



GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

RADIOLOGY TECHNICIAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR – HEALTHCARE

RADIOLOGY TECHNICIAN

(Non-Engineering Trade)

(Revised in 2018)

Version: 1.1

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

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Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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S No.	Topics	Page No.
1.	Course Information	1
2.	Training System	2-5
3.	Job Role	6
4.	General Information	7-8
5.	NSQF Level Compliance	9
6.	Learning Outcome	10-11
7.	Learning Outcome with Assessment Criteria	12-17
8.	Trade Syllabus	18-32
9.	Core Skill – Employability Skill	33-37
10.	Annexure I	
	List of Trade Tools & Equipment	38
	List of Tools & Equipment for Employability Skill	39
11.	Annexure II - Format for Internal Assessment	40

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1. COURSE INFORMATION

During one year duration of “Radiology Technician” trade, a candidate is trained on Professional Skill, Professional Knowledge and Employability Skill. In addition to this, a candidate is entrusted to undertake project work, extracurricular activities and on-the-job training to build up confidence. The broad components covered under Professional Skill subject are as below:-

First Year – During this year, the trainee will be able to understand Atomic and nuclear Physics, Electromagnetic radiation and the production of x-ray, construction of modern x-ray tubes and interactions of x-ray with the matter. Identify the x-ray circuit and units, operate the console panel, radiographic grid and beam restricting devices. He will practice radiation protection and operate radiation measuring devices and understand radiotherapy.

The candidate will be able to assemble general & radiographic anatomy, bones, joints and body systems using mannequins and skeleton. He will execute the radiographic and darkroom techniques, perform the radiographic film processing. The trainee will understand the radiographic contrast media and perform the radiographic positioning and special procedures.

Second Year – In this year, the trainee will be able to analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality and also operate MRI scan and perform patient positioning, review protocols for MRI scanning. They will analyze USG scan patient positioning, preparation, techniques general care and also analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality. The trainee will interpret the factors, tools and techniques affecting the radiographic image quality. They will illustrate the general patient care in handling and preparation of patients during radiological examination.

The trainee will be able to select and plan the radiographic calibration and tube rating charts. They will perform and understand emergency conditions and their remedy in medical emergency conditions. Also operation of radiotherapy units and understand basic of human radiobiology, effects of radiation protection in radiotherapy.

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of the economy/ Labour market. The vocational training programs are delivered under the aegis of the National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programs of NCVT for propagating vocational training.

'Radiology Technician' trade under CTS is one of the popular courses delivered nationwide through a network of ITIs. The course is of two-year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) imparts requisite core skill, knowledge and life skills. After passing out of the training program, the trainee is being awarded National Trade Certificate (NTC) by NCVT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;
- Perform tasks with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge & employability skills while performing jobs.
- Perform remedial in medical emergency conditions, undertake radiation protection and operate radiation measuring devices.
- Document the parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS

- Can join Apprenticeship programs in different types of industries leading to a National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming an instructor in ITIs.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years :

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2760
2	Professional Knowledge (Trade Theory)	552
3	Employability Skills	110
5	Library & Extracurricular activities	258
6	Project work	160
7	Revision	160
9	Examination	160
	Total	4160

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of the course and at the end of the training program as notified by the Government of India (GoI) from time to time. The employability skills will be tested in the first year itself.

a) The **Internal Assessment** during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NTC will be conducted by NCVT as per the guideline of Government of India. The pattern and marking structure is being notified by Govt. of India from time to time. **The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check** the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral

attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	<ul style="list-style-type: none"> • Demonstration of good skills and accuracy in the field of work/ assignments. • A fairly good level of neatness and consistency to accomplish job activities. • Occasional support in completing the task/ job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	<ul style="list-style-type: none"> • Good skill levels and accuracy in the field of work/ assignments. • A good level of neatness and consistency to accomplish job activities. • Little support in completing the task/ job.
(c) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	<ul style="list-style-type: none"> • High skill levels and accuracy in the field of work/ assignments. • A high level of neatness and consistency to accomplish job activities. • Minimal or no support in completing the task/ job.

Radiology Technician

Radiology Technician is also referred to as Radiologic technologists, Radiological Technologists and Technicians. Radiology Technicians perform diagnostic imaging examinations such as X-rays, CT and MRI scans under the guidance of a Radiologist. They are responsible for preparing patients and operating equipment for the test, besides keeping patient records and adjusting and maintaining equipment.

X-ray Technician

X-ray Technician; Radiographer; Radiological Assistant takes X-ray skiagraph (Photographs) for diagnosis of ailments or gives ray treatment by operating X-ray equipment and exposing patients to the rays. Prepares or gets patients prepared by Nurse for ray exposure. Regulates duration and intensity of exposure by adjusting machines and exposing patients to rays as directed by the Radiologist. Positions patient on the X-ray couch to ensure correct exposure of the part of the body required to be X-rayed and for ray exposure taking care to protect the patient and themselves from harmful exposure to X-ray. Adjusts X-ray tube at a proper distance and angle, by rotating the pivot, etc. to ensure centering of tube on part of the body to be X-rayed. Regulates controls of X-ray machine or therapy equipment, for duration, intensity of exposure and exposes film or patient to rays as directed by the Radiologist. Removes cassette with exposed film and hands over to Dark Room Assistant where available for developing fixing, washing, Labelling (date and name of patient) etc. Mixes, develops, fixes etc. and processes X-ray films in accordance with techniques and instruction of Radiologist. Keeps records of raw and exposed films, spare parts and of patients X-rayed or treated. May mix developers and process film in accordance with prescribed techniques.

Reference NCO-2015:

- (i) 3211.0101- Radiology Technician
- (ii) 3211.0100 - X-ray Technician

4. GENERAL INFORMATION

Name of the Trade	Radiology Technician
NCO - 2015	3211.0101, 3211.0100
NSQF Level	Level 5
Duration of Craftsmen Training	Two Years
Entry Qualification	Passed 10 th class examination
Unit Strength (No. of Students)	20
Space Norms	75 Sq. m
Power Norms	4.0 KW
Instructors Qualification for:	
(i) Radiology Technician	<p>Degree in Radiology Technician/Radiation therapy technician from recognized engineering College/university with one-year post qualification experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>Diploma in Radiology Technician from recognized board of technical education with two-year post qualification experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>NTC/NAC passed in the Trade of "Radiology Technician" with three-year post qualification experience in the relevant field.</p> <p>Essential Qualification: Craft Instructor Certificate in relevant trade under NCVT.</p>
(ii) Employability Skill	<p>MBA OR BBA with two-year experience OR Graduate in Sociology/ Social Welfare/ Economics with two-year experience OR Graduate/ Diploma with two-year experience and trained in Employability Skills from DGT institutes.</p> <p style="text-align: center;">AND</p> <p>Must have studied English/ Communication Skills and Basic Computer at 12th/ Diploma level and above.</p> <p style="text-align: center;">OR</p> <p>Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes.</p>

List of Tools and Equipment		As per Annexure – I		
Distribution of training on Hourly basis (Indicative only):				
Total Hrs/week	Trade Practical	Trade Theory	Employability Skills	Extracurricular Activity
40 Hours	30 Hours	6 Hours	2 Hours	2 Hours



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5. NSQF LEVEL COMPLIANCE

NSQF level for '**Radiology Technician**' trade under CTS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. Professional Knowledge
- c. Professional Skill
- d. Core Skill
- e. Responsibility

The broad learning outcome of '**Radiology Technician**' trade under CTS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's work and learning.

6. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

6.1 GENERIC LEARNING OUTCOME

1. Apply safe working practices.
2. Comply with environment regulation and housekeeping.
3. Interpret & use company and medical communication.
4. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.
5. Explain energy conservation, global warming and pollution and contribute in day-to-day work by optimally using available resources.
6. Explain personnel finance, entrepreneurship and manage/organize related task in day-to-day work for personal & societal growth.
7. Utilize basic computer applications and internet to take benefit of IT developments in the industry

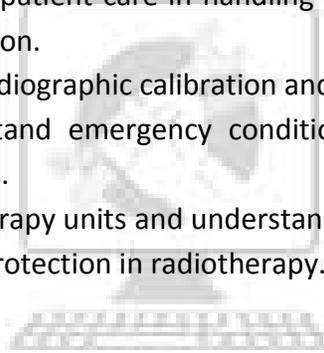
6.2 SPECIFIC LEARNING OUTCOME

First Year

8. Understand Atomic and nuclear physics.
9. Understand Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interaction of x-ray with matter.
10. Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel.
11. Practice radiation protection and operate radiation measuring devices and understand Radio Therapy.
12. Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons.
13. Execute the radiographic and darkroom techniques, perform the radiographic film processing.
14. Understand the Radiographic contrast media and perform the radiographic positioning and special procedures.

Second Year

15. Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality.
16. Operate MRI scan and perform patient positioning, review protocols for MRI scanning.
17. Analyze USG scans patient positioning, preparation, techniques, general care.
18. Analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality.
19. Interpret the factors, tools and techniques affecting the radiographic image quality.
20. Illustrate the general patient care in handling and preparation of patients during radiological examination.
21. Select and plan the radiographic calibration and Tube rating charts.
22. Perform and understand emergency conditions and their remedy in medical emergency conditions.
23. Operation of radiotherapy units and understand the Basics of Human radiobiology, effects of radiation, protection in radiotherapy.



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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Apply safe working practices	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements, and according to policy.
	1.2 Recognize and report all unsafe situations according to policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to work policy and procedures.
	1.4 Identify, handle and store/ dispose of dangerous goods and substances according to policy and procedures following safety regulations and requirements.
	1.5 Identify and observe policies and procedures with regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to accident/injury procedures.
	1.8 Identify and observe evacuation procedures according to site policy.
	1.9 Identify Personal Protective Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first-aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
2. Comply with environment regulation and housekeeping	2.1 Identify environmental pollution & contribute to the avoidance of instances of environmental pollution.
	2.2 Deploy environmental protection legislation & regulations.
	2.3 Take opportunities to use energy and materials in an environmentally friendly manner.
	2.4 Avoid waste and dispose waste as per procedure.
	2.5 Recognize different components of 5S and apply the same in the working environment.
3. Interpret & use company and medical communication.	3.1 Demonstrate use of personal protective dresses.
	3.2 Identify emergency exit route.
	3.3 Demonstrate fire fighting procedure using fire extinguishers.

4. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.	4.1 Explain the concept of productivity and quality tools and apply during execution of job.
	4.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	4.3 Knows benefits guaranteed under various acts.
5. Explain energy conservation, global warming and pollution and contribute in day-to-day work by optimally using available resources.	5.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
	5.2 Dispose waste following standard procedure.
6. Explain personnel finance, entrepreneurship and manage/organize related task in day-to-day work for personal & societal growth.	6.1 Explain personnel finance and entrepreneurship.
	6.2 Explain role of various schemes and institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/non-financing support agencies to familiarize with the Policies/Programmes & procedure & the available scheme.
	6.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
7. Utilize basic computer applications and internet to take benefit of IT developments in the Industry.	7.1 Yearly examination to test knowledge on basic computer working, basic operating system and uses internet services.
	7.2 Their applications will be assessed during execution of assessable outcome.

SPECIFIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
8. Understand Atomic and nuclear physics.	8.1 Identify the basic structure of atom and nuclei.
	8.2 Perform a presentation on atom.
	8.3 Determine the half-life & decay constant for various radioactive materials.
	8.4 Differentiate between the properties of alpha, beta, gamma particles and fusion & fission.
9. Understand Electromagnetic radiation, production of x-ray, construction of modern x-ray tube and Interactions of x-ray with matter.	9.1 Identify the type of radiation based on the Order of wavelengths, frequencies, amplitude and energy.
	9.2 Determine the properties and production of x-rays.
	9.3 Recognize the parts of x-ray tube and their functions.
	9.4 Identify the types of interaction of x-ray with matter and their probability of occurrence.
10. Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel.	10.1 Identify the parts of x-ray circuit and unit.
	10.2 Operate the parts of the control panel.
	10.3 Measure the major parameters responsible for the production of x-ray.
	10.4 Identify and use the beam restricting devices.
	10.5 Check and perform the use of grid devices.
	10.6 Select and choose the grid & the Bucky factor.
11. Practice radiation protection and operate radiation measuring devices and understand Radio Therapy.	11.1 Understand the public & occupational radiation protection.
	11.2 Identify the radiation protection equipments.
	11.3 Measure the dose levels by using dissymmetric instruments.
	11.4 Check and calculate the accuracy of different radiation safety equipments.
	11.5 Compute the dose measurement and dose limits.
	11.6 Identify the type of therapy.
	11.7 Identify the various types of machines used in radiotherapy.
12. Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons.	12.1 Identify the bones, joints, muscles and their types.
	12.2 Analyze the body positions, planes and movements.
	12.3 Identify the different body organs and cavities.
	12.4 Perform the general radiographic positioning.
	12.5 Perform and select the darkroom techniques.

13. Execute the radiographic and darkroom techniques, perform the radiographic film processing.	13.1	Identify the types of x-ray film, screen and cassettes.
	13.2	Prepare the x-ray film processing chemicals.
	13.3	Perform the use of x-ray film, screen and cassettes.
	13.4	Execute the handling and storage of radiographic film, screen and cassettes.
14. Understand the Radiographic contrast media and perform the radiographic positioning and special procedures.	14.1	Identify the difference between ionic and non-ionic contrast media.
	14.2	Perform and select the contrast for appropriate examination and care during contrast injection.
	14.3	Perform the routine radiographic positioning.
	14.4	Select the correct radiographic technical factors and analyze the x-ray film for image quality.
	14.5	Perform the radiographic positioning of special patients.
	14.6	Perform the radiographic procedures with appropriate techniques, patient care and handling.
SECOND YEAR		
15. Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality.	15.1	Perform the patient positioning correctly for a CT scan.
	15.2	Illustrate the use of contrast medium in CT.
	15.3	Operate CT console for selection of suitable technical factors and protocols.
	15.4	Illustrate the radiographic appearance of both normal and abnormal conditions.
16. Operate MRI scan and perform patient positioning, review protocols for MRI scanning.	16.1	Perform the patient positioning correctly for MRI scan.
	16.2	Identify the use of contrast medium in MRI scan.
	16.3	Operate MRI console for selection of suitable technical factors and protocols.
	16.4	Illustrate the radiographic appearance of both normal and abnormal conditions.
	16.5	Plan general safety rules in MRI practice.
17. Analyse USG scan patient positioning, Preparation, techniques, general care.	17.1	Understand the USG techniques.
	17.2	Illustrate the use of contrast medium in USG.
	17.3	Perform the patient positioning and preparation correctly for USG scan.
	17.4	Understand the USG Doppler techniques.
18. Analyze working of CR,	18.1	Operate CR, DR and Fluoroscopy system.

DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality.	18.2	Illustrate the difference between the working of CR, DR and Fluoroscopy system.
	18.3	Compare the technical factors in the operation of different digital modalities.
	18.4	Analyze the scanned images to determine image quality and clarity.
	18.5	Care and maintenance of CR, DR and Fluoroscopy system.
19. Interpret the factors, tools and techniques affecting the radiographic image quality.	19.1	Understand radiographic quality, resolution, noise and speed.
	19.2	Differentiate between the geometric factors affecting radiographic quality.
	19.3	Analyze the subject factors affecting radiographic quality.
	19.4	Analyze the tool and technique available to create high quality films.
20. Illustrate the general patient care in handling and preparation of patients during radiological examination.	20.1	Execute and schedule patient-load based on emergency or appointment priority.
	20.2	Perform documentation required for medical history, procedures.
	20.3	Understand how to manage a patient with contrast media.
	20.4	Understand care and handling of patients in special cases.
21. Select and plan the radiographic calibration and tube rating charts.	21.1	Understand and sketch tube rating charts.
	21.2	Assess application of tube rating charts in radiology.
	21.3	Illustrate the radiographic calibration.
22. Perform and understand emergency conditions and their remedy in medical emergency conditions.	22.1	Plan and perform the first aid in required conditions.
	22.2	Perform & operate the BP machine.
	22.3	Calculate & analyzes the heart rate.
	22.4	Select & perform the techniques of Bandage & dressings.
	22.5	Plan & perform the energy treatment, according to the conditions.
23. Operation of radiotherapy units and understand basic of human radiobiology, effects of radiation, protection in radiotherapy.	23.1	Identify the types of biological effects.
	23.2	Identify the different types of radiotherapy units.
	23.3	Operate the radiotherapy units.
	23.4	Execute planning set up for radiotherapy examination.
	23.5	Perform shielding methods for radiotherapy.
	23.6	Understand working and construction of LINAC.
	23.7	Calculate relative biological effectiveness and LET.

	23.8 Execute the treatment planning.



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SYLLABUS – RADIOLOGY TECHNICIAN			
FIRST YEAR			
Week No.	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
1-3	<ul style="list-style-type: none"> Understand atomic and nuclear physics. 	<ol style="list-style-type: none"> Demonstrate atomic and nuclear structure through Videos and models (12hrs) Understand and sketch of Rutherford's x-ray scattering experiment and relate it to Thomson's model of the atom. (23hrs) Practice and represent graphically the energy level diagram.(18hrs) Illustrate the property of alpha, beta and gamma radiation, though videos. (20hrs) Relate the half-life of different radioactive material by the help of decay curve.(17hrs) 	Atomic and Nuclear Structure. Rutherford Bohr Model. Atomic Number. Mass Number. Atomic Mass. Binding energy, Energy level, Nuclear binding energy. NP ratio. Definition of radioactivity. Natural radioactivity. Radioactive decay. Half-life. Decay constant. Mean life and their relation. Specific activity. Properties of Alpha, Beta and gamma radiations. Properties of Radium and its daughter products. Radioactivity equilibrium. Units of activity, specific gamma ray constant. Fusion and fission.
4-7	<ul style="list-style-type: none"> Understand Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter. 	<ol style="list-style-type: none"> Demonstrate different types of radiation through videos.(12hrs) Demonstrate and sketch the EMR spectrum.(12hrs) Compute the frequency of oscillation by rope.(12hrs) Illustrate the different parts of x-ray machine.(18hrs) Practice the x-ray component with the help of sketch.(12hrs) Evaluate total filtration of an x-ray tube using HVL method.(18hrs) Check the alignment of radiation 	Definition of radiation and its types, electromagnetic radiation, Radiation as a wave-motion, wavelength, frequency Magnitude, velocity and their relations, electromagnetic spectrum, common properties of electromagnetic radiation. X-ray:principles of

		<p>beam using beam alignment test tool.(17hrs)</p> <p>13. Understand x-ray interaction with matter, ionization and excitation.(19hrs)</p>	<p>production of x-ray, intensity, continuous and characteristic spectrum. Construction of Modern X-ray tubes, filaments, and cathode, methods of cooling anode, Inherent filtration, added filtration and their effect on quality of the spectrum. Interaction of X-ray and gamma ray with matter, Ionization & excitation. Modes of interactions.</p>
8-10	<ul style="list-style-type: none"> Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel. 	<p>14. Execute the operation of the x-ray circuit, controlling of different parameters. (18hrs)</p> <p>15. Check KVP accuracy, using the digital KVP meter.(12hrs)</p> <p>16. Measure effective focal spot size of x-ray tube using bas pattern test tool. (14hrs)</p> <p>17. Test the alignment of grid using grid alignment test tool.(13hrs)</p> <p>18. Check the consistency of timer.(11hrs)</p> <p>19. Check the consistency of mA loading stations. (12hrs)</p> <p>20. Check the consistency of x-ray tube output.(10hrs)</p>	<p>Focal spot, tube holders, grid ratio in relation to KV. Reciprocating and oscillating Grid. Potter Oscillating grid. Potter Bucky Diaphragms, Stationary grids. Control of scattered radiation, beam modification devices. Diagnostic H.T. Circuits, High tension generators, Half wave & full wave rectifiers. Three-phase circuits. Constant voltage regulator H. T. switches, measuring Instruments voltmeter, mill-ampere meter Control of scattered Radiation, beam modification devices.</p>
11-14	<ul style="list-style-type: none"> Practice radiation protection and operate radiation measuring devices and understand Radio 	<p>21. Compute the intensity of x-ray by using the inverse square law. (15hrs)</p> <p>22. Predict the radiation level in the vicinity of exposure area by using survey meter.(20hrs)</p>	<p>Radiation protection:code of practice for the protection of person against ionizing radiation,</p>

	Therapy.	<p>23. Check the accuracy of lead aprons by using survey meters.(18hrs)</p> <p>24. Test and calculate the thickness of protective barrier.(17hrs)</p> <p>25. Calculate the entrance surface dose by using water phantom.(17hrs)</p> <p>26. Measure the personnel dose on different modalities by using personal dosimeters. (16hrs)</p> <p>27. Understand and sketch the treatment units, simulators and making of thermoplastic mould of radiotherapy. (17hrs)</p> 	<p>protective, material, head, lead equipment building material, personnel monitoring, international-recommendations against hazards in ionizing radiation (internal and external). Units of Dose limit, ALARA Principle, Operational dose limits for radiation workers and public. Calculation of Barrier thickness, Film badges and TLD Badges, Survey meters, Gamma zone monitors, Pocket Dosimeter (Basic Principle).Basic of radiotherapy. General patient care.</p>
15-23	<ul style="list-style-type: none"> Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons. 	<p>28. Practice the region of body by using mannequins.(23hrs)</p> <p>29. Identify and place the bone & joint by using a skeleton. (23hrs)</p> <p>30. Practice the radiographic positioning on x-ray table.(25hrs)</p> <p>31. Identify and place the body organs by using mannequins and also relate their surface anatomy.(23hrs)</p> <p>32. Practice on radiographic and darkroom techniques.(18hrs)</p> <p>33. Check the safeness of safe light by performing the coin test.(22hrs)</p> <p>34. Check proper film screen contact by using wire mesh method.(19hrs)</p> <p>35. Identify the size of x-ray film and</p>	<p>i) Cell-Types, structure, function, reproduction, structure of general tissues.</p> <p>ii) General anatomy – language of anatomy: position, planes, terms in relation to various regions and movements, term used to describe the bone features. General terminology.</p> <p>iii) Skeleton: classification of bone and cartilage. Joints and their classification. Types of</p>

	<ul style="list-style-type: none"> Execute the radiographic and darkroom techniques, perform the radiographic film processing. 	<p>cassette.(15hrs)</p> <p>36. Perform a workshop to prepare processing chemicals and check the PH value.(22hrs)</p> <p>37. Practice the general cleaning and care of screen & cassette.(24hrs)</p> <p>38. Measure the sensitivity and density of x-ray film by using densitometer & sensitometer. Plot the H&D curve.(24hrs)</p> <p>39. Analyze the luminescence property of IF screen.(15hrs)</p> <p>40. Identify the radiographic image artifacts.(17hrs)</p> 	<p>muscles.</p> <p>iv) General introduction of body systems-nervous, circulatory, lymphatic. Skin fasciae.</p> <p>v) Radiographic anatomy and positioning terminology. Radiographic projections. Topographic landmarks of radiography.</p> <p><u>Radiographic Photographic and Dark room technique-</u> X-ray dark room construction, radiographic films- types, characteristics, handling and storage. Intensifying screens- construction types, characteristics, screen film combination, care and maintenance. X-ray cassettes: construction, types and general care.</p> <p>The development of radiographic film, processing chemistry, components of the automatic processor, alternative processing methods.</p>
24	<p>Project work/ Industrial visit/prepare reports</p> <p>Broad Areas:</p> <ol style="list-style-type: none"> Alpha, beta and gamma radiation X-ray machine Radiation beam Kilo Peak Voltage meter and exposure time Thermoplastic mould of radiotherapy X-ray film and cassette 		

25-26	Revision		
27-49	<ul style="list-style-type: none"> Understand the Radiographic contrast media and perform the radiographic positioning and special procedures. 	<ol style="list-style-type: none"> 41. Understand the type of contrast.(27hrs) 42. Perform and practice the ECG.(30hrs) 43. Perform and practice the radiographic positioning of the chest.(28hrs) 44. Perform and practice the radiographic positioning of the upper extremity. (27hrs) 45. Perform and practice the radiographic positioning of the lower extremity. (30hrs) 46. Perform and practice the radiographic positioning of the vertebral column. (35hrs) 47. Perform and practice the radiographic positioning of the digestive system.(35hrs) 48. Perform and practice the radiographic positioning of the urinary system. (35hrs) 49. Perform and practice the radiographic positioning of the skull. (35hrs) 50. Perform and practice the radiographic positioning of the breast.(34hrs) 51. Perform and practice the radiographic positioning of special patient.(40hrs) 52. Perform and practice the radiographic special procedures of G.I system- barium swallow, barium meal barium meal follow through, Enteroclysis, barium enema, Hypotonic duodenography. (38hrs) 53. Perform and practice the radiographic special procedures of Biliary system- Cholecystography, Cholangiography, T-tube, cholangiography ERCP, PTC, splenoportovenograp.(40hrs) 54. Perform and practice the 	<p>Contrast media:classification, chemistry, physiology, toxicity, mild, moderate severe reactions. Contrast media used in X-RAY ultrasound, CT and MRI.</p> <p>Systemic Anatomy and physiology- Circulatory system: blood, plasma, blood cells, blood groups, clotting mechanism, blood vessels, heart (circulation, nerve supply, function cardiac cycle), ECG, blood pressure, blood volume, aorta.</p> <p>Respiratory system: nose, pharynx, larynx, trachea, bronchi, lungs, pleura, blood supply of lungs, physiology of respiration, lung volume and capacities, gas transport in the blood.</p> <p>Digestive system: mouth and esophagus, salivary glands, stomach, small intestine, large intestine, liver, pancreas, gall bladder, general principle of digestion.</p> <p>Excretory system: functional anatomy of kidney, functions, formation and excretion of urine, nephrons, ureters, urinary bladder, urethra, micturition.</p> <p>Male Reproductive System: testes, scrotum,</p>

		<p>radiographic special procedures of Circulatory and lymphatic system: angiography Lymphangiography. (37hrs)</p> <p>55. Perform and practice the radiographic special procedures of Special sense- dacrocystography. (28hrs)</p> <p>56. Perform and practice the radiographic special procedures of Female reproductive- hysterosalpingography placentography. (40hrs)</p> <p>57. Perform and practice the radiographic special procedures of Excretory system- MCU, RGU, AGP, RGP, IVP, IVU. (45hrs)</p> <p>58. Perform and practice the radiographic special procedures of Brain- ventriculography cerebral angiography myelography. (40hrs)</p> <p>59. Perform and practice the radiographic special procedures of Mammary gland- Mammography. (36hrs)</p> <p>60. Perform and practice the radiographic special procedures of Joint-arthrography. (30hrs)</p>	<p>spermatic cord, spermatogenesis, epididymis, prostate, seminal vesicles, vas deferens.</p> <p>Female reproductive system: ovaries, fallopian tubes, uterus, vagina, perineum, female reproductive cycle, oogenesis.</p> <p>Lymphatic system: lymphatic organs, lymph, lymph nodes, lymphatic vessels and circulations.</p> <p>Endocrine glands: pituitary, adrenal, thyroid, pancreas and gonads (secretions and functions)</p> <p>Nervous system: function, nerve cells and nerve fibers, nerve impulse, central nervous system (CSF, brain and its parts, spinal cord), peripheral nervous system (cranial nerves), automatic nervous system (sympathetic and parasympathetic)</p> <p>The sensory system: skin and its layers, eye and structure of eye, optic nerves, physiology of vision, function of retina, ear and physiology of hearing, nose and tongue.</p> <p>Radiographic procedures: G.I SYSTEM barium suspension, barium swallow, barium</p>
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			<p>meal and barium meal follow through, enteroclysis, barium enema, and hypotonic duodenography.</p> <p>Respiratory system- bronchography, artificial pneumothorax.</p> <p>Biliary system- cholecystography, cholangiography, T-tube cholangiography, ERCP, PTC, splenoportovenography.</p> <p>Salivary gland- sialography.</p> <p>Circulatory and lymphatic system: angiography, lymphangiography.</p> <p>Special sense- dacryocystography.</p> <p>Female reproductive- hysterosalpingography, placentography.</p> <p>Excretory system- MCU & RGU, AGP, RGP, IVP, IVU.</p> <p>Brain- ventriculography, cerebral angiography, myelography.</p> <p>Mammary gland- mammography.</p> <p>Joint-arthrography.</p>
50	<p>Project work/ Industrial visit/Reports</p> <p>Broad Areas:</p> <ol style="list-style-type: none"> Electrocardiogram Radiographic positioning Radiographic special procedures of excretory system MCU, RGU, AGP, RGP, IVP, IVU 		
51	Revision		
52	Examination		

SYLLABUS – RADIOLOGY TECHNICIAN			
SECOND YEAR			
Week No.	Reference Learning outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
53-62	<ul style="list-style-type: none"> Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality. 	<p>61. Prepare the room, apparatus and instruments for CT scan. (15 hrs)</p> <p>62. Set up the CT scan machine and preparation of the patient for the procedure. (20 hrs)</p> <p>63. Position the patient correctly for the following CT positions:</p> <ol style="list-style-type: none"> Supine Prone Lateral Oblique(30 hrs) <p>64. Illustrate the relative position for CT tube and the patient for the relevant exposure factors related to these. (20 hrs)</p> <p>65. Understand the CT components. (12 hrs)</p> <p>66. Execute the use of contrast material for a CT scan and how to administer them under supervision of a radiologist. (20 hrs)</p> <p>67. Illustrate the radiographic appearance of CT both normal and common abnormal conditions. (15 hrs)</p> <p>68. Plan and apply radiation protection and principles code of practice. (14 hrs)</p> <p>69. Practice the routine procedures associated with</p>	<p>CT-SCAN: Principle, equipments, Generation, scan parameters, Image reconstruction, Image display, Image Quality, artefacts, control console etc.</p> <p>Recent in advancement in CT:</p> <ul style="list-style-type: none"> PET-CT SPECT CT-Biopsy CT-Angiography CT-Special Procedures <p>MRI- SCAN: Basic physics, principles, NMR, Image processing and display, safety, artifacts.</p> <p>MRI Recent Advancements:</p> <ul style="list-style-type: none"> Dynamic MR MR Angiography MR Urography MR Venography MRCP PET MRI Cardiac MR (Basics only)

	<ul style="list-style-type: none"> Operate MRI scan and perform patient positioning, review protocols for MRIscanning. 	<p>maintenances of imaging and processing systems. (20 hrs)</p> <p>70. Perform and practice the protocols for the CT scanning. (15 hrs)</p> <p>71. Understand the recent techniques of CT scan. (18 hrs)</p> <p>72. Understand the types of artefact on CT image.(18 hrs)</p> <p>73. Prepare the room, apparatus and instruments for MRI Scan. (08 hrs)</p> <p>74. Set up the MRI scan machine and preparation of the patient for the procedure. (10 hrs)</p> <p>75. Understand the MRI components.(15 hrs)</p> <p>76. Execute the use of contrast material for an MRI scan and how to administer them under supervision of a radiologist. (10 hrs)</p> <p>77. Illustrate the radiographic appearance of MRI both normal and common abnormal conditions.(15 hrs)</p> <p>78. Plan and perform the MRI safety. (10 hrs)</p> <p>79. Understand the MRI, recent techniques. (15 hrs)</p>	
63-66	<ul style="list-style-type: none"> Analyze USG scans patient positioning, preparation, techniques, general care. 	<p>80. Prepare the room, apparatus and instruments for USG scan. (25 hrs)</p> <p>81. Select and perform the appropriate USG techniques.(20 hrs)</p> <p>82. Documentation required of medical history of patient, procedure undertaken and reports.(30 hrs)</p>	<p>USG:</p> <p>Physics, basic principle, Techniques, equipments Processing, Piezo-electricity. Application safety. Ultrasonography Recent Advancement:</p> <ul style="list-style-type: none"> 3-D/4-D USG Doppler

		<p>83. Plan and perform the care of USG equipments (transducer). (30 hrs)</p> <p>84. Illustrate the techniques and general patient care during mammography. (15 hrs)</p>	<ul style="list-style-type: none"> • Colour Flow Imaging Doppler • US Guided Biopsy (Basics only) <p>Mammography: tube techniques, patient care, recent advancement.</p>
67-70	<ul style="list-style-type: none"> • Analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality. 	<p>85. Understand the construction and working of CR system. (20 hrs)</p> <p>86. Select the required exposure factor for the CR examination. (30 hrs)</p> <p>87. Understand the construction and working of DR system. (20 hrs)</p> <p>88. Evaluate the quality of digital image quality. (10 hrs)</p> <p>89. Understand the construction and working of fluoroscopy system. (25 hrs)</p> <p>90. Select the required exposure factor for the fluoroscopic examination. (15 hrs)</p>	<p>Computed Radiography: Construction of PSP plate, detectors, screen films, cassettes, methods of display, image quality</p> <p>Digital Radiography: films, detectors, TFC, CCD, direct and indirect radiography. Artefacts and image quality.</p> <p>Fluoroscopy: Image intensifier, spot film devices, details & devices</p>
71-73	<ul style="list-style-type: none"> • Interpret the factors, tools and techniques affecting the radiographic image quality. 	<p>91. Understand the factors affecting the radiographic image quality. (22 hrs)</p> <p>92. Understand the effect on image due to variation in focal object distance, object film distance, exposure angle, due tube movement pattern. (18 hrs)</p> <p>93. Understand the technical aspect of quality assurance. (20 hrs)</p> <p>94. Understand the quality</p>	<p>Radiographic Image: Radiographic factors affecting image contrast and sharpness, Variation in exposure time in accordance with quality of radiation, filters, distance, Intensifying screen, grid, film speed, developer and development. Characteristic curve.</p> <p>Identification of films, film cutters, Trimmers, corner cutters, viewing box, illuminators, projector, portable units, image intensifier (Basics only)</p>

		assurance of the related equipments and its benefits with respect to visual assessment. (30 hrs)	
74-75	<ul style="list-style-type: none"> Illustrate the general patient care in handling and preparation of patients during radiological examination. 	95. Understand the internal procedures and policies on safety precaution to be taken when operating radiological equipment. (10 hrs) 96. Illustrate the scheduling, treatment, room assignment and workload responsibilities with employee's co-workers. (14 hrs) 97. Plan the emergency trolley. (10 hrs) 98. Practice and perform the method of patient care and handling. (16 hrs) 99. Practice and perform the patient care in ICU, OT and NICU. (10 hrs)	General patient care: responsibilities of radiographer, legal, medico legal and ethical responsibilities. Penalties for misconduct and malpractice. Emergency drugs and trolley. Patient preparation for radiographic examinations. Patient care for paediatric patient, pregnant, comatose, ICU, OT, NICU, emergency. Method of patient shifting and handling. Care of special patients.
76	Project work/ Hospital visit/Reports Broad Areas: <ol style="list-style-type: none"> Room aperture and instruments for CT scan CT scan machine and the patient for the procedure. USG equipments MRI safety Quality of digital image 		
77-78	Revision		
79-80	<ul style="list-style-type: none"> Select and plan the radiographic calibration and Tube rating charts. 	100. Understand and sketch tube rating charts. Radiographic calibration. (30 hrs) 101. Understand methods of radiographic calibration. (30 hrs)	Care and maintenance of equipment General principles and routine use of charts supplied by manufacturer, Radiographic calibration procedure, Tube rating chart.
81-83	<ul style="list-style-type: none"> Perform and understand emergency conditions and 	102. Understand basics of first aid. (12 hrs) 103. Practically understand how to tie a tourniquet to a	First Aid: Shock, convulsion, asphyxia, artificial respiration, Administration of Oxygen, Burns

	<p>their remedy in medical emergency conditions.</p>	<p>patient. (14 hrs)</p> <p>104. Practically understand how to measure BP. (10 hrs)</p> <p>105. Perform and execute how to administer oxygen to in case of respiratory emergency. (20 hrs)</p> <p>106. Perform how to calculate pulse rate. (10 hrs)</p> <p>107. Perform techniques of application of bandages and dressing of wounds. (14 hrs)</p> <p>108. Understand how to prepare a first aid kit. (10 hrs)</p>	<p>Electric shock & burns, wound, haemorrhage, pressure points, Tourniquet. Injuries to bone joints and muscles. Dressing or bandages, Plaster of Paris technique, splints, Drug reaction, Poisons.</p>
<p>84-101</p>	<ul style="list-style-type: none"> Operation of radiography units and understand basic human radiobiology, effects of radiation, protection in radiotherapy. 	<p>109. Basic Familiarization (along with Doctor). (20 hrs)</p> <p>110. Demonstration of Patient treatment Telecobalt unit & Linear Accelerator using different treatment techniques. (25 hrs)</p> <p>111. Calculate the fetal dose limit of a pregnant female. (15 hrs)</p> <p>112. Plot cell survival curves to understand relationship between no. of cell survival and radiation exposure. (30 hrs)</p> <p>113. Plot cell survival curves to understand the effect of the Cell survival curves of oxygen, LET, and cell cycle, sub lethal damage. (12 hrs)</p> <p>114. Understand the effect of radiation on cell through</p>	<p>Radiotherapy</p> <p>i) Elementary Pathology- Health and disease. Degeneration, repair of wounds, inflammation, infection, immunity.</p> <p>ii) Tumors - Definitions, Classifications, causes, spread, General effects.</p> <p>iii) Methods of diagnosis (Elementary principles)- Clinical, Radiographic, histological and biochemical methods.</p> <p>iv) Treatments - Radical and Palliative, treatment. General Principles of medical, surgical, radio therapeutic methods, including anti-cancer drugs, hormones.</p> <p>v) Biological effects of radiation: Physical and chemical effects of radiation, General effects</p>

		<p>video. (12 hrs)</p> <p>115. Understand the effect of radiation on DNA through video. (16 hrs)</p> <p>116. Plot a curve between RBE and LET and understand it. (14 hrs)</p> <p>117. Operate pocket dosimeter for the calculation of instant radiation dose. (20 hrs)</p> <p>118. Understand radiotherapy units. (12 hrs)</p> <p>119. Dosimetric calculation for different protocols of cancer treatment.(18 hrs)</p> <p>120. Calculation methods applied in the studies of cancer surviving patients. (22 hrs)</p> <p>121. Measurement of output from teletherapy installation. (16 hrs)</p> <p>122. Understand calibration procedure for measuring and monitoring instruments. (16 hrs)</p> <p>123. Understand AERB safety codes. (14 hrs)</p> <p>124. Execute shielding in radiotherapy room.(16 hrs)</p> <p>125. Calculate the thickness of protective barriers in radiology room by HVL method. (18 hrs)</p> <p>126. Plan patient set up for teletherapy. (18 hrs)</p> <p>127. Measurement and calculation of depth dose.</p>	<p>on cells and tissues. Recovery, sensitivity. Special effects on skin, mucous membrane, bone, lymph nodes, bone marrow, blood, eyes, Gonads, spinal cord, lung. Effects of acute and chronic exposures. Whole body effects, radiation syndrome-Lethal dose.</p> <p>vi) Factors modifying Radiation effect- Dose, Type of radiation, area, Volume, total time and Fractionation of treatment. Local factors in tissue and tumors -type, site, blood supply,Oxygenation, infection, previous treatment. Constitutional factors-age, state of health.</p> <p>vii) Clinical aspects of radiation reaction - care of patients undergoing radiotherapy (including the use of blood counts). Care of reactions. Consequence of technical errors.</p> <p>viii) Absorption of X Rays and Gama Rays, Linear attenuation coefficient, Mass, Atomic absorption coefficient. Energy transfer and absorption co-efficient.</p> <p>ix) Measurement of X rays and Gamma rays-Ionizing process.Exposures. Absorbed dose- and its units - rad, Gy, principles of measurement- ionization, photographic, Scintillation, thermo luminescent etc. Ionization chambers. Measuring instruments.</p>
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		<p>(15 hrs)</p> <p>128. Plan radiation protection survey in and out of radiotherapy premises. (16 hrs)</p> <p>129. Plan patient set up for brachytherapy. (14 hrs)</p> <p>130. Understand various simulation techniques (localization x rays, barium swallow, etc.) (18 hrs)</p> <p>131. Plan radiological survey of radiotherapy equipments. (16 hrs)</p> <p>132. Preparation of POP moulds. Preparation of acrylic moulds. (13 hrs)</p> <p>133. Graphical demonstration of iso-dose curves. (12 hrs)</p> <p>134. Preparation of mantle blocks. (08 hrs)</p> <p>135. Patient setup in different radiotherapy techniques. (16 hrs)</p> <p>136. Plan treatment via computer. (14 hrs)</p> <p>137. Understand calibration of tele cobalt unit. (12 hrs)</p> <p>80. Plan and execute quality assurance for telecobalt machine. (15 hrs)</p> <p>138. HDR brachytherapy unit-programming and source loading/unloading.(16 hrs)</p> <p>139. Understand care of applicators used in brachytherapy. (14 hrs)</p> <p>140. Execute CT simulation planning. (12 hrs)</p>	<p>Dosimeters. Quality of radiation, Half value layer, etc.</p> <p>x) Radiotherapy treatment machines:Telecobalt units, Linear accelerators, Brachy therapy units, Simulator,TPS etc.</p> <p>xi) Radio therapeutic practices:</p> <p>a) Teletherapy calculations: SSD and SAD techniques. Use of charts and graphs for free air dose rate, back scatter factors, percentage depth dose, tissue air ratio, equivalent squares, wedges and compensator.</p> <p>b) Planning procedures: Construction of contour diagrams for plans. Tumor localization, field selection. Use of Isodose curves on body contours. Estimation of dose at different depth within the tissue using curves, tissue inhomogeneity correction, correction for curvature of body contour.</p> <p>c) Treatment techniques-treatment techniques commonly used in lesions of skin, breast, pelvis, abdomen, thorax, spine, gland areas, limbs, larynx, ant rum, nasopharynx, testis, bladder, penish, tonsil, tongue, etc. The use of single and multiple field arrangements, wedge filters, compensators, breast device, ROT, ARC, SKIP techniques etc.</p>
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		141. Understand procedure to be followed in source stuck situations. (15 hrs)	d) Branchy therapy Procedure: Definitions Types, intracavitary, Interstitial, Mould Intraluminal. Different Dosage systems. Sources used in Branchy therapy. Radiographic verifications. Superficial beta-ray applications. Mould room procedures, construction of moulds.
102	Project work/ Hospital visit Broad Areas: a) Tube rating charts and radiographic calibration b) Blood Pressure measurement c) CT simulation planning d) Cell survival curves and radiation exposure e) Pocket dosimeter f) Calibration of instruments		
103	Revision		
104	Examination		

Note:

1. Some of the sample project works (indicative only) are given at the mid and end of each year.
2. The instructor may design their own project and also inputs from local industry may be taken in designing such new project.
3. The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned to a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit a project report.
4. If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.

9. SYLLABUS - CORE SKILLS

CORE SKILL – EMPLOYABILITY SKILL	
Duration – 110 hrs.	
1. English Literacy	Duration : 20 hrs Marks : 09
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking/ Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on known people, picture reading, gain confidence through role- playing and discussions on current happening, job description, asking about someone's job, habitual actions. Cardinal (fundamental) numbers, ordinal numbers. Taking messages, passing on messages and filling in message forms, Greeting and introductions, office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
2. IT Literacy	Duration : 20 hrs Marks : 09
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of the computer.
Computer Operating System	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc. Use of Common applications.
Word Processing and Worksheet	Basic operating of Word Processing, Creating, Opening and Closing Documents, Use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & Creation of Tables. Printing

	document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.
Computer Networking and Internet	Basic of Computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, WebSite, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills	
	Duration : 15 hrs Marks : 07
Introduction to Communication Skills	Communication and its importance Principles of effective communication Types of communication - verbal, non-verbal, written, email, talking on phone. Non-verbal communication - characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening, guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active listening skills.
Motivational Training	Characteristics essential to achieving success. The power of positive attitude. Self awareness Importance of commitment Ethics and values Ways to motivate oneself Personal goal setting and employability planning.
Facing Interviews	Manners, etiquettes, dress code for an interview Do's & don'ts for an interview

Behavioral Skills	Problem solving Confidence building Attitude
4. Entrepreneurship Skills	
Duration : 15 hrs Marks : 06	
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises: Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & record, Role & function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.
Project Preparation & Marketing Analysis	Qualities of a good entrepreneur, SWOT and risk analysis. Concept & Application of PLC, Sales & Distribution management. Difference between small scale & large scale business, Market survey, Method of marketing, Publicity and advertisement, Marketing mix.
Institution's Support	Preparation of project. Role of various schemes and institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarize with the policies / programmes, procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop act, Estimation & costing, Investment procedure - Loan procurement - Banking processes.
5. Productivity	
Duration : 10 hrs Marks : 05	
Benefits	Personal/ Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working aids, Automation, Environment, Motivation - How it improves or slows down productivity.
Comparison with Developed Countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in select industries, e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and insurance.
6. Occupational Safety, Health and Environment Education	
Duration : 15 hrs Marks : 06	
Safety & Health	Introduction to occupational safety and health Importance of safety and health at workplace.

Occupational Hazards	Basic hazards, chemical hazards, vibroacoustic hazards, mechanical hazards, electrical hazards, thermal hazards. occupational health, occupational hygiene, occupational diseases/ disorders & its prevention.
Accident & Safety	Basic principles for protective equipment. Accident prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & sick at the workplaces, First-aid & transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. Safety, health, welfare under legislative of India.
Ecosystem	Introduction to environment. Relationship between society and environment, ecosystem and factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of energy, re-use and recycle.
Global Warming	Global warming, climate change and ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and harvesting of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
7. Labour Welfare Legislation	
Duration : 05 hrs Marks : 03	
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's Compensation Act.
8. Quality Tools	
Duration : 10 hrs Marks : 05	
Quality Consciousness	Meaning of quality, Quality characteristic.
Quality Circles	Definition, Advantage of small group activity, objectives of quality circle, Roles and function of quality circles in organization, Operation of quality circle. Approaches to starting quality circles, Steps for

	continuation quality circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of housekeeping, Practice of good housekeeping.
Quality Tools	Basic quality tools with a few examples.

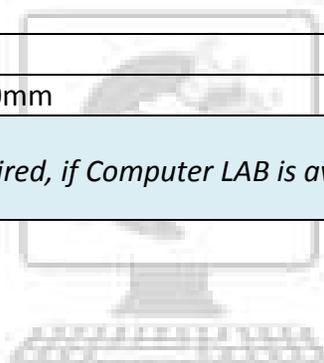


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LIST OF TOOLS & EQUIPMENT			
RADIOLOGY TECHNICIAN (For batch of 20 Candidates)			
S No.	Name of the Tools and Equipments	Specification	Quantity
1.	Model/ Diagram of		
	i) Van de Graff Generator		1 no.
	ii) Linear accelerator		1 no.
	iii) Betatron		1 no.
	iv) Cyclotron		1 no.
	v) Geiger Muller Counter		1 no.
	vi) Scintillation Counter		1 no.
	vii) Safety precaution chart		1 no.
	viii) Human Organs		1 no.
ix) Telecobalt Unit		1 no.	
2.	Pocket Dosimeter		20 nos. *
3.	TLD Badges		20 nos. *
4.	Continuation monitor		2 nos.
5.	X-ray Unit	500 MA, 80 KVP	1 no.
6.	Darkrooms facility		1 no.
7.	G.M B. V counting set up		1 no.
8.	Gamma Survey meter	Range 0-20m R/hr or 0-100 mR/hr	1 no.
9.	Jacket and Shoes		20 nos. *
10.	Fire Extinguisher		1 no.
11.	Lead Bricks		12 nos. *
<p>NOTE:</p> <ol style="list-style-type: none"> Quantity marked with * has been increased as per the batch size. Internet facility is desired to be provided in the class room. 			

TOOLS & EQUIPMENT FOR EMPLOYABILITY SKILLS		
S No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 nos.
2.	UPS - 500VA	10 nos.
3.	Scanner cum Printer	1 no.
4.	Computer Tables	10 nos.
5.	Computer Chairs	20 nos.
6.	LCD Projector	1 no.
7.	White Board 1200mm x 900mm	1 no.

Note: Above Tools & Equipmen not required, if Computer LAB is available in the institute.



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FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor:			Year of Enrollment:											
Name & Address of ITI (Govt./Pvt.):			Date of Assessment:											
Name & Address of the Industry:			Assessment location: Industry / ITI											
Trade Name:		Examination:		Duration of the Trade/course:										
Learning Outcome:														
S No.	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total Internal Assessment Marks	Result (Y/N)
	Candidate Name	Father's/Mother's Name	Safety Consciousness	Workplace Hygiene & Economical use of materials	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to Handle Tools/ Equipment/ Instruments/ Devices	Economical use of Materials	Working Strategy	Quality in Workmanship/ Performance	VIVA		
1														
2														