CURRICULUM
B.Sc Medical Radiologic Technology
SPIRITUAL PRINCIPLES IN EDUCATION

“In the gurukulas of ancient rishis, when the master spoke it was love that spoke; and at the receiving end disciple absorbed of nothing but love. Because of their love for their Master, the disciples’ hearts were like a fertile field, ready to receive the knowledge imparted by the Master. Love given and love received. Love made them open to each other. True giving and receiving take place where love is present. Real listening and ‘sraddha’ is possible only where there is love, otherwise the listener will be closed. If you are closed you will be easily dominated by anger and resentment, and nothing can enter into you”.

“Satguru Mata Amritanandamayi Devi”
Introducing AIMS

India is the second most populous nation on earth. This means that India’s health problems are the world’s health problems. And by the numbers, these problems are staggering: 41 million cases of diabetes, nearly half the world’s blind population, and 60% of the world’s incidences of heart disease. But behind the numbers are human beings, and we believe that every human being has a right to high-quality healthcare.

Since opening its doors in 1998, AIMS, our 1,200 bed tertiary care hospital in Kochi, Kerala, has provided more than 4 billion rupees worth of charitable medical care; more than 3 million patients received completely free treatment. AIMS offers sophisticated and compassionate care in a serene and beautiful atmosphere, and is recognized as one of the premier hospitals in South Asia. Our commitment to serving the poor has attracted a dedicated team of highly qualified medical professionals from around the world.

The Amrita Institute of Medical Sciences is the adjunct to the term “New Universalism” coined by the World Health Organization. This massive healthcare infrastructure with over 3,330,000 sq. ft. of built-up area spread over 125 acres of land, supports a daily patient volume of about 3000 outpatients with 95 percent inpatient occupancy. Annual patient turnover touches an incredible figure of almost 800,000 outpatients and nearly 50,000 inpatients. There are 12 super specialty departments, 45 other departments, 4500 support staff and 670 faculty members.

With extensive facilities comprising 28 modern operating theatres, 230 equipped intensive-care beds, a fully computerized and networked Hospital Information System (HIS), a fully digital radiology department, 17 NABL accredited clinical laboratories and a 24/7 telemedicine service, AIMS offers a total and comprehensive healthcare solution comparable to the best hospitals in the world. The AIMS team comprises physicians, surgeons and other healthcare professionals of the highest caliber and experience.

AIMS features one of the most advanced hospital computer networks in India. The network supports more than 2000 computers and has computerized nearly every aspect of patient care including all patient information, lab testing and radiological imaging. A PET (Positron Emitting Tomography) CT scanner, the first of its kind in the state of Kerala and which is extremely useful for early detection of cancer, has been installed in AIMS and was inaugurated in July 2009 by Dr. A. P. J. Abdul Kalam, former President of India. The most recent addition is a 3 Tesla Silent MRI.

The educational institutions of Amrita Vishwa Vidya Peetham, a University established under section 3 of UGC Act 1956, has at its Health Sciences Campus in Kochi, the Amrita School of Medicine, the Amrita Centre for Nanosciences, the Amrita School of Dentistry, the Amrita College of Nursing, and the Amrita School of Pharmacy, committed to being centres of excellence providing value-based medical education, where the highest human qualities of compassion, dedication, purity and service are instilled in the youth. Amrita School of Ayurveda is located at Amritapuri, in the district of Kollam. Amrita University strives to help all students attain the competence and character to humbly serve humanity in accordance with the highest principles and standards of the healthcare profession.

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Part I
Rules and Regulations
## Under Graduate Programmes (Bachelor of Sciences)

### I.1. Details of Under Graduate Courses:

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<tr>
<th>Sl. No.</th>
<th>Course</th>
<th>Duration</th>
<th>Conditions of Eligibility for admission to the course</th>
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<tbody>
<tr>
<td>1</td>
<td>Medical Laboratory Technology (MLT)</td>
<td>4 years</td>
<td>Pass in plus Two with 50% marks with Physics, Chemistry and Biology</td>
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<td>2</td>
<td>Medical Radiologic Technology (MRT)</td>
<td>4 Years</td>
<td>First class in plus two with Mathematics, Physics, Chemistry, and Biology</td>
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<tr>
<td>3</td>
<td>Emergency Medical Technology</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>4</td>
<td>Anaesthesia Technology</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>5</td>
<td>Respiratory Therapy (RT)</td>
<td>3 Years + One year Internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>6</td>
<td>Dialysis Therapy</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>7</td>
<td>Physician Assistant</td>
<td>3 years + one year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>8</td>
<td>Cardio Vascular Technology (CVT)</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>9</td>
<td>Echocardiography Technology</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>10</td>
<td>Cardiac Perfusion Technology (CPT)</td>
<td>3 Years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>11</td>
<td>Diabetes Sciences</td>
<td>3 years + One year Internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>12</td>
<td>Optometry</td>
<td>3 Years + One year Internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
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<tr>
<td>13</td>
<td>Bachelor of Audiology &amp; Speech Language Pathology (BASLP)</td>
<td>3 years + One year Internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>14</td>
<td>Neuroelectro-physiology</td>
<td>3 years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>15</td>
<td>Operation Theatre Technology</td>
<td>3 years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
<tr>
<td>16</td>
<td>Intensive Care Technology</td>
<td>3 years + One year internship</td>
<td>Pass in plus two with 50% marks in Physics, Chemistry and Biology</td>
</tr>
</tbody>
</table>
I.2. Medium of Instruction:
English shall be the medium of instruction for all subjects of study and for examinations.

I.3. Eligibility:
Generally Science Graduates with Physics, Chemistry, and Biology are eligible for admission to the Under Graduate Courses except in respect of certain specialties for which other qualification or subjects are specifically called for. Essential qualifications for eligibility are mentioned under clause I.1

II. General Rules:
Admissions to the courses will be governed by the conditions laid down by the University from time to time and as published in the Regulations for admissions each year.

II.1. Duration of the Course
Duration details are mentioned under clause No.I of this booklet.
Duration of the course : 4 Years
Weeks available per year : 52 weeks
Vacation / holidays : 5 weeks (2 weeks vacation + 3 weeks calendar holidays)
Examination (including preparatory) : 6 weeks
Extra curricular activities : 2 weeks
Weeks available : 39 weeks
Hours per week : 40 hours
Hours available per academic year : 1560 (39 weeks x 40 hours)

Internship wherever specified are integral part of the course and needs to be done in Amrita Institute of Medical Sciences, Kochi itself.

II.2. Discontinuation of studies
Rules for discontinuation of studies during the course period will be those decided by the Chairman, Admissions, Amrita School of Medicine, and Published in the “Rules and Regulations” every year.

II.3. Educational Methodology
Learning occurs by attending didactic lectures, as part of regular work, from co-workers and senior faculty, through training offered in the workplace, through reading or other forms of self-study, using materials available through work, using ma-
II.4. Academic Calendar

Course will follow and annual scheme as per details mentioned under:

**FIRST YEAR**

- Commencement of classes: August 2019
- First sessional exam: November 2019
- Second sessional exam: February 2020
- Model Exam (with practical): May - June 2020 (one week study leave)
- University exam (with practical): June - July 2020 (10 days study leave)
- Annual Vacation: 3 weeks after the University Examination.

**SECOND YEAR**

- Commencement of classes: August 2020
- First sessional exam: November 2020
- Second sessional exam: February 2021
- Model Exam (with practical): May - June 2021 (one week study leave)
- University exam (with practical): June - July 2021 (10 days study leave)
- Annual Vacation: 2 weeks after the University examination.

**THIRD YEAR**

- Commencement of classes: August 2021
- First sessional exam: November 2021
- Second sessional exam: February 2022
- Model Exam (with practical): May 2022 (one week study leave)
- University exam (with practical): June 2022 (10 days study leave)
- Annual Vacation: 2 weeks after the University examination.

**Final Year**

- Commencement of classes: August 2022
- First sessional exam: November 2022
- Second sessional exam: February 2023
- Model Exam (with practical): May 2023 (one week study leave)
- University exam (with practical): June 2023 (10 days study leave)
- Date of completion of Final academic year: 31st July 2023
III. **Examination Regulations:**

### III.1. Attendance:

**75% of attendance (physical presence) is mandatory.** Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the final examination in each subject.

### III.2. Internal Assessment:

1. Regular periodic assessment shall be conducted throughout the course. At least three sessional examinations in theory and preferably one practical examination should be conducted in each subject. The model examination should be of the same pattern of the University Examination. Average of the best of two examinations and the marks obtained in assignments / viva / practical also shall be taken to calculate the internal assessment.

2. A candidate should secure a minimum of 50% marks in the internal assessment in each subject (separately in theory and practical) to be eligible to appear for the University examination.

3. The internal assessment will be done by the department thrice during the course period in a gap of not more than three months and model exam will be the same pattern of university examination. The period for sessional examinations of academic year are as follows:
   - First Sessional Exam : November
   - Second Sessional Exam : February
   - Model Exam : May / June

4. Each student should maintain a logbook and record the procedures they do and the work patterns they are undergoing. It shall be based on periodical assessment, evaluation of student assignment, preparation for seminar, clinical case presentation, assessment of candidate’s performance in the sessional examinations, routine clinical works, logbook and record keeping etc.

5. Day to day assessment will be given importance during internal assessment, Weightage for internal assessment shall be 20% of the total marks in each subject.

6. Third sessional examinations (model exam) shall be held three to four weeks prior to the University Examination and the report shall be made avail-
able to the Principal ten days prior to the commencement of the university examination.

III.3. University Examinations:

- University Examination shall be conducted at the end of every academic year. A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.
- One academic year will be twelve months including the days of the University Examination. Year will be counted from the date of commencement of classes which will include the inauguration day.
- The minimum pass marks for internal assessment is 50% and for the University Examination is 50%. The student should score a total of 50% (adding the internal and external examination) to pass in each subject (separately for theory and practical).
- If a candidate fails in either theory or practical paper, he/she has to reappear for both the papers (theory and practical).
- Maximum number of attempts permitted for each paper is five (5) including the first attempt.
- The maximum period to complete the course shall not exceed 6 years.
- All practical examinations will be conducted in the respective clinical areas.
- Number of candidates for practical examination should be maximum 12 to 15 per day.
- One internal and external examiner will jointly conduct the theory evaluation and practical examination for each student during the final year.

III.4. Eligibility to appear University Examination:

A student who has secured 50% marks for Internal Assessment is qualified to appear for University Examination provided he/she satisfies percentage of attendance requirement as already mentioned at the III (1).

III.5. Valuation of Theory – Revaluation Papers:

1. Valuation work will be undertaken by the examiners in the premises of the Examination Control Division in the Health Sciences Campus.
2. There will be Re-Valuation for all the University Examinations. Fees for revaluation will be decided by the Principal from time to time.
3. Application for revaluation should be submitted within 10 (ten) days from the date of result of examination declared and it should be submitted to the office with payment of fees as decided by the Principal.
III.6. Supplementary Examinations:

Every main University examination will be followed by a supplementary examination which will normally be held within four to six months from the date of completion of the regular examination.

As stipulated under clause No. III.2 under Internal Assessment, HOD will hold an internal examination three to four weeks prior to the date of the University Examination. Marks secured in the said examination or the ones secured in the internal examination held prior to the earlier University Examination whichever is more only will be taken for the purpose of internal assessment. HODs will send such details to the Principal ten days prior to the date of commencement of University Examination.

Same attendance and internal marks of the main examination will be considered for the supplementary examination, unless the HOD furnishes fresh internal marks and attendance after conducting fresh examination.

Students who have not passed / cleared any subjects in the first University Examination will be permitted to attend the second year classes and also eligible to appear for second year University Examination along with first year supplementary examination. However, he / she can appear for the third (final) year university examination, only if he / she clear all the subjects in the first as well as in the second year examinations.

Students of supplementary batches are expected to prepare themselves for the University Examinations. No extra coaching is expected to be provided by the Institution. In case at any time the Institution has to provide extra coaching, students will be required to pay fees as fixed by the Principal for the said coaching.

III.7. Rules regarding carryover subjects:

A candidate will not be permitted to continue the second and third year respectively of the course if he/she has failed in more than 3 subjects in the first or second year university examinations.

IV. Criteria for Pass in University Examination - Regulations:

IV.1. **Eligibility criteria for pass in University Examination:**

In each of the subjects, a candidate must obtain 50% in aggregate for a pass and the details are as follows:
- A separate minimum of 50% for Internal Assessment.
- 50% in Theory & 50% in Viva.
- A separate minimum of 50% in aggregate for Practical / Clinics (University Examinations).
- Overall 50% is the minimum pass in subject aggregate (University Theory + Viva + Practicals + Internal Assessment).
IV.2. Evaluation and Grade:

1. Minimum mark for pass shall be 50% in each of the theory and practical papers separately (including internal assessment) in all subjects except English.

2. A candidate who passes the examination in all subjects with an aggregate of 50% marks and above but less than 65% shall be declared to have passed the examination in the second class.

3. A candidate who passes the examination in all subjects in the first attempt obtaining not less than 65% of the aggregate marks for all the three years shall be declared to have passed the examination with First Class.

4. A candidate who secures an aggregate of 75% or above marks is awarded distinction. A candidate who secures not less than 75% marks in any subject will be deemed to have passed the subject with distinction in that subject provided he / she passes the whole examination in the first attempt.

5. A candidate who takes more than one attempt in any subject and pass subsequently shall be ranked only in pass class.

6. A candidate passing the entire course is placed in Second class / First class / Distinction based on the cumulative percentage of the aggregate marks of all the subjects in the I, II and III (Final) university examinations.

7. Rank in the examination: Aggregate marks of all three year regular examinations will be considered for awarding rank for the B.Sc Graduate Examination.

V. General considerations and teaching / learning approach:

There must be enough opportunities to be provided for self learning. The methods and techniques that would ensure this must become a part of teaching-learning process.

Proper records of the work should be maintained which will form the basis for the student’s assessment and should be available to any agency that is required to do statutory inspection of the school of the course.

The students will be posted in Amrita Institute of Medical Sciences, Kochi and Amrita Institute of Medical Sciences, Faridabad, if necessary, during third / final year.

VI. Project:

Each student should submit a project in consultation with HOD and guidance under Project Guide, 3 months prior to their final year university exam. The student will be eligible to appear for the final year examination only after submission of the project.

VII. Maintenance of Log Book

- Every graduate student shall maintain a record of skills he/she has acquired during the training period certified by the various Heads of Departments/Program Coordinator under whom he/she has undergone training.

- In addition, the Head of the Department shall involve their graduate students in Seminars, Journal Club, Group Discussions and participation in Clinical, Clinical-Pathological meetings.
- The Head of the Departments/Program coordinator shall scrutinize the log-book in every month.

- At the end of the course, the student should summarize the contents and get the log book certified by the Head of the Department.

The log book should be submitted at the time of practical examination for the scrutiny of the Board of Examiners.
Part II
Syllabus
INTRODUCTION AND ADVANCEMENT

The branch of allied health field known as Radiological Technology deals with the use of sophisticated technology in medical imaging and cancer treatment. It has various sub specialties such as Radiology, Radiotherapy & Nuclear medicine.

Radiotherapy - deals with the use of ionizing radiation as part of cancer treatment.

Diagnostic Radiology – deals with the imaging of internal organs, bones, cavities and foreign objects with the use of plain X-ray, CT & MRI also includes cardiovascular imaging and interventional radiology.

Nuclear Medicine – this uses radioactive isotopes which can be administered to examine how the body and the organs function and also to detect abnormal areas in different organs. Certain radioactive isotopes can be administered to treat certain cancers such as thyroid cancer.

A Radiological technologist also known as medical radiation technologist or Radiographer performs the following duties

- Imaging of human body using advanced imaging technology such as Magnetic resonance imaging (MRI), Computed tomography (CT), Ultrasonography (USG), Nuclear medicine, Digital & conventional radiography (X-ray) for diagnostic purpose.
- Exposing patient’s body to various types of ionizing radiation by using equipments such as linear accelerators (Linac) Cobalt-60 teletherapy unit Brachytherapy (HDR, MDR, LDR) units for treatment of cancer.

Students of this program are taught Human Anatomy, Physiology, Biochemistry, General physics & electronics, Atomic & nuclear physics, Mathematics, Pathology, Community medicine, Radio diagnosis, Radiation Oncology and Radiation Physics.

In Amrita Institute of Medical Sciences, Departments of Radiology & Radiation Oncology are jointly conducting BSc.MRT program from 2005.

The department of radiology has all kinds of advanced imaging equipments such as

1. Five X-ray machines(GE Tejus Digital Radiography, Prognosis DR System & Siemens Multiphlos 10) and four portable X-ray units(Siemens multimobilite 300MA, Siemens Multiphlos 100 MA & Shimadzu Mobileart) with three CR processors (Fuji FR prefect CS, Fuji FCR XG I & Fuji FCR Capsula Excel II) & Two film processors [Kodak Dryview 8900& Promax X-ray film processor(wet processor)].
2. Mammography unit (Siemens Mammoth 3000 Nova) for imaging of breast lesions.
3. C-arm (Siemens Axion Artis Zee 1000MA) for interventional & angiographic procedures.
4. Fluoroscopy equipment(Siemens Siereskop 1000MA) for special radiographic procedures.
5. Two MRI(Magnetic Resonance imaging)machines (siemens Magnetom Symphony 1.5 T & GE Signa HDX XT).
6. Three CT(Computed Tomography) machines( Siemens Somatom Emotion 16 slice, GE discovery Pet-CT 8 slice & Siemens cardiac sensation 64).
7. Six Doppler /Ultrasound Machines (Siemens Sonoline G 40,Siemens Acuson Antares, Siemens Sonoline Antares, Aloka alpha 7 ,Siemens adara & Sonosite).

The department of Radiation oncology is well equipped with:

- Three linear accelerators(Electa Precise & Synergy) with triple photon energies(4MV,6MV &15 MV),set of electron energies(4,6,8,10,12 & 15 MeV) and EPID.
- Steriotactic RadioSurgery(SRS) & Steriotactic Radiotherapy(SRT) (3D Line system) with micro MLC for treatment of intracranial lesions.
- CT Simulator (Siemens-Somat Emotion) with lasers system for precise patient set up.
- Computerized treatment-planning system (CMS XIO) with CT/MRI/PET fusion and image contouring for both CT- based 3-Dimensional and Intensity Modulated Radiation Treatment (IMRT) planning.
- Nucletron Simulix Evolution Simulator with Amorphous Silicon EPID for simulation and verification.
- High dose rate (HDR) Brachytherapy (Nucletron-micro Selectron) after loader together with a CT/MRI based treatment planning system for intraluminal, interstitial and intracavitary brachytherapy of a variety of disease sites including head and neck, lung, esophagus, cervix and breast.
- Mould room for designing customized Cerrobend blocks for individual patients & individual immobilization devices.

The department of Nuclear Medicine has:

1. Two Gamma cameras, Siemens SYMBIA E (SPECT) variable angle gamma camera for all routine nuclear medicine procedures & GE Infinia Hawkeye 4(SPECT CT) for all routine Nuclear Medicine procedures, Low dose Ct correlation & attenuation correction.
2. PET – CT (Discovery STE 8 slice ) for oncology applications , Cardiac & Neurology PET Scans with high quality CT Correlation & also performs standalone CT procedures.

The students receive training in all these equipments and at the end of the course they will be able to Carry out independently all routine good quality radiographic procedures. Operate all advanced imaging equipments such as CT, MRI, Mammography, SPECT &PET. Assist radiologists in all special investigations. Execute all routine therapeutic procedures in radiation oncology using linear accelerators, & Brachytherapy units including simulations using conventional X-ray simulator & CT simulator as per prescription of Radiation oncologists & under the direction of Medical physicists. Operate and assist in maintenance & quality assurance of all equipments used in diagnostic & therapeutic procedures.
Scope & career options

Nowadays a plenty of job opportunities are being created in the field of radiological technology. A large number of hospitals started installing advanced imaging & therapeutic equipments & there will be an increased need of radiological technologists in the coming years in India and abroad.

After the completion of the course candidates can work as:

11. Radiological technologist  
12. Radiotherapy technologist  
13. Nuclear medicine technologist  
14. Clinical Application specialist

They have excellent overseas job opportunities and for those interested in higher studies various postgraduate courses are available in India or abroad.

MAIN OBJECTIVES OF THE COURSE

At the end of the course the candidate should be:

1. Able to independently do routine, good quality radiographic procedures.  
2. Able to assist in special investigations under the guidance of specialists in diagnostic radiology.  
3. Able to execute all routine therapeutic procedures in Radiation Oncology, using Linear Accelerator and Cobalt Tele-therapy and Brachy-therapy, including simulations using conventional X-ray Simulators and CT Simulators, as per prescription of Radiation oncologists and direction of Medical Physicists.  
4. Able to operate and assist in the maintenance and quality assurance of all equipment used in Diagnostic and Therapeutic procedures

PROGRAM STRUCTURE

The undergraduate program is a Four-year full time degree that provides education in all areas of Medical Application of Radiation, with emphasis in Diagnostic Imaging and Radiation Oncology.

First Year:  
Students undertake a series of courses in subjects designed to provide them with an introductory understanding of the application of all Medical Radiation disciplines in Clinical Medicine.

The courses studied include:

1. Anatomy and Histology-  
2. Physiology and Bio chemistry  
3. Basic Radiation Physics  
4. Atomic and Nuclear Physics
6. General Subjects - Psychology

**Second Year:**
In this year, students continue to study a mix of both general and core courses. The syllabus studied is designed to provide students with a more in-depth understanding of practice in radiological technology.

Courses studied in second year include:
1. Regional and Imaging Anatomy
2. Radio diagnosis - I
3. Radiation Oncology - I
4. Radiation Physics - I
5. Pathology, dietetics, sociology and community health
6. Clinical posting

**Third Year:**
In the third year of the program, the students continue to study general and core courses. The third year content is designed to allow students the opportunity to develop knowledge and understanding of more complex and advanced procedures within their specialty.

During the third year, the students will have the opportunity to participate in interdisciplinary lectures, tutorials and group-based activities, designed to develop an understanding of the interdisciplinary nature of Medical Radiations as experienced in the workplace by patients, professionals and the community.

Courses studied in third year include:
- Radio diagnosis II
- Radiation Oncology II
- Radiation Physics II
- Nuclear Medicine and Radiation Safety
- Clinical posting; lectures, seminars and symposia

**Fourth Year:**

**Practical training:**
Six months practical training in the Department of Radiation Oncology and Six months practical training in the Department of radio-diagnosis.

**Project work:**
The candidates are required to complete a project work in the field of their choice: Radio Diagnosis or Radiation Oncology.
## Distribution of Teaching Hours

### First Year

<table>
<thead>
<tr>
<th>SI No:</th>
<th>Subject</th>
<th>Theory (hours)</th>
<th>Demonstration (hours)</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anatomy &amp; Histology</td>
<td>80</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Physiology &amp; Biochemistry</td>
<td>100</td>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>Basic Radiation Physics</td>
<td>200</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>4</td>
<td>Atomic and Radiation Physics</td>
<td>200</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>Mathematics and Computer Applications</td>
<td>200</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>6</td>
<td>Psychology</td>
<td>200</td>
<td>-</td>
<td>200</td>
</tr>
<tr>
<td>7</td>
<td>Clinical Observation/Seminar &amp; Symposium</td>
<td>-</td>
<td>-</td>
<td>330</td>
</tr>
</tbody>
</table>

**Total Hours**: 1440

### Second Year

<table>
<thead>
<tr>
<th>SI No:</th>
<th>Subject</th>
<th>Theory (hours)</th>
<th>Demonstration (hours)</th>
<th>Total Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regional and Imaging Anatomy</td>
<td>160</td>
<td>40</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>Radio Diagnosis I</td>
<td>160</td>
<td>40</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>Radiation Oncology I</td>
<td>160</td>
<td>40</td>
<td>200</td>
</tr>
<tr>
<td>4</td>
<td>Radiation Physics</td>
<td>160</td>
<td>40</td>
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</tr>
<tr>
<td>5</td>
<td>Pathology and Community Health</td>
<td>100</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Clinical Observation /Seminar and Symposium</td>
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**Total Hours**: 1440

### Third Year

<table>
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<th>SI No:</th>
<th>Subject</th>
<th>Theory (hours)</th>
<th>Demonstration (hours)</th>
<th>Total Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>Radio Diagnosis - II</td>
<td>180</td>
<td>40</td>
<td>220</td>
</tr>
<tr>
<td>2</td>
<td>Radiation Oncology - II</td>
<td>180</td>
<td>40</td>
<td>220</td>
</tr>
<tr>
<td>3</td>
<td>Radiation Physics - II</td>
<td>180</td>
<td>40</td>
<td>220</td>
</tr>
<tr>
<td>4</td>
<td>Nuclear Medicine and Radiation Safety</td>
<td>180</td>
<td>40</td>
<td>220</td>
</tr>
<tr>
<td>5</td>
<td>Clinical Observation /Seminar and Symposium</td>
<td>-</td>
<td>-</td>
<td>560</td>
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</tbody>
</table>

**Total Hours**: 1440

### Fourth Year

In the fourth year there will be clinical postings in the departments of radiation oncology and radio diagnosis of the Amrita Medical Institutions and other participating Medical Institutions. The project work will proceed along with the clinical posting.

**Posting and Project work**: 1440 hours
**First Year – Paper I**

**Anatomy & Histology**

Time allotted: 100 hrs  
Theory: 80 hrs.  
Demonstration: 20 hrs.

**AIM:** The student identifies the concepts and facts of human anatomy and histology to facilitate learning physiology and related clinical subjects and shows beginning ability to apply these in giving comprehensive proper care.

<table>
<thead>
<tr>
<th>Content</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit I</strong> Introduction and orientation to the course</td>
<td>Demonstration of cavities and contents of a cadaver;</td>
</tr>
</tbody>
</table>
| **Unit II** Body as an integrated whole  
Organization of the body  
cells, tissues, organs, systems | Cell tissues, Membranes & glands. Basic knowledge preparation of slides of Tissues |

**Unit III** Musculoskeletal system

<table>
<thead>
<tr>
<th>Content</th>
<th>Laboratory</th>
</tr>
</thead>
</table>
| Bones:  
Classification;  
Development of bones  
Gross and microscopic Structure of Bones, Classification and structure of cartilage  
Development, and detailed study Of the structure of individual bones separately | Histology of bones and cartilages  
Demonstration and examination of individual bones |
Osteology

a) Bones

- **Cranial bones:**
  - Frontal Bone
  - Parietal Bone (2)
  - Temporal Bone (2)
  - Occipital Bone
  - Sphenoid Bone
  - Ethmoid Bone

- **Facial bones:**
  - Zygomatic Bone (2)
  - Maxilla
  - Nasal Bone (2)
  - Mandible
  - Palatine Bone (2)
  - Lacrimal Bone (2)
  - Vomer Bone
  - Inferior Nasal Conchae (2)

- **In the middle ears (6):**
  - Malleus (2)
  - Incus (2)
  - Stapes (2)

- **In the throat (1):**
  - Hyoid bone

- **In the shoulder girdle (4):**
  - clavicle or collarbone (2)
  - scapula or shoulder blade (2)

- **In the thorax (25):**
  - Sternum
  - Ribs (2 x 12)

- **In the vertebral column (26):**
  2. Thoracic Vertebrae (12)
  3. Lumbar Vertebrae (5)
  4. Sacrum
  5. Coccyx
In the arms (6):

1. Humerus (2)
2. Condyles Of Humerus
3. Ulna (2)
4. Radius (2)
5. Head Of Radius

In the hands (54):

7. Wrist (carpal) bones:

   Scaphoid Bone (2)
   Lunate Bone (2)
   Triquetrum Bone (2)
   Pisiform Bone (2)
   Trapezium (Bone) (2)
   Trapezoid Bone (2)
   Capitate Bone (2)
   Hamate Bone (2)

8. Palm or metacarpal bones:

   • Metacarpal Bones (5 × 2)

9. Finger bones or phalanges:

   Proximal Phalanges (5 × 2)
   Intermediate Phalanges (4 × 2)
   Distal Phalanges (5 × 2)

In the pelvis (2):

a) Pelvis (2)

In the legs (8):

• femur (2)
  – hip joint (joint, not bone) (2)
  – greater trochanter of femur
  – condyles of femur

• patella (2)
• tibia (2)
• fibula (2)
In the feet (52):

- **Ankle (tarsal) bones:**
  - Calcaneus (Heel Bone) (2)
  - Talus (2)
  - Navicular Bone (2)
  - Medial Cuneiform Bone (2)
  - Intermediate Cuneiform Bone (2)
  - Lateral Cuneiform Bone (2)
  - Cuboidal Bone (2)

- **Instep bones:**
  - Metatarsal bone (5 × 2)

- **Toe bones:**
  1. Proximal Phalanges (5 × 2)
  2. Intermediate Phalanges (4 × 2)
  3. Distal Phalanges (5 × 2)

**Joints:**

Examination of
Formulation and structure of joints
Classification;
Human cadaver – study gross structure of muscles
Major skeletal muscles

**Unit IV Other Major Organ Systems**

- **Broad outline of the circulatory system**
  Gross structure of the heart
  - The Heart structure and major blood vessels
  - Major Arteries and its branches
  - Major Veins and its tributaries
  - Major Lymph node groups and their
  - Lymphatic Drainage

- **Organs of respiration;**
  Gross structure of Respiratory tract,
  - Larynx, Trachea respiratory tract
  - Bronchus lungs, pleura, Thoracic wall
  - Thorax, Lungs and Diaphragm

- **Structure and organization of Digestive system**
  Gross structure of
  - Oral cavity, pharynx, esophagus, stomach;
  - Small intestine, large intestine, Rectum, large intestine, Rectum, pancreas, liver, biliary tract and gall bladder, liver, Spleen.
Urinary System
Gross structure of
Kidney, Ureter, Bladder, Urethra Kidney, Ureter, Bladder, Urethra

e) Reproductive system
Male - Testes, Seminal vesicle, prostate, penis
Gross structure of Testes
Female - Ovary, Fallopian tube, uterus, Cervix, prostate, penis, Ovary,
vagina, Vulva Fallopian tube, uterus
Structure of the breast Cervix, breast

f) Nervous system:
- Spinal cord
- Coverings of the brain,
- Dural structures, meninges, arachnoid,
- Gross Structure of the brain
- Gross structure brain
- Ventricle system, CSF
- Blood supply of brain - carotid artery,
- Vertebral artery, circle of willis
- Cerebral arteries
- Pituitary, hypothalamus
- Basal ganglia, thalamus
- White Matter Corpus callosum, internal capsule
- Brain stem- midbrain, pons, medulla
- Cerebellum
- Organs of Special senses
  Eye Demonstration of the
  Ear structure of the eye and ear
  Skin Tongue
  Tongue Nose
  Nose

Reference:
- Tortora Grabowski, Principles of Anatomy and Physiology, 8th edn., Haifer Collins.
- Kimber & Gray, Text Book of Anatomy & Physiology, C.B. Mosby, St. Louis.
- Millard et al., Human Anatomy and Physiology, W.B. Saunders Company, Philadelphia.
- Bajpai, R.N., human Histology, Jaypee Brothers Medical Phublishers, P.B. 7193, Ansari Road, New Delhi.
### Paper II

**Physiology and Biochemistry**

Time allotted: Theory : 100 hrs.  
Demonstration : 10 hrs.

**Part I - Physiology**

Physiology : 90 hrs  
Theory : 80 hrs.  
Demonstration : 10 hrs.

**AIM:** The student identifies the concepts and principles of physiology of human body and applies these in giving comprehensive care to the patients.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit I</td>
<td>Cell, Tissue, glands.</td>
</tr>
<tr>
<td>Unit II</td>
<td>Blood tissue, Fluid and Lymph</td>
</tr>
<tr>
<td></td>
<td>Functions of blood, Composition of blood</td>
</tr>
<tr>
<td></td>
<td>Demonstration of different cells, plasma protein-concentration, functions, PCV, Viscosity.</td>
</tr>
<tr>
<td></td>
<td>WBC Count variations, Agranulocytosis:</td>
</tr>
<tr>
<td></td>
<td>Platelets, Coagulation of Blood, Anticoagulants.</td>
</tr>
</tbody>
</table>
Body fluids –
Lymphatic Systems
Hemorrhagic disorders
Blood groups: Rh
Transfusion Reactions

Blood grouping and cross matching

Unit III
Man as a moving organism,
physiology of muscle contraction,
physiology of neuromuscular junction

Unit IV
Cardiovascular system,
Physiological anatomy of
Heart and blood vessels,
Structure and properties of

<table>
<thead>
<tr>
<th>Theory</th>
<th>Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit V</td>
<td></td>
</tr>
<tr>
<td>Respiratory system</td>
<td>Pulmonary function</td>
</tr>
<tr>
<td>Physiological anatomy, Mechanism of Respiration, Lung volumes and capacities, Pulmonary and alveolar Respiration, Exchange of gases. Transport of gases, Hypoxia, Cyanosis, Respiratory patterns- Variations, abnormal patterns, Artificial respiration.</td>
<td>test, spirometry, vital capacity</td>
</tr>
<tr>
<td>Unit VI</td>
<td></td>
</tr>
<tr>
<td>Digestive system</td>
<td></td>
</tr>
<tr>
<td>Physiological anatomy, Digestion in the mouth. Deglutition, Digestion in the stomach, gastric movements. Digestion in the intestine, Pancreatic Juice, Bile, liver, gall bladder &amp; Biliary system, Large intestine, intestinal juice</td>
<td></td>
</tr>
</tbody>
</table>
Movement of intestine, Absorption of carbohydrates, proteins, fat, water, etc.

Unit VII
Endocrine System
Endocrine glands- Pituitary, Thyroid, Adrenal, Parathyroid, Endocrine part of Pancreas, Thymus
Gland, Function, Secretion Disorders, Prostate gland, sex hormone.

Unit VIII
Reproductive System – gonads
Male: Vas deference- significance of Vasectomy, Spermatogenesis- stages, factors influencing,
Female: Ovary, puberty, menstruation, Placental hormones, Foetal circulation changes at birth, lactation.

Unit IX
Excretory system
Functions of Kidney
Formation of urine, Acid base balance: Renal Function Test Impaired renal function, glomerular filtration, tubular reabsorption, secretion.
Skin functions

Unit X
Nervous System
Neuron Receptors, Spinal cord, Reflex action, Sensory pathways, Motor system – cerebral Cortex and hemispheres, Cerebrospinal fluid, Autonomic nervous system, Cerebral circulation

Unit XI
Special Senses
Physiology of vision, Abnormalities of vision Refractive errors, Physiology of Hearing, Hearing impairment Nose - olfaction, Tongue-gustation Skin- Tactile

Part II  BIOCHEMISTRY - 20 hrs.
Unit I
Human cell protoplasm, Chemistry of Protoplasm, Osmosis, diffusion, filtration, dialysis

Unit II
Man’s internal environment Homeostasis- Meaning, Maintenance, Blood Chemistry, Coagulation of Blood, Plasmolysis, Reaction of blood, Acidosis, Alkalosis.
Unit III
Chemistry of food.
Definition, composition, classification, functions and
Elementary chemistry of carbohydrates, lipids, proteins,
and vitamins, Minerals- Requirements, Functions, deficiency-symptoms. Enzymes- definition, classifications, factors affecting enzyme reaction.

Unit IV
Biochemical investigations
Fractional Test meal, Augmented Histamine test,
Liver function test, Blood tests for sugar, urea and
Electrolytes
Arterial blood gas analysis
Urine analysis:- Sugar
Albumin
Acetone
Bile
C.S.F. Analysis

Unit V
Clinical Biochemistry
Inborn errors of metabolism

References:
- Text Book of Biochemistry (for medical students), 4th Edition
  Dr. D.M. Vasudevan and S. Sreekumari; Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.
- Chatterjee C.C, Human physiology, Vol. I & II, Medical allied agencies, Calcutta
- Gyton, Text Bood of Medical Physiology, 9th edn. W.B. Saunders, Philadelphia
- Chodhari, Concise Medical Physiology 9th edn. W.B. Saunders, Philadelphia
- Mahapatra Choudhari, Text Book of Physiology S. Chand & Co.

Paper III
BASIC RADIATION PHYSICS

Time allotted: Theory : 200 hrs.
SECTION: I
Properties of radiation:
Radiation – dual nature – different types – ionizing and non-ionizing – directly & indirectly ionizing – Exponential law of attenuation – attenuation coefficients (Mass, electronic and atomic) - HVL & TVL and relation between them – Narrow and Broad beams
Interaction of ionizing radiation with matter:
Interaction of charged particles - In-elastic collision with atomic electron and nucleus – elastic collision with atomic electron and nucleus- interaction of heavy charged particles – Bragg curve – LET

Radiation quantities and units:
- Properties of Radiation field – concepts of point source – divergence and inverse square law - stochastic and non-stochastic quantities flux – fluence – planar

Measurement of ionizing radiation:

Paper IV

Atomic And Nuclear Physics
Time allotted: Theory : 200 hrs.

- Discovery of Cathode rays, nature and properties, e/m- Thomson’s method, charge on the electron, Millikan’s experiment.
- positive rays, isotopic constitution of matter, Aston’s mass spectrograph.
- Structure of atom- Thomson’s model, Rutherford Nuclear atom model, Bohr’s theory of hydrogen atom, critical potential Excitation- potential, Limitations of Bohr’s theory, Ritz combination principle, Sommerfeld’s modification- elliptical orbits- relativistic correction.
  Vector atom model- Quantum numbers, coupling schemes, Pauli’s exclusion principle, Bohr magneton, Electronic configuration- periodic classification, Larmor precession, Zeeman effect (qualitative).
- Quantum Physics- Photoelectric effect, Laws of Photo - electric emission, Einstein’s theory, Millikan’s verification of Einstein’s equation.
  Matter Waves- De- Broglies theory (qualitative), phase and group velocities, uncertainty principle.
  - Atomic Nucleus- general properties, Binding energy, packing fraction, Nuclear forces, general ideas on meson theory.
  - Radioactivity – Natural and artificial radioactivity, nature of radioactivity, Law of radioactive disintegration, half life and mean life, radio active series, Law of successive disintegration, radio active equilibrium, unit of radioactive strength.
  Gamma ray spectra absorption by matter, pair production, conversion electrons, electron capture, Auger electrons.
Nuclear reactions- (Alpha, P), (alpha, n) reactions, proton bombardment, neutron bombardment, deuteron bombardment, fission, fusion, Q values, Nuclear Reactors, production of isotopes, Nuclear isomerism.

- Elementary particles and Cosmic rays.

**Paper V**

**MATHEMATICS AND BASIC COMPUTER APPLICATIONS**

Time allotted: Theory : 200 hrs.
Demonstration : 100 hrs.

**Part I – MATHEMATICS**

1 **ALGEBRA**

Laws of indices, Logarithm, Exponential, Logarithm series, Progression, Permutation and combination, Matrices- sum, product and transpose of matrices, 2 x 2 & 3 x 3 determinants, Use of theorems in evaluation, Cramer’s Rules, Partial fractions, Mathematical induction, Binomial expansion 

\[(1 + x)^n \text{ & } (1 - x)^n\] for all n.

2 **TRIGONOMETRY**

Measurement of angles, Trigonometric ratios, Relations connecting complementary & supplementary angles, ratios of compound angles Product formula, Multiple & sub multiple angles, Areas of triangle, Relations between sides & angles of a triangle, Trigonometric equations, inverse trigonometric functions.

3 **CALCULUS**

Functions and Limits, Differentiation, Rules of differentiation, sum, difference, Product and quotient formulae, function of a function rule, Differentiations of inverse trigonometric functions parametric functions, Implicit functions, Logarithmic differentiation. Higher order derivatives and partial differentiation Integration: Methods of integration, Integration by substitution, Integration by parts, Definite integral and its properties.

- **STATISTICS**

Calculation of mean, median, mode, standard deviation, mean deviation, variance, coefficient of variation, calculation of correlation coefficient, regression analysis, concept of probability, calculation of probability in a discrete sample space, Binomial, Poisson and Normal Distribution, Simple problems.

- **GENERAL IDEAS** (This section is not for University Exam). There will be only internal evaluation.


**Part II - BASIC COMPUTER APPLICATIONS**

Explore computer terminology, computer parts, the importance and convenience of computers, basic organization on the computer and other important functions, different software programs, and learn to create, save, and print files.
Navigation in Windows, understanding and operating the program, copying/moving and managing files with Explorer.

Microsoft Word: word processing, creation of many types of business and personal communications. Students learn to create, edit, save and print documents, move and copy text and use automatic features.

Power point: create, edit, play, print and save presentations, use WordArt, clip art, and objects, slide outlines, create charts, tables, organization charts, and add multimedia elements, color schemes and templates.

Excel: create, modify, format, and print worksheets; work with basic formulas and functions; use multiple worksheets; enhance worksheets; use AutoFormats; and work with charts, work with advanced functions and formatting features, locate and update data, use special format and print options, protect worksheet data, manipulate the screen display, share worksheet data, use automation, and share workbooks, components of Excel such as sorting, functions, filters, and automated features. Using and modifying pivot tables, using advanced data analysis to audit worksheets, working with scenarios, and creating reports.

Access: design basic databases and work with objects, create and work with table information, and select queries, create, use, and enhance forms and reports, charts, filters, and relationships; maintain data integrity; and use advanced form features, use macros, and advanced report and query features, design applications, create advanced controls and dialog boxes, use of macros, work with custom tool bars, create custom menus and short cuts, and create custom switchboards.

Fundamental Internet concepts, navigating and searching the Web, revisiting sites, and using Web integration and Active Desktop features, customizing the browser, using e-mail and newsgroups

**Paper VI**

**General Subjects – Special English, Health Education, And General Psychology**

Time allotted: Theory : 200 hrs.

**Part I - Special English - English for Medical Sciences**

Students of professional courses have a tendency to neglect the language content. The paper “English for Special Purposes” is introduced with a view to developing the communication skills of the participants in written and spoken English. The emphasis will be fully on the practical aspects of language use, and not on literature.
Writing skills (15 hours)

**Composition:**
Writing effective paragraphs - ability to describe objects, people, process and ideas and narrating incidents - note taking/ making summaries. Writing telegrams, advertisements. Preparing laboratory reports.

**Letter writing:**
Business letters - applying for a job, for higher studies- preparing curriculum vitae - subscribing to a journal – requesting for information- ordering equipments- Letters to the Editor.

Foundation English (10 Hours)
Revision of basic grammar; common errors in English. Language functions in medical writing- use of passive voice particularly in scientific and official writing, expressing obligation use of must, should, ought; expressions of possibility, likelihood, certainty, degrees of expression of generalizations and emphasis.

Vocabulary: (5 hrs)

Spoken English
A course in speech and conversation with focus not on phonetics and grammar, but on developing their ability to talk about objects and experienced around them.

Fixing appointments- Getting information- Managing medical representative- Telephoning in a hospital: The objective is to provide practice in fluent conversation. Focus is on specific expressions typical of familiar situations in medical practice. Techniques of discussion at medical meetings, making presentation at workshop or conference.

Recommended Reading:

**Part II - Health Education**

- Health education – philosophy, main principles and objectives, health education versus health legislation; education versus propaganda.
- Review of beliefs, values, norms, habits and taboos among practices. Mores in human groups and their importance in learning and change process.
- Principles and process of communication.
- Methods and tools of health education: Individual and group methods. A critical evaluation of the theories and tools and health education.
- The role of professional health education; role of other personnel in health education, co-ordination and co-operation in health education with other members of health team.
  Elements of planning, implementation and evaluation of a health education programme

4. **PSYCHOLOGY**

- **Introduction to Psychology**

- **Stress Coping and Subjective Wellbeing**
  Nature and sources of stress
  Types of stress – Pressure, Conflicts, and Frustration
  Stress and Health
  Coping with Stress
  Coping Strategies – Functional and Dysfunctional Wellbeing – Definition and determinants

- **Counseling**
  Principles
  Effective counseling
  Counseling terminally ill
  Counseling the relatives

- **Communication**
  Process of communication
  Listening
  Nonverbal Communication
  Effective interpersonal communication

- **Basic Psychotherapies**
  Anxiety management
  Basics of Solution focused brief therapy

- **Mental Health and mental illness**
  Overview of mental health - concepts, characteristics of mentally healthy person, Warning signs of poor mental health Psychosocial impact and consequences of cancer diagnosis and consequences

**References:**
- Razeena Viswambaran (IMS) Text Book of Psychology for Health Professionals.
Second Year - Paper VII

Regional and Imaging Anatomy

Time allotted: Theory: 160 hrs.
Demonstration: 40 hrs.

The anatomical relationships of bones, organs, blood vessels, nerves and muscles. The unit will address in turn the general anatomy of the head and neck including the brain, the thorax, the abdomen, the pelvis, the vertebral column and spinal cord, the upper and lower extremities and their associated articulations. Each topic will include consideration of osseous, muscular and vascular components, nerves and viscera. The related sectional anatomy in transverse, sagittal and coronal planes will be addressed utilizing contemporary 3D medical imaging.

- Upper Limb: relevant osteology; regional anatomy of the shoulder, axilla, arm, forearm, and wrist; detailed plain radiographic anatomy of skeletal mature and skeletal immature individuals

- Lower Limb: relevant osteology; regional anatomy of the hip, thigh, leg and foot regions; detailed plain radiographic anatomy of skeletal mature and skeletal immature individuals

- Head and Neck: relevant osteology of the skull and cervical spine; regional anatomy of the mouth, nasal cavities, pharynx, and structures of the neck, brain and its blood supply

- Regional anatomy of the thorax: relevant osteology; thoracic wall, lungs and pleura, and the mediastinum

- Imaging anatomy of the thorax: plain radiographic anatomy; mammography

- Regional anatomy of the abdomen: relevant osteology, abdomen wall, peritoneum, supracolic and infracolic organs; retroperitoneum

- Regional anatomy of the pelvis and perineum: pelvic wall, male pelvic organs, female pelvic organs, contents of the male and female perineum

- Imaging anatomy of the abdomen and pelvis: plain radiographic anatomy.

- Ultrasonic anatomy: introduction to terminology; major organs and structures that can be imaged using ultrasound.

REFERENCE BOOKS
- Radiotraphic anatomy - Messchan
- Gray’s anatomy
Paper VIII

Radio-Diagnosis – I

Time allotted: Theory : 160 hrs.
Demonstration : 40 hrs.

1. Preliminary steps in Radiography
2. Radiation hazards, genetic and somatic effects
3. General anatomy and radiographic positioning terminology
4. Practical safety measures in diagnostic radiography
5. Physical principles of x-ray diagnosis
6. Radiological images, intensifying screens, fluoroscopic screens, grids, moving grid,
   radiographic cones
7. Radiographic films, single coated, double coated films
8. Various stages of film processing
9. X-ray developer, fixer, replenisher
10. Dark room construction, dark room safe light, pass box
11. Fog in x-ray film
12. Automatic x-ray film processing
13. Practical aspects in radiography of children
14. Bed side radiography, High KV Radiography, soft tissue radiography

II. (a) UPPER EXTREMITY
   Basic alternative and additional projections for special conditions of the bones and joints of the upper extremity.
   Shoulder girdle: Basic and alternatives techniques for the shoulder joint and scapula, clavicle, ACJ and SCJ.

(b) LOWER EXTREMITY
   Basic and alternative projections of the lower extremity. Toes, foot, fingers, calcaneus, subtalar joint, ankle joint leg. Knee intercondylar notch, patella femur.

(c) PELVIC GIRDLE AND HIP REGION
   Basic and alternative techniques for the whole pelvis and upper femora, pelvis and hip joints, femoral necks, acetabulum, anterior pelvic bones, ilium, spectral technique for congenital dislocation of the hip.

(d) VERTEBRAL COLUMN
   Basic and alternative techniques for the occipito cervical, articulations, Atlas and axis (Open mouth) Odontoid process cervical vertebrae, cervical intervertebral foramina, cervicothoracic region; thoracic vertebrae, lumbar- lumbosacral vertebrae, lumbo sacral junction and scaro iliac joints, sacroiliac joints and coccyx.

(e) BONY THORAX
   Techniques for sternum, sternoclavicular joints, Ribs, upper and lower.

(f) THORACIC VISCERA
   Techniques for Trachea, and pulmonary apex, chest (lungs and heart).
(g) ANTERIOR PART OF NECK: Techniques for pharynx and larynx.
(h) DIGESTIVE SYSTEM: Abdomen, gall bladder, spleen and liver.
(I) SKULL: Techniques applicable to the whole skull cranial bone, sella turcica, orbit, optic foramen, superior and inferior orbital fissure.
(j) FACIAL BONES:  
Radiographic positioning of face bone Nasal bone Zygomatic arches, maxilla, mandible, mandibular symphysis TMJ, Panoramic tomography of the mandible.
   ◦ PNS: Radiography and positioning of paranasal sinuses.
(l) TEMPORAL BONE: Radiography and techniques for the mastoid process and mastoid and petrous positions, jugular foramina

(m) Dental Radiography

**Paper IX**

**Radiation Oncology –I**

Time allotted: Theory : 160 hrs.
Demonstration : 40 hrs.

1 Cancer registry, Epidemiology and Prevention of cancer,
2 Oncopathology
3 Methods of cancer treatment
   a. Medical oncology
   b. Radiation oncology
   c. Surgical oncology
   d. Hormones in oncology
4 Radiobiologic basis of Radiotherapy
   Radiobiology: Direct and indirect effect of radiation, cell survival curves, linear energy transfer (LET), oxygen effect, cell cycle, radio sensitivity of normal and tumor cells;
   Radiation response of various tumors, normal tissue tolerance, radio resistance, the 4 R’s of radiotherapy, radiation dose and fractionation in radiotherapy, time-dose fractionation, therapeutic ratio, radiation response modifiers, radiobiological effects in radiosurgery.

Cancers of various sites
- Skin cancers: squamous cell carcinoma, basal cell carcinoma, malignant melanoma, skin appendage tumors
- Head and neck tumors: oral cavity, nasal cavity and para nasal sinuses, naso pharynx, oro pharynx, laryngo pharynx, larynx, salivary glands, ears
- Thoracic tumors: lung, esophagus, thymus
- Gastrointestinal tumors: stomach pancreas, liver, gall bladder, colon, rectum anal canal
- Urological tumors: kidney, ureter, urinary bladder, urethra
- Gynaecological cancer: uterus, ovary, cervix, vagina, vulva
- Male genital tumors : prostrate, testis, penis
- Breast Cancer
- Tumors of bone and soft tissue : osteo sarcoma, Ewing’s tumor, fibro sarcoma,
  - Lympho reticular tumors : Hodgkin’s disease, non Hodgkin’s lymphoma
- Hematological malignancies: Leukemia, multiple myeloma
- CNS tumors: gliomas, meningioma, medulloblastoma
- Cancer in children: retino blastoma, Wilm’s tumor, neuroblastoma, rhabdo myo sarcoma
- Endocrine tumors: thyroid, pituitary, adrenal
- Orbital and ocular tumors
- Metastasis of unknown primary site

**Paper X**

**Radiation Physics - I**

**SECTION: I**

X-rays:

Production and properties – Continuous and characteristic x-rays-xray spec-tra- Intensity and Quality of X-rays- Hard and Soft x-rays- Heel effect.

**SECTION: II**

X-ray Technology -1

X-ray tubes: Diagnostic and therapy tubes, Gas tubes, Collidge tube- Rotating anode tube- Line focus tube voltage – Self rectifier circuit. Half wave rectifier circuit – Full wave rectifier circuit. – Dual focus tube – Hooded anode tube- other therapy tubes (qualitative study – x-ray generators of circuits- Auto transformer- Filament transformer- Rectification of anode


**SECTION III: X-ray Technology 2**

Timers:

Synchronous, Electronic, Ionization, Photo, MAS timers

1. Pulse counting
2. Rating factors controlling rating
3. Use of rating charts
4. Accelerators

**SECTION IV**

Principles of Diagnostic Radiology:

Physical principles – Filters and Filtration – Inherent and Added Filtration – Heavy metal filter- Effect of filtration on low and high energy beams.

SECTION: V
Effects of X-rays
Fluorescence – Phosphorescence – Luminescence
X-ray Films:
Screens:
Intensifying and fluorescent screens – Actions- Intensifying factors – Screen thickness – materials used – quantum mottle (Brief) – Modulation Transfer Function (Brief)

SECTION VI: Images:

SECTION VII
New Imaging Techniques
a. Computerised Tomography
CT scanner – various generation of CT – Collimators, CT beam attenuation, linear attenuation coefficients, Hounsfield Unit, back-projection, filtered back-projection and Fourier transform. Computed tomography system components inherent in computer acquisition, processing and image display
b. Magnetic Resonance Imaging
Basic properties of the hydrogen nucleus, precession in a magnetic field (classical picture); Larmor equation; energy levels in a magnetic field; size of bulk magnetisation; effects of RF ("B1") fields; Rotating frame, free precession and signals (FIDs), principle of slice selection; importance of RF pulse profile, Gradients and 1-D profiles - frequency encoding; mention of projection-reconstruction imaging (not in detail); introduction to sequence timing diagrams.

SECTION VIII :
Special procedures

Paper XI
Pathology, And Community Health
Total time allotted :100 hrs.

PATHOLOGY 60 hrs
- Disorders of circulation
  - Thrombosis
  - Embolism
  - Infarction
  - Oedema
• Mechanism and changes in inflammation
• Detailed study of tumours
  ◦ Characteristics
  ◦ CLASSIFICATION
  ◦ Astiology & pathogenesis
  ◦ All the common benign and malignant tumors
• Common Infection
  ◦ Common acute bacterial infection
  ◦ Detailed study of tuberculosis, Leprosy, Syphilis
  ◦ Commonest fungal infection with a short account of opportunistic fungal infection
  ◦ Brief account of all viral infections including AIDS
  ◦ Common protozoa and helminthes
• Detailed study of biological effects of radiation
• Regenerative changes
  Fatty change
  Necrosis
  Gangrene
  Pathogenic calcification
• Genetic diseases
  Down’s syndrome
  Haemophilia
• Immunology
  Auto immune diseases
  Rheumatoid arthritis
  SLE
  Immuno deficiency –AIDS
• Brief study of nutritional diseases

DISEASES OF INDIVIDUAL ORGAN SYSTEMS
1. CVS
  - I H D
  - R H D
  - infective endocarditis
  - Hypertension
  - Valvular diseases

2. Lung
  - Pneumonias
  - TB
  - Asthma
  - Tumors

3. G I T
  - Oral cavity
  - Oesophageal Ca
  - Peptic Ulcer
  - Ca stomach
  - Malabsorption
  - Inflammatory Bowel diseases
  - Dysentry
  - Appendicits
- Peritonitis

4. Gall bladder - Stones
- Cholecystitis

5. Pancreas - Pancreatitis
- Stones
- Diabetis mellitus

6. Male Reproductive system - Hydrocoele
- Orchitis & Epididynitis
- Benign prostate hypertrophy
- Brief mention of tumors

7. Female Reproductive system - Cervicitis
- Ca Cx
- Ca Endometrium
- Disorders of Menstruation
- Lyomyoma
- Brief account of ovarian tumors
- Disease of pregnancy – PHT – Ectopic

8. Breast - Fibro adenoma
- Ca breast

9. Blood - Anaemias
- Leukaemia
- Bleeding disorders

10. Lymphoreticular Systems - Lymphadenitis
- Lymphomas

11. Bones - Congenital
- Osteomyilits
- Rickets osteomalacia
- Bone tumors
- Arthritis

12. Endocrine - Thyroid
- Pituitary
- Adrenal
- Parathyroid

13. Brief account of eye and ear infection

14. Skin - Psoriasis
- Eczema
- Skin tumors (Bassal, squamous
- Malignant Melanoma)

15. Kidney - Stones
- Glomerulonephritis
- Pyelonephritis
- Renal failure
- Nephrotie syndrome
- Tumors

Reference:
III. COMMUNITY MEDICINE (40 hrs)

[Recommended Text Book: Park’s textbook of Preventive & Social Medicine by K.Park]

1) General concepts of health and disease with reference to
   Natural history of disease and levels of prevention
   Determinants of health
   Epidemiology and scope
2) Role of environment in health and disease
3) Communicable diseases - an overall view of communicable diseases
   classified according to principal mode of transmission.
   Non communicable diseases.
   National Health Programmes in relation to communicable and noncommunicable diseases.
4) Health problems of vulnerable groups- Pregnant and lactating women, infants and pre-school children, Geriatrics.
5) Family Planning, Objectives of National Family Planning Programmes and Family Planning methods. A general idea of advantages and disadvantages of the methods.
6) Occupational Health- Definition, Scope, Occupational diseases, Prevention of occupational disease and hazards with special emphasis on radiation hazards and protection.
7) Mental health – Community aspects of mental health and mental health as part of Primary Health Care.
8) Health care of community – Health care delivery system including relevance of Primary Health Care.
9) Public Health Administration- overall view of the health administration set up at different levels.
10) International Health Agencies
    Park K. Park’s Text Book of Preventive and Social Medicine (latest edn), Banarasidas Banot Publishers, Jabalpur.
    Park J.E. and Park K., Text Book of Community Health for Nurse, Assam Publicaitons, Jabalpore.
    Ghosh B.N.A. Treatise in Hygiene and Public Health.
Third Year - Paper XII

Radiation Physics – II
Time allotted: Theory : 180 hrs.
Demonstration : 40 hrs
Section I

RADIOThERAPY
Principles of Radiotherapy – High energy Machines – Co 60, Cs 137, LINAC
source choice and design – Treatment head – shutter mechanism – Beam collimation
and Penumbra Beam shaping devices – Beam modification – shielding – Beam
flattening – Tissue compensators – Wedge Filters – Beam direction devices – Front
and Back pointer.

Section II
Phantoms- Functions used in dose calculation – TAR – BSF – PDD – Isodose
curve – Characteristics – Comparison of charts for beams of various energies.
Patient data acquisition – Body contours – Patient immobilization, Simulators
– Treatment simulation – Treatment verification – contour irregularities – Correction
for field shaping – Geometric separation of adjacent fields.

Section III
Treatment planning – SSD set up – isocentric set up – integral dose – Direct
beam therapy – Calculations – Opposing beam therapy – 3 field technique (qualitative)
– Rotation therapy – whole body radiation.

Section IV
Radioactive sources used – Ra, Co, Cs, I, Ir, Au- source construction and care
– Activity – Exposure rate constant – Effective Ra eq – Mg hr- Treatment planning –
surface moulds- line source – Interstitial treatment – single plane implant – 2 plane
implant – volume implant – Treatment of cancer of cervix Paterson – Parker and
Paris technique (qualitative)- after loading applicators – manual –remote.

Section V
Nuclear Medicine
Radioisotopes used – measurement of sample activity – Detection of radioac-
tivity in the body – simple collimator system – whole body counting – scanners-
Gamma Cameras.
Radiopharmaceutical – Radionuclides – Types of radiations used – Biological,
Physical and Effective half life – Specific activity – Thyroid uptake – Plasma volume –
elusion.

- Positron emission Tomography – brief

Section VI
New Imaging Techniques
a. Ultrasonography
Characteristics of ultrasound beam and propagation in human tissue. Basic principles of ultrasound imaging equipment – interaction of ultrasound energy and tissue – modes of ultrasound sound imaging – probes, transducers and Ultrasound beam shapes- B-Mode, real time, gray scale – Ultrasound imaging systems- Doppler Ultrasound – Care of instrument.

Section VII
Radiobiology


Paper XIII

Radio Diagnosis – II
Time allotted: Theory : 180 hrs.
Demonstration : 40 hrs.

Special Radiography And Imaging

• CONTRAST MEDIA
  Type of contrast agents. Strength and quantities and methods of introduction to be taught along side the appropriate subject in association with the radiographic technique.

• CNS:
  Myelography
  Ventriculography and Encephalography
  Discography
(a) Digestive System:
  Radiological anatomy, preparations of the patient for contrast examinations. Ba meal, Ba FT, Ba enema Examination procedures and Radiographic techniques.

• Biliary system:
  Radiological Anatomy, and Radiological procedures. Oral cholecystography, Intra venous choleon angiography, cholangiography, operative, post operative, percutaneous and ERCP.

1.1 Urinary system:
  Radiological Anatomy, contrast media used in urography. Excreting urography, Retrograde urography, Retrograde cystography, Female cysto urethrography, male cysto urethrography.
1.2 Reproductive system:
   Radiological Anatomy, Contrast media used in HSG Hysterosalpingography, Radiographic pelvimetry and cephalometry; vesiculography, localization of IUCD.

1.3 Circulatory System:
   Diagnostic visceral and peripheral angiography

1.4 Cardiovascular system:
   Cardiographic angiography, cathereization methods and Techniques, catheterization studies and procedures.

1.5 Sialography – Parotid, sub maxillary and sub linqual
1.6 Broncography – Oral and Crico – thyroid
1.7 Dacto cystography – Lacrimal ducts

II.


2. Computed tomography – CT imaging protocols for the head, neck, thorax, spine, abdomen, pelvis, and musculoskeletal system. These include procedure indications, patient education, preparation, orientation and positioning, patient history and assessment, contrast media usage, scout image, selectable scan parameters, and filming and archiving of the images.

3. Magnetic Resonance Imaging : Overview of MRI system; magnets - types, field strength, homogeneity, stability, shimming, fringe field and shielding; gradient coils - geometry, amplitudes and rise-times; eddy-currents; pre-emphasis; shielded gradient sets
   Image contrast - proton density; TE and T2-weighting; TR and T1-weighting; inversion-recovery sequences; examples of sequence parameters used clinically; Factors affecting SNR in MRI - gamma, B0, spin density, temperature, coil design, pixel size, no of acquisitions, bandwidth, sources of noise; signal sampling; gradient strength and resolution; line width broadening; chemical shift artifact


5. Diagnostic ultrasound – physical principles, clinical applications, Ultrasound colour Doppler techniques.
   - Nuclear medicine – clinical nuclear medicine
   - Position emission tomography – principles, clinical studies
   - Macroradiography
   - Stereography
   - MMR or flurography
   - Cine radiography
   - Fluroscopy
   - Image intensifier
   - Kymography
• Subtraction radiography
• Indirect Radiography
• Pulsed radiography

III. Quality control of diagnostic X-ray machines, acceptance tests. Description and functioning of various QA and acceptance testing Devices – KVp meter, KVp cassettes, mA and mAS measuring systems, resolution device, focal spot and field congruence test tools, cassette test device, spinning top, use of Pocket Dosimeters for QA etc.

Paper XIV

Radiation Oncology – II

Time allotted: Theory : 180 hrs.
Demonstration : 40 hrs.

3. Radiation Oncology: Overview

4. Clinical Implementation of Technology:
   - Imaging for Radiation Therapy planning: CT, MRI, PET, Ultrasound
   - Simulators: Virtual simulation, Conventional simulator
   - Patient Immobilization and support devices; Mould room techniques
   - Treatment Techniques: External Beam Radiation Therapy:
     - CNS
     - Head and Neck
     - Breast
     - Lung, Esophagus
     - Liver, Pancreas, Bladder, Rectum
     - Cervix, Uterus, Vagina, Vulva, ovary
     - Prostate, Testes
     - Lymphomas
     - Sarcomas
     - Bone
   - Radiation Reaction: Radiation tolerance of various organs and tissues, acute radiation reaction and its management, delayed radiation reactions, long term effects of radiation, complications of radiation therapy in children, patient follow up

3. Computerized Radiation Treatment Planning: 2D, 3D conformal.

   - Treatment verification: Portal Imaging, Portal radiography

   - Special Techniques in Radiotherapy: Intensity Modulated Radiation Therapy (IMRT), Stereoradiosurgery (SRS, SRT), Intraoperative radiotherapy (IORT), Tomotherapy, Image Guided Radiotherapy (IGRT), Total Body Irradiation with Photon beams, Total Skin Electron Therapy
Particulate beam therapy: protons, neutrons, heavy ions, neutron capture therapy
Hyperthermia, Photodynamic therapy

5. Brachytherapy:
Radio nuclides used in Brachytherapy, Brachytherapy sources, manual brachytherapy, remote afterloading brachytherapy, LDR, MDR, HDR and, PDR; intracavitary, interstitial, intraluminal, intravascular and surface applications, intraoperative brachytherapy

6. Quality Assurance in Radiation Therapy
   Periodic Quality Assurance Checks
   1. Light field vs digital
   2. ODII vs MDI
   3. Laser alignment
   4. MLC QA (optical)
   5. Rotation check for isocentre
   6. Light field vs radiation field
   7. Beam quality (j20/j10)

7. Mould room techniques
   Patient positioning in Radiotherapy
   Immobilization and Beam defining devices
   - Plaster of Paris mould (POP), Thermoplastic mould, Acrylic mould, Vacuum immobilization cushion & Stereo tactic radiotherapy
   - Beam modifying devices, Tissue compensators, Conformal/secondary beam shaping block, Surface mould Brach therapy, Special Procedures Intra-oral prosthesis, corneal shield for electron therapy, Build up glove with lead shield for protection of nail bed, Bolus material, Jig for treatment of penile cancers.

8. Computer Networking and Information System in Radiation Oncology Networks:
   1. Hardware: Servers, workstation, peripherals
   2. Software: Servers, clients
   3. Topology: Bus, Star, Ring, Fiber distributed data interface
   4. Communication protocol, connectors, network infrastructure

Information System
- Over view of hospital information system
- Integration of radiation oncology systems to HIS
- DICOM and DICOM RT
- DICOM conformance
- PACS
Paper XV

Nuclear Medicine and Radiation Safety

Time allotted: Theory : 180 hrs.
Demonstration : 40 hrs

Radio pharmacy and Chemistry for Nuclear Medicine
Integrated survey of radio pharmacy and chemistry essential to nuclear medicine procedures. Explanation of technical skills with practical examples in preparation for clinical practice. Includes design and function of radionuclide generator, radiopharmaceutical kit preparation, and chemical principles including chemical bonding, calculation of eluant, isotopic labeling, and disposal of nuclear waste and radiation emergency procedures in event of a spill.

Nuclear Medicine Instrumentation
Variety of equipment and methods employed in radiation detection, measurement, and diagnostic imaging. Practical considerations along with concepts of data analysis, measurement concerns, and spectroscopy. Topics include gas-filed detectors, basic scintillation systems and spectroscopy, imaging systems – both stationary and tomographic – including hardware, software and accessories, and quality control.

Nuclear Medicine Procedures
Methods of performing patient organ visualization procedures in Nuclear Medicine. Review of anatomy, physiology and pathology of various organs, radiopharmaceuticals, applicable instrumentation, methodologies, and techniques utilized. Therapeutic and in vivo clinical procedures, including radiation safety techniques, patient care, and patient preparation for nuclear studies. Imaging studies include lung ventilation, perfusion, cardiac procedures, indications, renal studies, GI bleeding, Meckel's diverticulum, thyroid studies, brain scans and bone scans.

Radiation Protection and Safety
Safe handling of radioactive materials and disposal of radioactive waste. Radiation safety regulations and safety guidelines including personnel monitoring and accurate record keeping.

Part II - Radiation Safety

Units – Roentgen, Rad, Gy, REM, Sievert – Biological Effects of Radiation Exposure – somatic, genetic, acute chronic, stochastic and deterministic effects.
Radiation Detection Instruments
Ionization chamber - Proportional counter – G M Counter – Scintillation counter – Thermoluminiscent Dosimeter – Film. Solid state detectors – Chemical Dosimeters


Time, distance and shielding calculations, primary and secondary protective barriers, radiological protection survey. Patient Exposures in Diagnostic Radiology,
- Radiation monitoring instruments – Pocket dosimeters, film badges, TLD, area monitoring instruments, survey monitors.
Radiation hazards – evaluation and control – Radiation emergencies – medical management of personnel exposed to ICRP Recommendations (Brief) – Operational Units – Current codes of practice for protection of radiation workers an public against ionizing radiation arising from medical and dental use. AERBN safety codes – National regulatory requirements.
Radiation protection measures in the departments of Radiology, Radiotherapy and Nuclear Medicine.

Radiation protection standards and regulations; need for protection, philosophy of radiation protection, basic radiation protection criteria, external and internal exposure, additive risk model and multiplicative risk model, risk coefficients, dose to the fetus, dose limits to occupational exposure, for public and special exposure situations, ICRP and AERB recommendations, basic safety standards, source, practices, types of exposure, interventions.

Administrative and legislative aspects of radiation protection – Historical background of legislation in the atomic energy field – Need for control of radiation exposure at national and international levels – National control through acts with supporting regulation at central and state levels – International control through specialized agencies – Third party liability and insurance in the atomic energy fields.

Atomic energy act, radiation protection rules, notifications, transport regulations, waste disposal rules, licensing, approval of devices, Installations, sites and packages containing radioactive material.

Radiation protection measures in the departments of Radio-diagnosis, Radiotherapy and Nuclear Medicine. Radiation Hazards in brachytherapy and teletherapy departments. Handling of patients, radiation safety during source transfer operation, special safety consideration for Linear accelerator installations, – Minimizing radiation exposures by adopting different techniques

**Fourth Year**

Clinical postings in the departments of radiation oncology and radio diagnosis of the Amrita Medical Institutions and other participating Medical Institutions. The project work will proceed along with the clinical posting.
PATTERN OF QUESTION PAPERS

Paper I
The duration of this theory paper will be three hours; the paper will have one section of 70 marks.

Pattern of Question Paper
Structured Essay (2 out of 2) - 30 marks (2 x 15 marks)
Short Notes (5 out of 7) - 25 marks (5 x 5 marks)
Short answer question (5 out of 7) - 15 marks (5 x 3 marks)

Total Marks - 70 marks

Paper II
The duration of this theory paper will be three hours; the paper will have two sections. 40 marks for Section A & 30 marks for Section B and a total of 70 marks.

Pattern of Question Paper

Section A
Structured Essay - 10 marks
Short Notes (3 out of 4) - 15 marks (3 x 5 marks)
Short answer question (5 out of 7) - 15 marks (5 x 3 marks)

Total Marks - 40 marks

Section B
Structured Essay - 10 marks
Short Notes (2 out of 3) - 10 marks (2 x 5 marks)
Short answer question (5 out of 7) - 10 marks (5 x 2 marks)

Total Marks - 30 marks

Paper III, IV, V and VII to X
The duration of each theory paper will be three hours; the paper will have only one section of 100 marks.

Pattern of Question Paper
Structured Essay (4 out of 4) - 40 marks (4 x 10 marks)
Short Notes (6 out of 8) - 30 marks (6 x 5 marks)
Short answer question (10 out of 12) - 30 marks (10 x 3 marks)

Total Marks - 100 marks
Paper VI
The duration of this theory paper will be two hours; the paper will have one section of 50 marks.

**Pattern of Question Paper**

- Structured Essay (2 out of 2) - 20 marks (2 x 10 marks)
- Short Notes (3 out of 4) - 15 marks (3 x 5 marks)
- Short answer question (5 out of 7) - 15 marks (5 x 3 marks)

Total Marks - 50 marks

Paper XI
The duration of this theory paper will be three hours; the paper will have two sections. 50 marks for Section A & 50 marks for Section B and a total of 100 marks.

**Pattern of Question Paper**

**Section A**

- Structured Essay (2 out of 2) - 20 marks (2 x 10 marks)
- Short Notes (3 out of 4) - 15 marks (3 x 5 marks)
- Short answer question (5 out of 7) - 15 marks (5 x 3 marks)

Total Marks - 50 marks

**Section B**

- Structured Essay (2 out of 2) - 20 marks (2 x 10 marks)
- Short Notes (3 out of 4) - 15 marks (3 x 5 marks)
- Short answer question (5 out of 7) - 15 marks (5 x 3 marks)

Total Marks - 50 marks

Paper XII to XV
The duration of each theory paper will be three hours; the paper will have only one section of 80 marks.

**Pattern of Question Paper**

- Structured Essay (3 out of 3) - 30 marks (3 x 10 marks)
- Short Notes (4 out of 6) - 20 marks (4 x 5 marks)
- Short answer question (10 out of 12) - 30 marks (10 x 3 marks)

Total Marks - 80 marks
### SCHEME OF EXAMINATION

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**FIRST YEAR**

| Paper VII | Regional and Imaging Anatomy                  | 100     | 20        |         |       | 610         |
| Paper VIII| Radio-diagnosis I                             | 100     | 20        |         |       |             |
| Paper IX  | Radiation Oncology I                          | 100     | 20        |         |       |             |
| Paper X   | Radiation Physics I                           | 100     | 20        |         |       |             |
| Paper XI  | Pathology & Community Health                  | 100     | 20        |         |       |             |

**SECOND YEAR**

| Paper XII | Radiation Physics II                         | 80      | 20        |         |       | 600         |
| Paper XIII| Radio-diagnosis II                           | 80      | 20        |         |       |             |
| Paper XIV | Radiation Oncology II                        | 80      | 20        |         |       |             |
| Paper XV  | Nuclear Medicine and Radiation Safety        | 80      | 20        |         |       |             |

**THIRD YEAR**

| Paper XII | Radiation Physics II                         | 80      | 20        |         |       | 400         |
| Paper XIII| Radio-diagnosis II                           | 80      | 20        |         |       |             |
| Paper XIV | Radiation Oncology II                        | 80      | 20        |         |       |             |

**FOURTH YEAR**

| Paper VII | Radio-diagnosis (Practical – 50, Viva – 25)  | 75      | 75        |         |       | 100         |
| Paper VIII| Radiation Oncology (Practical – 50, Viva – 25)| 75      | 75        |         |       | 400         |

### IMPORTANT TELEPHONE NUMBERS

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