2nd Semester

PHYSICS RELEVANT TO RADIOLOGY

Subject Code:**MRMIS1-201** **L T P C** **Duration: (60 Hrs.)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge related to physics of radiology

Course Outcomes:

- Demonstrate knowledge of electromagnetism, physics of radiation and radioactivity, its measurement instrumentation of X-ray generator.

Unit-1. **15 Hrs**

Law of physics, Units of measurement, Electrostatics, Principle of motor, Electromagnetism, Electromagnetic induction, Capacitor, A.C. Transformer, Semi-conductor material, Exposure and timing circuit, Electricity of DC motor

Unit-2. **15 Hrs**

Construction and operation of X-ray tubes, Monitoring and protection of X-ray tubes, Law of modern physics, Atomic physics, Radioactivity, X-ray and matter, Factors effecting X-ray beam, Interaction of X-ray with matter, Elementary structure of atom

Unit-3. **15 Hrs**

Image properties, Imaging modalities, X-ray and gamma- ray interaction, absorption of energy from X-ray and gamma-ray, Electric and magnetic field, Electromagnetic waves, Production of X-rays, Components of X-ray circuits, Resistors and transistors

Unit-4. **5 Hrs**

Components and construction of X-ray generator, mechanism of X-ray interaction, X-ray ionization radiations, Contrast density of X-rays, magnification of image, Exposure technique and technical factors, MTF and other measures.
Quantity and quality of radiation, intensity of radiation, radiation exposure, units of radiation dose, measurement of radiation dose, variation in quality across an X-ray beam, spectral distribution of an X-ray beam, interactions of X-ray and gamma ray.

Unit-5. **10 Hrs**

Imaging in medicine, structure of matter, nuclear fission and fusion, Decay equilibrium, nomenclature, Production and information about radioactive nuclides, non-ionizing radiations, interaction of non-ionizing electromagnetic radiations, attenuation of X-ray and gamma-radiation, artificial production of radionuclides

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

BASIC LOGIC GATES

Subject Code:**MRMIS1-202** | **L T P C** | **Duration: (60 Hrs)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to know about basic logic gates related to the field of radiology.

Course Outcomes:

- Demonstrate knowledge of logic gates and its technical aspects, probability and related statistical tests.

Unit-1. **15 Hrs**

Principle of basic logic gates, Storage and transfer of data in computer, storage of letters and symbols, analogue data and conversion of digital forms concept, Use of medical imaging, Voxel, Matrix size, Fov, Pixel size, Pixel bit depth, binary number, components and operations of computer, performance of computer system, computer software, storage data device.

Unit-2. **15 Hrs**

Micros processors, mother board, input and output system, central processing unit (CPU), RAM (Random access memory), ROM (Read only memory), Types of computers, computer applications, Hard and MOD drive

Unit-3. **15 Hrs**

Numerical description of data, Parameters, Standard deviations, coefficient of variation, simple linear regression, linear regression model, residual sum of squares, modes, quintiles least square method, estimating model parameters

Unit-4. **5 Hrs**

Probability theory, axioms of probability, conditional probability, samples space and events, independent events, bayes formula for testing hypothesis, level of significance and estimation of errors in hypothesis, sampling theory, sampling methods

Unit-5. **10 Hrs**

Non-parametric tests, Unbiased estimator, confidence interval, population mean, population varience, limit pheromones, central limit theorem, strong law of large number, parametric tests of association

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014).
Diagnostic radiology physics: A handbook for teachers and students

DUTIES AND ORGANIZATION OF RADIOLOGY DEPARTMENT

Subject Code: **MRMIS1-203** **L T P C** **Duration: (60 Hrs.)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the duties and responsibilities to be performed in radiology department

Course Outcomes:

- Demonstrate knowledge of legal and ethical issues in radiology department, data collection and analysis, waste disposal and technical aspects of radiation dose reduction.

Unit-1. **15 Hrs**

Duties of a radiographer, Professional organization in radiological technology, Criteria for radiology, Ethics of radiographer, Legal issues in radiology department, Responsibilities of radiographer, Care of patient, Handling and transfer of critical patients, Handling and care of radiographic equipments, Medical records and documentation

Unit-2. **15 Hrs**

Patient assessment, Data collection and analysis, Planning and implementation, Patient evaluation, Cultural variations, Non-verbal communication, Factors affecting the communication, Psychological issues in patients, Rights of HIV positive patient.

Unit-3. **15 Hrs**

Medico legal issues in diagnostic radiology, Planning of radiology department, Electrical hazards and accidents in radiography, Waste disposal in radiography, Presentations and viewing of radiographics, Film identification, Waste disposal in radiography room.

Unit-4. **5 Hrs**

Physics of radiology, Basics of Biostatics, Experimental radiology, Human radiology, Molecular and cellular radiology, Designing for radiation protection, Radiation dosimetry, Early and late effects of radiation, Health physics.

Unit-5. **10 Hrs**

Methods of reduction of patient doses in CT, Mammography, Fluoroscopy, Digital radiography, Angiography, OPG, Dental radiography, Plain radiography.
Protection of staff, Dose limits, Principle of dose monitoring, Methods of monitoring, Protection of patient by radiations, Radiological techniques, Fixed and movable barriers, Personnel protection equipments, Beam design features

Recommended Text Books / Reference Books:

- Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

BASIC ELECTRONICS OF RADIOLOGY

Subject Code: **MRMIS1-204** **L T P C** **Duration: (60 Hrs.)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the duties and responsibilities regarding the use of electronics in the radiography

Course Outcomes:

- Demonstrate knowledge of computer applications and computer related technical aspects and softwares used in radiology.

Unit-1. **15 Hrs**

Principle of basic electronics, Computes in radiology, Radiography and mathematics, Geometric radiography, Exponential and logarithmic functions, Sine function of waves and space, Reconstruction algorithm

Unit-2. **15 Hrs**

Computer in medical imaging, storage and transfer of data, Analog and conversional data, Components and operations of computers, Computer softwares, Software functioning in radiology, Display of digital image

Unit-3. **15 Hrs**

Principle of computer applications in radiology, Principles of bio statics, Historic developments, Semiconductor devices diodes, Transistors, Transistor circuits, Principle of transistor, Input-Output of emitter, Common base, Common collector, Machine representation of data, Numerical and logic operations

Unit-4. **10 Hrs**

A.C. transformer, Semiconductor material, Rectification, Heat dissipation, Electromagnetic radiation, Electrostatics, Ionizing radiations, Matter and energy, Units of ionizing radiation, Ionization chamber

Unit-5. **5 Hrs**

Infection control, Institutional safety, Safe practises, micro-organism, Nosocomial infections, body defence, adverse reactions, compatibility, general principles of investigation

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

MEDICAL ILLEGAL ISSUES IN DIAGNOSTIC RADIOLOGY

Subject Code: **MRMIS1-205**

L	T	P	C
3	1	0	4

Duration: (60 Hrs.)

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the illegal medical issues related to diagnostic radiology

Course Outcomes:

- Demonstrate knowledge of cellular effects of radiation and its safe applications to patients.

Unit-1. **15 Hrs**

Instruction of radiations with tissue, cellular radiology, acute radiation syndrome, radiation exposure, effect of ionization radiation, cell killing with radiation, carcinogenesis, radiation hazards

Unit-2. **15 Hrs**

Protection of radiations, experimental radiology, modification of radiology, Effect of non-stochastic radiation, Domestic use of radiation, Background radiation, unusual levels of radiation, effects of dose, estimating risks of radiation

Unit-3. **15 Hrs**

Molecular effects of radiation, cellular effects of radiation, cell radio-sensitivity, organic damage from ionizing radiation, cell damage by ionizing radiation

Unit-4. **10 Hrs**

Ultrasound bio-effects, MRI bio-effects, Ecoustic power affected by ultrasound, safety issues, claustrophobia and dis management, magnetic field of radiation, physical characteristics of radiation.

Care and preparation of patient, infection control, safe practice, disposal in hospital and clinicals, infections with radiology, defences with radiology.

Unit-5. **5 Hrs**

Biological effects of radiation, internal and external objects, electrical effects of radiation, specific absorption rate, Magnetic field strength, Surface burns, MRI safety and management, Hazards of MRI, Accidents with MRI

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014).
Diagnostic radiology physics: A handbook for teachers and students

PHYSICS RELEVANT TO RADIOLOGY PRACTICAL

Subject Code:**MRMIS1-206** | **L T P C** | **Duration: 4Hrs/week**
0 0 4 2

Course Objectives:

- Students will be able to learn the concepts of physics relevant to radiology

Course Outcomes:

- Demonstrate knowledge of construction and monitoring and other technical aspects of X-Ray tube/generator

Practicals

1. Principle of motor and Electromagnetic induction
2. Construction and operation of X-ray tubes
3. Monitoring and protection of X-ray tubes
4. Law of modern physics and Atomic physics
5. Components and construction of X-ray generator
6. Ionization radiations and Contrast density of X-rays
7. Production and information about radioactive nuclides
8. Interaction of non-ionizing electromagnetic radiations

BASIC ELECTRONICS OF RADIOLOGY PRACTICAL

Subject Code:**MRMIS1-207** | **L T P C** | **Duration: 4Hrs/week**
0 0 4 2

Course Objectives:

- Students will be able to learn the basic use of electronics in radiology

Course Outcomes:

- Demonstrate knowledge of Principle and practice of basic electronics, computer applications and electromagnetic radiation

Practicals

1. Principle and practice of basic electronics
2. Geometric and computed radiography
3. Storage and transfer of data
4. Principle of computer applications in radiology
5. Principle of Transistors and circuits
6. A.C. transformer and Semiconductor material
7. Electromagnetic and Electrostatic radiation
8. Ionizing radiations and Ionization chamber

3rd Semester

RADIATION BIOLOGY

Subject Code:**MRMIS1-301** | **L T P C** | **Duration: (60 Hrs)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the duties and responsibilities to understand role of biology in radiation

Course Outcomes:

- Demonstrate knowledge of different types of ionizing radiation, cellular and molecular effects of radiation and its long term effects.

Unit-1. **15 Hrs**

Principle of radiation biology, Introduction, Sources of ionizing radiation, types of ionizing radiation, particulate radiations, linear energy transfer, radiation dose and units, principles of radiation dosimetry, direct and indirect effects

Unit-2. **15 Hrs**

Molecular and cellular radiology, Radiation lesions in DNA, Major types of DNA repair, Damage recognition and signalling, consequence of unrepaired DNA damage, radiological definitions of cell death, cell cycle effect

Unit-3. **15 Hrs**

Relative biological effectiveness (RBE), Cellular repair exemplified in survival curves, Cellular hyper responsibility (HRS), Indusive repair, Other molecular targets, radiation sensitizers, radiation protection

Unit-4. **5 Hrs**

Tumour radiography, tumour growth, tumour response to irradiation, defence of tumour control, dose and size of tumour, dose fractionation and effects, tumour hypoxia

Unit-5. **10 Hrs**

Normal tissue response to radiotherapy, cellular and tissue response, acute tissue response, late tissue response, therapeutic ratio, whole body irradiation
Long-term radiation risks, health consequences, epidermological radiation exposure populations, mechanism of radiation indusive cancer, radiation effects in embryo and foetus, Radiation indusive heritable disease.

Recommended Text Books / Reference Books:

Shinghai, Beijing. Radiation Biology: Handbook for Radiology. Vienna International Centre

PRINCIPLES OF RADIATION PROTECTION

Subject Code:**MRMIS1-302** **L T P C** **Duration: (60 Hrs)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the protection from the X-ray radiation

Course Outcomes:

- Demonstrate fundamental knowledge of radiographic processing and protection of patients from untoward radiation

Unit-1. **15 Hrs**

Principles of radiation protection, Fundamentals of radiation protection, Radiation protection from external sources, Regulatory authorities for radiation protection, Safety recommendations for X-ray, Safety recommendations for gamma radiation, Protection barriers for radiation sources, protection from internal source of radiation

Unit-2. **15 Hrs**

Recommendations for use of radioactive needles, X-ray beam production, X-ray beam energy, Attenuation of x-rays, Probability of X-rays, Process of interaction, Historical evaluation of radiation, quantities and units of radiation

Unit-3. **15 Hrs**

Justification and responsibility for radiographic procedures, Principles of ALARA, Patient protection, Patient education, radiation protection standards, Organizations of radiation protections, National regulatory agencies, goals for radiation protection

Unit-4. **5 Hrs**

Objectives of radiation protection, Protection risks, Basic effective doses, Protection of patient during radiology procedure, Effective communication, Immobilization of radiation, X-ray beam limitation devices

Unit-5. **10 Hrs**

Technical exposure factors, radiographic processing, Film screening combinations, Radiographic grids, Ear grip technique, repeat radiographs, unnecessary radiological procedures, minimal sources of skin distance for radiography, fluoroscopic procedures
Fluoroscopy, C arm, High level control interventional procedures, amount of radiation received to patient, CT technique, paediatric radiography, pregnant patient examination with radiography, other diagnostic examination, protection of radiation to pregnant patient

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

ADVANCE TECHNIQUES AND INSTRUMENTATION OF ULTRASONOGRAPHY

Subject Code:**MRMIS1-303**

L	T	P	C
3	1	0	4

Duration: (60 Hrs)

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to get knowledge about the Advance techniques and instrumentation of ultrasonography

Course Outcomes:

- Demonstrate knowledge of advance techniques and instrumentation of ultrasonography

Unit-1. **15 Hrs**

Basic principle of ultrasonography, Types of sounds, Transducer frequency, Continuous waves, Ultrasound terminology, Amplitude, Intensity, Propagation speed density, Stiffness, acoustic impedence, attenuation, coefficient, non-linear propagation

Unit-2. **15 Hrs**

Speed in the body, Beam formation, transmitted pulse, focal zones resolution, longitudinal resolution, lateral resolution, temporal resolution, resolution phantoms, elevation resolution

Unit-3. **15 Hrs**

Reflections, Reflection and transmission, specular reflections, scattering, penetration and resolution, eco review points, Echose reflection, Rayligh scattering, transducers, Pizoelectric materials, depolarisation, construction frequency, phased arrays, starring beam

Unit-4. **5 Hrs**

Advancement in Technology, instrumentation, beam former, pulse delays, transmit receive switch, amplifiers, signal processor, image processor, digital scan converter, image memory

Unit-5. **10 Hrs**

Display, instrument review points, artifacts, refraction, multiple power, mirror image, reverberation, acoustic shadowing, acoustic enhancement, Doppler, Doppler effect, Doppler shift CW Doppler, PW Doppler, PW and CW spectrums, colour flow imaging, packet size, blood flow direction, speed virus velocity, majoring velocities, spectral analysis

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

X-RAY PRODUCTION

Subject Code:**MRMIS1-304** | **L T P C** | **Duration: (60 Hrs)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the production of X-rays

Course Outcomes:

- Demonstrate basic knowledge of X-ray production and various factors affecting X-ray production.

Unit-1. **15 Hrs**

Introduction, Fundamentals of X-ray production, Beam strahlung, Characteristics of radiation, X-ray spectrum, X-ray tubes, components of X-ray tube- cathode and anode

Unit-2. **15 Hrs**

Energizing and controlling the X-ray tube, X-ray tube and generator ratings, collimation and filtration, filament circuit, generating tube voltage, exposure time, falling load

Unit-3. **15 Hrs**

X-ray tube generator, tube house, collimator and light field, inherent flitration, added filtration, compensation filters

Unit-4. **10 Hrs**

Factors influencing X-ray spectra and output, quantities describing X-ray output, tube voltage and current, tube voltage ripple, anode angle

Unit-5. **5 Hrs**

X-ray formation, components of an X-ray, effects of X-ray, magnification imaging of an X-ray, contrast agents of X-ray, technique selection of X-ray

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

COMPUTED INSTRUMENTATION

Subject Code:**MRMIS1-305** | **L T P C** | **Duration: (60 Hrs)**
3 1 0 4

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to get knowledge about computed instruments used in radiology

Course Outcomes:

- Demonstrate knowledge of technicalities of computed instruments like CT angiography, MRI instruments etc.

Unit-1. **15 Hrs**

Imaging principle in computer tomography, instrumentation of CT scan, advanced instruments of CT scan, Multi-slice CT scan system, Isotropic imaging, Image display, Pre and post processing techniques, image quality in CT scan

Unit-2. **15 Hrs**

X-rays: 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.

Unit-3. **5 Hrs**

CT angiography, CT fluoroscopy, Multi-dimentional deformation (MPR), Curved MPR, 3-D imaging, 4-D CT scan, CT colonoscopy, CT bronchioscopy, CT coronary angiography, CT myocardial imaging

Unit-4. **10 Hrs**

MRI instruments, Types of magnets, RF transmitter, Receiver coils, Gradient coils, Shim coils, RF shielding, Fluoroscopic equipments, Tomographic equipments for cranial and dental radiography, equipments for mammography

Unit-5. **15 Hrs**

MR contrast media, MR angiography, TOF and PCA MR, Spectroscopy MR, MRartifacts, Safety aspects in MRI, Cardiac MRI, Muscular skeleton imaging protocols, abdominal imaging protocols

Recommended Text Books / Reference Books:

Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

PRINCIPLES OF RADIATION PROTECTION PRACTICAL

Subject Code: **MRMIS1-306** **L T P C** **Duration: 4Hrs/week**
0 0 4 2

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the protection from the X-ray radiation

Course Outcomes:

- Demonstrate fundamental knowledge of radiographic processing and protection of patients from untoward radiation

1. Protection barriers for radiation sources
2. Principles of ALARA
3. Standard Operating Procedure for Patient protection, Patient education, radiation protection standards, Organizations of radiation protections
4. Basic effective doses
5. Immobilization of radiation
6. Radiographic grids, Ear grip technique

Recommended Text Books / Reference Books:

- Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

X-RAY PRODUCTION PRACTICAL

Subject Code: **MRMIS1-307** **L T P C** **Duration: 4Hrs/week**
0 0 4 2

Course Objectives:

- Students will be able to learn the terminology of the subject and basic knowledge to understand the production of X-rays

Course Outcomes:

- Demonstrate basic knowledge of X-ray production and various factors affecting X-ray production.

1. Characteristics of radiation
2. X-ray spectrum
3. Demonstration of X-ray tubes, components of X-ray tube- cathode and anode
4. X-ray formation
5. Components of an X-ray, effects of X-ray
6. Magnification imaging of an X-ray, contrast agents of X-ray, technique selection of X-ray
7. Demonstration of generation of X-ray

Recommended Text Books / Reference Books:

- Dance, D. R., Christofides, S., Maidment, A. D. A., McLean, I. D., & Ng, K. H. (2014). Diagnostic radiology physics: A handbook for teachers and students

4th Semester

THESIS AND INTERNSHIP

Subject Code: **MRMIS1-401**

L	T	P	C
0	0	30	15

The candidates will be supervise by the concern faculty & and the project report will be submitted following competitions. The Viva-Voce examination shall be conducted by external expert.