

SYLLABUS

**for Courses affiliated to the
Kerala University of Health Sciences**

Thrissur 680596



**BACHELOR OF SCIENCE IN
MEDICAL RADIOLOGICAL TECHNOLOGY
(BSc MRT)**

Course Code:017

(2016-17 Academic year onwards)

2016

2. COURSE CONTENT

2.1 Title of course:

Bachelor of Science in Medical Radiological Technology- B.Sc. (M.R.T)

2.2 Objectives of course

To mould professionally competent Radiological Technologists at the end of the course the successful candidate should be:

1. Able to do independently qualitatively good routine radiographic procedures.
2. Able to do special investigations under guidance of specialists in diagnostic radiology.
3. Able to execute all routine and state of the art radiotherapy programmes as per prescription and direction of radiation oncologists and physicists
4. Able to operate and maintain all equipments used in investigative and therapy procedures.
5. Able to exercise professional skill and optimisation in all technological aspects of existing and emerging branches of radiological and radiotherapy practices.
6. Able to use ionising radiation observing all national and international guidelines on radiological safety and accepted protocols in individual cases of the different applications. The technologists will develop a high level of safety consciousness and learn to follow accepted work practices to achieve optimum use of radiation in varied applications.
7. Able to assist in the use of ionising and non-ionising radiations for diagnosis and treatment of diseases.

2.3 Medium of instruction:

English.

2.4 Course outline

Radiological Technology deals with the application of different types of radiations and allied tools for the diagnosis and treatment of diseases. Radiations of significance are all the ionising and non-ionising radiations like the complete electromagnetic spectrum – radio waves to cosmic radiation, ultrasound waves and particle type atomic radiations. Besides, use of nuclear magnetic resonance and application of various radio

nuclides in medicine also form significant components. Graduates in Radiological Technology are professionals who most often work as technologists in medical institutions. Besides, industry engaged in the design, manufacture, and sale of radiological systems, need these graduates as application specialists. There is a great demand for these professionals in all the developed and developing countries. Hence, career opportunities for radiology technologists will continue to be bright and rewarding in the near and distant future.

2.5 Duration

The duration of the course shall be four academic years.

2.6 Subjects

First year

Paper	Subjects	Theory Hours	Practical Hours	Tutorials Hours	Total Hours
Paper I	Anatomy	200		40	240
Paper II	Physiology	200		40	240
Paper III	General Physics and Electronics	200	80	40	320
Paper IV	Atomic and Nuclear Physics	160		40	200
Paper V	Mathematics	120		40	160
Paper VI	Computer Science	30	40	10	80
Paper VII	General Papers: A. Special English, B. Community Medicine, C. Health education, D. Psychology, E. Sociology.	30 40 30 30 30		40	200
	TOTAL	1070	120	250	1440

Second year

PAPER	SUBJECT	THEORY Hours	PRACTICAL Hours	TUTORIALS Hours	TOTAL Hours
Paper VIII	Radiation Physics I	160	40	40	240
Paper IX	Radiotherapy I	180	360	40	580
Paper X	Radiodiagnosis I	180	360	40	580
Paper XI	Pathology	30		10	40
	TOTAL	550	760	130	1440

Third year:

PAPER	SUBJECT	THEORY Hours	PRACTICAL Hours	TUTORIALS Hours	TOTAL Hours
Paper XII	Radiodiagnosis II	180	310	40	530
Paper XIII	Radiotherapy II	180	310	40	530
Paper XIV	Radiation Physics II	180	40	40	260
Paper XV	Radiological Protection and statutory aspects	70	40	10	120
	TOTAL	610	700	130	1440

Fourth year:

In the fourth year, the students will be posted to work in a hospital attached to the institution and to carry out project work simultaneously. No transfer to another Hospital, which is not attached to the institution will be allowed for the purpose. It is a training program for developing the candidate as a professional in the field. Hospital posting as well as project work must be substantiated with records duly signed by the Head of the Department in the Institution, where the candidate is posted.

The concept of health care counselling shall be incorporated in all relevant areas.

2.7 Total number of hours

As given in clause 2.6

2.8 Branches if any with definition

The course shall comprise of both theoretical and practical studies in different branches of Medical Radiological Technology and its related subjects such as:

1. Anatomy and Physiology.
2. Basic Mathematics, Physics, and Electronics.
3. Physics of Radiology.
4. Pathology.
5. Radiodiagnosis.
6. Radiotherapy.
7. Radiological protection.
8. Computer Technology.
9. General topics - Special English, Community Medicine, Health education, Psychology and Sociology.

2.9 Teaching learning methods

Lecture and Practical classes

Regular clinical posting to pick up practical skill and practice techniques on medical radiological technology. Students should present seminars in various clinical subjects in medical radiological technology to attain presentation skill.

2.10 Content of each subject in each year

B.Sc. (MRT) - FIRST YEAR

Paper I

ANATOMY

The student has to know basic anatomy of human body with reference to radiologically relevant anatomy. The syllabus does not have as much in depth as that for MBBS students.

INTRODUCTION TO ANATOMY



Terms used in Anatomy; Regions of the body; Description of a typical animal cell: Cell mitosis; genes; sex cell; ova and spermatozoa. Fertilisation of the ovum. Broad lines of embryonic development. Cell function and differentiation of tissues. General Histology: Epithelium; simple and complex epithelial glands; skin. Connective tissue; fibrous tissue; cartilage; bone; Haversian systems; blood; numbers and types of cells in blood; clotting of blood. Muscle tissue; involuntary, voluntary, and cardiac muscle. Nerve tissue.

MUSCULOSKELETAL SYSTEM

Classification of muscles, Anatomical relationships of muscles, origin and insertion of muscles, General description of bones, their main processes and attachments, including the skull with emphasis on the skull as a whole. Development of bones, Primary and secondary centres; diaphysis and epiphysis. Position and function of main joints. Some common diseases and injuries of bones and joints.

THORAX AND THORACIC CAVITY

Thoracic wall, pleura, lungs and its lobes and segments. Mediastinum and its contents, Heart and great vessels.

RESPIRATORY SYSTEM

Nasal cavity, Paranasal sinuses, Nasopharynx, Oropharynx, Larynx, Hypopharynx, Trachea, Bronchi, Bronchial tree, Thoracic cavity, Mediastinum, Pleura. Lungs-Position, relation, Structure, Bronchopulmonary segments.

DIGESTIVE SYSTEM

Oral cavity, teeth, salivary glands, tongue, tonsil, pharynx, oesophagus, stomach, duodenum, small intestine, caecum, appendix, large intestine, rectum, anal canal, mesentery, omentum, peritoneum, peritoneal cavity.

Liver- Position, relations, structure, gall bladder, cystic duct, common bile duct, gall stones, Portal circulation.

Pancreas- Position, structure, pancreatic duct.

Spleen- Position, relation, blood supply.

GENITO URINARY SYSTEM

The kidneys, collecting system, Urinary bladder and urethra in male and female. Testis, seminal vesicles, spermatic cord, prostate, penis, ovaries, fallopian tubes, uterus, vagina, vulva and clitoris.

NERVOUS SYSTEM

Brain- its coverings, different parts, cerebrum, cerebellum, midbrain, pons medulla oblongata, Corpus callosum, cranial nerves and ventricles of brain. Spinal cord-its position and structure, coverings, spinal nerves and applied anatomy. Brief study of important peripheral nerves, sympathetic and parasympathetic system.

CARDIOVASCULAR SYSTEM

Heart, Pericardium, cardiac chambers, aorta, its paired and unpaired branches. Major blood vessels of extremities and brain.

LYMPHATIC SYSTEM

Structure of lymph node, different lymph node groups and its drainage areas, lymphatic vessels and thoracic duct.

ENDOCRINE SYSTEM

Gross anatomy of endocrine glands- Pituitary, Thyroid, Parathyroid, Pancreas, Adrenals, Pineal, Ovary, testes.



MISCELLANEOUS

Gross and microscopic structure of skin and appendages. Orbit and Orbital structures. External, middle and internal ear, mastoid air cells.

REFERENCE BOOKS.

1. Radiographic anatomy – Meschan
2. Gray's anatomy- Henry Gray.
3. Gray's anatomy- 2nd edition. By Richard L Drake et al.
4. Anatomy and physiology for nurses including notes on their clinical application- Evelyn C. Pearce
5. Basic Anatomy and Physiology for Radiographers- MRE Dean.
6. Surface and Radiological Anatomy – 3rd edition – A Halim.

Paper II

PHYSIOLOGY

The student expected to know basic physiology of human body. The syllabus does not have as much in depth as that for MBBS students.

INTRODUCTION TO PHYSIOLOGY

RETICULO-ENDOTHELIAL SYSTEM:

Composition of blood, gross structure of RBC, WBC, platelets, its production and functions. Anaemia, polycythaemia, leukopenia, leucocytosis, thrombocytopenia, pancytopenia-definition, common causes and clinical significance. Physiology of coagulation, coagulation factors, thrombus formation.

LYMPH:

Lymph formation, functions

RESPIRATORY SYSTEM:

General physiological functions of respiratory system, Mechanism of ventilation. Pulmonary circulation. Respiratory and non-respiratory functions of lung. Diffusion of gases in lungs and factors influencing.

ENDOCRINE SYSTEM:

Brief description of endocrine organs, its hormones, functions of hormones, diseases produced by excess or deficiency of the hormones. Thyroid hormone production giving importance to role of iodine in detail.

DIGESTIVE SYSTEM:

Physiology of deglutition, movement of food through oesophagus, stomach, small and large intestines and defecation. Brief study of different digestive juices, its functions, digestion and absorption.

REPRODUCTIVE SYSTEM

Functions of gonads. Male reproductive system, secondary sexual characters in male and onset of puberty. Physiology of the sperm, normal characteristics and composition of semen.

Cryptorchidism.

Female reproductive system, secondary sexual characters in female and onset of puberty. Physiology of formation of ovum and menstrual cycle. Pregnancy, infertility and menopause.

CARDIOVASCULAR SYSTEM:

General functions of cardiovascular system. Systemic and pulmonary circulation. Cardiac cycle, atrial systole and diastole, ventricular systole and diastole. Pulse, blood pressure, shock. Anaphylactic shock- detection and management.

NERVOUS SYSTEM

General introduction and structure.

Functions of central nervous system-motor, sensory and special senses.

CSF- Formation, properties, functions and absorption.

REFERENCE BOOKS;

1. The human body- Best and Taylor.
2. Basic anatomy and physiology for radiographers- MRE Dean.
3. Human anatomy and Physiology- King and showers.

Part 1: GENERAL PHYSICS

Basic knowledge at the level of Plus II syllabus in Kerala is a pre requisite.

1. INTRODUCTORY GENERAL PHYSICS

- Matter and Energy, Basic forces of nature, Gravitational, Weak, Electromagnetic and Nuclear forces – basic characteristics and examples,
- Electromagnetic Radiations, Principles of quantum theory of radiations, Basic mechanisms of production and propagation of the whole range of EM waves, Fluorescence, Phosphorescence, specification of intensity and quality of radiations
- Particle type radiations and their characteristics, Atom and Nucleus, energy states, Transformations between energy states, emission, and absorption of radiation, Radioactivity, and radionuclides and their different modes of decay.

2. OPTICS:

- Interference- Principle of superposition, coherent sources, conditions of brightness and darkness expression for bandwidth.
- Diffraction: General ideas, types of diffraction- Fresnel and Fraunhofer diffraction, plane transmission grating determination of wave length.
- Polarisation- Polarisation by reflection and refraction, Brewster's law, Double refraction: Ordinary and extra ordinary rays, Quarter and half wave plates.
- Scattering of light: Rayleigh scattering, Raman effect: Explanation based on quantum theory. Relative intensities of stokes and antistokes lines.
- Production and properties of Lasers. Fibre optics: Principle and applications.

3. MAGNETISM AND ELECTRICITY

- Static and current electricity, Role of C, R, L in direct and alternating currents, conductors, insulators and semiconductors, Basic semiconductor devices like diodes, Transistors and their characteristics with emphasis on applications in electronic circuits. Alternating currents: peak and RMS values of current and voltage, circuit containing LR, CR and LCR- Power factor, watt less current, the J operator, series and parallel LCR circuits, resonance and Q factor, Acceptor and rejector circuits. Single phase and three phase circuits, Star and Delta connections
- Magnetism and electricity, Basic concepts of induction, Intensity of magnetisation- Magnetic susceptibility, BH curve, magnetic hysteresis, Dia, para and ferromagnetism.
- Construction of magnets, Electromagnets, High strength magnets using super conductors and their applications.
- Varying currents- Growth and decay of LR circuit, time constant, charge and discharge of a capacitor through a resistance and inductance, Oscillations in an LC circuit. Rectification – half wave and full wave rectifiers, rectification in three phase systems, basic circuits and applications. RMS and peak values of current and voltage in rectified circuits. Transformers of different types, Electricity and heat production,
- Eddy currents and hysteresis loss etc.
- Units of measurement in electricity, measuring instruments for measurement of Current, Voltage, Resistance, power, Energy consumed, inductance and capacitance. Construction and maintenance of the meters.

4. OSCILLATIONS:

- Differential equations and solutions of S.H.M, expressions for period, velocity and acceleration, phase, initial phase, forced oscillations, resonance.
- Doppler Effect: General expression for apparent frequency. Applications,
- Ultrasonics- production-magnetostriction and piezo electric methods, properties and uses.

Part II: ELECTRONICS

- Semiconductors: Conduction in crystals, Energy bands (qualitative). Intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, majority and minority carriers.
- Semiconductor diodes: p-n junction- properties, forward and reverse bias, characteristics of p-n junction, Rectifiers- Half wave and full wave, ripple factor, Efficiency of HW and FW rectifiers, filter circuits, Zener diode, regulated power supply.
- Transistors- Symbols, Transistor connections and characteristics, Transistor as an amplifier in CE arrangement, load line analysis, operating point, types of amplifiers, feed back- negative feed back in amplifiers.
- Transistor oscillators- Hartley, Colpitt's and phases light oscillators.
- Transistor as a switch- multivibrators- Astable, monostable, bistable multivibrators- simple.
- Special devices- SCR, Diac, UJT, FET, Mosfet, simple ideas on OPAMP, Microwave generators like Magnetron and Klystron, Wave-guides.
- Micro chips, Integrated circuits, Measuring systems
- Radiofrequency waves, generation and detection and measurement.

List of Practical.

1. Spectrometer- Refractive index of the prism
2. Spectrometer- Dispersive power
3. Spectrometer- i-d curve
4. Spectrometer-Grating-Normal incidence
5. Full wave rectifier
6. Full wave bridge rectifier
7. Semiconductor diode -Characteristics
8. Zener diode – Characteristics
9. Op-Amp inverting amplifier
10. Digital gates-(OR, AND, NOT) verification

11. Op-Amp differentiator

12. Conversion of galvanometer into ammeter

Paper IV

ATOMIC AND NUCLEAR PHYSICS

- Discovery of cathode rays, nature and properties, e/m - Thomson's method, charge on electron, Milliken'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, Stern Gerlach experiment, Electronic configuration- periodic classification, Larmour precession, Zeeman Effect (qualitative).
- Quantum Physics- photo electric effect, Laws of photo electric emission, Einstein's theory, Millikan's verification of Einstein's equation.
- Matter waves- De-Broglie's theory (qualitative), phase and group velocities, uncertainty principle.
- Atomic Nucleus- general properties, binding energy, nuclear forces, general ideas on meson theory, reasons for instability in nuclei.
- Radioactivity- Natural and artificial radioactivity, nature of radioactivity, Law of radioactive disintegration, half-life and mean life, radioactive series, law of successive disintegration, radioactive equilibrium, various modes of radioactive decay with common examples, units of radioactive strength.
- Range of alpha particles, Theory of alpha decay (qualitative), Beta and Gamma decay with examples. Finite range of beta rays, Neutrino hypothesis, other sub atomic particles.
- Gamma ray spectra absorption by matter, pair production, conversion electrons, electron capture, Auger electrons.

- Nuclear reactions- (α, p) , (α, n) and common nuclear reactions, proton bombardment, Fission, Fusion, Q values, Nuclear reactors, production of short lived and long lived isotopes, nuclear isomerism.
- Qualitative ideas on elementary particles and cosmic rays.

Paper V

MATHEMATICS

1. ALGEBRA

- Laws of indices, logarithm, Exponential, Logarithm series, progression, permutation and combination, matrices- sum, product and transpose of matrices, 2×2 and 3×3 determinants, Use of theorems in evaluation, Cramer's rules, Partial fractions. Mathematical induction, Binomial expansion $(1+x)$ and $(1-x)$ for all n

2. TRIGONOMETRY

- Measurement of angles, Trigonometric ratios, Relations connecting complementary and supplementary angles, Ratios of compound angles Product formula, Multiple and sub multiple angles, Area of triangle, Relations between sides and 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.

4. VECTORS

- Definition, Product of vectors, scalar and vector products, scalar and vector triple products, vector differentiation, Gradient, Divergence and curl.

5. COMPLEX NUMBERS

- Definition, Modulus, Amplitude and properties, De Moivre's theorem, Extraction of roots of a complex number.

6. STATISTICS

- Basic ideas of statistical evaluation, mean, standard deviation etc. Calculation of mean, median, mode, standard deviation, mean deviation, variance, coefficient of variation, calculation of correlation coefficient and regression analysis, concept of probability. Calculation of probability in a discrete sample space, Binomial, Poisson and normal distribution, Simple problems.

7. GENERAL IDEAS

- Fourier transforms, Laplace transform, Sievert integral, Differential equations, Numerical methods of integration

Paper VI **COMPUTER SCIENCE**

Module – I: Introduction to PC

- Functional Units of Digital Computer-Basic Operation Concepts-Hardware and Software- I/O devices, CPU, Memory-Primary and Secondary, RAM, ROM, Storage Devices - Hard Disk, Floppy, Optical Disk, etc.-Overview of Parts of a PC- Cabinet, Motherboard, Video card, Sound cards, Modems, Hard Drive, Zip Drive, CD ROM Drive, Network card, CPU, Main Memory, Power Supply-Computer Generations, Multiprocessors and Multicomputers
- Types of Computers: Analog, Digital and Hybrid Type- Micro, mini, main frame and super computers
- Programming Languages: Machine language, Assembly language, High level language
- Algorithm- Flowchart and coding- Computer Software: System Software and
- Application Software
- Introduction to Database: Database System concepts- DBMS and RDBMS

- Introduction to computer Networks: Advantages of networking -Types of computer networks- LAN, MAN, WAN, Internet, Public networks, intranet and extranet, wireless network

Module-II: Introduction to Operating System

- Introduction to Operating Systems: Basic concepts - Types of OS: batch processing, multiprogramming, time sharing, real time system
- Components of an operating system - OS structure - Multiprocessor system- Distributed system-Operating system services.
- Different Operating Systems- DOS: Introduction, Loading and Quitting the Operating Systems, Important DOS Commands (Internal and External), File and Directory System Concepts in DOS- MS Windows: Introduction, Desktop icons, Creating Folder, creating, copying and cutting files, Renaming, introduction to MS-office package- Word, Excel, Power point- Linux: Introduction, basic commands, Introduction to open office -Writer, Calc, Impress

Module-III: Introduction to C Programming

- Introduction to C Language- History of C, Characteristics of C Language, C Program Structure, Pre-processor and the #include and #define Directives, Data Types: Variables and Constants, Operators: Arithmetic, Logical, Relational, Bitwise, Unary and Ternary Operators.
- Conditional Statements, Looping and Iteration, Arrays: Single and Multi Dimensional array, Pointers and Strings, Dynamic Allocation of Memory

Module-IV: Preparing and running a C program

- Structures and Union, Enum Data Type, Functions-Types of functions, Pass by value, Pass by reference- Class Storage: Auto, Extern, Static and Global Variable, File Handling, C Program to Swap two Numbers, Generate Fibonacci series and add two arrays.

Module-V: Introduction to Health IT

- IT application in different fields : Internet and the World Wide Web, Basics of Internet - Getting connected – Addresses and Names - web objects - sites, E-mail, setting up E-mail, Web server, Proxy server, Web Browsers, Firewalls, Search Engines, Web TV, Internet Telephone, E-commerce, E-Publishing, IT as an educational management tool, online learning, multimedia - IPR and implication – Viruses, different types of viruses- Cyber Laws – Social, Economic, Political, and Ethical Perspective of IT.
- Health Information Technology: definition, common HIT applications- Hospital Information Systems, practice management systems, Electronic Medical records and Electronic health records, e prescribing, Personal Health records, Patient registries, patient portals, e health and telemedicine, Mobile health, PACS, Use of HIT- Advantages and challenges.

Reference Books:

1. Fundamentals of Computing, J. B. Dixit, Laxmi Publications
2. Database System Concepts, Korth, Silberschatz, and Sudarsan- Tata McGraw Hill
3. Computer Networks-Andrew S. Tannenbaum-PH
4. Internet for Everyone - Alexis Leon and Mathews Leon -- Vikas Publishing House Pvt. Ltd., New Delhi
5. Operating System Concepts, Silber Schatz, Galvin, Gange (6th Edition)
6. Open Office Basic: An Introduction, Prof. James Steinberg, Gold Turtle Publishing, December 2012, ISBN 978-1481270939
7. C – Programming, E.Balagurusamy, Tata Mc Gray Hill
8. C The Complete Reference - H.Sohildt, Tata McGraw Hill
9. Let us C - Y.Kanetkar, BPB Publications
10. The C programming language : Kerninghan and Ritchie
11. Information Systems For Healthcare Management, C.J. Austin, S.B. Boxerman, 6th Edn, ISBN 81-8014-093-8, Standard Publishers distributors, New Delhi

Paper VII

GENERAL

A. SPECIAL ENGLISH

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. The course content may also help the students to take up overseas examinations in English proficiency like the IELTS or TOEFL.

Writing skills 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 equipment- Letters to the editor.

Foundation English

- 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 comparison, expression of necessity: must, have to, need to, expression of generalisations and emphasis.

Vocabulary:

The language of doctor and patient. Medical terminology- roots, prefixes and suffixes, medical abbreviations.

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

Recommended reading:

1. John Cristopher Maher, International Medical communication in English (London, Edinburg, University press) 1990.
2. Jones L. Functions of English (Cambridge University Press) Tickoo Subramaniam.

B. COMMUNITY MEDICINE.

- General concepts of Health and diseases with reference to natural history of disease with pre pathogenic and pathogenic phase.
- The role of socioeconomic and cultural environment in health and disease. Epidemiology and scope.
- Public Health Administration- overall view of the health administration setup at Central and State levels.
- The national Health programme: Highlighting the role of socio economic and cultural factors in the implementation of the national programmes.
- Health problems of vulnerable groups- pregnant and lactating women, infants and pre-school children. Occupational groups; geriatrics.
- Occupational health. Definition; Scope: occupational disease; prevention of occupational disease and hazards.
- Social security and other measures for the protection from occupational hazards, accidents and diseases. Details of compensation acts.

- Family planning, Objectives of National family planning programme and family planning methods. A general idea of advantages and disadvantages of methods.
- Mental health- Community aspects of mental health; role of physiotherapists. Therapists in Mental Health problems such as mental retardation.
- Communicable diseases- An overall view of communicable diseases classified according to mode of transmission. Role of insects and other vectors.
- International Health Agencies.

Recommended reading:

Text Book: Preventive and social medicine by J.E park

C. 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.
- Review of concepts of perception, attitudes, socialisation process, learning and theories of learning, social change and change process, Motivation, needs and drives.
- Principles and process of communication.
- Methods and tools of health education: Individual and group methods; a critical evaluation of the theories and tools of 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.

D. PSYCHOLOGY

A sound knowledge of psychology is essential to help the students understand themselves and other people, and how to develop inter personal relationships. This knowledge would then be applied in working with any patient and as a member of the treatment team.

- What is psychology?
- Fields of application of psychology
- Respective influences of heredity and environment on the individual.
- Development and growth of behaviour in infancy and childhood.
- Intelligence and intelligence testing.
- Aptitudes and interests, motivation.
- Emotions and emotional development.
- Personality and assessment thereof.
- Memory- remembering, forgetting, and thinking.
- Learning theories, methods of learning.
- Sensation, Perception
- Social Psychology, influence of individuals and groups of behaviour of others. Leaderships; Group Psychology.

E. SOCIOLOGY

- Introduction: What is sociology? Importance of the study of sociology. Its relation with other social sciences. Application of Sociology: Formulating policies and laws of Government Development of agriculture, Industry, Harijan and Tribal welfare. Labour welfare. Education, family welfare etc.
- Individual and society: Socialisation: The individual as an isolate unit. The socialised individual: Importance of society in the development of individual personality.
- Social group: Primary and secondary groups:
- Family: Family as a basic unit of society. Importance of family in the community. Social institutions.
- Culture: Meaning of culture. Culture traits: cultural similarity and diversity.

- Social change: Factors of social change. Nature of social change and meaning of social progress; social changes in urban and rural areas.
- Community development and rural reconstruction programme.
- Social and case study methods.
- Social problems:
 - Migration of population from rural to urban areas overcrowding.
 - Problem of housing; government housing schemes; slums and slum clearance.
 - Problem of poverty: Social security scheme.
 - Prostitution: Venereal diseases and control.
 - Unemployment causes and remedies.
 - Juvenile delinquency
 - Alcoholism: Various aspects of prohibition drug addiction.
 - Population explosion: Malthusian theory. Family welfare and birth control.
 - Problem of beggary.
 - Malnutrition.
- The Indian ideals of womanhood: working women. Problems at home and unemployment.
- Medical social work.

B.Sc. (MRT) - SECOND YEAR

Paper VIII

RADIATION PHYSICS I

SECTION I:

- Cathode Rays: Conduction of electricity through rarefied gases, Production and properties of cathode rays- Thermionic emission- variation of anode current with voltage- Voltage and filament temperature- Thermionic gas diode- photoelectric emission-Laws, Quantum theory.

SECTION II:



- Spectra: Emission spectra- continuous, Line and band spectra- Spontaneous and stimulated emission-Laser action.
- He-Ne Laser- Absorption Spectra.
- Luminance, Fluorescence and Phosphorescence with examples and uses.

SECTION III:

- Physics of X-ray production: Production and properties of X-rays, Continuous and characteristic x-rays, X-ray spectra, intensity and quality of X-rays and factors controlling them, Various types of X-ray tubes, Associates electrical and electronic circuits, High Tension Transformer, Filament Transformer, Auto transformer, KV, mA, mAs and exposure time measuring systems, Heel effect. Dissipation of Heat in X-ray production, X-ray tube and housing rating charts and their evaluation, comparison of different X-ray systems like self-rectified, half wave rectified, full wave rectified, multi pulse and constant voltage systems. Measures to protect X-ray units from over-heating, preventive measures. Comparison of diagnostic and therapy X-ray tubes, CT tubes, Mammography tubes, High energy systems – MV generators, Linear accelerators (brief features)

SECTION IV:

- X-ray production continued, Intensity distribution around the focal spot, Quality and quantity analysis, dependence on KV, mA, exposure time, distance, filtration, characteristic component – its removal and special applications, calibration techniques for exposure factors, use of spinning top, KVP meter, mA(S) meter, KVP cassettes etc.

SECTION V:

- Interaction of ionising radiation with matter: Absorption and Transfer of energy- Attenuation- Attenuation coefficients-HVL-Narrow and Broad beams- Attenuation processes- photoelectric effect- Thomson scattering- Rayleigh scattering- Compton scattering- pair production- Total attenuation coefficient- importance of these interactions in medical imaging and radiation oncology.

SECTION VI:



- Units and Measurement of ionising radiation quantities, Energy, Intensity, Exposure, Kerma, Energy absorbed, dependence on relevant factors like nature of the absorber, type and energy of the radiation-Roentgen- Free Air ionisation chamber- Other measuring systems(qualitative)- Absorbed dose, Rad, Gray, Kerma, Electronic equilibrium, Exposure rate constant.
- Description and working of common measuring systems, Ion chambers, GM detectors, proportional chambers, scintillation detectors, TLD, chemical detectors, photographic detectors etc.

Section VII:

- X-Ray Technology-1: X-ray tubes: Diagnostic and Therapy tubes, Gas tubes, Coolidge tube, Rotating anode tube, Line focus tube, Dual focus tube, Hooded anode tube, other therapy tubes(qualitative study), X-ray generator circuits, auto transformer, Filament transformer, Rectification of anode voltage, self-rectifier circuit, Half wave and full wave rectification.
- 3 Phase generators, Phase transformers- 6 pulse 6 rectifier, 6 pulse 12 rectifier, Power storage generators(Qualitative), capacitor, Units for diagnosis- Villard circuit, Grenacher circuit, MA stabiliser, KV stabiliser, Mains compensator, Main stabiliser, measurement of KV, sphere gap method, series resistance volt meters, electrostatic volt meters, KV meter, crystal spectrometer.

SECTION VIII:

- X-Ray Technology 2: Timers: Synchronous, Electronic, ionisation, Photo, MAS timers. - Pulse counting Rating factors controlling rating - Use of rating charts -Accelerators.

SECTION IX

- Principles of Diagnostic Radiology: Physical principles, Physics and chemistry of image formation, latent image and its processing, automatic and manual processing techniques, flat panel detectors and filmless imaging filters and filtration, inherent and added filtration, heavy metal filter, Effect of filtration on low and high energy beams.

- Characteristics of radiographic images, contrast, sharpness, definition, distortion and factors affecting them to be discussed in detail, methods to improve the quality of images
- Collimators, grids, grid characteristics, Types of grids, evaluation of grid performance, stroboscopic effect... Exposure factors in imaging. QA of diagnostic X-ray units- necessity and procedures.

SECTION X:

- Effects of X-rays.
- Fluorescence, Phosphorescence, Luminescence and their applications.

SECTION XI:

- X-ray films and other image receptors:
- Film construction, image production, Development, Fixation and hardening, Processing, Properties of x-ray films, H&D curve, film gamma, speed or sensitivity, latitude, contrast.
- Screens:
- Intensifying and fluorescent screens, Actions, intensifying factors, screen thickness, materials used, quantum mottle (Brief), Modulation Transfer Function (Brief) Solid state detectors and image receptors, amorphous silicon flat panel detectors.

SECTION XII:

- Image details: Primary radiological images, image intensifier, Cine radiography, Video tape recording, TV technique, image quality, geometric factors influencing the image, Magnification and distortion, Unsharpness, Penumbra, Radiographic exposure, Quality assurance in X-Ray radiology.

SECTION XIII:

- Special procedures.
- Fluoroscopy, Tomography, Stereoscopy, Myelography, Mammography, Pelvimetry, Xeroradiography.

SECTION XIV:

- Modern systems of imaging.
- Computed Tomography:

- Principles and operations, Different generations of CT units, spiral CT machines, Special features of X-ray generators and detectors.
- Digital subtraction Angiography, Dental radiography, and imaging techniques, special features of dental units.

Paper IX

RADIOTHERAPY- 1

The student should have knowledge of various diseases, which encompass radiotherapy. This knowledge includes pathology and epidemiology. A general knowledge of the disease process, including knowledge of normal cell structure and life cycle, is necessary basis for an understanding of the abnormality. In the disease below basic pathology, etio-pathogenesis, basic epidemiology, patterns of spread, treatment options for various stages and role of radiotherapy should be known. Common diseases to consider are:

- Brain tumours
- Head Neck Cancers
- Lung Cancers
- Breast Cancer
- Oesophageal Cancer
- Rectal Cancer
- Cervical Cancer
- Endometrial Cancer
- Vulva and Vagina
- Soft Tissue Sarcomas
- Testis
- Penis
- Prostate
- Kidney, Ureter and Bladder
- Pancreas Liver Stomach
- Lymphomas

- Paediatric tumours: Retinoblastoma, Wilms Tumour and Rhabdomyosarcoma
- Effect of radiation on tissues including acute and late effects of radiotherapy.
- Skin, Mucosa, GI tract, Genito-urinary system, respiratory system, CNS.
- Stochastic and non-stochastic effects
- Effect of radiation on the body including effects of total and hemi body radiation.
- Linear energy transfer and relative biological effectiveness;
- Radio sensitisers and Radio protectors: Examples and principles of action. Oxygen effect.
- The student should have an understanding of principles underlying the choice of treatment and the relative place of radiotherapy with surgery, chemotherapy and hormone therapy in treatment of malignant diseases. This understanding should include sound knowledge of principles of radiation dosage, effect of fractionation, sensitivity and relative biological effectiveness of the radiation used.
- Patterns of spread. Basic tests done for cancer patient's workup including biopsy and staging workup.
- TNM, FIGO, and Ann Arbor Staging systems.

Paper X

RADIODIAGNOSIS -I

- Preliminary steps in Radiography
- Radiation hazards, genetic and somatic effects.
- General anatomy and radiographic positioning terminology.
- Practical safety measures in diagnostic radiography
- Physical principles of x-ray diagnosis.
- Radiological images, intensifying screens, fluoroscopic screens, grids, Moving grid, radiographic cones.
- Radiographic films, single coated, double coated films.

- Various stages of film processing
- X-Ray developer, fixer, replenisher
- Dark room construction, dark room safe light, pass box
- Fog in X-ray films.
- Automatic X-ray film processing.
- Practical aspects in radiography of children.
- Bed side radiography, High KV Radiography, soft tissue radiography.

(a) UPPER EXTREMITY:

Basic alternative and additional projections for special conditions of the bones and joints of the upper extremity.

Shoulder girdle: Basic and alternative techniques for the shoulder joint and scapula, clavicle, ACJ and SCJ.

(b) LOWER EXTREMITY

Basic 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, special 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, lumbo-sacral junction and sacro-iliac joints and coccyx.

(e) BONY THORAX:

Techniques for Sternum, sternoclavicular joints, Ribs, upper and lower.

(f) THORACIC VISCERA:

Techniques for Trachea, Trachea and pulmonary apex, chest (lungs and heart)

(g) ANTERIOR JOINT 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.

(k) 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.

(n) X-ray imaging of women, children, precautions during pregnancy etc.

Paper XI

PATHOLOGY

- Disorders of circulation
 - Thrombosis
 - Embolism
 - Infarction
 - Oedema
- Mechanism and changes in inflammation
- Detailed study of tumours
 - Characteristics
 - Classification

- Aetiology and pathogenesis
- All the common benign and malignant tumours
- 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 helminths
- 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 (Basic Outline only is required about the pathology and important radiological features as well as areas where radiological imaging is useful in the management)

1. CVS

- I H D
- R HD

- Infective endocarditis
- Hypertension
- Valvular diseases

2. Lung

- Pneumonias
- TB
- Asthma
- Tumours

3. GIT

- Oral cavity
- Oesophageal Ca
- Peptic ulcer
- Ca stomach
- Malabsorption
- Inflammatory Bowel diseases
- Dysentery
- Appendicitis
- Peritonitis

4. Gall bladder

- Stones
- Cholecystitis

5. Pancreas

- Pancreatitis
- Stones
- Diabetes mellitus

6. Male Reproductive system

- Hydrocele
- Orchitis and Epididymitis
- Benign prostate hypertrophy

7. Female reproductive system

- Cervicitis
- Ca Cervix

- Ca Endometrium
 - Disorders of Menstruation
 - Leiomyoma
 - Brief account of ovarian tumours
 - Disease of pregnancy- PHT- Ectopic
1. Breast
 - Fibro adenoma
 - Ca Breast
 2. Blood
 - Anaemias
 - Leukaemia
 - Bleeding disorders
 3. Lymphoreticular systems
 - Lymphadenitis
 - Lymphomas
 4. Bones
 - Congenital Conditions
 - Osteomyelitis
 - Rickets, osteomalacia
 - Bone tumours
 - Arthritis
 5. Endocrine
 - Thyroid
 - Pituitary
 - Adrenal
 - Parathyroid
 6. Brief account of eye and ear infection
 7. Skin
 - Psoriasis
 - Eczema
 - Skin tumours (Basal, squamous, Malignant Melanoma)
 8. Kidney
 - Stones
 - Glomerulonephritis
 - Pyelonephritis
 - Renal failure
 - Nephrotic syndrome
 - Tumours

B.Sc. (MRT) THIRD YEAR

Paper XII

RADIO DIAGNOSIS- II

- Contrast media: Type of contrast agents, Strength, and quantities and methods of introduction to be taught alongside the appropriate subject in association with the radiographic technique.
- CNS:
 - Radiological Anatomy, Cerebral angiography, Patient preparation. Examination procedure and radiography technique. Myelography (MR and CT), Ventriculography, and Encephalography Discography Stereotactic surgery
- Digestive system:
 - Radiological anatomy, preparations of the patient for contrast examinations. Ba swallow, Ba meal, Ba FT, Ba enema, Examination procedures and radiographic techniques.
- Biliary system: Radiological anatomy and radiological procedures, Oral cholecystography, cholangiography, operative, postoperative, percutaneous and ERCP.
- Urinary system: Radiological anatomy, contrast media used in urography, Excreting urography, retrograde urography, retrograde cystography, Female cysto-urethrography, male cysto-urethrography.
- Reproductive system: Radiological anatomy, contrast media used in Hysterosalpingography (HSG), Radiographic Pelvimetry, and cephalometry; seminal vesiculography, localisation of IUCD.
- Circulatory system:
 - Diagnostic visceral and peripheral angiography
- Cardiovascular system:
 - Cardiac angiography, Coronary angiography catheterisation methods and techniques, catheterisation studies and procedures.

- Parotid, sub maxillary and sub lingual Sialography.
- Bronchography (conventional and CT).
- Lacrimal ducts, Dacryocystography.
- Mammography: Film- mammography, film- screen mammography, Xero mammography, Techniques.
- Computer fundamentals and applications in Radiology
- Computed tomography- Equipment and methodology
- Reconstructive image parameters
- Digital radiography- Digital angiography- Digital subtraction angiography Diagnostic ultra sound:
- Physical principles, clinical applications, Ultrasound colour Doppler techniques.
- Magnetic Resonance Imaging Equipment, positioning, comparison of MR to conventional radiology, physical principles, biomedical effects of MR, clinical applications
- Nuclear medicine-Clinical nuclear medicine.
 - Radioisotopes used, measurement of sample activity, Detection of radioactivity in the body, simple collimating system, whole body counting, scanners, and Gamma cameras.
 - Radiopharmaceuticals, Radionuclide, Types of radiation used, Biological, physical and effective half-lives, specific activity, Thyroid uptake, Plasma volume, elution.
- Positron emission tomography-principles, clinical studies
- Macro radiography
- Stereo radiography
- Cine radiography
- Fluoroscopy/Image intensifier
- Subtraction radiography, Indirect Radiography, Pulsed radiography.
- Computed Radiography, Direct, and Indirect Digital Radiography – Principles in detail about all the current systems.

- Basic Tumour location and simulation: Tumour localisation principles and procedures. Use of imaging techniques for tumour localisation. Use of X-ray, CT, MRI, PET in tumour localisation. Use of Image registration.
- Treatment planning: Principles of beam modifying devices. Beam directed radiotherapy principles and practice. Steps involved in beam directed radiotherapy.
- X-ray and CT based treatment planning of common malignancies given in Radiotherapy Part I. Bony landmarks for field placement. Mantle field planning.
- ICRU guidelines for target volume delineation and concept of GTV / CTV / PTV and ITV.
- Practical experience with care of radiotherapy machines. Care of machine-Set up single, multiple fields-Use of wedges, shields and tissue compensators-Use of beam directional devices, methods of patient immobilisation-Knowledge of technique involving electron beam therapy-moving beam therapy-conformal therapy-stereo tactic radio surgery and radiotherapy-Handling emergencies in Teletherapy
- Principle of brachytherapy; interstitial-intracavitary-surface mould-intra luminal- Safe handling of small sealed radioactive sources. Preparation, Storage of Brachytherapy Source-Check x-rays -Record keeping in relation to brachytherapy sources patient data.
- Mould room techniques: Construction of casts, shields and electron applicators.
- General welfare of the patient during and after the treatment including the care of any inter-current disease (diabetes, tuberculosis, arthritis). Diet and fluid intake. The observation and reporting of any change in the signs and symptoms of patients receiving treatment.
- The use of blood count in the control of certain treatment. The care of local and systemic reaction. Local reaction should include those in the ear, nose, throat and eye and those arising from treatments given to the pelvis. Care of cancer patients.
- Organisation of radiotherapy, department practice, appointment organisation in the planning room, treatment area. Management of waiting patients.

- Special techniques in Radiation Therapy, Stereo tactic radiation Therapy (SRT) – Stereo tactic Radio surgery (SRS) –. Methods – BRW and CRW frames – angiographic localiser box – preparation of target sheets – Quality Assurance – Isocentric check –Treatment execution – care to be taken – check list.
- 3DCRT / IMRT / VMAT / Helical Tomotherapy/Total Body Radiation / Total Skin Electron therapy
- Basic knowledge in ELORA registration with AERB and its formalities.
- Radioactive source disposal principles and formalities.

Paper XIV

RADIATION PHYSICS II

SECTION I

- Principles of Radiotherapy-High energy Machines- Co 60, Cs 137, –Betatron, Cyclotron, Microtron LINAC, source choice and design- treatment head – shutter mechanism- beam collimation and Penumbra Beam shaping devices – beam modification – shielding – beam flattening - Bolus - compensating filters- wedge filters- MLC -beam direction devices – front and back pointer. Radiotherapy with Protons, Neutrons and heavy charged particles.

SECTION II

- Phantoms – functions used in dose calculation – TAR,TMR,TPR, PSF- PDD Iso dose curves, Beam profile– characteristics – comparison of charts for beams of various energies. Tumour dose calculations using various techniques-
- Patient data acquisition – body contours- patient immobilisation radiotherapy simulator, CT Simulator – Computerised treatment planning system –Volume definition –Gross tumour volume (GTV) - Clinical target volume (CTV) - Planning target volume (PTV) –Organ at risk (OAR) - Dose volume histograms - treatment simulation –Virtual simulation - treatment verification – Electronic portal imaging devices - 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

- Electron Beams – Interaction with absorbing medium – depth dose curve – Virtual source position –Range (csda) –Therapeutic range R_{90} - isodose curves – Field shaping – Electron arc therapy

SECTION V

- Brachytherapy
 - Radioactive sources used: - Ra, Co, Cs, I, Ir, Au, Pd – 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- permanent implants - treatment of cancer of cervix Paterson- Parker and Paris technique (qualitative) – Stepping source dosimetry systems -after loading applications – manual –remote – Intravascular brachytherapy.

SECTION VI

- Special Procedures and Techniques in Radiotherapy
 - Stereotactic irradiation – Total body irradiation (TBI) – Total skin electron irradiation (TSEI) – Intra operative radiotherapy (IORT) – Conformal radiotherapy – Intensity Modulated Radiation Therapy (IMRT) –Image Guided Radiation Therapy (IGRT) – recent advances in radiotherapy.

SECTION VII

- Nuclear Medicine

- Radioisotopes used- measurement of sample activity- detection of radioactivity in the body- simple collimator system- whole body counting – scanners- gamma cameras.
- Radiopharmaceuticals- Radionuclides- Types of radiations used- Biological, Physical and effective half-lives- specific activity- Thyroid uptake – plasma volume- elution. Radio isotopes in therapy

LIST OF PRACTICALS

- Radiation protection survey of Teletherapy Unit (Cobalt 60)
- Radiation protection survey around Brachytherapy Installation (HDR)
- Shutter timer error
- Timer error in HDR
- Radiation protection survey of LINAC
- Parallel opposed technique with dose to one critical organ measurement
- Four field technique with dose to one critical organ measurement
- Planning of multiple technique (3 field) with measurement of dose to one critical organ
- Characteristics of GM Counter
- Transport of radioactive package
- Output measurement of Linear Accelerator
- Output measurement of HDR
- Output measurement of cobalt 60
- Congruence between light field and radiation field

Paper XV RADIOLOGICAL PROTECTION AND STATUTORY ASPECTS:

SECTION I

INTRODUCTION

- Radiation units- Roentgen-Kerma-Absorbed dose-Rad-Gray-Exposure rate constant RHM and RMM-Equivalent dose-Effective dose-committed dose-collective dose- Genetically significant dose- ALARA- Sources of radiation- Natural, terrestrial, artificial and occupational

- Radiation exposure control- critical organs and tissues- quantities used in Radiological protection- Radiation weighing factors- equivalent dose- Tissue weighing factors- effective dose.

SECTION II

- Biological effects of radiation.
- Cell- interaction of radiation with cells- target theory (brief) – cell survival curve- Dose response curve - response to radiation – lethal dose- LD 50- oxygen effect- oxygen Enhancement Ratio- RBE-LET- QF-Effects of radiation on DNA- radiation risk-effects of radiation in utero-ten day rule.

SECTION III

- Radiation Detection Instruments
- Ionisation chamber- proportional counter –GM counter- scintillation counter- thermo-luminescent Dosimeter- film- solid state detectors- chemical dosimeters calorimetry, Radiation monitoring instruments- Pocket dosimeters film badges, TLD, area monitoring instruments, survey monitors.

SECTION IV

- Principles of radiation protection, Time, distance and shielding calculations, HVL and TVL primary and secondary protective barriers, radiological protection survey-leakage levels protective barriers used in X-rays Patient exposures in diagnostic radiology including CT, Nuclear medicine, dental radiology.

SECTION V

- Planning of radiological facility
- General guidelines- x-ray facility-fluoroscopy installation- mammography-CT
- Radiotherapy facility-cobalt rooms-LINAC rooms- Brachy therapy installations
- Nuclear medicine – in vivo and in vitro – gamma camera rooms- nuclear medicine therapy rooms.

SECTION VI

- Radiation monitoring –Personnel monitoring- Film badge-TLD badge-pocket dosimeters – Area monitoring – protection survey – diagnostic – therapy and nuclear medicine installations- protection of patients and staff-record keeping
- Radiation protection measures in the departments of Radiology, Radiotherapy and Nuclear Medicine. Radiation hazards in brachytherapy and Teletherapy departments. Handling of patients, radiation safety during source transfer operation, special safety consideration for LINAC installations,- minimising radiation exposures by adopting different techniques.
- Radiation protection: Principle, history and development-National and international agencies; AERB, BARC, ICRP, WHO, IAEA and their role. Equivalent dose-effective dose-Sievert-rem. Sources of radiation-natural-man made and internal exposures; Biological effects of radiation; effects on cell-stochastic and deterministic effects radiation risk-tissues at risk -genetic, somatic and foetus risk-risk at other industries. Dose equivalent limits-philosophy-ICRP (60) concepts-AERB guidelines. Section VII
- Quality assurance – introduction- Quality assurance – diagnostic X-ray-fluoroscopy-mammography-CT-gamma camera; Therapy units- cobalt-LINAC – brachytherapy-PET –CT.

SECTION VIII

- Transport and Waste disposal
- Type of package-transport index- package requirements- placards-consignors declaration- tremcard-information to carriers
- Waste management-sources and nature of waste- type of waste- classification of waste-disposal of low active waste-disposal of radioactive effluent into ground-disposal of P32 and I131 waste-decontamination procedures

SECTION IX

- Radiation emergencies

- Type of radiation emergencies- accidents-injuries in diagnostic X-rays- radiation accidents in nuclear medicine- radiotherapy-brachy therapy- emergency action plan- medical management of personnel exposures.

SECTION X

- Regulations and dose limits, ICRP Recommendations (Brief) – operational units- current codes of practice for protection of radiation workers and public against ionising radiation arising from medical and dental use. AERB safety codes- National regulatory requirements.

B.Sc. (MRT) FOURTH YEAR

POSTING in RADIODIAGNOSIS and RADIOTHERAPY.

PROJECT WORK

In fourth year, the students will be posted to work in attached hospital of the institution and to carry out project work simultaneously. Hospital posting as well as project work must be substantiated with bonafide records duly signed by the designated senior staff members concerned. Submission of a Project work is a compulsory requirement. Each student can choose a topic for the project, in any one of the subjects related to Radiodiagnosis or Radiotherapy. The supervising Teacher should have minimum 3 years full time teaching experience in the concerned subject. The student under the guidance of the supervising staff, should carry out the work on the topic selected and prepare a project report including results and references.

2.11 No: of hours per subject

As given in clause 2.6

2.12 Practical training

As given in clause 2.6

2.13 Records

Records should be maintained for each exercise done in the practical laboratory for every subject and duly signed by the supervising teacher should be submitted at the time of University practical examination.

2.14 Dissertation:

Not applicable

2.15 Speciality training if any

As decided by the concerned HOD

2.16 Project work to be done if any

a) Synopsis/protocol

A project work synopsis/protocol based on medical radiological technology work on a current topic of relevance. It is to be approved by the HOD. The general/specific guidelines of the University (KUHS) are to be followed for the format and style of the project/thesis/dissertation synopsis/protocol submission.

b) Submission

The project report duly certified by the supervising staff and head of the department should be submitted at least one month prior, on or before the date prescribed by the university, for approval.

c) Valuation

The project evaluation will be conducted by the internal and external examiners in the concerned subject during the Fourth year B.Sc. (MRT) University practical examination. If the project submitted by the candidate is rejected by examiners (the marks obtained is less than 50%), the candidate has to do a fresh project in the parent institution under direct guidance and supervision of a senior faculty. The same has to be submitted for re-examination.

2.17 Any other requirements [CME, Paper Publishing etc.]

Students may be encouraged in these aspects as per requirement of the course

2.18 Prescribed/recommended textbooks for each subject

See clause 2.10 and as supported and decided by the concerned faculties/HoD

2.19 Reference books

See clause 2.10 and as supported and decided by the concerned faculties/HoD

2.20 Journals

As decided by the concerned faculties/HoD

2.21 Logbook

To be maintained by the candidate and counter signed by the concerned HOD.

a) Log Book

A log book has to be maintained by all students and this has to be reviewed by the HOD of the department periodically. Periodic assessment has also to be done in the department by the teachers. Log book is to be submitted at the time of practical examination for perusal by examiners.

b) Model of Log Book

LOG BOOK OF B.Sc. (MRT)

1. Name.....
2. Roll No.
3. Address
4. Details Of Posting: To Be Signed By The Supervising Teacher
 - Radiotherapy
 - Imageology/Radiology
 - Nuclear Medicine
 - Radiation physics
 - Others
5. Participation Conferences – CME Programmes.
6. Details of Leave Availed.
7. Details of Participation in Academic Programmes.
8. Seminars /Symposia Presented
9. Journal Clubs
10. Special Duties (If Any)
11. Miscellaneous
12. Daily Activities Record (Blank Pages)

(Four Page for Each Month X 48 Month Pages)

Signature of Student:



Signature of Supervising Teacher:

Signature of Head of Division/Co-ordinator of the course:

3. EXAMINATIONS

3.1 Eligibility to appear for exams

- No candidates shall be admitted to any year of B.Sc (MRT) examination unless he/she has a minimum of 80% attendance with the provision for one time condonation up to 10% on medical grounds (condonable limit 70%). Condonation for shortage of attendance shall be vested with a committee constituted by the Principal/ Head of Institution, with the Principal/ Head of Institution as the Chairman and five members (senior teachers) in the committee, and remittance of required fee to the University.
- A candidate who has not attained 80% attendance and the shortage is beyond the condonable limit he/ she shall not be eligible to continue the course with the same batch of students. He/ She may obtain special sanction (Condonation of Break of Study) from the institution and the university to continue with the junior batch of students.
- Those who obtain 50% of aggregate in each paper towards internal assessment will be eligible for appearing the university examinations.

3.2 Schedule of Regular/Supplementary exams

- Every year there shall be an examination to examine the students.
- Each examination may be held twice a year. The first examination in a year shall be the annual examination and the second examination shall be supplementary examination.
- The examinations shall be of written and practical (including viva voce) carrying maximum marks for each part of a subject

<i>First year</i>	
Paper-I	Anatomy
Paper-II	Physiology
Paper III	General Physics and Electronics

Paper IV	Atomic and Nuclear Physics
Paper V	Mathematics
Paper VI	Computer Science
Paper VII	General: <ul style="list-style-type: none"> A. Special English B. Community Medicine C. Health education D. Psychology E. Sociology
<ul style="list-style-type: none"> • No University examination and only internal examination for Paper VII. • Practical Examination in Paper III will be for one day. • No Practical examination for Paper I, II, IV, V, VI and VII. 	
Second year	
Paper VIII	Radiation Physics I
Paper IX	Radiotherapy I
Paper X	Radiodiagnosis I
Paper XI	Pathology
No Practical examination in Paper VIII, IX, X and XI	
Third year	
Paper XII	Radiodiagnosis II
Paper XIII	Radiotherapy II
Paper XIV	Radiation Physics II
Paper XV	Radiological Protection and statutory aspects
No Practical examination for Paper XV. Practical examination in Paper XII, XIII and XIV will be one day for each paper.	
Fourth year	

Paper XVI Project	Should be submitted for evaluation in the fourth year B.Sc. (MRT) practical examination.
In the fourth year, the students will be posted to work in attached hospital of the institution and to carry out project work simultaneously. Hospital posting as well as project work must be substantiated with records duly signed by the Head of the Department where the candidate is posted. Paper XVI shall be valued by the university examiners for the final year.	

3.3 Scheme of examination showing maximum marks and minimum marks

FIRST YEAR EXAMINATION

(Max- Maximum and Min- Minimum for a pass, NA- not applicable)

Paper and Subjects	Theory						Practical						Grand Total	
	University		Internal		Total		University		Viva voce		Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Paper I Anatomy	100	50	50	25	150	75							150	75
Paper II Physiology	100	50	50	25	150	75							150	75
Paper III General Physics and Electronics	100	50	50	25	150	75	100	50	50	NA	150	75	300	150
Paper IV Atomic and Nuclear Physics	100	50	50	25	150	75							150	75
Paper V Mathematics	100	50	50	25	150	75							150	75
Paper VI Computer Science	100	50	50	25	150	75							150	75
Paper VII General: Only Internal examination-no University examination														

Special English			50	25	50	25							50	25
Community Medicine and Health education			50	25	50	25							50	25
Psychology, Sociology			50	25	50	25							50	25
Total Marks	600	300	450	225	1050	525	100	50	50	NA	150	75	1200	600

SECOND YEAR EXAMINATION

(Max- Maximum and Min- Minimum for a pass, NA- not applicable)

Paper and Subjects	Theory						Practical						Grand Total	
	University		Internal		Total		University		Viva voce		Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Paper VIII (Radiation Physics I)	100	50	50	25	150	75							150	75
Paper IX (Radiotherapy I)	100	50	50	25	150	75							150	75
Paper X (Radiodiagnosis I)	100	50	50	25	150	75							150	75
Paper XI (Pathology)	100	50	50	25	150	75							150	75
Total Marks	400	200	200	100	600	300							600	300

THIRD YEAR EXAMINATION

(Max- Maximum and Min- Minimum for a pass, NA- not applicable)

Paper and Subjects	Theory						Practical						Grand Total	
	University		Internal		Total		University		Viva voce		Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Paper XII (Radiodiagnosis II)	100	50	50	25	150	75	100	50	50	NA	150	75	300	150
Paper XIII (Radiotherapy II)	100	50	50	25	150	75	100	50	50	NA	150	75	300	150
Paper XIV (Radiation Physics II)	100	50	50	25	150	75	100	50	50	NA	150	75	300	150
Paper XV (Radiological Protection And statutory aspects)	100	50	50	25	150	75							150	75
Total Marks	400	200	200	100	600	300	300	150	150	NA	450	225	1050	525

FOURTH YEAR EXAMINATION

Max- Maximum, Min- Minimum for a pass

PAPER	SUBJECT	Radiodiagnosis/Radiotherapy Posting and Project Work	
		Max	Min
Paper XVI	Radiodiagnosis and Radiotherapy		
	Practical	100	50

	Project + Posting (Viva Voce)	40	25
	Project Report	10	
Total Marks for Fourth Year		150	75

Total Marks for the whole course:

3000

3.4 Papers in each year

See clause 2.6 and clause 3.3

3.5 Details of theory examinations

See clause 2.6

3.6 Model question paper for each subject with question paper pattern

All the question papers should be of standard type. Each theory paper will be of 3 hours duration with a maximum of 100 marks. It predominantly consists of brief-answer-type questions and essay type questions,

MODEL QUESTION PAPERS

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper I

ANATOMY

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay

(2x15=30)

1. Describe the gross anatomy of lung. Mention the various structures at the right hilum and their relationships.
2. Name the paranasal sinuses. Describe the anatomy of maxillary sinus.

Short notes:

(8x5=40)

3. Corpus callosum
4. Stomach
5. Spleen



6. Mediastinum and contents
7. knee joint
8. Anal canal
9. Gall bladder
10. Middle ear

Answer briefly:

(10x3=30)

11. Simple epithelium
12. Neuron
13. Haversian system
14. Fertilisation
15. Carpal bones
16. Cardiac muscle
17. Mandible
18. Structure of lymph node
19. Mesentery
20. Palatine tonsil

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper II

PHYSIOLOGY

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay

(2x15=30)

1. Describe the stages of red blood cell formation
2. Name the 12 cranial nerves. Describe the functions of any two of them in detail



Short notes:

(8x5=40)

3. Functions of insulin.
4. Digestion of fats.
5. Cardiac cycle.
6. Types of hypoxia.
7. Leukopenia and its clinical significance.
8. Menstrual cycle.
9. Non-respiratory functions of lungs.
10. Composition of semen.

Answer briefly:

(10x3=30)

11. Functions of thrombocytes
12. Functions of mineralocorticoids
13. Ovulation
14. Anti-diuretic hormone
15. Functions of Gall bladder
16. Functions of progesterone
17. Cretinism
18. Cryptorchidism
19. Functions of kidney
20. Primary taste sensations

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper III

General Physics and Electronics

Time: 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay:

(2x15=30)



1. Explain in detail of production, working and properties of ultrasound using Piezo electric effect and application of ultrasound non-destructive method.
2. Explain the forward and reverse bias characteristics of NPN and PNP transistor. Enumerate common emitter transistor amplifier and its importance over common base amplifier

Short notes:

(8x5=40)

3. Define Brewster's law with a diagram. The critical angle of water is 48° . What is the polarising angle?
4. Explain the formation of the depletion region in an open circuited PN junction.
5. Derive the differential equation of angular SHM in case of compound pendulum
6. Draw the circuit of an op-amp, which employs negative feedback with a resistor. Show the voltage polarities and direction of currents through the input and output.
7. State the principle and types of transformer.
8. Define the electromagnetic induction. State Faraday's laws of electromagnetic induction.
9. What do you mean by doping state the necessary condition for doping and methods of doping
10. Explain neutrino hypothesis

Answer briefly:

(10x3=30)

11. Define current and voltage. Give its SI units.
12. What is total internal reflection and refractive index.
13. Mention one assumption of de Broglie's relation.
14. Three capacitors are connected in parallel and derive the expression for equivalent capacitor.
15. What are super conductors and its use?
16. Obtain the expression for self-induced e.m.f and hence define its SI unit.
17. Distinguish between single and three phase circuits.
18. A 100Hz AC is flowing in 15mH coil. Find its reactance.
19. Define conductor and insulator on the basis of electrical conductivity. Give its examples
20. Define time constant for growth of charge in R-C circuit.

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper IV

ATOMIC AND NUCLEAR PHYSICS

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay

(2x15=30)

1. What is nuclear reactor? Explain in details of construction and working.
2. Explain Thomson's parabola method of positive ray analysis discuss its draw backs.

Short notes:

(8x5=40)

3. Explain the theory and method of determination e/m of an electron
4. What is excitation and ionisation in relation with energy and potential?
5. Discuss the Sommerfeld atom model.
6. Discuss vector atom model.
7. Explain about radioactive equilibrium with appropriate example
8. Explain the term Nuclear fission, nuclear fusion, and nuclear reactor
9. Explain about Aston's spectrograph.
10. Distinguish between natural and artificial radio activities.

Answer briefly:

(10x3=30)

11. What are mesons and mention examples
12. Define specific binding energy and draw binding energy
13. What is Annihilation of a matter
14. Types of chain reaction
15. The merits and demerits of liquid drop model
16. State the principle of uncertainty in relation with de Broglie theory
17. Define isotopes and isobars
18. What is electromagnetic spectrum
19. Ritz combination principle
20. Define Q value of nuclear reaction. Explain (Alpha, n) reaction

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper V

MATHEMATICS

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay

(2x15=30)

1. a) Show that $\tan \theta / (\sec \theta + 1) + \tan \theta / (\sec \theta - 1) = 2 \operatorname{cosec} \theta$
b) If $\sin (A-B) = 1/2$ and $\cos (A+B) = 1/2$, Find A, B.
c) Show that $\tan (\pi/4 + A) - \tan (\pi/4 - A) = 2 \tan 2A$
2. a) Find mean and standard deviation for the data
X: 0—5, 5—10, 10—15, 15—20, 20—25
Frequency: 3 7 15 14 4
b) For a Poisson distribution $P(X=1) = P(X=2)$, Find $P(X=3)$
c) Two cricket players Mean and SD of scores are given below. Who is the consistent player

	Player A	Player B
Mean	48.4	50.8
SD	12.1	14.6

Short notes:

(8x5=40)

3. Find the inverse of the matrix A $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$
4. Show that the vectors $A=2i+j-3k$, $B=i-4k$, $C=4i+3j-k$ are linearly independent.
5. Prove that $\sec^4 A - \sec^2 A = \tan^2 A + \tan^4 A$
6. If $x = \log t + \sin t$, $y = e^t + \cos t$, find dy/dx .
7. Solve $(x+y+1)^2 \cdot dy/dx = 1$
8. Identify the regression lines $3x-5y=12$, $2x-7y=23$

9. Evaluate $\log_e 7$ by Simpson's Rule
10. Find the second order partial derivatives of $u = \log(x^2 + y^2)$

Answer briefly:

(10x3=30)

11. What is a vector valued function?
12. What is the exponential rule of indices
13. Expand $\log(1-x)$, where $0 < x < 1$
14. When a matrix is said to be Hermitian
15. Give an application for $\sin(A-B)$
16. Integrate $1/(25-x^2)$
17. Solve $x^8 - x^5 + x^3 - 1 = 0$
18. How SD is better than mean deviation
19. $z = x + iy$, Express x and y in terms of z
20. Two regression coefficients are $3/16$ and $1/3$. Find correlation coefficient.

QP CODE:

Reg. No.....

Name.....

FIRST YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper VI

COMPUTER SCIENCE

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay

(2x15=30)

1. What are high level languages? How are they different from low level and assembly languages.
2. What are batch processing, multi-programming and multi-processing. Mention suitable examples.

Short notes:

(8x5=40)

3. What are hybrid computers
4. Fourth generation computers
5. Features of RDBMS



6. Patient portals
7. Looping statements in C
8. LAN, WAN, MAN
9. Real time systems
10. Pass by value and pass by reference

Answer briefly:

(10x3=30)

11. Computer virus.
12. Firewall.
13. E-commerce.
14. Hospital information system.
15. Main frame systems.
16. Mention four DOS commands.
17. Bit wise operation in C
18. Online learning.
19. E-prescribing.
20. Tele-medicine.

QP CODE:

Reg. No.....

Name.....

SECOND YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper VIII

RADIATION PHYSICS I

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essays:

(2x15=30)

1. Describe the components of an X-ray tube with the help of a neat diagram.
Explain the functions of each components.
2. What is mammography? Explain the importance of heavy metal filters in mammography X-ray unit.



Short notes:

(8x5=40)

3. Structure of an X-ray film and explain emulsion layer.
4. Self-rectification
5. What is photo electric effect? Explain the importance in diagnostic radiology.
6. G.M. Counter
7. Potter Bucky grid.
8. Digital radiography
9. Basic principles of radiation detection
10. Calculate the optical density of an x-ray film if the percentage of light transmitted by it is 50%.

Answer briefly:

(10x3=30)

11. Thermionic emission
12. Heel effect
13. Dose and KERMA
14. Stroboscopic effect
15. OPG
16. Speed of a film
17. Exposure rate constant
18. Subject contrast
19. Energy to mass conversion interaction
20. Grid ratio.

QP CODE:

Reg. No.....

Name.....

SECOND YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper IX

RADIOTHERAPY I

Time 3 Hours

Max Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essays:

(2x15=30)



1. How would you investigate and treat a patient of carcinoma oesophagus middle third. Explain various techniques of radiation.
2. Describe pathology and staging of carcinoma cervix and discuss the management of

Short notes:

(8x5=40)

3. Craniospinal radiation.
4. Neuroblastoma
5. Cell survival curve
6. Mammography
7. Bone marrow toxicity following chemotherapy.
8. SVC syndrome
9. Beam modifying devices
10. Linear accelerator

Answer briefly:

(10x3=30)

11. Staging of Hodgkin's lymphoma
12. Radio protectors and sensitizers
13. Oncogenes
14. Spinal cord compression
15. HDR Brachy therapy
16. Simulator
17. Gamma knife
18. Hormone therapy in carcinoma prostate
19. ALARA principles
20. Carcinoma cervix stage IIIB.

QP Code:

Reg.No.....

Name.....

SECOND YEAR B.Sc. (MRT) DEGREE EXAMINATION 20...

PAPER X

RADIODIAGNOSIS I

Time: 3 hrs

Max Marks: 100

Answer all Questions.
Draw Diagrams wherever necessary.

Essays

(2 x 15 = 30)

1. Discuss on radiation hazards with special emphasis on genetic and somatic effects.
2. Discuss the radiological anatomy of hip joint and various projections to demonstrate hip joint.

Short Notes

(8 X 5 = 40)

3. Radiographic technique of wrist joint.
4. Radiography of sella turcica.
5. Grids in radiography.
6. Development of film after exposure.
7. Unsharpness in radiography.
8. Replenisher in film processing.
9. Dark room design.
10. Developer chemistry.

Answer briefly

(10 x 3 = 30)

11. Double coated films in radiology.
12. Dental radiography.
13. Fixer chemistry.
14. Pass box between radiographic room and dark room.
15. Apical view of chest.
16. Imaging of gall bladder.
17. Precautions for a woman coming for radiography.
18. Fluoroscopic screens.
19. Radiography of knee inter-condylar notch.
20. Collimators.

QP CODE:

Reg. No.....

Name.....

SECOND YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20



Paper XI
PATHOLOGY

Time 3 Hours

Max Marks: 100

Answer all questions

Draw Diagrams wherever necessary

Essays:

(2x15=30)

1. Describe five important characteristics of a malignant cell. Discuss the differences between benign and malignant tumours.
2. What are renal calculi? Describe the aetiology, pathogenesis, types and effects of renal calculi.

Short notes:

(8x5=40)

3. Morphological features of tuberculous infection
4. Pathogenesis of thrombosis
5. Pathogenic calcification
6. Gross and microscopy of infective endocarditis
7. Gross and microscopy of peptic ulcer
8. Breast Cancer
9. Fibro adenoma
10. Microcytic, hypochromic anaemia

Answer briefly:

(10x3=30)

11. Papillary carcinoma thyroid
12. Osteomyelitis
13. Psoriasis
14. Nephrotic syndrome
15. Chronic myeloid leukaemia
16. Leiomyoma uterus
17. Acute appendicitis
18. Chronic cholecystitis
19. Hydrocele
20. Asthma

QP CODE:

Reg. No.....

Name.....

THIRD YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper XII

RADIODIAGNOSIS- II

Time 3 Hours

Max Marks: 100

Answer all questions

Draw Diagrams wherever necessary

Essays:

(2x20 = 40)

1. Enumerate various investigations of genitourinary system. Discuss in detail about IVP.
2. Enumerate various investigations of reproductive system. Discuss in detail about Hysterosalpingography.

Write briefly:

(6x10 = 60)

3. Short notes on
 - a) Digital subtraction angiography
 - b) A mode and B mode Sonography.
4. Short notes on
 - a) Fluoroscopy
 - b) Contrast agents and preparation of the patient for contrast examinations.
5. Short notes on
 - c) ERCP
 - d) Sialography
6. Briefly describe ultrasound colour Doppler techniques.
7. Clinical applications of Magnetic Resonance imaging.
8. What is the principle of Computed Tomography? Explain with neat diagram, the different generations of CT scanner.

QP CODE:

Reg. No.....

Name.....

THIRD YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper XIII

RADIOTHERAPY- II

Time 3 Hours

Max Marks: 100

Answer all questions

Draw Diagrams wherever necessary

Essays:

(2x20 = 40)

1. Describe the staging of Carcinoma Nasopharynx. Discuss in detail the steps of radiotherapy planning, portals with special emphasis on newer modalities.
2. What are the different types of brachytherapy and explain brachytherapy in the case of carcinoma cervix.

Write briefly:

(6x10 = 60)

3. Short notes on
 - a) Role of radiation in Hodgkin's lymphoma and technique of mantle field irradiation.
 - b) IMRT
4. Short notes on
 - a) Stereotactic radiotherapy and surgery
 - b) Cranio-spinal irradiation.
5. Treatment of Ca breast stage IIIB with explaining Radiotherapy planning and newer trends.
6. Describe in detail Simulation in Radiotherapy.
7. Indication and techniques of cranio-spinal irradiation
8. Role, techniques, and side effects of radiation in carcinoma of oesophagus.

QP CODE:

Reg. No.....

Name.....

THIRD YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper XIV

RADIATION PHYSICS - II

Time 3 Hours

Max Marks: 100

Answer all questions

Draw Diagrams wherever necessary

Essays:

(2x20 = 40)

1. Compare various characteristics of Ion chamber, Proportional counter, and GM counter.
2. Explain angular distribution of X-ray in thin and thick target. What is a transmission target and what are the materials used for the same. How do we obtain a useful electron beam from a LINAC?

Write briefly:

(6x10 = 60)

3. Short notes on
 - a) Wedge filters.
 - b) Define wedge angle and Hinge angle with suitable equations.
4. What is isodose chart? How do you measure isodose curves? What is the difference between an SSD chart and SAD chart?
5. Explain with neat diagram the construction and working of medical linear accelerator.
6. Briefly describe Electronic portal imaging devices.
7. Briefly describe MLC, its composition and its properties.
8. Explain the differences between 3DCRT, IMRT, IGRT.

QP CODE:

Reg. No.....

Name.....

THIRD YEAR B.Sc. (MRT) DEGREE EXAMINATION.....20

Paper XV

RADIOLOGICAL PROTECTION AND STATUTORY ASPECTS

Time 3 Hours

Max Marks: 100

Answer all questions

Draw Diagrams wherever necessary

Essays:

(2x20 = 40)

1. Define HVL and TVL and derive the relation between them.
2. What are the different types of Collimators used in Gamma camera? Explain in detail with diagram.

Write briefly:

(6x10=60)

3. Short notes on
 - a) Explain the principle of SPECT
 - b) What is RIA
4. Write short notes on
 - a) Pocket dosimeters
 - b) Film badges
5. Distinguish between tissue weighting factors and radiation weighting factors.
6. Draw a LINAC room layout and label it.
7. Discuss various methods for reducing patient exposures in Diagnostic Radiology
8. What are the requirements of radionuclides used in Nuclear Medicine? 12. Quality assurance of Teletherapy units – Cobalt and LINAC

3.7 Internal assessment component

Sl. No	Items	Maximum. Marks	Split up
1	Attendance	5	96% and above - 5 marks 92.1% – 95.9% - 4 marks 88.1% – 92% - 3marks 84.1% – 88% - 2marks 80% - 84% - 1mark-
2	Assignments	20	Must be handwritten. Valuation is based on content, presentation, and originality. Plagiarism will not be accepted and treated seriously and those assignments will be rejected.
4	Class tests	25	The affiliated colleges shall conduct at least three internal examinations/tests in each subject. Marks in best out of 2 examinations shall be taken for internal assessment. However model examination is mandatory to conduct.
TOTAL		50	

The maximum marks of internal assessment in each paper will be 50. Those who obtain 50% of aggregate in each subject only, will be eligible for appearing the university examinations. The class average shouldn't exceed 75%. The internal assessment marks should be intimated to the University along with the attendance and application.

3.8 Details of practical/clinical practicum exams

See clause 3.3

3.9 Number of examiners needed (Internal & External) and their qualifications

See clause 2.16 and 5.2 (annexure)

3.10 Details of viva voce: division of marks

See clause 3.3



4. INTERNSHIP

Not applicable

5. ANNEXURES

5.1 Check Lists for Monitoring: Seminar Assessment etc. to be formulated by the curriculum committee of the concerned Institution

5.2 Institutional Requirements

1. The institution and the Departments

The Institution should have well-established Departments of Radiotherapy with facilities, Nuclear Medicine, Diagnostic Radiology Department having CT and MRI and Medical/Radiation Physics facilities with all radiation measuring tools required for calibration of equipment and radiation protection.

	Facility		Numbers
Radiation Physics	Lab facilities for Quality Assurance (with RFA, Survey meters etc.)		1
Radiotherapy	Teletherapy (Cobalt 60/LINAC)		1
	Brachytherapy (Manual/remote after loading systems)		1
	CT simulator		1
	Treatment planning system		1
	Professor	1	
	Associate Professor	1	
	Assistant Professor	1	
	Assistant Professor (Radiation Physics)	1	
	Radiographic technicians (for every machine)	2 each	
	Tutors/Registrars	2	
	Storekeeper	1	
	Stenographers	1	

	Record clerk	1		
Radiodiagnosis	MRI (1.5 Tesla)		1	
	CT Scanner		1	
	Mammography Unit		1	
	800mA (80kW) Radiography-Fluoroscopy unit (Digital/IITV)		1	
	500mA Radiography unit		1	
	300mA Radiography unit		2	
	Mobile X Ray Unit		2	
	Ultrasonography Machine (Basic)		2	
	Ultrasonography Machine (with colour Doppler)		1	
	Store room for X-Ray films and related material (15 Sq.m.)			
	Professor	1		
	Associate Professor	1		
	Assistant Professor [with MD/MSc MRT having 3 years teaching experience]	1		
	Radiographic technicians (for every machine)	2 each		
	Tutors /Registrars [with BSc MRT]	2		
	Dark room assistant	2		
	Storekeeper	1		
	Stenographers	1		
	Record clerk	1		
Nuclear Medicine	Gamma Camera		1	
	Radio Iodine therapy Unit		1	
	Proper licencing of the department.			
Others				
	Attached Hospital (200 bedded for Radiotherapy, Medical and surgical oncology and other specialities taken together)		1	
	Furnished class room with chairs and table (with space adequate to accommodate all students admitted with chairs and space for teaching and also one Table with chair for the teacher)		1	
	The room sizes for various Diagnostic Imaging Systems			

	shall be as per the Provision of the Atomic Energy Regulatory Board.	
	The staff of the department shall be covered by Personal Monitoring System as per BARC regulations.	
	Museum (25 Sq.m) for all departments taken together.	1
	Waiting room for patient, enquiry office and staff rooms shall be provided as per requirement.	
	Library (with two sets of Reference books and journals)	1

2. Teacher Student Ratio

	Teacher : student
Professor/ Associate Professor/Reader	1: 10
Assistant Professor	1: 5
in each of the departments of Radiodiagnosis, Radiotherapy, Radiation physics and Nuclear Medicine taken together.	

Qualification of Teacher, Examiner and Guide.

a) Qualification of Teacher

Acquisition of BSc MRT/ MD/DNB or Master's Degree in the concerned subject, in any Institute or Medical College approved by the Kerala University of Health Sciences and Government of Kerala.

b) Qualification of Examiner

There shall be two examiners for practical and viva voce – one internal and one external. The external examiner shall be drawn from other institutions where a similar course is being conducted. Both internal and external examiners should have MD/DNB or Master's Degree in the concerned subject and those who are full time teachers of Master's Degree in the concerned speciality with at least two years teaching experience in concerned speciality after acquisition of MD/DNB or Master's Degree in the concerned subject. The theory papers should also be evaluated by teachers with above qualifications.

c) Qualification of Guide for Project.

The supervising Teacher should have minimum 3 years full time teaching experience after acquisition of MD/DNB or Master's Degree in the concerned subject.