मौलाना आज़ाद नेशनल उर्दू यूनिवर्सिटी مولانا آزاد نیشنل اُردو یونیورسٹی

MAULANA AZAD NATIONAL URDU UNIVERSITY

(A Central University Under Ministry of Education, Government of India)

Accredited 'A+' grade by NAAC

SCHOOL OF SCIENCES

Department of Vocational Studies and Skill Development

B. Voc. (Medical Imaging Technology)
SEMESTER- IV

S. No.	Component	Title of The Paper	Paper Code	Credits	Marks (Theory)		Marks (Practical)		Total
					External Assessment	Internal Assessment	External Assessment	Internal Assessment	
1.	Skill Paper - 1	Physics of Advanced Imaging Technology (Theory)	BVMI411CCT	04	70	30	---	---	100
		Physics of Advanced Imaging Technology (Lab.)	BVMI411CCP	02	---	---	35	15	50
2.	Skill Paper - 2	Quality Control in Radiology and Radiation Safety(Theory)	BVMI412CCT	04	70	30	---	---	100
		Quality Control in Radiology and Radiation Safety (Lab.)	BVMI412CCP	02	---	---	35	15	50
3.	Skill Paper - 3	Cross Sectional Anatomy and Physiology (Theory)	BVMI413CCT	04	70	30	---	---	100
		Cross Sectional Anatomy and Physiology (Lab.)	BVMI413CCP	02	---	---	35	15	50
4.	Non-Skill Paper - 4	Physics of Newer Imaging Modalities (Theory)	BVMI414CCT	04	70	30	---	---	100
		Physics of Newer Imaging Modalities (Lab.)	BVMI414CCP	02	---	---	35	15	50
5.	Non-Skill Paper - 5	Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR(Theory)	BVMI415CCT	04	70	30	---	---	100
		Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR(Lab.)	BVMI415CCP	02	---	---	35	15	50
		Total		**30**					**750**

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SEMESTER-IV

(Skill Paper - I) Physics of Advanced Imaging Technology (Theory)

Credits – 04

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1. Basic Computed Tomography- Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality. CT image display Image process: Digital Image Processing, Definitions
Image Domains, Characteristics of the Digital Image Matrix, Pixels, Voxels, etc.
Data acquisition, Mode of scan, Data processing, Image reconstruction & its types,

2. Advanced Computed Tomography

Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone - beam geometry, reconstruction of helical CT images, CT artefact, CT angiography, CT fluoroscopy. HRCT, post processing techniques MPR. MIP. Min IP. 3D rendering SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols - CT angiography - (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.

3. Fundamentals of MRI Physics Nuclear Magnetism:

Definitions
Study of Hydrogen
Net Magnetization and B0
Hydrogen and Magnetic Fields
Precessional, Resonant and Larmor frequency
Basics of MRI:
MRI Basic Principles: Spin – precession – relaxation time –
pulse cycle – T1 Recovery – T2 decay, Pulse timing parameters.
Frequency of Hydrogen

MRI INSTRUMENTATON

Types of magnets –permanent, resistive and superconductive. RF transmitter, RF receiver, Gradient coils, Shim coils

4. Ultrasonography

A. Basic Acoustics, Ultrasound terminologies: acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity

B. Interaction of US with matter reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing

C. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.

D. Ultrasound display modes: A, B, M

E. Real-time ultrasound: Line density and frame rate, Real-time ultrasound transducers: mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements.

F. Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.

G. Doppler Ultrasound- Patient preparation for Doppler, Doppler artifacts, vascular sonography,

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SEMESTER-IV

(Skill Paper - I) Physics of Advanced Imaging Technology (Lab/Practical)

Credits – 02

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1. CT image display
2. Post processing techniques MPR. MIP. Min IP. 3D rendering SSD and VR, CT Dose
3. Demonstration of Ultrasound display modes: A, B, M
4. Demonstration of CT angiography - (Aortogram, selective angiogram head, neck and peripheral

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SEMESTER-IV

(Skill Paper - 2) Quality Control in Radiology and Radiation Safety (Theory)

Credits – 04

1. Objectives of quality Control Improve the quality of imaging thereby increasing the diagnostic value to reduce the radiation exposure. Reduction of film wastage and respect examination to maintain the various diagnostic and imaging units at their optimal performance

2. Quality assurance activities Equipment selection phase; Equipment installation and acceptance phase Operational phase, Preventive maintenance

3. Quality assurance programme test General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually machine calibration basic concepts of quality assurance -LASER printer - Light beam alignment: X-ray output and beam quality check: KVp check: Focal spot size and angle measurement: Timer checks mas Test Grid alignment test High and low contrast resolutions: Mechanical and electrical checks Cassette leak check, Proper screen film contact test Safe light test: Radiation proof test: Field alignment test for fluoroscopic device Resolution test, Phantom measurements - CT, US and MRI.

4. Quality assurance of film and image recording devices Sensitometer: Characteristic curve: Film latitude: Film contrast: Film speed Resolution: Distortion; Artifacts of films and image recording, Monitor calibration SMPTE pattern

5. Maintenance and care of equipment Safe operation of equipment Routine cleaning of equipment and instruments; Cassette, screen maintenance, Maintenance of automatic processor and manual processing units, Routine maintenance of equipment, Record keeping and log book maintenance Reject analysis and objectives of reject analysis programme.

6. Care and maintenance of diagnostic equipment General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually care in use, special care of mobile equipment.

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SEMESTER-IV

(Skill Paper - 2) Quality Control in Radiology and Radiation Safety (Lab/Practical)

Credits – 02

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1. Artifacts of films and images
2. Routine cleaning of equipment and instruments
3. Equipment installation and acceptance phase Operational phase
4. Safe light test , coin test
5. Radiation proof test
6. Field alignment test for fluoroscopic device Resolution test

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SEMESTER-IV

(Skill Paper - 3) Cross Sectional Anatomy and Physiology (Theory)

Credits – 04

Radiology has been developing dramatically during the past few years. With enhancements in magnetic resonance imaging (MRI) and computed tomography (CT), the role of the radiologic technologist has also been changing.

Skills in cross-sectional anatomy 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.

At the completion of this, candidates will be able to:

1. Identify cross-sectional anatomy in the sagittal, coronal and axial planes on CT and MR Images.
2. Describe anatomical structural relationships
3. Recognize nomal anatomy and build personal resource system for future study
4. Locate and identify pertinent cerebral, upper thorax, mid-thorax, and abdominal anatomy
5. On CT and MR images, Identity anatomical structures of the body and of the head
6. Distinguish between arterial and venous anatomy of the entire body's vascular system
7. Classify the various sections of anatomical regions and their associated parts

The students will be given a thorough understanding of:

1. Introduction to Sectional Anatomy & Terminology - Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax-Surface anatomy relationships. Bony structures and muscles, Blood vessels.
3. Divisions of the mid-thorax, heart and great vessels-Lungs, heart and great vessels, Esophagus
4. CT/MRI Images of the Thorax - Normal and pathologies
5. Anatomy of the Abdomen-Major organs and their accessories, Abdominal blood vessels
6. CT/MR Images of Abdomen - Normal and pathologic
7. Anatomy of the Pelvis-Bony structures and associated muscles, Digestive and unary systems
8. Reproductive Organs
9. CT/MR Images of the Male/Female Pelvis- Normal and pathologic

10. Neuro Anatomy Scan planes
11. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts Arterial/venous systems, Basal ganglia, Canal nerves
12. Spine-Vertebra and disc, Spinal cord and meanings
Neck- Arterial/venous systems, Muscles, Glands and pharynx

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SEMESTER-IV

(Skill Paper - 3) Cross Sectional Anatomy and Physiology (Lab/Practical)

Credits – 02

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

Describe anatomical structural relationships

CT/MRI Images of the Thorax - Normal and pathologies

Neuro Anatomy Scan planes

CT/MR Images of Abdomen - Normal and pathologic

Demonstration of Digestive and unary systems

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SEMESTER-IV

(Non - Skill Paper - 4) Physics of Newer Imaging Modalities (Theory)

Credits – 04

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1. **Magnetic Resonance Imaging- its principle, advancements and applications.**

   Study of Hydrogen

   Net Magnetization and B0

   Hydrogen and Magnetic Fields

   Precessional, Resonant and Larmor frequency

   Basics of MRI:

   MRI Basic Principles: Spin – precession – relaxation time –

   pulse cycle – T1 recovery – T2 decay –pulse timing parameters

2. **Digital Tomosynthesis, Principles of Digital Tomosynthesis**

   Fundamentals and mechanism of image acquisition

   Advantages over conventional X-ray and limitations

   Applications in Clinical Practice

   Breast tomosynthesis in mammography

   Musculoskeletal and chest imaging

   Image Processing and Analysis

   3D image reconstruction and display techniques

   Noise reduction and image optimization

3. **Dual-Energy Imaging and Spectral CT**

   Fundamentals of Dual-Energy CT (DECT) and Spectral CT

   Principles and system configurations (kVp-switching, dual-source)

   Spectral decomposition and material characterization

   Clinical Applications and Advantages

   Kidney stone differentiation, virtual non-contrast imaging

   Vascular imaging and contrast optimization

   Image Quality and Radiation Dose Management

   Image optimization strategies in DECT

   Dose-saving protocols and comparative analysis

4. **Artificial Intelligence and Machine Learning in Radiology** Introduction to AI and Machine Learning Concepts,Fundamentals of AI, machine learning, and deep learning Types of algorithms used in medical imaging,Applications of AI in Radiology Image analysis, segmentation, and automated diagnosis, Predictive analytics and workflow optimization,Ethical Considerations and Limitations of AI in Radiology Data privacy, bias in algorithms, and regulatory issues Future trends and potential of AI in radiology

5. **Photon-Counting CT (PCCT)**:-Principles and Technological Advances in Photon Counting CT, Mechanism of photon-counting detectors and image formation, Differences from conventional CT and benefits in dose reduction
   Clinical Applications and Advantages, Low-dose imaging, spectral resolution, and improved soft tissue contrast, Initial clinical studies and comparative efficacy

B. Voc. (Medical Imaging Technology)

SEMESTER-IV

(Non - Skill Paper - 4) Physics of Newer Imaging Modalities (Lab/Practical)

Credits – 02

Demonstration of MRI EQUIPMENTS

Demonstration of DECT equipment- principle,

Demonstration of Digital Tomosynthesis

Digital subtraction angiography equipment components

Magnetic Resonance Imaging coils

Demonstration of Machine Learning in Radiology

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SEMESTER-IV

(Non - Skill Paper - 5) Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR

(Theory)

Credits – 04

Regulatory Requirements in Diagnostic Radiology & Imaging,

1. Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) -Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses, registrants & employers and Enforcement of Regulatory requirements.

2. Role of Radiographer in Planning, QA & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines Planning of X-ray rooms, dark rooms – Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors – Occupational exposure and protection Tools/devices. ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection. NABH guidelines, AERB guidelines, PNDT Act and guidelines

BMRIT Directed 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.

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SEMESTER-IV

(Non - Skill Paper - 5) Regulatory Requirements in Diagnostic Radiology & Imaging, Act and rules, regulations for JCI, NABH, NABHR

(Lab/Practical)

Credits – 02

QA & Radiation Protection
Inspection of X-ray room & dark room
Personal and area monitoring in the department
Regular quality check of Lead apron and other lead assessories
Application filing for the certificate of NABH
Application filing for the certificate of AERB
Application filing for the certificate of PNDT