# Syllabus (2014-2015)

## B.Sc Radiology & Imaging Technology

### BRIEF SUBJECT TITLES TO BE COVERED

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<th>Main Subjects</th>
<th>Internal Subjects</th>
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<tr>
<td><strong>1st Year</strong></td>
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<tr>
<td>1 Human Anatomy, Physiology &amp; Pathology relevant to Radiology.</td>
<td>English</td>
</tr>
<tr>
<td>2 General Physics, Radiation Physics &amp; Physics of Diagnostic Radiology</td>
<td>Basics of Computer</td>
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<tr>
<td>3 Radio diagnosis Equipments, Maintenance and Quality Control.</td>
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<tr>
<td><strong>2nd Year</strong></td>
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<tr>
<td>4 Clinical Radiography.</td>
<td>Patient Care &amp; Medical Ethics.</td>
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<td>5 X-ray Film / Image processing Techniques including Dark Room Techniques.</td>
<td>Principles of Medical Emergencies</td>
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<td>6 Contrast &amp; Special Radiography procedures.</td>
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<td><strong>3rd Year</strong></td>
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<tr>
<td>7 Equipments of modern Imaging Modalities</td>
<td>Log Book</td>
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<tr>
<td>8 Modern Imaging Techniques and Recent Trends in Imaging</td>
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<tr>
<td>9 Quality Control, Radiobiology &amp; Radiation Safety in Radiodiagnosis / Imaging.</td>
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*NOTE: For the supportive internal subjects Examination is to be conducted by the institute conducting the course and marks should be submitted to the University.*
Syllabus for B.SC Radiology & Imaging Technology

FIRST YEAR

Internal Paper

ENGLISH

SYLLABUS DETAILS

DESCRIPTION

The course is designed to enable students to enhance ability to comprehend spoken and written English (and use English) required for effective communication in their professional work. Students will practice their skills in verbal ad written English during clinical and classroom experience.

OBJECTIVES

At the end of the course, the student will develop

1. Ability to speak and write grammatically correct English.
2. Effective skill in reading and understanding the English language.
3. Skill in reporting

CONTENT

1. COMMUNICATION

   • Role
   • Definition
   • Communication
   • Classification of communication
• Purpose
• Major difficulties
• Barriers
• Characteristics – The seven Cs
• Communication at the workplace
• Human needs and communication “Mind mapping”
• Information communication

2. COMPREHENSION PASSAGE

• Reading purposefully
• Understanding what is read
• Drawing conclusion
• Finding and analysis

3. EXPLAINING

• How to explain clearly
• Defining and giving reasons
• Explaining differences
• Explaining procedures
• Giving directions

4. WRITING BUSINESS LETTERS

• How to construct correctly
• Formal language
• Address
• Salutation
• Body and conclusion
5. REPORT WRITING
   - Reporting and accident
   - Reporting what happened at a session
   - Reporting what happened at a meeting

PRACTICUM
   - The clinical experience in the wards and bedside nursing will provide opportunity for
     students to fulfill the objectives of learning language.
   - Assignment on writing and conversation through participation in discussion debates
     seminars and symposia. The students will gain further skills in task oriented
     communication.

METHODS OF TEACHING
1. Lecture
2. Pair and Group work
3. Role plays
4. Oral presentations
5. Decoding & production grammar exercise
6. Comprehension exercise
7. Writing assignments
8. Word puzzles & Quizzes
9. Communicative games & fluency activities

METHODS OF EVALUATION
1. Individual oral presentations
2. Group discussion
3. Answering questions from the prescribed English text.
4. Summary / Essay / Letter writing
5. Grammar exercises
6. Medical / General vocabulary exercises
**Internal Assessment in Year 1: English** (Total 50 marks)

**Theory:** English Theory Paper for internal assessment in First Year to be combined with computer science paper as follows-
- English-25 + Computer Science-25 marks

**Viva:** 25 marks

**Reference Books**

1. Selva Rose. 1997, Career English for Nurses. Published by: Orient Blackswan Ltd

**2. Basics of Computer**

*Digital electronics and computers fundamental*

**Number systems:** Binary, octal, decimal & Hexa-decimal, conversions from one system to another, Analog to Digital Converter and Digital to Analog Converter.

**Computer fundamentals:** Central Processing Unit, Memory RAM and ROM, Arithmetic and Logic Unit, Display devices, Hard copy devices, Input devices. Computer Applications related to Radiography with examples.

**Internal Assessment in Year 1: Computer Science** [Total 50 marks]

**Theory:** Theory Paper in Computer Science for internal assessment in First Year to be combined with English paper as follows-
- English-25 + Computer Science-25 (Total 50 marks)
Human Anatomy, Physiology & Pathology relevant to Radiology.


2. Elementary tissues of human body- Epithelial tissue, muscular tissue, connective tissues and nervous tissue.


5. Lymphatic system - Name and function of lymph glands, Lymphatics and Lymphatic pathway outline.


9. **Reproductive System** physiology and anatomy of Male & Female reproductive system- Prostate & Uterus & Ovaries etc. The Mammary glands –anatomy & physiology and & its importance in imaging.


12. **Nervous System** various parts of nervous system- Brain and its parts Divisions of brain and its functions–functions of nervous system - Spinal Cord & Nerves, Cranial nerves, Anatomy of nerves, sensory pathway Spinal cord and spinal nerves. The méninges and ventricles of brain and the CSF.

13. **Endocrine System**: Endocrine glands, their hormones and functions-Thyroid, Parathyroid, Suprarenal, Pituitary, pituitary and Thymus).

14. **Surface Anatomy & Surface Markings of Human Body.**

**Practical**
1. Study of human skeleton.
2. Study with the help of charts and models of the following systems and organs.
   a) Digestive system
e) Reproductive system
   b) Respiratory system
f) Nervous system
c) Cardio-vascular system
g) Eye
d) Urinary system
h) Ear
3. Microscopic examination of epithelial tissue, cardiac muscle, smooth muscle, skeletal muscle, connective tissue and nervous tissue.
4. Examination of blood films for TLC, DLC and malarial parasite.
5. Determination of clotting time of blood, erythrocyte sedimentation rate and hemoglobin value.
6. Recording of body temperature, pulse, heart rate, blood pressure and ECG.

Reference Books
1. Anatomy and Physiology for Radiographers- C.A. Werrick
2. Imaging Atlas of Human Anatomy – Jamie Weir et all (Mosby-Elsevier)
4. Anatomy and Physiology for Nurses
5. Comprehensive Radiographic Pathology. Ronald L. Eisenberg, NancyM. Johnson
6. Surface and Radiological Anatomy – Hamilton et al (Heffer)

Paper-II General Physics, Radiation Physics & Physics of Diagnostic Radiology.

1. Basic concepts: Basic Units, Heat, Acoustics etc. Basic concepts of power, work, force, energy - Einstein’s formula - Electronics, Electricity & Magnetism, -electromagnetic waves - Units and measurements - temperature and heat-SI units of above parameters-Atomic structure- Nucleus - Atomic Number, Mass Number electron orbit and energy levels-Periodic table -Isotopes-Isobars-Ionisation and excitation.


**X-Ray generators and circuits:** Filament current and voltage, X-Ray circuits—primary circuit—auto transformer—switch and timers—principle of automatic exposure control 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- falling load generators- capacitors discharge and grid control systems.

**X-ray tables**-floating top table & variable height table.

**X-Ray Grids /Bucky**


**Practical**

Practical involving not less than 20 numbers must be prescribed to the students.

The title and nature of practical may be framed by the respective institution conducting the course.

Study with charts, models & power point presentations Atomic structure, X-ray tubes, X-ray circuits involving students to present and discuss.

Topics:-

1. Congruence of Radiation and Optical field and beam.
2. Determination of focal spot size of diagnostic X-ray tube.
3. K.V. and Exposure time testing.
4. Linearity testing of the Timer.
5. Consistency of M.A. loading.
7. Evaluation of Total filtration of the tube.
8. Film screen contact testing.
9. Table top Exposure rate measurement in fluoroscopy.
10. Radiation protection survey, in and around of diagnostic installations.
Reference Books

1. Physics for Radiography - Hay and Hughes
3. Basic Medical Radiation physics – Stanton.

Paper-III. Radio Diagnosis Equipments, Maintenance and Quality Control


6. **Mammography** -basic principle, equipment & image acquisition-conventional & digital mammo studies- Mammotomogram.

7. **Dental Radiography** – Equipment Basics –types of equipments- Intra oral radiography unit-orthopantomograph unit -imaging techniques- Dental films-film types and processing.

8. **Tomography**: Theory of tomography – multi section radiography- Tomography equipment-Basic requirements and controls, attachments.


**Practicals**

Demonstration of basic procedures with all radiographic equipments
Reference Books


EXAMINATION SCHEDULE

FIRST YEAR
Note: For the supportive subjects English and Basics of Computer internal tests, Assignment / Practical are to be conducted by the institute during the 1st year of the course and marks should be submitted to the University.

SCHEDULE OF EXAMINATION

<table>
<thead>
<tr>
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# FIRST YEAR - SCHEME OF EXAMINATIONS

<table>
<thead>
<tr>
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<th>University Theory Exam</th>
<th>Practical Marks</th>
<th>VIVA</th>
<th>IA</th>
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<tr>
<td>Human Anatomy, Physiology &amp; Pathology relevant to Radiology.</td>
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Theory 100 Marks  
Practical 100 Marks  
Viva 50 Marks  
IA 50 Marks

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Internal Subjects

(1) Patient care & Medical Ethics:
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.
Ethics of medical practice- Radiography professionalism-essential qualities of the radiographer-improving professional and personal qualities- Radiographer as a part of Hospital /Organization-responsibilities. Medico-legal considerations - radiographers clinical and ethical responsibilities- misconduct and malpractice.

(2) Principles of Medical Emergencies
Reference Books:

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

Internal Assessment in Year 2: Patient care & Medical Ethics (Total 50 marks)

Principles of Medical Emergencies (Total 50 marks)

Theory Paper for internal assessment in Second Year to be combined as follows-

- Patient care & Medical Ethics 25 marks + Principles of Medical Emergencies 25 marks

Viva

- Patient care & Medical Ethics 25 marks + Principles of Medical Emergencies 25 marks

Paper-I - Clinical Radiography

- Techniques, Preparations, Instructions, Positioning of patient for conventional and digital radiography in the imaging of following-

Conventional Non contrast radiography-


**Chest Radiography** – Basic views (PA & AP) - inspiratory & expiratory films- special chest views & their significance – larynx- trachea- thoracic inlet -Sternum - Ribs – Heart and great vessels – mediastinum -Diaphragm – double exposure technique.

**Abdomen & Pelvic Radiography** – all projection – the acute abdomen investigation.

**Soft tissue radiography:**

**Stereo Radiography:**

**Macro radiography:** Principle sizes of focal spot its limitation in its application.

**High kv technique:** technique & usefulness.

**Foreign body localization:**

**Dental radiography**-types of equipments –techniques- indications-films-dental radiography in trauma patients.

**Practical**
Practical involving patients not less than 10 numbers must be prescribed to students. The title and nature of practical may be framed by the respective institution conducting the course.

**Reference Books:**
1. X-Ray film
X-ray film construction and film characteristics – Composition of single and double coated radiographic films -structure of emulsion- film characteristics; speed, base fog, gamma, latitude -effect of grain size on film response to exposure, interpretation of characteristics curve- exposure to x-rays.

2. Types of Radiographic Films-
applications -advantages/limitations of different types Structure, properties of different parts- Film storage - handling -film wrappings- andling of exposed and unexposed films -safe light requirements.


5. Film archiving systems- Image recording devices-Laser imager/camera functioning. Multiformatter- Optical Disc. System Film archiving systems - MOD/disc/PACS etc.

7. **Radiographic illuminators**: and viewing conditions, visual acuity and resolution.

8. **Dark Room**: Site - layout - dark room design - construction - processing area - illumination - safe light compatibility - entrance safe lighting - types - storage - shelving of films - cleaning and maintenance.

### Practicals

Practical involving not less than 10 numbers must be prescribed to the students.

The title and nature of practical may be framed by the respective institution conducting the course.

Study with charts, models & power point presentations involving students to present and discuss.

### Reference Books

1. Radiographic latent image processing – W. E. J Mckinney
Non-contrast Special radiography

1. Paediatric Imaging:
special needs of patient and radiographer- use of dedicated equipment and accessories- modified technical considerations - selection of exposure factors-image quality considerations - radiation protection of the patient - special techniques in children for contrast studies.

2. Geriatric radiography
Equipment and accessories – exposure factor considerations in special care. Elderly patients profile - difficulties during radiography – technical considerations-projections with unconventional special positioning.

3. Trauma/Emergency Radiography

4. Operation theatre radiography

Contrast radiography

Radiological contrast media – classification -need for radiological contrast media - methods of administration-dosage-reactions to contrast media- role of radiographer in management of patient with contrast reaction.

For all contrast investigations-patient preparation, positioning, patient care during the study-post procedural patient care-types of contrast media used and dosage-alternative contrast used-side effects and its identification-treatment of complication during the procedure - pathological conditions- indications and contraindications- injection procedure –techniques for radiographic projections - radiographic appearances– radiation protection.
5. Sialogram
6. Barium studies- different types – Barium swallow Barium meal study of upper GIT, Barium meal follow through, Barium enema, small bowel enema, distal colography, defaecography.
7. Percutaneous Transhepatic Cholangiogram, ERCP, T-Tube cholangiography, per-operative cholangiography.
8. IVP-rapid sequence-infusion pyelography-high dose urography, Cystogram, Anterior Urethrogram RGU, MCU, RCP
9. Angiography, Diagnostic & therapeutic, venography, Lymphangiogram
10. Orthography, Discography
11. Myelogram,
13. Sinography.
14. Fistulogram,
15. Ductogram.

Practical:
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Reference Books:

Radiological patient care – Jensen Chesney.
Atlas of dental and maxillofacial radiological imaging – Brownie
EXAMINATION SCHEDULE

SECOND YEAR

Note: For the supportive subjects Medical Ethics & Patient Care and Principles of Medical Emergencies internal tests to be conducted by the institute during the 2nd year of the course and marks should be submitted to the University.

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<td>Long Case-Positioning techniques</td>
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<tr>
<td>PAPER-II X-ray Film / Image processing Techniques including Dark Room Techniques.</td>
<td>Films Developing and Dark Room Techniques.</td>
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<tr>
<td>PAPER-III Contrast &amp; Special Radiography procedures.</td>
<td>Contrast &amp; Special Procedures</td>
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SCHEME OF EXAMINATION

SECOND YEAR

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B.Sc Radiology & Imaging Technology

THIRD YEAR

PAPER I  Equipments of modern Imaging Modalities

1. Mammography system:
   History - Imaging requirements- Mammography system - construction/types accessories -
   tube, compression, grids, AEC etc.- nature of X-Ray beam suitable
   – accessories for immobilization - film processing - image quality - image recording devices -
   interventional procedures – accessories-biopsy equipment attachments - radiation dose- -
   mammo tomogram-Sonomammography-future developments.

2. Ultrasonography/ Doppler systems:
   Basic acoustics principle- Basic physics of sound propagation in different media, production of
   Ultrasound (piezoelectric effect), ultrasound terminologies – interaction of ultrasound with
   matter – ultrasound properties propagation in tissue, absorption, scattering, reflection and
   refraction- acoustic impedance – piezo electric effect – transducer – Pulsar – receiver –
   beam/sensitivity and gain - generators- A, B and M scanning & echo modes- transducers-
   techniques of sonography-equipment selection- display methods – ultrasound image
   formation - data storage and display – image and artifacts – doppler instrumentation – doppler
   equation – transducer – quality assurance and performance tests – bio effects and safety
   considerations. Types of machines –portable systems- acoustic coupling agents-
   ingredients/preparation.

3. CT scan systems:
   History- generations of scanners-CT technology -helical/spiral & multi slice C.T- ultra fast
   scanners-system components - performance parameters - image quality and methods of
   image reconstruction- radiation dose measurements and technical aspects of Q.A -calibration
   and image acquisition-

5. Angiography and Cine Studies /DSA

6. Nuclear Medicine Equipments
Nuclear Physics - basics in Nuclear Medicine- Nuclear medicine equipments - Gamma Cameras- rectilinear scanners- radioisotope generators-SPECT-CT & PET-CT- introduction-basic physics and principle involved- equipments basic structure—differences- fusion techniques- image formation-storage devices— advantages-limitations.

7. Recent Advances in Imaging Systems
Mobile units of Computer Radiography & Digital Radiography system.
3D/4D Sonography systems
128 slice & higher slice C.T equipments.
3 Tesla & higher T MRI scanners
Image processing & Display systems-Recent advances, concepts and applications in processing of images in digital form using computer based systems.

Practical
Practical involving not less than 10 numbers must be prescribed to the students. The title and nature of practical may be framed by the respective institution conducting the course.

Reference Books
Step by Step CT; Step by Step MRI and MRI made Easy for beginners – Govind B. Chavhan – Jaypee brothers and Medical Publishers (p) Ltd, New Delhi
CT & MRI protocol – Satish K. Bhargava, CBS publishers.

PAPER-II Modern Imaging techniques and recent trends in imaging.

1. Mammography:

2. Ultrasonography/ Doppler studies:
Techniques of sonography-selection- Preparations - instructions and positioning of patient for TAS, TVS, TRUS, neck USG and extremities- patient care and maintenance protocols-clinical applications display methods –quality image reproducible extend -assurance to patients.
3. CT scan studies acquisition/ protocols/techniques:
CT of head and neck – thorax – abdomen – pelvis – musculo skeletal system – spine – PNS.
Anatomy – clinical indications and contraindications – patient preparation – technique –
contrast media-types, dose, injection technique; timing, sequence - image display – patient
care – utilization of available techniques & image processing facilities to guide the clinician-
CT anatomy and pathology of different organ systems.

4. MRI Scanners:
Methods of MRI imaging methods – Head and Neck, Thorax, Abdomen, Musculoskeletal System imaging - Clinical indications and contraindications- types of common sequences-
effects of sequence on imaging - Protocols for various studies- slice 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 unco-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.

5. Angiography and Cine Studies/DSA
Conventional / DSA studies- Abdominal, visceral, peripheral, cerebral and cardiac angiography - arterial/venous anatomy, physiology-clinical indications and contraindications -
patient preparation-positioning of the patient -patient care-contrast media - types of contrast -
dosage - accessories catheters, guide wires- pressure injection- control of radiographic and
fluoroscopic equipment - exposure factors for serial programmes-programming-injection protocols- outline on each radiological procedure- radiographer’s role- patient management before -during and after the procedure - venography- interventional angiography in hepatobiliary, GIT, urology and vascular system- coils/stents etc- indications and contraindications - role of radiographer-radiation safety.
6. **Nuclear Scintiscan procedures:**
SPECT-CT & PET-CT studies, protocols, Basics of common clinical Nuclear Medicine procedures/techniques–comparison with different structural imaging studies-advantages and limitations.

7. **Recent Advances in Imaging**
Dynamic CT & MRI studies
Per operative application of various imaging systems including detector probes application in Nuclear Medicine
Imaging guidance in therapeutic procedures-IGRT, TACE & TARE etc.

**Practical**

Practical involving not less than 10 numbers must be prescribed to the students. The title and nature of practical may be framed by the respective institution conducting the course.

**Reference Books**

1. Concepts in Medical Radiographic Imaging – Marianne Tortoice
2. Radiographic Imaging - Derrick
3. Processing and Quality Control – William
Quality Control, Radiobiology and Radiation Safety in Radiodiagnosis/Imaging.

1. Radiation Quantities and Units

2. Biological Effects of radiation
Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell -Chromosomal aberration and its application for the biological dosimetry- Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus -Somatic effects and hereditary effects- stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio-sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.


4. Radiation protection:
5. Q.A in Diagnostic Radiology

Quality assurance (Q.A), acceptance testing and quality control tests in Radiology-
Meaning of the terms used and aspects of a QA programme, equipment and staff requirements, benefits of QA procedures in an imaging department –NABH guidelines. Verification of Optical & Radiation field congruence, Beam alignment, Focal spot size, Linearity of tube current mA and Timer, applied potential, HVT and total tube filter, Contact between film and intensifying screen, contrast resolution, Grid alignment, Special techniques like mammography, CT - CT Dose Modulation-Patient dose management.

6. Radiation Hazard evaluation and control

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

7. 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.

8. Role of Radiographer in Planning, QA & Radiation Protection:

Practical

Practical involving not less than 10 numbers must be prescribed to the students. The title and nature of practical may be framed by the respective institution conducting the course as follows-

1. Time, Dose, Shielding, Measurement of HVT & TVT
2. Familiarization of Radiation Survey meters and their functional performance checks
3. Radiological Protection Survey of Diagnostic X-Ray installation
5. AERB safety requirements- Atomic Energy Act, Radiation protection rules.

Reference Books:

3. Quality Control in Diagnostic Imaging J.E.Gray
## EXAMINATION SCHEDULE
### THIRD YEAR

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<td>Identification &amp; describing Radiation safety equipments. Demo- Radiation Survey in different Equipments Rooms</td>
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Note: Internal test in the subjects ‘Patient Care’ & ‘Principles of Medical Emergencies’ to be conducted by the centre during IIInd year of the course and marks should be sent to University.
## SCHEME OF EXAMINATION

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<td>Modern Imaging Techniques and Recent Trends in Imaging.</td>
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**Theory** 100 Marks  
**Practical** 100 Marks  
**Viva** 50 Marks  
**IA** 50 Marks

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## Question Paper Pattern

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