VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)

PALLAVARAM - CHENNAI

ACCREDITED BY NAAC WITH 'A' GRADE

Marching Beyond 30 Years Successfully

M.Sc Radiology & ImagingTechnology

4th Board of Studies Meeting-Minutes

Effective from the Academic year
2024-2025

Venue

Vel Nursing College,
Velan Nagar,Manjankaranai, Thiruvallur Dt

Date & Time

31.05.2024 & 11.00 am

MINUTES OF BOARD OF STUDIES

The meeting of the Board of Studies in School of Allied Health Sciences , VISTAS held on **31-05-2024 at 11am** to discussthe Rules and Regulations, **Framework of UG Program, Curriculum & Syllabus** of the following **newly introduced Program – M.Sc.Radiology & Imaging Technology** which to be followed from academic year 2024– 2025.

The following members were present for the BOS meeting

S. No	Name of the Board Member	Designation	Institute / Industry	Role
Internal Members				
1	Mr.Kishore Kanna.K M.Sc.(Radiology)	Vice Principal	Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai	Chairperson
3	Mrs.Jebaseeli V M.Sc(Biochemistry)	Assistant Coordinator	Vels Institute of Science, Technology & Advanced Studies(VISTAS), Chennai	Member
4	Ms.Kamali.S M.Sc(Echocardiography)	Lecture	Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai	Member
External Expert Members				
1	Dr.Yamini.B M.Sc.Echocardiog aphy Ph.D. (Cardiology)	Asst.Professor &Clinical Coordinator	Faculty of Allied Health Sciences, KM Cherian Heart Foundation-Frontier Life Line Hospitals.	Member
2	Dr.M.Radhika M.Sc MLT, PhD(Biochemistry)	Assistant Professor	Sri Ramachandra Institute of Higher Education & Research, Porur,Chennai-116	Member
3	Dr.A Mani, M.Sc,Ph.D (Ophthalmology)	Associate Professor	Chettinad Academy of Research and Education Kelambakkam.	Member
4	Mr.Vyshak M.Sc(Radiology)	Associate Professor	ACS Medical College & Hospital,Velapanchavadi	Member

AGENDA OF THE MEETING

Item No.	Particulars
BoS / 2024 / RIT/PG / 1.1	Develop curriculum based on Learning Outcome Based Curriculum Framework (LOCF) /Choice Based Credit System(CBCS)
BoS / 2024 / RIT/PG / 1.2	Objective of new Program
BoS / 2024 / RIT/PG / 1.3	Feedback from Stakeholders to ensure that the syllabus of the courses include the state-of-the-art technologies focusing on skill development, employability,band entrepreneurship
BoS / 2024/ RIT/PG / 1.4	To review the UGC policy for CBCS and LOCF curriculum

Item No:1 BOS / 2024 / PG / 1.1

Develop curriculum based on Learning Outcome Based Curriculum Framework (LOCF) /Choice Based Credit System(CBCS)

- To develop the curriculum and syllabi based on the guidelines of UGC and the principles of Outcome Based Education (OBE)/Learning Outcome Based Curriculum Framework (LOCF).
- To implement the guidelines and suggestions of the new education policy.
- To consider the Competencies and Performance Indicators of the M.Sc.Radiology & Imaging Technology programme defined as per the recommendations of the National Model Curriculum.
- To enhance the Course Outcomes (CO) of all the courses by focusing on skill development, employability, and entrepreneurship.
- To consider the mapping of CO to the Program Outcomes (PO) and Programme Specific Outcomes (PSO) of all the courses using the defined Competencies and Performance Indicators.

Minutes are Reviewed and Confirmed

Item No : 2 BOS / 2024 / RIT /PG / 1.2

Objective of the Program

- To provide the perfect balance and academic intensity between theoretical and practical learning.
- To design the curriculum focusing on Activities/ Content with direct on Employability/Competency/ Entrepreneurship/ Skill Development / Interdisciplinary
- To demonstrate and adopt technical skill set and in depth of knowledge.
- To aid students to refine their skills.
- To discover various techniques and develop their knowledge through experimental learning.
- To deliver the Program as per UGC norms.

Item No : 3 BOS / 2024 /RIT / PG / 1.3

Feedback from Stakeholders to ensure that the syllabus of the courses include the state-of-the-art technologies focusing on skill development, employability, and entrepreneurship

External Members: The course is well framed and the curriculum is elaborate and focuses on inculcating the skills and knowledge required for students in the medical world..

Academic Experts: The course covers all the basic inputs to provide expertise training in the medical world.The Competencies and Performance Indicators (PI) are well defined for both the programmes. The CO-PO mapping is based on Knowledge Levels and is well justified.

The course explores a wide range of careers in the medical world through internships and enable students toinculcate practical skills for Entrepreneurship.

Minutes are Reviewed and Confirmed

Item No : 4 BOS / 2024 /RIT / PG / 1.4

To review the UGC policy for CBCS and LOCF curriculum

- Resolved that the Curriculum & Syllabus for the M.Sc. Radiology & Imaging Technology programme (Regulation 2024), designed as per the Learning outcome-based curriculum framework (LOCF) guidelines of UGC, effective from the Academic Year 2024-2025 be approved.

Resolution:

The members of the BOS adopted the following resolutions: Resolved to recommend that the Curriculum and Syllabus developed for M.Sc.Radiology & Imaging Technology is based on Learning Outcome Based Curriculum Framework (LOCF) and Choice Based Credit System (CBCS). Newly introduced UG Program and courses focused on Activities Content with direct on Employability / Competency/ Entrepreneurship/ Skill Development / Interdisciplinary and new courses introduced during the Academic Year – 2024 – 2025 is designed as per the guidelines and Model Curriculum Framework of UGC. The Board of studies approved the UG curriculum for the academic year 2018 – 2019 is enclosed **Annexures .**

New Curriculum and Syllabi of PG Program courses focused on Activities / /Content with direct focus on Employability / Competency/ Entrepreneurship / Skill development/Interdisciplinary/ Cross Cutting Issues e

S. No	Name of the Board Member	Designation	Institute / Industry	Signature
Internal Members				
1	Mr.Kishore Kanna.K M.Sc.(Radiology)	Vice Principal	Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai	
2	Mrs.Jebaseeli V (M.Sc.Biochemistry)	Assistant Coordinator	Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai	
3	Ms.Kamali.S M.Sc(Echocardiography)	Assistant Professor	Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai	
External Expert Members				
1	Dr.Yamini.B M.Sc.Echocardiogaphy Ph.D. (Cardiology)	Asst.Professor &Clinical Coordinator	Faculty of Allied Health Sciences, KM Cherian Heart Foundation-Frontier Life Line Hospitals.	
2	Dr.M.Radhika M.Sc MLT, PhD (Biochemistry)	Assistant Professor	Sri Ramachandra Institute of Higher Education & Research, Porur,Chennai-116	
3	Dr.A Mani, M.(Optometry),Ph.D (Ophthalmology)	Associate Professor	Chettinad Academy of Research and Education Kelambakkam.	
4	Mr.Vyshak M.Sc(Radiology)	Associate Professor	ACS Medical College & Hospital,Velapanchavadi	

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M.Sc. Radiology & Imaging Technology

Curriculum and Syllabus - 2024 Regulation

(Based on Choice Based Credit System (CBCS) and

Outcome Based Education (OBE)

Effective from the Academic year 2024-2025

School of Allied Health Sciences

1. SHORT TITLE AND COMMENCEMENT:

These regulations shall be called "Specific Regulations for the M.Sc. Radiology and Imaging Technology course of Vels Institute of Science Technology and Advanced Studies, Deemed to be University u/s3 of UGC act 1956.These Regulations are applicable to the students who are admitted to the M.Sc. Radiology and Imaging Technology in this University.

As per the decision of the Academic Council of this University, these regulations have been prepared by adopting the regulations of the VISTAS.

2. AIMS

The aim of the course is to

a) Prepare graduates to assume responsibilities as professional, competent Technicians in providing promotive, preventive, curative and rehabilitative services.

b) Prepare students to diagnose and treating diseases with the help of image techniques such as x-rays, ultrasounds, magnetic resonance imaging (MRI), computed tomography, positron emission tomography, etc.

3. OBJECTIVES

On completion of the four years M.Sc. Radiology and Imaging Technology Programme thegraduates will be:

1. Discover the radiologist combines clinical knowledge and skills with technology to impactthe clinical care of the patient.
2. Apply knowledge gained on clinical service to complete reflection questions for eachsubspecialty site.
3. Recognize the normal anatomic structures on imaging studies and how the appearance is altered due to disease.
4. Exhibit professional behavior and appearance while on service including when interacting with residents, technologists, patients, and support personnel.
5. Explore the clinical care areas of the radiology department and interact with personnel by interviewing an attending radiologist, resident, radiologic technologist, and patient in each subspecialty
6. Provide the profession and community with trained qualified technologist/ lecturer.

7. Provide education and comprehensive program that promotes problem solving, critical thinking and communication skills in the clinical environment

8. Demonstrate quality patient care skills including professionalism and ethical behavior as specified in the code of ethics

4. ELIGIBILITY FOR ADMISSION

A Candidate desiring to join the M.Sc. Radiology And Imaging Technology should have completed B.Sc Radiology/ Radiography from any recognized university.

No upper age limit for Admission

A candidate is required to obtain 50% in the Entrance exam conducted by the VISTAS

5. DURATION OF THE COURSE:

The duration of the MSc. Radiology and Imaging Technology Degree course shall be 2 Years full-time programme comprising 4 Semesters under Choice based Credit System.

6. MEDIUM OF INSTRUCTION:

English shall be the medium of instruction for all subjects of study and examinations will be conducted only in English.

7. COMMENCEMENT OF THE COURSE:

The course shall commence on August of the academic year.

8. WORKING DAYS IN A SEMESTER:

Each semester shall consist of not less than 100 working days and each academic year shall have a total of 200 working days

9. REGISTRATION

A Candidate admitted to the course shall be registered by remitting the prescribed fees along with the Application form for registration duly filled with in the stipulated dates.

10. COMMENCEMENT OF THE EXAMINATIONS:

Regular Semester Examinations will commence from last week of November and last week of April If the date of commencement of the examination falls on Saturday, Sunday or declaredPublic Holidays, the examination shall begin on the next working day.

M.Sc. – RADIOLOGY & IMAGING TECHNOLOGY CURRICULUM

SEMESTER 1

Sl.No.	Category	Course Titles	Hours/Credits							Maximum Marks				
			Lecture		Tutorial		Practical		Total	IA		UA		Total
			Hours	Credits	Hours	Credits	Hours	Credits	Credits	Theory	Practical	Theory	Practical	
1.1	Program Core	Radiological Physics	45	3	30	1	60	2	6	25	50	75	50	200
1.2	Program Core	Conventional Radiological and Imaging Equipment	45	3	30	1	60	2	6	25	50	75	50	200
1.3	Program Core	Radiographic and Imaging Techniques	45	3	30	1	60	2	6	25	50	75	50	200
1.4	Program Elective	Principles of Epidemiology, Research Methodology, Biostatistics and Medical Ethics*	30	2	-	-	-	-	2	100	-	-	-	100
1.5	Program Elective	RIT Directed Clinical Education	-	-	-	-	120	4	4	50	50	-	-	100
Total									**24**	**Total**				**700**

SEMESTER 2

Sl.No.	Category	Course Titles	Hours/Credits							Maximum Marks				
			Lecture		Tutorial		Practical		Total	IA		UA		Total
			Hours	Credits	Hours	Credits	Hours	Credits	Credits	Theory	Practical	Theory	Practical	
2.1	Program Core	Radiographic Procedure and Positioning	45	3	30	1	60	2	6	25	50	75	50	200
2.2	Program Core	Advanced Technique & instrumentation of CT	45	3	30	1	60	2	6	25	50	75	50	200
2.3	Program Core	Advanced Technique & instrumentation of MRI	45	3	30	1	60	2	6	25	50	75	50	200
2.4	Program Elective	Health Care management*	30	2	-	-	-	-	2	100	-	-	-	100
2.5	Program Elective	RIT Directed Clinical Education	-	-	-	-	120	4	4	50	50	-	-	100
Total									**24**	**Total**				**800**

SEMESTER 3

Sl.No.	Category	Course Titles	Hours/Credits							Maximum Marks				
			Lecture		Tutorial		Practical		Total	IA		UA		Total
										Theory	Practical	Theory	Practical	
			Hours	Credits	Hours	Credits	Hours	Credits	Credits					
3.1	ProgramCore	Quality Assurance andQuality Control in Diagnostic Radiology and Imaging	45	3	30	1	60	2	6	25	50	75	50	200
3.2	ProgramCore	Newer ImagingModalities	45	3	30	1	60	2	6	25	50	75	50	200
3.3	Program Core-	Advanced Technique & instrumentation of ULTRASOUND	45	3	30	1	60	2	6	25	50	75	50	200
3.4	ProgramElective	Patient care*	30	2	-	-	-	-	2	100	-	-	-	100
3.5	ProgramElective	RIT Directed Clinical Education	-	-	-	-	120	4	4	50	50	-	-	100
							Total		24				Total	800

SEMESTER 4

Sl.No.	Category	Course Titles	Hours/Credits							Maximum Marks				
			Lecture		Tutorial		Practical		Total	IA		UA		Total
										Theory	Practical	Theory	Practical	
			Hours	Credits	Hours	Credits	Hours	Credits	Credits					
4.1	Program Core	Radiation protection in diagnostic imaging and Nuclear Medicine imaging techniques, Post processing techniques in radiology	45	3	30	1	60	2	6	25	50	75	50	200
4.2	Program Core	Intervention Radiological Techniques and Patient Care	45	3	30	1	60	2	6	25	50	75	50	200
4.3	Program core	Dissertation/Project	-	-	-	-	120	4	4	-	50	-	50	100
4.4	Program Elective	Seminars, Journal Clubs and Group Discussions	-	-	-	-	120	4	4	50	50	-	-	100
4.5	Program Elective	RIT Directed Clinical Education	-	-	-	-	120	4	4	50	50	-	-	100
							Total		24				Total	700

11. SUBMISSION OF LABORATORY RECORD NOTE BOOKS:

At the time of practical examination, each candidate shall submit to the examiners his / her laboratory note books duly certified by the Head of the Department as a bonafide record of the work done by the candidate.

12. INTERNALASSESSMENT:

a) A minimum of two written internal assessment examinations shall be conducted in each subject during a semester and the Best / Average marks of two examinations shall be taken into consideration for the award of internal marks.

b) A model practical examination shall be conducted in each subject (wherever practical have been included in the curriculum) shall be taken into consideration for award of internal marks in practical.

c) Tests will be conducted giving sufficient time for preparation.

d) No repeat, reschedule and postponement of the assessment date is permitted. Students shall compulsorily attend any three continuous assessments

13. ATTENDANCE REQUIRED FOR ADMISSION TO EXAMINATIONS:

(a) No candidate shall be permitted to appear for the University examinations, unless he/she attends the course for the prescribed period.

(b) Every candidate is required to put in a minimum of 80% of attendance both intheory and practical separately in each subject for admission to the examination.

(c) A candidate lacking in the prescribed attendance in any subject in theory and /orpractical shall not be admitted to the entire examination.

14. CONDONING LACK OF ATTENDANCE

1. Condoning of shortage of attendance up to a maximum of 10% in the prescribed eligible attendance for admission to year end examination rests with the discretionary power of the Vice Chancellor. A Candidate lacking in attendance should submit an application in the prescribed form and remit the stipulated fee, 15 days prior to the commencement of the theory examination, The Head of the Department should satisfy himself on the reasonableness of the candidate's request while forwarding the application of the candidate to the Controller of Examinations, who would obtain the Vice – Chancellor's approval for admission to the examination. No application would be accepted if it is not forwarded through proper channel.

2. Condoning lack of attendance should be taken up for consideration under the following circumstances: -

a) Any illness affecting the candidate – Candidates should submit amedical certificate from registered medical practitioners.

b) Any unforeseen tragedy in the family. The parents/ guardian shouldgive in writing about what had happened.

c). Participation in National Service Scheme and other co-curricularactivities representing the University.

15. RE-ADMISSION AFTER BREAK OF STUDY:

A separate regulation is available for all the UG/PG courses of this university for thereadmission of candidates after a break of study.

16. YEAR END EXAMINATIONS

1. Commencement of the Examination will be in November /April
2. If the date of commencement falls on Saturdays, Sundays or declaredpublic holidays, the examination shall begin on the next working day.
3. The duration of the examination of each subject is 3hours.
4. Carryover of failed subjects.

a. A candidate has to pass in theory and practical examinations separately in each of the subject.

b. If a candidate fails in either theory or practical of the subjects,he/she has to reappear for both the Theory and Practical.

c. The candidate if fails can be permitted for admission to next year.

17.REVALUATION / RETOTALLING OFANSWER PAPERS:

There is provision for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates cannot apply for retotaling.

18.CREDITS

Credits will be assigned on the basis of the lectures (L) /tutorials (T) Clinical Training (CR) /laboratory work (P) /Research Project (RP) and other form of learning in a 15-20 week schedule.

- L- One credit for one hour lecture per week (1 credit = 15 hours)
- P/T – One credit for every two hours of laboratory or practical (1 credit = 30 hours)
- CR – One credit for every two hours of Clinical Training/ClinicalRotation/Posing (1 credit = 30 hours)
- RP – One credit for every two hours of Research Project per week – Max Credit20-25 (1 credit =30 hours)

19.GRADING SYSTEM

Based on the performance, each student shall be awarded a final grade at the end of the semester for each course. Absolute grading is used by converting the marks to grade, based on pre-determined class intervals.
UGC 10-point grading system is used with pass grade modified.

Letter Grade	**Grade Point**	**Range of Marks***
O (Outstanding)	10	85% & above
A+ (Excellent)	9	80-84.99%
A (Very Good)	8	75-79.99%
B+ (Good)	7	65-74.99%
B (Above Average)	6	60-64.99%
C (Average)	5	50-59.99%
P(Pass)	-	>50%
F (Fail) / RA (Reappear)	0	<50%
AB (Absent)	0	0

1. A candidate is declared to have pass in a course if he /she secures a minimum 50% marks the university theory & practical Examinations separately & 50% in aggregate of university theory/practical & Internal assessment put together

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):
SPGA is the weighted average of the grade points obtained in all courses by the student during the

semester

SGPA Computation:

$$SGPA = \frac{\sum_{i}^{n} (C_i \times (GP)_i}{\text{.....}}$$

$$\sum^{n} C_i$$

Where C_i - credits for the course, $(GP)_i$ - the grade point obtained for the i^{th} course , n – total number of courses and the sum is over all the courses taken in that semester, including those in which the students has secured "F" and "Ab" grades.

CGPA Computation:

Computation of CGPA:

CGPA is calculated with SGPA of all semesters to two decimal points and is indicated in final grade in mark card/transcript showing grades of all 8 semesters and their courses/subjects.

$$CGPA = \frac{\sum_i^r S_i \times (SGPA)_i}{\sum_i^r S_i}$$

where:-S_i- sum of credits in i^{th} semester , $(SGPA)_i$- semester grade point average earned in i^{th} semester and r- number of semester and the sum is over all the semesters under consideration. The cumulative grade point average (CGPA) is calculated by consideration all the courses taken from the first semester onwards for regular students and from third semester onwards taken for lateral entry students.

20.CLASSIFICATION OF SUCCESSFUL CANDIDATES

The CGPA arrived at the completion of the course shall be the criteria for the classification of successful candidates as below:

Cumulative Grades and Grade Points

Letter Grade	Grade Point	Range of Marks*
O (Outstanding)	10	85% & above
A+ (Excellent)	9	80-84.99%
A (Very Good)	8	75-79.99%
B+ (Good)	7	65-74.99%
B (Above Average)	6	60-64.99%
C (Average)	5	50-59.99%
P(Pass)	-	>50%
F (Fail) / RA (Reappear)	0	<50%
AB (Absent)	0	0

a) Successful candidates who secure 75% marks and above as a course aggregate in the first appearance taking University theory, practical, project / dissertation evaluation and viva shall alone be awarded Distinction. This will also apply for award of University rank.

b) Successful candidates who secure 60% marks and above as a course aggregate in the University theory, practical, project / dissertation evaluation and viva shall be awarded First Class.

c) All others who secure 50-59% in gross percentage will be classified to havepassed in Second Class.

20.PATTERN OF QUESTION PAPER FOR UNIVERSITY EXAMINATION:

EXAMINATION QUESTION PAPER PATTERN

Essay	**2 x 15**	**= 30 Marks**
Short Notes	**7 x 5**	**= 35 Marks**
Short Answers	**5 x 2**	**= 10 Marks**
Total		**75 Marks**

Internal Split up – Theory

1. Continuous Assessment: 10 Marks

S.no	Continuous Assessment	Marks
1	Attendance	5
2	Assignment	5

2. Internal Assessment: 15 marks Two

Sessional Exams per Course

Internal Split up – Practical

1. Continuous Assessment: 20 Marks

S.no	Continuous Assessment	Marks
1	Group Project	10
2	Record note Book	10

2. Model Practical Examination: 30 Marks

21.GRACE MARKS

Maximum of 8 grace marks for each subject is permitted, and grace marks should not exceed 8 marks in each subjects.

22. MARKS QUALIFING FOR PASS

A candidate is declared to have passed in a course if he/she secures a minimum of 50% marks in university theory and practical examinations separately and 50% in aggregate of University theory /practical and internal assessment put together.

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M.Sc. Radiology & Imaging Technology

Syllabus

Paper: I

Radiological Physics

UNIT -I

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 -II

Interaction of ionizing radiation with matter-Types of interactions of X-and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.

UNIT -III

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.

UNIT -IV

Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number

UNIT -V

Radiation intensity and exposure, photon flux and energy flux density.

UNIT -VI

LET, range of energy relationship for alpha, beta particles with X-Rays.

UNIT -VII

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.

UNIT -VIII

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.

UNIT -IX

Heat dissipation methods, tube rating, heat units, operating conditions and maintenance and Q.A procedures.

UNIT - X

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.

UNIT -XI

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 generatorconstant potential generator-Fuses, switches and interlocks-Exposure switching and timers-HT cables- earthing.

UNIT – XII

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 (HU).

UNIT XIII

Radiation quantities and units: Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent-rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.

UNIT- XIV

Radiation detection and measurements: Principle of radiation detection-Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors. Measuring system: free ionization chamber-thimble ion chamber-condenser chamber- secondary standard dosimeter-film dosimeter-chemical dosimeter-Thermo Luminescent Dosimeter-Pocket dosimeter.

UNIT- XV

Picture archiving and communication system (PACS)

Text Books:

Physics for Radiography - Hay and Hughs

Ball and mores essential physics radiographers, IV edition, Blackwell publishing.

Basic Medical Radiation physics – Stanton.

Christensen's Physics of Diagnostic Radiology – Christensen.

New Understanding physics for advanced level – Jim Breithauput.

Advanced Physics for you by Keith Johnson, Simmons hewett, Sue holt, John miller

Christensen's Physics of diagnostic Radiology by Thaomas S. Curry III, M.D., Robert C Murry, Jr. Phd., Dow Dey, Phd.

Applied Electronics, A. Subramanyam, The National Publishing co., Madras (1996).

Design and Development of Medical Electronic Instrumentation, David Prutchi and Michael Norris, John Wiley & Sons (2005). Allied Health Sciences Radiology & Imaging Technology

Paper - II

Conventional Radiological and Imaging Equipment

UNIT -I

Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, 0methods of cooling the anode, rating chart and cooling chart; 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.

UNIT-II

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 stabilising equipment; mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage, kV compensator; high tension selector switch, filament circuit, control of tube current, space charge compensation.

UNIT-III

Meters and exposure timers: Moving coil galvanometer: construction and working/conversion to milliammeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines, pre reading kV meter and milliammeter, digital panel meters. Clockwork timers, synchronous motor timer, electronic timers, photo metric timers (fluorescent and photoelectric effect as applied in timers), ion chamber based timers, integrated timer.

UNIT-IV

Interlocking circuits: Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.

UNIT-V

Control of scattered radiation: Beam limiting devices: cones, diaphragms, light beam collimator, beam centring device, methods to verify beam centring and field alignment; grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.

UNIT-VI

Fluoroscopy: Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier -

UNIT VII

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.

UNIT-VIII

Portable and mobile x-ray units, dental x-ray unit, skull unit.

UNIT-IX

Mammography unit- Technical aspects of Mammography

UNIT-X

General care; functional tests; testing the performance of exposure timers, assessing the MA settings, testing the available KV, measurement of focal spot of an xray tube, testing the light beam diaphragm, practical precautions pertaining to Brakes and locks, H.T. cables, meters and controls, tube stands and tracks as well as accessory equipment.

Text Books:

X-ray Equipments for Radiographers – Noreen Chesney & Muriel Chesney
Christensen's Physics of Diagnostic Radiology

Text book of Radiology for Technicians – Bhargava.S.K
Practical approach to Modern X.ray equipment – Thompson Thomas

PAPER-III

Radiographic and Imaging Techniques

UNIT -I

1. Skeletal system:

a. Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. eg. carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.

b. Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. Supplementary techniques: Stress view for torn ligaments,Subtalar joint and talo calcaneal joint. .Inter condylar projection of the knee.ibial tubercle, Length measurement technique.

c. Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint. Supplementary projections and techniques for recurrent dislocation of shoulder. Traumatic dislocation of shoulder. Cervical ribs.

d. Vertebral column: Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoracolumber spine, lumbo sacral spine, sacrum and coccyx. Supplementary techniques to demonstrate: Scoliosis, Kyphosis, Spondylolisthesis , disc lesion, Union of spinal graft. Adaptation of techniques to demonstrate specific pathologies.

e. Pelvic girdle and hip region: Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. Supplementary techniques to demonstrate Congenital dislocation of hip joints, Epiphysis of femur, Lateral projections for hip joints to show femoral head and neck relationship.

f. Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

g. Skull: Basic projections for cranium, facial bones, nasal bones and mandible. Technique for Petrous temporals for mastoids, Internal auditory canal, Accessory nasal sinuses,Tempero - mandibular joint, Orbits and optic foramen, Zygomatic arches,Styloid process, Pituitary fossa, Jugular foramen.

UNIT-II

Dental Radiography: Technique for intra oral full mouth, Occlusal projections, Extra oral projections including orthopantomography,Supplementary techniques.

UNIT-III

Upper respiratory tract:Technique for post nasal airways, larynx, trachea, thoracic inlet,Valsalva manoeuvre,Phonation.

UNIT-IV

Lungs and Mediastinum:Technique for routine projections,

UNIT-V

Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated posteroanterior projection, Expiration technique,Technique for pleural fluid levels and adhesions.

UNIT-VI

Abdominal viscera:Technique for plain film examination.- Projection for acute abdomen patients.- Technique to demonstrate: Foreign bodies, Imperforate anus.

UNIT-VII

Radiography using mobile Xray equipment: Radiography in the ward: Radiography in the specialised unit, such as: Intensive care unit, Coronary care, Neonatal unit,Radiography in the operating theatre.

UNIT-VIII

Macroradiography: Principle, advantage, technique and applications.

UNIT-IX

Stereography: Procedure, presentation, for viewing, stereoscopes.

UNIT-X

High KV techniques: Principle and its applications.

UNIT-XI

Soft tissue Radiography including Mammography : its techniques, equipment , advancements and applications.
UNIT-XIII
Localization of foreign bodies: Various techniques
UNIT-XIV
Operation theatre techniques: General precautions, Aspesis in techniques,Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.
UNIT-XV
Trauma radiography/Emergency radiography,
UNIT-XVI
Neonatal and Paediatric Radiography,
UNIT- XVII
Tomography and Tomosynthesis
UNIT-XVIII
Dual energy X-ray absorptiometry
UNIT-XIV
Forensic Radiography

Text Books:

1. Clark's Positioning in Radiography, A. Stewart Whitley, Charles Sloane, Graham Hoadley, Adrian D. Moore,12th edition, CRC Press, 2010.

2. Diagnostic Radiography, Glenda Bryan, 4th edition, SPCK Publishing, 1991.

PAPER – ELECTIVE

PRINCIPLES OF EPIDERMOLOGY & RESARCH METHODOLOGY BOSTATICTS & MEDICAL ETHICS

UNIT I
EPIDEMIOLOGY Introduction: Historical aspects and evolution of epidemiology, definitions and concepts in Epidemiology. Natural history of disease. Approaches in Epidemiology. Descriptive and Analytical Epidemiology, Disease burden and Measures of risk and death. Epidemiological Investigations
UNIT-II
Principles of Research study designs, Sampling Methods, Sample size Estimation, Protocol writing and Measures of Association.
Introduction to Operations Research.
UNIT III
Fundamentals of Biostatistics: Introduction, Types of data, Tabular and graphical presentation of data. Measures of location, dispersion and correlation: Measures of central tendency. Mean, mode, median, GM, HM, quartiles Measures of dispersion—Range, Standard Deviation, Variance, Coefficient of Variation.
Probability and statistical inference: Concept and probability distribution. Normal distribution—density curves, applications and statistical tables. Concept of significance tests, parametric and nonparametric tests, standard error and confidence intervals.
Inferential statistics: Probability and distributions – Poisson, Binomial and Normal distribution – Chi-square test – Hypothesis test - Student's t-test – Correlation and Regression – ANOVA.
UNIT IV
Bioethics and Medical ethics: Historical perspectives & Introduction to Bioethics, Nuremberg Code, Declaration of Helsinki, Principle of essentiality, informed consent, confidentiality, minimisation of risk, accountability and responsibility. Ethics of clinical trials: Drug trials, vaccine trials, Clinical Trials with medical devices/surgical procedures/radioactive materials, Research in transplantation and stem cell therapy. Regulatory framework and guidelines for conduction of human research: Review processes, Institutional ethical committees, composition of

committees, review procedures, WHO, UNESCO and ICMR guidelines.

References :

1. Epidemiology: An Introduction. Kenneth J. J. Rothman. Latest edition / Pub. Date: May 2002. Publisher: Oxford University Press.
2. Epidemiology. Leon Gordis. Latest edition / Pub. Date: November 2004. Publisher: Elsevier Health Sciences.
3. Diseases and Human Evolution. Ethne Barnes. Latest edition / Latest edition / Pub. Date: March 2005. Publisher: University of New Mexico Press.
4. Epidemiology: Beyond the Basics. F. Javier Nieto, Moyses Szklo. Latest edition / Pub. Date: November 2003. Publisher: Jones & Bartlett Publishers, Inc.
5. Basic and Clinical Biostatistics. Beth Dawson, Robert G. Trapp, Robert Trapp. Latest edition / Pub. Date: March 2004.
6. Discovering Statistics Using SPSS. Andy Field. Latest edition / Pub. Date: April 2005. Publisher: SAGE Publications.
7. Arora PN & Malhon PK (1996). Biostatistics Imalaya Publishing House, Mumbai.
8. Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
9. Stanton A & Clantz, Primer of Biostatistics —– The McGraw Hill Inc., New York.
10. Government of India. Good Clinical Practices for Clinical Research in India. New Delhi: 2001
11. Indian Council of Medical Research. Ethical Guidelines for Biomedical Research on Human Subjects. New Delhi: 2000

SEMESTER-II

PAPER -I

Special Radiographic/Radiological procedures

UNIT-I

Selection of Fluoroscopy Equipment, general considerations, responsibility of radiographers. Patient Preparation, Indications Contraindications Technique Post Care and Preparation of Drug Trolley/Tray, Radiation Safety. Contrast Media - Positive and Negative, Ionic & Non – Ionic, Adverse Reactions To Contrast Media and Patient Management, Emergency Drugs in the Radiology Department, Aseptic technique for the following procedures.

UNIT-II

Gastrointestinal Tract: Barium swallow, pharynx and oesophagus. Barium meal and follow through. Hypotonic duodenography. Small bowel enema.Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined. Including water soluble contrast media - eg. gastrograffin studies.Including CT,US and MRI Special Imaging Techniques.

UNIT-III

Salivary glands: Routine technique, procedure - sialography.

UNIT-IV

Biliary system: Plain film radiography. Intravenous cholangiography. Percutaneous cholangiography, Endoscopic retrograde cholangio-pancreatography (ERCP). Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography). Including CT, US and MRI Special Imaging Techniques.

UNIT- V

Urinary system: Intravenous urography, Retrograde pyelography. Antegrade pyelography. Cystography and micturating cystouresthrography. Urethrography (ascending) Renal puncture. Including CT,US and MRI Special Imaging Techniques.

UNIT-VI

Reproductive system: All the Techniques relating to Male and Female reproductive system including Hysterosalpingography.

UNIT-VII

Breast Imaging: Mammography: Basic views, special views, wire localization. Ductography, Tomosynthesis, ABVS, Various Biopsy Techniques including Prone Table Biopsy, CT, US and MRI Special Imaging Techniques

UNIT-VIII

Respiratory system: - Bronchography: Including CT,US and MRI Special Imaging Techniques.

UNIT-IX

Sinography:Routine technique and procedure.

UNIT-X

Central Nervous System: Myelography. Cerebral studies.Ventriculography etc including CT, US and MRI Special Imaging Techniques.

UNIT-XI

Venography: Peripheral venography.Cerebral venography.Inferior and superior venocavography.Relevant visceral phlebography.

Text Books:

Radiographic positioning – Clarke's
Radiographic positioning – Merriil's
Diagnostic Radiography – Glends Bryan
Christensen's Physics of Diagnostic radiology
Radiographic Imaging – Chesney & Chesney
Anatomy & Physiology-Ross and Wilson
Normal Radiation Anatomy-Meschan
Human anatomy – Chaurasia.
Atlas of Human anatomy – Antunez
Basic anatomy and Physiology for radiographers – Dean.M.R.E

PAPER -II

Advanced Technique & Instrumentation Computer Tomography

UNIT-I

Imaging principles in computed tomography 12 Instrumentation of CT scan Advances in Detector technology, Slip ring technology Helical CT, Single slice and Multi slice CT Scan system. Isotropic imaging, Image display Pre and Post Processing techniques Image quality in single slice and multi slice helical CT scan Patient radiation dose considerations in Helical CT.

UNIT-II

Protocols for adult Whole-Body CT 12 Protocols for pediatric Whole-Body CT, Documentation Common and specific artifacts in Helical CT images. HRCT of Lungs Technical aspects Volumetric HRCT Expiratory HRCT HRCT protocols Artifacts

UNIT-III

CT angiography 11 CT fluoroscopy Multidimensional reformations MPR, Curved MPR, MIP 3D imaging & 4D CT. CT Perfusion scanning. CT colonoscopy CT bronchoscopy
CT coronary angiography CT calcium scoring Myocardial Imaging. Care, Maintenance and tests General care, Functional tests Quality assurance program Acceptable limits of variation, Corrective action.

Text Books:

Computed Tomography – Physical Principles , Clinical Applications & Quality Control by Euclid Seeram
Computed Tomography by Stewart C. Bushong
The essential physics of medical imaging – Bushberg

Clinical Computed Tomography for the Technologist – Chiu.L.C

PAPER -III
Advanced Technique & Instrumentation Magnetic resonance Imaging

UNIT-I
MRI- Basic Principles: Spin – precession – relaxation time – pulse 12 cycle – T1 weighted image – T2 weighted image – proton density image.
UNIT-II
Pulse sequence: Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences

UNIT-III
MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers. Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MR Spectroscopy – functional MR
UNIT-IV
MRI imaging – Head and Neck ,Thorax, Abdomen, Musculoskeletal System 12 imaging - Clinical indications and contraindications- types of common sequences effects of sequence on imaging - Protocols for various studiesslice section-patient preparation positioning of the patient -patient care - calibration - paramagnetic agents and dose, additional techniques and recent advances in MRI - image acquisition-modification of procedures in an unconscious or un co-operative patient - plain studies- contrast studies - special procedures reconstructions- 3D images- MRS blood flow imaging, diffusion/perfusion scans - strength and limitations of MRI- role of radiographer. Techniques of Fusion and hybrid Imaging Technology including PET CT, PET MRI, PET Ultrasound, MRI, CT, Fluoroscopy, Hybrid Imaging as well as Advanced Interventional suite

Text Books:
MRI physics for Radiologist - Alfred Horowitz
Fundamentals of MRI – Stark & Bradley
MRI in Practice – Catherine brook
The essential physics of medical imaging – Bushberg

HEALTHCARE MANAGEMENT

Objectives:

- To familiarize with the healthcare environment
- To understand the concepts of management with relevance to hospitals

UNIT I
Introduction – Theoretical frame work - Environment - Internal and External – Environmental Scanning – Economic Environment – Competitive Environment – Natural Environment – Politico Legal Environment – Socio Cultural Environment - International and Technological Environment.
UNIT II
A Conceptual Approach to Understanding the Health Care Systems – Evolution – Institutional Setting - Out Patient services – Medical Services – Surgical Services – Operating department – Pediatric services – Dental services – Psychiatric services – Casualty & Emergency services – Hospital Laboratory services – Anesthesia services – Obstetrics and Gynecology services – Neuro – Surgery service – Neurology services.
UNIT III
Overview of Health Care Sector in India – Primary care – Secondary care – Tertiary care – Rural Medical care – urban medical care – curative care – Preventive care – General & special Hospitals-Understanding the Hospital Management – Role of Medical, Nursing Staff, Paramedical and Supporting Staff - Health Policy - Population Policy - Drug Policy – Medical

Education Policy

UNIT IV
Health Care Regulation – WHO, International Health regulations, IMA, MCI, State Medical Council Bodies, Health universities and Teaching Hospitals and other Health care Delivery Systems
UNIT V
Epidemiology – Aims – Principles – Descriptive, Analytical and Experimental Epidemiology - Methods - Uses
REFERENCES
Seth,M.L. MACROECONOMICS, Laksminarayana Agrawal, Edu,Pub.Agra.1996
Peter,Z & Fredrick, B. HEALTH ECONOMICS, Oxford Pub., New York, 1997
Shanmugansundaram, Y., HEALTH ECONOMICS, Oxford Pub. New York, 1997

SEMETER -III

Paper I
Quality Assurance and Quality Control in Diagnostic Radiology and Imaging

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 repeat 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 in the radiological faculty level:Responsibility; Purchase; Specifications; Acceptance; Routine testings; Evaluation of results of routine testings; automatic; Consideration for storage of film and chemicals; Faults tracing; Accuracy of imaging- image distortion
for digital imaging devices. LASER printer calibration
4. Quality assurance programme tests: 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 out-put and beam quality check; KVp check; Focal spot size and angle measurement; Timer check; 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.
5. Quality assurance of film and image recording devices: Sensitometry; Characteristic curve; Film latitude; Film contrast; Film speed Resolution; Distortion; Artifacts of films and image recording. Monitor calibration. SMPTE pattern.
6. 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 equipments; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.
7. 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.
8. Quality Assurance and quality control of Modern Radiological and Imaging Equipment which includes Digital Radiography, Computed Radiography, CT scan, MRI Scan, Ultrasonography and PACS related. Image artifacts their different types, causes and remediesQuality 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

Text Books:

Radiologic science for technologist – 9th edition (2008) Stewart Carlyle Bushong, Mosby Elsevier, UK.
Text Book of Radiological Safety – K. Thaylan (2010) Jaypee Brothers and medical Publishers, New Delhi.

Quality Control in Diagnostic Imaging J.E.Gra

Paper II

Newer Imaging Modalities

UNIT-I

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

UNIT-II

Advanced Computed Tomography - Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, 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.

UNIT-III

Advanced technique & instrumentation of MRI

UNIT-IV

Basic Principle: Spin – precession – relaxation time – pulse cycle – T1 weighted image – T2 weighted image – proton density image.

UNIT-V

Pulse sequence : Spin echo pulse sequence – turbo spin echo pulse sequence - Gradient echo sequence – Turbo gradient echo pulse sequence - Inversion recovery sequence – STIR sequence – SPIR sequence – FLAIR sequence – Echo planar imaging – Advanced pulse sequences.

UNIT-VI

MR Instrumentation: Types of magnets – RF transmitter – RF receiver – Gradient coils – shim coils – RF shielding – computers.

UNIT-VII

Image formation: 2D Fourier transformation method – K-space representation – 3D Fourier imaging – MIP.

UNIT-VIII

MR contrast media – MR angiography – TOF & PCA – MR Spectroscopy – functional MRI

Text Books:

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

PAPER -III

Advanced Technique & Instrumentation of Ultrasound

UNITI

Ultrasound Properties of ultrasound Interaction of ultrasound with matter

UNIT II

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

UNIT III

Image display Display modes Real time ultrasound Pulse echo ultrasound instrumentation Beam former Pulse transmitter – receiver Controls CRT displays – television monitors Image storage Scan converter memory Photographic film Multiformat camera Laser imager Colour & video thermal printers Computer storage Pre and post processing techniques
UNIT IV
Doppler Imaging Doppler principles Continuous wave Doppler and Pulsed Doppler Duplex scanning Doppler spectral analysis & display Color flow imaging Power Doppler Harmonic imaging Real time compounding Extended field of view
Doppler Instrumentation
UNIT V Ultrasound contrast agents
UNIT VI Image characteristics and artifacts Ultrasound tissue characterization and organ dynamics Vascular, interventional, intra operative and ophthalmic Ultrasonography 3D & 4D ultrasound imaging Acquisition, visualization and display methods
UNIT VII
Bio-effects and safety considerations in ultrasound US system performance measurements US equipment quality assurance - Conventional & Doppler system testing.

Text Books:

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

PATIENT CARE

Patient vital signs - temperature, pulse, respiration and blood pressure - normal values and methods of taking and recording them. Development of communication skills with patient- general comfort and reassurance to the patient-patient education and explaining about the study drugs used in the preparation of the patient. Handling of an unconscious patient shifting of patients - hazards of lifting and maneuvering patients - rules for correct lifting- transfer from chair/wheel chair or trolley to couch and vice-versa - safety of patient and worker while lifting & shifting of patients- handling of geriatric, pediatric and trauma patients -handling female patients-pregnant women. Communicable diseases - hygiene in the department-cross infection and prevention-handling of infectious patients in the department -application of asepsis.

Text Books: .

1. Notes on Radiological Emergencies – Ansell and Churchill
2. Care of patient in diagnostic Radiography – Chesney & Chesney.
3. First Aid – Haugher and Gardner.
4. Practical Nursing and First Aid – Ross and Wilson.

SEMESTER IV

PAPER -I

Radiation Protection In Diagnostic Imaging and Nuclear Medicine Imaging Techniques

UNIT-I
Introduction to Radiation protection-Need for protection, Aim of radiation protection,.
UNIT-II
Limits for radiation exposure: Concept of ALARA ,maximum permissible dose ,exposure in pregnancy, children.
Occupational Exposure Limits - Dose limits to public.
UNIT-III
Radiation Protection in: Radiography, Fluoroscopy, Mammography , Mobile Radiography ,CT Scan ,DSA and Interventional Radiology.
UNIT-IV
Radiation measuring instruments: survey meters, area monitor , personnel dosimeters ,film badge, thermo luminescent dosimeter, pocket dosimeter.

UNIT-V

Radiation Quantities and Units: Radiation, Radioactivity, Sources of radiation - natural radioactive sources, cosmic rays, terrestrial radiation, manmade radiation sources. Kerma, Exposure, Absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose.

UNIT-VI

Biological Effects of radiation: Direct & Indirect actions of radiation, concept of detriment ,Deterministic & stochastic effect of radiation, somatic and genetic effects, dose relationship, effects of antenatal exposure 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 radiosensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

UNIT-VII

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 Dosimeter, Pocket dosimeter, Radiation survey meter, wide range survey meter, zone monitor, contamination monitor - their principle function and uses. Advantages & disadvantages of various detectors & appropriateness of different detectors for different type of radiation measurement.

UNIT-VIII

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.

UNIT-IX

Radiation protection, Hazard evaluation and control:: Philosophy of Radiation protection Radiation protection of self and patient and General Public, Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey, Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology.

UNIT-X

Planning consideration for radiology, including Use factor, occupancy factors, and different shielding materials. Protection for primary radiation , work load ,use factor , occupancy factor , protection from scatter radiation and leakage radiation , X-Ray/Fluoroscopy/Mammography/Intervention/DSA/CT room design , structural shielding , protective devices.

UNIT-XI

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. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection).

UNIT-XII

NABH guidelines, AERB guidelines, PNDT Act and guidelines Newer Radiation safety protocols and recent advances in radiation safety. Role of Radiographer in Planning & 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/CT 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.

Physics of Diagnostic radiology – Christensen

ICRP manual 3. Radiation protection measurement – Glenn F.Knoll

Radiation protection in hospitals – R.F.Mold

Advanced medical radiation dosimetry – Govinda Rajan

Radiation protection – Medical Radiography – Sherer

Radiation protection for radiologic technologist – Frankerl Robert

Nuclear Medicine basics – Chandra.R

Principles & practice of Nuclear medicine – Early.P.J
Physics and Radiobiology of Nuclear Medicine – Gopal.
Essentials of Nuclear Medicine Imaging – Mettler
Radionucleid Imaging artifacts – Wells & Bernier

PAPER -II

Intervention Radiological Techniques and Patient Care

UNIT-I

Basic Angiography and DSA: History , technique, patient care, Percutaneous catherisation, catheterization sites, Asepsis ,Guide wire, catheters, pressure injectors, accessories, Use of digital substraction- single plane and biplane. All forms of diagnostic procedures including angiography, angioplasty, biliary examination, renal evaluation and drainage procedure and aspiration cytology under flouoro,CT,US,MRI guidance.

UNIT-II

Central Nervous System: Myelography.Cerebral studies.Ventriculography.

UNIT-III

Arthrography: Shoulder, Hip, Knee, Elbow

UNIT-IV

Angiography: Carotid Angiography (4 Vessel angiography).Thoracic and Arch Aortography. Vertebral angiography, femoral arteriography. Selective studies: Renal, SMA, Coeliac axis.Angiocardiography.

UNIT-V

Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography. Relevant visceral phlebography.

UNIT-VI

Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker.

UNIT-VII

Microbiology Introduction and morphology - Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria. Growth and nutrition -nutrition, culture media, types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test.Sterilization and disinfection - principles and use of equipments of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, anti-septic and disinfectants.

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

Seminars, Journal Clubs and Group Discussions

Each student will be assigned topics for presentations as seminars, will explore recent innovations in MRIT for presenting topics during journal clubs and shall be holding group discussions along with other students in the presence of MRIT faculty. This will also include visits to other Institutions, Factories or Industries in the field of MRIT.

Project

Each candidate will have to carry out of a project on the related subject. The project will be guided by one or two members of the faculty or medical Physicists of the department. The project will be evaluated by the External/Internal Examiners at the time of viva voice examination of the candidate during the second year. The candidate will be asked to make PPT presentation before the External / Internal Examiner at the time of practical Examination

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