         N           5.         I           6.         3           7.         H           8.         A           9.         N	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography Breast Elastography Nbbreviated Breast MRI Nuclear Medicine Studies	Hours 8 6 8 8 8 8 10 6 10	54	Terssions - Mar		
Total           SUGGESTE           Sr. No           1.         C           2.         I           3.         F           4.         N           5.         I           6.         3           7.         I           8.         P           9.         N	D PRACTICALS/DEMONSTRATION Computer-Aided Detection Digital Breast Tomosynthesis (DBT) Breast Imaging Biomarkers Non-ionizing techniques Dedicated Breast CT B-D Ultrasound Imaging Dual Energy Contrast-enhanced Mammography Breast Elastography Abbreviated Breast MRI Nuclear Medicine Studies Fotal	Hours 8 6 8 8 8 10 6 10 72	54	TESSIONS .		

#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component		Marks	Weightage	IA marks
1.	Sessional test(s)		•	•	•
	Two Written tests		50		
	Same pattern as Summative test				
	Average of two to be considered				
	Absence without prior permission to	be marked as 0			
	Total	LILD AN	50 Hr	0.3	15
2.	Continuous assessment		12	4/ >.	
	Seminars/Case presentations/ I records/Record book/assignment	Logbook/ Case		HCAR	
	Total		50	0.3	15
	Total CIE marks				30
Туре о	of question	No. of quest	tions <mark>Mark</mark> q <mark>ues</mark> t	s per] ion	Total
Long I	Essay	2	15	3	0 5
Short I	E <mark>ss</mark> ay	8	5	4	0
	N			7	
Durati	on (minutes)		<u>c</u>	1	50
	भेष्ठे रवारथ्यम्	<u>, रावार</u>	14116	1-1-1-1	in the second se
	R S	ince-202	<b>)</b> 1	ALC: A	
	· 84 317 -		7251	EG.	

End Semester Evaluation (ESE)

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

Distribution of marks for university examination practical exams:

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

# SUGGESTED LEARNING RESOURCES ED AND HE

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6			
S. No.	Title of Book	Author	Publication
1.	Basic radiological physics	K. Thayalan	Jaypee Brothers Medical Publishers (P) Limited, 2003
2.	Christinsens physics of diagnostic radiology	Curry and Dowdey	Wolters Kluwer
3.	X-Ray Equipment for Student	D.N. And M.O. Chesney	Blackwell Science Ltd
V I V	Digital Mammography	Ulrich <mark>Bick,</mark> Felix Diekmann	SN

Since-2021

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#### Subject: Quality Assurance, Radiation Protection and Patient care in Breast Imaging Subject Code: MMRIT25

#### RATIONALE

Radiation Protection and Patient care provides an overview of the principles of radiation protection, including the responsibilities of the radiographer for patients, personnel and the public. This content provides the concepts of optimal patient care, including consideration for the physical and psychological needs of the patient and family. Routine and emergency patient care procedures are described, as well as infection control procedures using standard precautions. The role of the Imaging Technologist in patient FOR ALLIED AND HEALTH education is identified.

#### **COURSE OUTCOMES**

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

C01:		Identify and justify the need to minimize unnecessary radiation exposure of humans.						
C02:	E	Explain the objectives of a radiation protection program.						
C03:	D	efine radia	ation and r <mark>adio</mark>	pactivity u	units of measur	re <mark>ment.</mark>		
C04:	Ic	lentify effe	ective dose lim	its (EDL)	) for occupation	nal a <mark>nd no</mark>	n-occupatio	onal radiation exposure.
C05:	D	escribe the	e AL <mark>ARA cor</mark>	cept.		~ ~		0
<b>C06:</b>	Ic	lentify ion	izing r <mark>adiation</mark>	sources	from natural a	nd man-m	ade source	s.
<b>C07:</b>	C	omply wit	h legal a <mark>nd et</mark> h	ical radia	tion protection	n responsi	<mark>bilities</mark> of ra	adiation workers.
<b>C08:</b> (	(Ja	lentify app	propr <mark>iate appl</mark> i	cations a	nd limitations f	for each ra	<mark>diation</mark> det	ection device.
<b>C09:</b>	D	escribe ho	w iso-exposu	re curves	are used for ra	diation pr	otection.	0
<b>C010:</b>		lentify per	formance stan	dards for	: beam-limiting	g device <mark>s.</mark>		Z
<b>C011:</b>	D	istinguish	between cont	rolled and	<mark>d non-con</mark> trolle	ed areas ar	nd list accep	otable exposure levels.
<b>C012:</b>	D	escribe th	e function of	federal,	state and loca	l regulatio	ns governi	ng radiation protection
	p	ractices.						
C013:	R	ole of Rad	iation safety o	officer				t
C014:	D ez	escribe pe ach device.	rsonnel monit	oring de	vices, including	g applicatio	ons, advant	ages and limitations for
C015:	С	ompare v	alues for indi	vidual ef	fective dose l	imits for	occupation	nal radiation exposures
	(a	innual and	lifetime).			<b>F</b>		2E
C016:	Ic	lentify effe	ective dose lim	its for th	e embryo and	fetus in oc	cupational	ly exposed women.
C017:	D	istinguish	between prim	ary and s	econdary radia	tion barrie	ers.	
C018:	D	emonstrat	te how the ope	eration of	f various x-ray	and ancill	ary equipm	ent influences radiation
	SZ	itety and d	escribe the po	tential co	onsequences of	equipmen	nt failure.	
Teachi	ing S	Scheme	Total	Examin	ation Scheme			
(In Ho	ours)		Credits	Theory	Marks	Practical	Marks	Total Marks
			(L+T+P)					
L	T	Р	С	CIE	ESE	CIE	ESE	
2 1	1	4	5	30	70	30	70	200

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

#### THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Unit	Topic and contents	Hours	Marks
1.	<b>ALARA Principle:</b> Optimizing imaging techniques and using the lowest possible radiation dose are essential components of ALARA.	10	12
2.	Appropriate Indications and contraindications. Technique Optimization: Patient education, consent and preparation, history taking, exposure factors and compression settings based on the patient's breast size and density.	10	14
3.	Mammographic Procedure: Collimation and Field Size, Compression, Receptor Sensitivity (reduction of patient dose), Use of AEC, Patient Comfort.	8	14
4.12	<ul> <li>Staff Education and Training: Radiation safety protocols, Regular continuing education and training about latest techniques and guidelines.</li> <li>Quality Assurance and Audits: Implement quality assurance programs to monitor and assess radiation dose levels, image quality, and compliance with radiation safety protocols.</li> </ul>	8	16
5.	<ul> <li>Patient Care in Interventional Mammographic procedures:</li> <li>Pre-procedural care: Knowledge of informed consent, Use of 2 patient identifiers, Hard stop process, Vital signs, Explanation of procedure, Proper documentation</li> <li>During procedure: Patient awareness, Signs of vasovagal reaction and syncope, Signs of allergic reactions to anesthesia, Anxiety, patient compliance.</li> <li>Post-procedural care: Post-procedure imaging for clip placement, compression and wound dressing, instructions and medications prescribed, Follow-up.</li> </ul>	नम् ¹⁸	12/15
	Total	54	70

#### SUGGESTED PRACTICALS/DEMONSTRATION

Sr. No			Hours	
1.	ALARA Principle		15	
2.	Appropriate Indications and contraindications. Technique Optimization		10	
3.	Mammographic Procedure		6	
4.	Staff Education and Training Quality Assurance and Audits	ND HEA	20	
5.	Patient Care in Interventional Mammographic pr Pre-procedural care During procedure Post-procedural care	rocedures:	21	DE PR
	Total		72	9
	₹			FF
C <mark>ontinuc</mark> Sl. No. C	ous Internal Evaluation (CIE)	Marks	Weightag	IA marks
			e	
1. Solution	essional test(s) wo Written tests ame pattern as Summative test average of two to be considered beence without prior permission to be marked as 0		नम्	With I
7	Total NOATH	50	0.3	15
		-		
2. C	Continuous assessment Since-202	1	100	
2. C Si re	Continuous assessment Since-202 eminars/Case presentations/ Logbook/ Case ecords/Record book/assignment	रेखान्रे	Jet Cr	
2. C Si re <b>7</b>	Continuous assessment Since-202 eminars/Case presentations/ Logbook/ Case ecords/Record book/assignment	2 2 50	0.3	15

End Semester Evaluation (ESE)

#### Written Paper

Type of question	n			No. of questic	onsMarks question	perTotal
Long Essay				2	15	30
Short Essay				8	5	40
						70
End Semester Ex Fhere shall be prace Distribution of ma	v <b>aluation (I</b> ctical examin urks for univ	E <b>SE)</b> nation fo versity ex	or 70 mar	ks in the subject	D HEALTA	HC
2	ESE		CIE		Grand total	NP \
2	Practical	Viva		Sub Total		
S	50	20	30	100	100	P
SUGGESTED L	EARNING	RESO	URCES		K	OFESS

11	ESE		CIE		<mark>Gran</mark> d total
11	Practical	Viva		Sub Total	
	50	20	30	100	100

## SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Ultrasound physics and technology	Vivien gibbs, davidcole, Antonio sassano	Churchill Livingstone;
2.	Manual of Diagnostic Ultrasound	Philip E. S. Palmer (Author)	World Health Organization
3.	Physics and Technical Aspects Diagnostic Ultrasound	DINESH K BAGHEL (Author	AITBS PUBLISHERS
4.	Diagnostic Ultrasound	Carol M. Rumack (Author), Deborah Levine (Author)	Elsevier;
5.	Concise Textbook on Hospital Managment& Patient Care In Diagnostic Radiology	N.K.Kardam,, Lalit Agarwal	JBD Publications
6.	Patient care in radiography : with an introduction to medical imaging	Ehrlich, Ruth Ann and joanA.daly	St. Louis, Mo. : Mosby Elsevier

Subi	ect:	<b>Basics</b>	Pathology	and	Image	Interpretati	on ir	Breast	Imag	ring
,	,					1			C	, 0

#### Subject Code: MMRIT26

#### RATIONALE

ImagingPathology and image Interpretationprovides the knowledge about the concepts of breast pathology detection and diagnosis. This section presents characteristics of benign and cancerous pathologies and their mammographic appearance.

#### **COURSE OUTCOMES**

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

CO1: Discuss the factors and physiologic changes that will affect breast tissue composition.

CO2: Identify physical changes of the breast.

CO4: Correlate clinical breast changes with imaging findings, and comparison with previous mammograms.

CO5: Identify the mammographic appearance of pathologies.

CO6: Describe assessment categories and the recommended clinical follow up.

CO7: Identify the high risk and low risk factors limited to breast cancer.

CO8: Describe the etiology, mammographic appearance, diagnosis and treatment of benign breast pathologies.

CO9: Describe the etiology, mammographic appearance, diagnosis and treatment of malignant breast pathology.

CO10: Identify the procedures used to diagnosis breast cancer.

CO11: Describe treatment options for breast cancer.

CO12: Explain breast cancer stages 0 to IV and stage characteristics.

CO13: Explain tumor node metastasis (TNM) classifications of breast cancer.

CO14: Identify the significance of breast cancer detection through patient screening and diagnostic mammograms.

CO15: Discuss the practice of clinical breast examinations and breast self-examinations, and current evidence-based data about them.

CO16: Identify the risk factors associated with breast cancer.

Teac	ching S	Scheme	Total - 22	Examin	ation Scheme	418		E I
In I	Hours	B	Credits	Theory	Marks	Practical I	Marks	Total Marks
		R	(L+T+P)	NC	CAHP		de la	
L	Т	PG	С	CIE	ESE2021	CIE	ESE	
		6	3 37		- >	30	70	100

CIE, Continuous Internal Evaluation; ESE, End Semester Evaluation; L, lecture; T, Tutorial; P, Practical

#### **TUTORIAL ASSIGNMENTS**

Tutorials should be planned to enhance learning. The faculty shall decide suitable tutorial assignments of minimum one hour per unit based on the curriculum.

#### PRACTICAL COMPONENTS

The following topics/subtopics should be taught and assessed in order to attain the identified competency:

Unit	Topic and contents	Hours	Marks
1.	Breast Anomalies Asymmetry Inverted nipples Accessory nipples Accessory breast tissue Other (e.g. congenital)	8	5
2. INATIONAL	Clinical Breast Changes Lumps: Location, Size, Pain, Mobility, Duration and Other associated indications (e.g. trauma, fever, antibiotics) Thickening: Location, Size and Duration Swelling: Location, Size and Duration Dimpling: Location, Size and Duration Skin irritation and lesions (e.g. moles, keratosis, cysts, ulcers, blisters, scaling): Location, Size and Duration Pain: Location, Duration and New Onset Discharge: Duration, New onset, Color of discharge, Ipsilateral or bilateral, Single duct or multiple ducts and Spontaneous vs. Expressed Nipple retraction, inversion, and areolar changes: Location, Duration and New Onset Edema Erythema	20	10 PROFESSIONS
2107	Mammoplasty Breast Augmentation: Types: Silicone, Saline Location: Sub-glandular & Subpectoral Breast lift, Breast reduction & Other Reconstructive surgery: Autologous (e.g. TRAM flap, DIEP flap, latissimus dorsi flap), Tissue expander, Implant & Other Post surgical excision Radiation changes	म्	In the last
3.	Mammographic Appearance of Pathology Masses: Definition, Location & Margins Circumscribed Ill-defined(indistinct) Lobulated Spiculated Asymmetric density: Definition & Location Focal asymmetry: Definition & Location Calcifications: Location- Dermal and Internal Causes:	20	15

	Cystic changes, Sutural, Vascular, Malignancy, Characteristics,		
	Number(quantity), Size & Shape		
	Distribution:		
	Clustered or grouped, Segmental, Regional, Diffuse(scattered),		
	Multiplegroups		
	Margins		
	Benign characteristics(typical)		
	Coarse		
	Rim or eggshell		
	Milk of calcium(teacup-like)		
	Dystrophic Dystrophic Dystrophic		
	Vascular		
	Skin(superficial)		
	Secretory	NO.	
	Fat necrosis	1	
	Punctate	72	$\land$
	Suspicious morphology (nondeterminate characteristics)		0
	Indistinct (amorphous)		P
			0
	Pleomorphic, granular (clustered)		TI
Z	Linear		10
$\leq$	Linear		()
0			5
	Reporting Terminology (e.g.BI-RADS)		9
X	Assessment categories		$\overline{\Box}$
-	Recommendations		
4.		10	5
N	Interpretation of imaging		
	Density Score, BIRADS, Comparison of mammographic images		*
	with other modalities.		PI
	<u>्र स्वास्थ्यम् सवाथसाधन</u>	H, I	8
	Benign Breast Pathology	~	
	Cyst, Galactocele, Fibroadenoma, Lipoma,	20	
F	Hamartoma(fibroadenolipoma), Papilloma, Ductal ectasia,	10	
5.	Breast infection/abscess, Hematoma, Fat Necrosis, Radial Scar,	10.5	5
	Lymph node & Gynecomastia	/	
	Etiology, Mammographic appearance, Diagnosis and Treatment		
	Breast Cancer Classification		
	Stage Characteristics		
	Suge characteristics		
6	Description		
6.	Size	15	10
	Invasive vs. Noninvasive		
	Lymph node involvement		
	Spread beyond the breast Stages		

NATIONAL S	Stage I Stage II Stage III Stage IV TNM classification characteristics TNM description Size Lymph node involvement Metastasis T –size TX T0 Tis T1, T2, T3,T4 N – lymph node involvement NX N0 N1, N2,N3 M –metastasis MX, M0, M1 Cell grade Definition Grade1 Grade2 Grade3 Multifocal Multicentric Hormone receptors andHER2 Importance oftests Estrogen Progesterone HER2	THCAP	E PROFESSIONS . Le
7.	Risk Factors Associated with Breast Cancer Gender Age Breast density and breast composition Personal history of breast cancer Family history of breast cancer Personal history of female cancer Genetic predisposition Menses: Early age at menarche Late age at menopause Parity: Nulliparity, Primiparity Hormone replacement therapy Obesity Ethnicity Bisk assessment models (e.g. Gail Tyrer Cuzick)	H 15	10

	Breast Cancer Detection Methods		
	Screening mammograms		
	ACS and ACR guidelines		
	Diagnostic mammograms: Clinical findings & Recall from		
8.	screening	10	10
	Clinical examinations		
	Women aged 20 to 40 years, every 3years		
	Women older than 40 years, every year AND L		
	Breast self-examinations		
Total	Slor	108	70
/		"Ap	
Evaluation	System	1	
There will b	e no Theory examination at university level for this subject.		P
Continuous	Internal Evaluation (CIE)		OF

#### **Evaluation System**

#### Continuous Internal Evaluation (CIE)

Sl. No.	Component	Marks 🦳	Weightage	IA marks
1.	Sessional test(s)			S
i	Two Practical tests	50		0
	Same pattern as Summative test			$\sim$
	Average of two to be considered			S
	Absence without prior permission to be marked as 0			
	Total	50	0.3	15
2.	Continuous assessment			F
	Seminars/Case presentations/ Logbook/ Case records/Record book/assignment	साध	नम् ह	121h
	Total NOALI	50	0.3	15
	Total CIE marks		22	30
End	Since-202 Semester Evaluation (ESE)	1 declared	et et	

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

Distribution of marks for university examination practical exams:

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

#### SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Clinical Breast Imaging: A Patient Focused	Gilda Cardenosa	
	Teaching File		
2.	Interventional Breast Procedures: A	Cherie M. Kuzmiak	
	Practical Approach	DAND,	
3.	D' CHE EORALLIE	Carol M.	
	Diagnostic Ultrasound	Rumack (Author), Deborah	Elsevier;
	SION	Levine (Author)	

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

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





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#### Annexures

#### 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 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.

The learning out comes to be assessed should include:

- e. Acquisition of knowledge: the methods used comprise of 'Log Book' which records participation in various teaching/ learning activities and mentoring of students. The number of activities attended and the number in which presentations are made are to be recorded. The log bookshouldperiodicallybe validated by the supervisors. Some of the activities are listed.
- f. 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 ChecklistI)*.
- g. 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 checklist *(see Model Checklist II).*
- *h.* Teaching skills: candidates should be encouraged to teach undergraduate students. 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)*.
- i. Work diary/ Log Book- every candidate shall maintain a work diary and record his participation in the training programs conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of experiments or procedures, if any conducted by the candidate.
- j. Records: records, log books and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University.

#### Log Book

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

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 he fails to fulfill the requirements inspite of being given adequate chances to set himself right.

#### Format of Model Checklists Checklist- I: MODEL CHECKLIST FOR EVALUATION OF JOURNAL REVIEW PRESENTATIONS

Name of the student:

Date:

Name of the faculty/ observer:

Title of the paper:

Journal detail:

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Sl.	Items of observation during	Poor	Below	Average	Good	Very	
1101	presentation	0	1	2	3	g00 <b>u</b> 4	
1	Article chosen was		$\mathcal{L}$				
2	Extent of understanding of scope & objectives of the paper by the candidate				2no	DOF	
3	Whether cross- references have been consulted					SS ²	
	Whether other relevant references have been consulted					101	
5_	Ability to respond to questions on the paper/ subject					S	
6	Audio- visual aids used					1	
7	Ability to defend the paper					F	
8	Clarity of presentation	-	~		7	5	
9	Any other observation	ति	श्रेमा	ानम	4		
	Total score				3		
	Remarks D						
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Name and Signature of the Faculty ...

# Checklist- II: MODEL CHECKLIST FOR THE EVALUATION OF THE SEMINAR PRESENTATIONS

Name of the student:

Date:

Name of the faculty/ observer:

Title of the seminar:

S1.	Items of observation during	Poor0	Below	Average	Good	Very
No	presentation		average 1	EA2/ >	3	good 4
1	Topic chosen was			~//		
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3	Whether cross- references have been consulted	1	$\sim$			PP
4	Whether other relevant references have been consulted					OF
5	Ability to respond to questions on the paper/ subject					ES
6	Audio- visual aids used					Ś
7	Ability to defend the topic					5
8	Clarity of presentation					9
9	Any other observation					
	Total score					0
Rema	rks					

Name and Signature of the Faculty

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#### Checklist - III: MODEL CHECKLIST FOR EVALUATION OF TEACHING SKILL

Name of the student:

Date:

Name of the faculty/ observer:

Topic:

Under Graduate batch:

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S1	Items to be observed during teaching	Strong Point Weak Point
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1	Communication of th <mark>e purpose of the t</mark> alk	
2	Evokes audience interest in the subject	
3	The introduction	P
4	The sequence of ideas	
5	The use of practical examples and/or illustrations	in in
62	Speaking style (enjoyable, monotonous, etc., specify)	S.S.
7	Summary of the main points at the end	
8	Ask questions	
9	Answer questions asked by the audience	
10	Rapport of speaker with the audience	
11	Effectiveness of the talk	
12	Uses of AV aids appropriately	4
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121 न देखा-रेखे Since-2021 Name and Signature of the Faculty......

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# Checklist- IV: CONTINOUS EVALUATION OF DISSERTATION WORK BY GUIDE/ CO- GUIDE

Name of the student:

Date:

Name of the faculty/ observer: Topic:

S1.	Points of observation during	Poor 0	Below	Average	Good	Very
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1	Periodic consultation with guide/ co-		H	1	5	
	guide			M/Jr		
2	Depth of Analysis/ Discussion			· M	2	
3	Department presentation of findings	A.		5		
4	Quality of Final Output		1		12	
5	Others		6		1.	
	Total score					5
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Institute/University Logo



Batch:

#### PARTICULARS OF STUDENT



#### **DISSERTATION DETAILS**

**Title of Dissertation** : ND HEALTHCARE PROFESSIONS Name of the Guide : Designation of the Guide : Name of the Co-guide Designation of the Co-guide Synopsis Presentation date **IEC Approval Completion and Submission date** : Alat. H & d & 31 देखा-रेखी

# **CERTIFICATE**

This	is	to	certify	that
Mr/Ms				has
completed the	training require	ments for the progra	amme Master in Medica	al Radiology
and Imaging T	echnology (MM	RIT) of (name of th	ne Institute/University	& address).
She/He has co	mpleted all the	cl <mark>inical re</mark> sponsibilit	ies during her/his Pos	t-graduation
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# SECTION I: CLINICAL/AREA/FIELD POSTINGS

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# SECTION II. SEMINARS PRESENTED/ATTENDED

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SEMINAR EVALUATION FORM
Evaluation of Seminar

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3.	Oratory & Presentation Skills					
4.	Audio- visual aids used					
5.	Clarity of presentation	IED AV	DHE			
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7.	Ability to respond to questions			HC		
8.	Ability to defend the topic			44		
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# SEMINAR SCORE SHEET

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## SECTION III. JOURNAL PRESENTED/ATTENDED



# JOURNAL CLUB EVALUATION

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1	Paper Selection (importance, interest,					
1	general appeal):					
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	System.					
	Critical Analysis of Results, Concise and					
3	Accurate Conclusions, and Future		ND			
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	Slides / Visual aids: (organization,		11	AIN		
	number, clarity) , Oral Presentation &			- C/L		
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	speech, enunciation, appropriate use of		1		YS \	
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# **JOURNAL CLUB SCORE SHEET**
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# **SECTION IV: Seminar taken for UG students**

# **Review of Dissertation**

SI. No.	Date	ACTIVITY	Remarks	Signature of the Co- Guide	Signature of the Guide
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# SECTION V. Extension/Extra Curricular activities

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# EVALUATION OF THE LOGBOOK

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7	Work Relationship & Frequency of consulting faculty			E.	100
8	Overall quality of department work			10	
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	Signature of the Co-ordinator	)			

# Scoring:

- 1 Poor
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- 3 Average
- 4 Good
- 5 Excellent

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#### ICAHP Committee - 3 (Minimum Standards and Procedures for Award of Ph.D. Degree in MRIT in the related special fields) to be followed as per UGC Guidelines.

The ICAHP Committee – 3 hereby makes the following Regulations:

#### 1. Short title, Application, and Commencement. –

- (1) These Regulations may be called ICAHP Committee 3 (Minimum Standards and Procedure for Award of Ph.D. Degree) Regulations, 2024.
- 2. Definitions.- (1) In these Regulations, unless the context otherwise requires,-
- a) "Adjunct Faculty" means a part-time or contingent instructor, but not full-time faculty member hired to teach by a Higher Educational Institution
- b) "Cumulative Grade Point Average (CGPA)" means a measure of the overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all semesters. It is expressed up to two decimal places;
- c) "Credit" means the number of hours of instruction required per week over the duration of a semester. A three-credit course in a semester means three one-hour lectures per week, with each one-hour lecture counted as one credit;
- d) "College" means an institution engaged in higher education and/or research, either established by a University as its constituent unit or is affiliated with it;
- e) "Course" means one of the specified units which go to comprise a programme of study;
- f) "Course Work" means courses of study prescribed by the School/Department/ Centre to be undertaken by a student registered for the Ph.D. Degree;
- g) "Degree" means a degree awarded by a Higher Educational Institution in accordance with NCAHP act;
- h) "External examiner" means an academician/researcher with published research work who is not part of the Higher Educational Institution where the Ph.D. scholar has registered for the Ph.D. programme;
- i) "Foreign Educational Institution" means—(i) an institution duly established or incorporated in its home country and offering educational programmes at the undergraduate, postgraduate and higher levels in its home country and (ii) which offers programme(s) of study leading to the award of a degree through conventional face-to-face mode, but excluding distance, online, ODL mode;
- j) "Grade Point" means a numerical weight allotted to each letter grade on a 10-point scale;
- k) "Guide/Research Supervisor" means an academician/researcher recognized by Higher Educational Institution to supervise the Ph.D. scholar for his/her research;
- l) "Higher Educational Institution" means a university or institution;
- m) "Interdisciplinary Research" means research conducted by a Ph.D. scholar in two or more academic disciplines;
- n) "Plagiarism" means the practice of taking someone else's work or idea and passing them as one's own;

- o) "Programme" means a higher education programme pursued for a degree specified by the NCAHP;
- p) "Research Proposal" means a brief write-up giving an outline of the proposed research work which the Ph.D. scholar shall submit along with the application for registration for Ph.D. programme;
- q) Stipend/Remuneration to be paid to the candidate as per UGC Guidelines.

# 3. Eligibility criteria for admission to the Ph.D. Programme.-The following are eligible to seek admission to the Ph.D. programme:

# Candidates who have completed:

A 2-year/4-semester MMRIT degree programme after BMRIT or Equivalent Degree or a 1-year/2semester master's degree programme after a 4-year/8-semester honors degree programme or a 2year/4-semester master's degree programme after a 3-year bachelor's degree programme or qualifications declared equivalent to the master's degree by the corresponding statutory regulatory body of NCAHP, with at least 55% marks in aggregate or its equivalent grade in a point scale wherever grading system is followed or equivalent qualification from a foreign educational institution accredited by an assessment and accreditation agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country to assess, accredit or assure quality and standards of the educational institution.

A relaxation of 5% marks or its equivalent grade may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per the decision of the Commission from time to time.

# 4. Duration of the Programme.-

- (1) Ph.D. Programme shall be for a minimum duration of three years, including course work, and a maximum duration of six (6) years from the date of enrolment to the Ph.D. programme.
- (2) A maximum of an additional two (2) years can be given through a process of re-registration as per the Statute/Ordinance of the Higher Educational Institution concerned; provided, however, that the total period for completion of a Ph.D. programme should not exceed eight (8) years from the date of admission in the Ph.D. programme.

Provided further that, female Ph.D. scholars and Persons with Disabilities (having more than 40% disability) may be allowed an additional relaxation of two (2) years; however, the total period for completion of a Ph.D. programme in such cases should not exceed ten (10) yearsfrom the date of admission in the Ph.D. programme.

(3) Female Ph.D. Scholars may be provided Maternity Leave/Child Care Leave for up to 240 days in the entire duration of the Ph.D. programme.

#### 5. Procedure for admission. -

- (1) The admission shall be based on the criteria notified by the institution, keeping in view the guidelines/norms in this regard issued by the NCAHP and other statutory/regulatory bodies concerned, and taking into account the reservation policy of the Central/State Government from time to time.
- (2) Admission to the Ph.D. programme shall be made using the following methods:
  - i. HEIs may admit students who qualify for fellowship/scholarship in UGC-NET/UGC-CSIR NET/GATE/CEED and similar National level tests based on an interview.

And/or

- ii. HEIs may admit students through an Entrance Test conducted at the level of the individual HEI. The Entrance Test syllabus shall consist of 50% of research methodology, and 50% shall be subject- specific.
- iii. Students who have secured 50 % marks in the entrance test are eligible to be called for the interview.
- iv. A relaxation of 5 % marks will be allowed in the entrance examination for the candidates belonging to SC/ST/OBC/differently-abled category, Economically Weaker Section (EWS), and other categories of candidates as per the decision of the Commission from time to time.
- v. HEIs may decide the number of eligible students to be called for an interview based on the number of Ph.D. seats available.
- vi. Provided that for the selection of candidates based on the entrance test conducted by the HEI, a weightage of 70 % for the entrance test and 30 % for the performance in the interview/viva- voce shall be given.
- (3) Universities and Colleges which are eligible to conduct Ph.D. programmes, shall:
  - Notify a prospectus well in advance on the institution's website specifying the number of seats for admission, subject/discipline-wise distribution of available seats, criteria for admission, the procedure for admission, and all other relevant information for the candidates;
  - ii. Adhere to the National/State-level reservation policy, as applicable.
- (4) The Higher Educational Institution shall maintain a list of Ph.D. supervisors (specifying the name of the supervisor, his or her designation, and the department/school/centre), along with the details of Ph.D. scholars (specifying the name of the registered Ph.D. scholar, the topic of his/her research and the date of admission) admitted under them on the website of the institution and update this list every academic year.
- 6. Allocation of Research Supervisor.- Eligibility criteria to be a Research Supervisor, Co-Supervisor, Number of Ph.D. scholars permissible per supervisor, etc.
- (1) Permanent faculty members working as Professor/Associate Professor of the Higher Educational Institution with a Ph.D., and at least five research publications in peer-reviewed or refereed journals and permanent faculty members working as Assistant Professors in Higher Educational Institutions with a Ph.D., and at least three research publications in peerreviewed or refereed journals may be recognized as a Research Supervisor in the university where the faculty member is employed or in its affiliated Post-graduate Colleges/institutes.

Such recognized research supervisors cannot supervise research scholars in other institutions, where they can only act as co-supervisors. Ph.D. awarded by a university under the supervision of a faculty member who is not an employee of the university or its affiliated Post- graduate Colleges/institutes would be in violation of these Regulations.

For Ph.D. scholars working in Central government/ State government research institutions whose degrees are given by Higher Educational Institutions, the scientists in such research institutions who are equivalent to Professor/Associate Professor/Assistant Professor can be recognized as supervisors if they fulfill the above requirements.

Provided that in areas/disciplines where there is no, or only a limited number of peer-reviewed or refereed journals, the Higher Educational Institution may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing.

Co-Supervisors from within the same department or other departments of the same institution or other institutions may be permitted with the approval of the competent authority.

Adjunct Faculty members shall not act as Research Supervisors and can only act as cosupervisors.

- (2) In case of interdisciplinary/multidisciplinary research work, if required, a Co-Supervisor from outside the Department/School/Centre/College/University may be appointed.
- (3) An eligible Professor/Associate Professor/Assistant Professor can guide up to eight (8) / six
   (6) / four (4) Ph.D. scholars, respectively, at any given time.
- (4) In case of relocation of a female Ph.D. scholar due to marriage or otherwise, the research data shall be allowed to be transferred to the Higher Educational Institution to which the scholar intends to relocate, provided all the other conditions in these Regulations are followed, and the research work does not pertain to a project sanctioned to the parent Institution/Supervisor by any funding agency. Such scholar shall, however, give due credit to the parent institution and the supervisor for the part of research already undertaken.
- (5) Faculty members with less than three years of service before superannuation shall not be allowed to take new research scholars under their supervision. However, such faculty members can continue to supervise Ph.D. scholars who are already registered until superannuation and as a co-supervisor after superannuation, but not after attaining the age of 70 years.

## 7. Admission of International students in Ph.D. programme.-

- (1) Each supervisor can guide up to two international research scholars on a supernumerary basis over and above the permitted number of Ph.D. scholars as specified in clause 6.3 above.
- (2) The HEIs may decide their own selection procedure for Ph.D. admission of international students keeping in view the guidelines/norms in this regard issued by statutory/regulatory bodies concerned from time to time.
- 8. At any point, the total number of Ph.D. scholars under a faculty member, either as a supervisor or a co-supervisor, shall not exceed the number prescribed in clause 6.3 and clause 7.1.

- 9. Course Work.- Credit requirements, number, duration, syllabus, minimum standards for completion, etc.
- (1) The Credit requirement for the Ph.D. coursework is a minimum of 12 credits, including a "Research and Publication Ethics" course as notified by UGC vide D.O. No. F.1-1/2018(Journal/CARE) in 2019 and a research methodology course. The Research Advisory Committee can also recommend UGC recognized online courses as part of the credit requirements for the Ph.D. programme.
- (2) All Ph.D. scholars, irrespective of discipline, shall be required to train in teaching /education /pedagogy/writing related to their chosen Ph.D. subject during their doctoral period. Ph.D. scholars may also be assigned 4-6 hours per week of teaching/research assistantship for conducting tutorial or laboratory work and evaluations.
- (3) A Ph.D. scholar must obtain a minimum of 55% marks or its equivalent grade in the UGC 10-point scale in the course work to be eligible to continue in the programme and submit his or her thesis.

# 10. Research Advisory Committee and its Functions.-

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- (1) There shall be a Research Advisory Committee or an equivalent body as defined in the Statutes/Ordinances of the Higher Educational Institution concerned for each Ph.D. scholar. The Research Supervisor of the Ph.D. scholar concerned shall be the Convener of this committee, and this committee shall have the following responsibilities:
  - To review the res<mark>earch pr</mark>oposal and finalize the topic of research.
  - To guide the Ph.D. scholar in developing the study design and methodology of research and didentify the course(s) that he/she may have to do.
- iii. To periodically review and assist in the progress of the research work of the Ph.D.scholar.
- (2) Each semester, a Ph.D. scholar shall appear before the Research Advisory Committee to make a presentation and submit a brief report on the progress of his/her work for evaluation and further guidance. The Research Advisory Committee shall submit its recommendations along with a copy of Ph.D. scholar's progress report to the Higher Educational Institution concerned. A copy of such recommendations shall also be provided to the Ph.D. scholar.
- (3) In case the progress of the Ph.D. scholar is unsatisfactory, the Research Advisory Committee shall record the reasons for the same and suggest corrective measures. If the Ph.D. scholar fails to implement these corrective measures, the Research Advisory Committee may recommend, with specific reasons, the cancellation of the registration of the Ph.D. scholar from the Ph.D. programme.
- 11. Evaluation and Assessment Methods, minimum standards/credits for award of the degree,etc.-
- (1) Upon satisfactory completion of course work and obtaining the marks/grade prescribed inclause (3) of Regulation 9 above, the Ph.D. scholar shall be required to undertake research work and produce a draft dissertation/thesis.
- (2) Before submitting the dissertation/thesis, the Ph.D. scholar shall make a presentation before the Research Advisory Committee of the Higher Educational Institution concerned, which shall also be open to all faculty members and other research scholars/students.

- (3) The Higher Educational Institution concerned shall have a mechanism using well-developed software applications to detect Plagiarism in research work and the research integrity shall be an integral part of all the research activities leading to the award of a Ph.D. degree.
- (4) A Ph.D. scholar shall submit the thesis for evaluation, along with (a) an undertaking from the Ph.D. scholar that there is no plagiarism and (b) a certificate from the Research Supervisor attesting to the originality of the thesis and that the thesis has not been submitted for the award of any other degree/diploma to any other Higher Educational Institution.
- (5) The Ph.D. thesis submitted by a Ph.D. scholar shall be evaluated by his/her Research Supervisor and at least two external examiners who are experts in the field and not in employment of the Higher Educational Institution concerned. Such examiner(s) should be academics with a good record of scholarly publications in the field. Wherever possible, one of the external examiners should be chosen from outside India. The viva-voce board shall consist of the Research Supervisor and at least one of the two external examiners and may be conducted online. The viva-voce shall be open to the members of the Research Advisory Committee/faculty members/research scholars, and students. Higher Educational Institutions may formulate appropriate rules/ordinances to effect the provisions of this Regulations.
- (6) The viva-voce of the Ph.D. scholar to defend the thesis shall be conducted if both the external examiners recommend acceptance of the thesis after incorporating any corrections suggested by them. If one of the external examiners recommends rejection, the Higher Educational Institution concerned shall send the thesis to an alternate external examiner from the approved panel of examiners, and the viva-voce examination shall be held only if the alternate examiner does not recommend acceptance of the thesis, the thesis shall be rejected, and the Ph.D. scholar shall be declared ineligible for the award of a Ph.D.
- (7) The Higher Educational Institution concerned shall complete the entire process of evaluating a Ph. D. thesis, including the declaration of the viva-voce result, within a period of six (6) months from the date of submission of the thesis.
- 12. Academic, research, administrative, and infrastructure requirements to be fulfilled by Colleges for getting recognition for offering Ph.D. programmes.-
- (1) Post-graduate Colleges offering 4-year Undergraduate Programmes and/or Post-graduate Programmes, may offer Ph.D. programmes, provided they satisfy the availability of eligible Research Supervisors, required infrastructure, and supporting administrative and research facilities as per these Regulations.
- (2) Colleges and research institutions established by the central government or a State government whose degrees are awarded by Higher Educational Institutions shall offer Ph.D. programmes provided they have:
- i. At least two faculty members in a college or two Ph.D.-qualified scientists in the research institution.
- ii. Adequate infrastructure, administrative support, research facilities and library resources as specified by the HEI.

## 13. Ph.D. through Part-time Mode-

(1) Ph.D. programmes through part-time mode will be permitted, provided all the conditions stipulated in these Regulations are fulfilled.

- (2) The Higher Educational Institution concerned shall obtain a "No Objection Certificate" through the candidate for a part-time Ph.D. programme from the appropriate authority in the organization where the candidate is employed, clearly stating that:
- i. The candidate is permitted to pursue studies on a part-time basis.
- ii. His/her official duties permit him/her to devote sufficient time for research.
- iii. If required, he/she will be relieved from the duty to complete the course work.
- (3) Not with standing anything contained in these Regulations or any other law, for the time being in force, no Higher Educational Institution or research institution of the Central government or a State Government shall conduct Ph.D. programmes through distance and/online mode.

## 14. Issuing a Provisional certificate.-

Prior to the actual award of the Ph.D. degree, the degree- awarding Higher Educational Institution shall issue a provisional certificate to the effect that the Ph.D. is being awarded in accordance with the provisions of these Regulations.

## 15. Depository with INFLIBNET.-

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Following the successful completion of the evaluation process and before the announcement of the award of the Ph.D. degree(s), the Higher Educational Institution concerned shall submit an electronic copy of the Ph.D. thesis to INFLIBNET, for hosting the same so as to make it accessible to all the Higher Educational Institutions and research institutions.

NOTE: Above contents are prepared as per UGC Guidelines.



#### **REFERENCES:**

- i. Narayan, K Kar, S Gupta, N. From 'Paramedics' to 'Allied Health Professionals': Landscaping the Journey and Way Forward. Public Health Foundation of India: New Delhi, India, 2012.
- ii. Allied Health Professions Federation. AHPs involvement in health and social care 2011. Available from: <u>http://www.ahpf.org.uk/files/ahpf_gov_briefing_v7_09-05-11.pdf</u>.
- Narayan. K. How many doctors it takes to fix India's healthcare glitches? Deccan Herald [Internet]. 2014. Available from: http://www.deccanherald.com/content/381371/how-manydoctors-takes-fix.html.
- iv. Introduction to clerkship 1999. Available from: https://umanitoba.ca/faculties/medicine/media/missiion goals object class 2011.pdf.
- v. Standards of practice for ACT Allied Health Professionals 2005. Available from: http://health.act.gov.au/c/health?a=dlpubpoldoc&document=863.
- vi. Pamela Mitchell et al. Core principles and values of effective team based healthcare2012. Available from: <u>https://www.nationalahec.org/pdfs/VSRT-Team-Based-Care-Principles-values.pdf</u>.
- vii. Professionalism in nursing, midwifery and the allied health professions in Scotland. Scottish Government, 2012 978-1-78045-925-7.
- viii. Nursing & Midwifery Council .Standards for competence for registered nurses. Available from: http://www.nmc-uk.org/Documents/Standards/Standards%20for%20competence.pdf.
- ix. Social Accountability- A vision for Canadian medical schools Available from: <u>https://www.afmc.ca/fmec/pdf/sa vision canadian medical schools en.pdf.</u>
- x. University of Manitoba. Faculty of medicine teaching handbook2004. Available from: umanitoba.ca/faculties/medicine/media/teaching_handbook04.doc.
- xi. Medical Council of India. Vision 2015. Published March 2011. Available from: http://www.mciindia.org/tools/announcement/MCI booklet.pdf.
- xii. Sherwin J. Competency-Based Medical Education Takes Shape2011. Available from: <u>https://www.aamc.org/newsroom/reporter/april11/184286/competency-</u> <u>based medical education.html</u>.
- xiii. Bushway D, Everhart D. Investing in Quality Competency-Based Education2014. Available from: http://www.educause.edu/ero/article/investing-quality-competency-based-education.
- xiv. Brookfield, S. D. Self-Directed Learning In: YMCA George Williams College ICE301 Lifelong learning Unit 1 Approaching lifelong learning. London: YMCA George Williams College; 1994.
   xv. Ramnarayan K, Hande S. Thoughts on Self-Directed Learning in Medical Schools; Making Students More Responsible 2005. Available from: http://education.jhu.edu/PD/newhorizons/lifelonglearning/higher-education/medical-
- xvi. Harvey, B. J., Rothman, A. I., Frecker, R.C. Effect of an undergraduate medical curriculum on students' self-directed learning. Academic Medicine. 2003; 78(12): 1259-65.
- xvii. Credit-Based-Grading-System for Assessment of Students. Available from: http://www.presiuniv.ac.in/web/exam_assessment.php.
- xviii. Manual on semester based, credit and grading system Mumbai: University of Mumbai 2011. Available from: <u>http://www.mu.ac.in/1 Manual SCGS Arts 09-06-2011.pdf</u>.
- xix. Vertical Integration2015. Available from: <u>http://www.mcw.edu/Medical-School/Curriculum/Traditional-Curriculum/Vertical-Integration.htm</u>.
- xx. Baker D, Day R, Salas E. Teamwork as an essential component of high reliability organisations. Health Services Research. 2006; 41(4):1576-98.
- xxi. Srinivas, D.K. Adkoli, B.V. Faculty Development in Medical Education in India: The Need of the Day. Al Ameen J Med Sci (2009)2 (1):6-13. Available at: http://www.alameenmedical.org/ajms/ArticlePDFs/AJMS3.6-13.pdf
- xxii. The Royal Australian and New Zealand College of Radiologists®. http://www.insideradiology.com.au/
- xxiii. Minimum standard requirements for the medical college for 100 admissions annually regulations, 1999 MCI