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

COMPETENCY BASED CURRICULUM

RADIOLOGY TECHNICIAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – HEALTHCARE

Directorate General of Training

RADIOLOGY TECHNICIAN

(Non-Engineering Trade)

(Revised in July 2022)

Version: 2.0

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NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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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 related to job role. In addition to this, a candidate is entrusted to undertake project work, extracurricular activities and industrial visit 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. TRAINING SYSTEM

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 Directorate General of Training (DGT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programsofDGT 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 DGT which is recognized worldwide.

Candidatesbroadlyneed 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 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- 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 as applicable.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

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	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification or add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGTfrom time to time..

a) The Continuous Assessment(Internal) 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 formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTCwill be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT 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 Trade Practical and Formative assessment is 60% & for all other 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/reductionofscrap/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 some of 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
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate	• Demonstration of good skills and accuracy

should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	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) Marks 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	• 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) Marks 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.	• 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.

3. JOB ROLE

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

Reference NOS:

(i) HSS/N9451
(ii) HSS/N 9452
(iii) HSS/N 9453
(iv) HSS/N 9454

(v) HSS/N 9455
(vi) HSS/N 9456
(vii) HSS/N 9457
(viii) HSS/N 9458
(ix) HSS/N 9459
(x) HSS/N 9460
(xi) HSS/N 9461
(xii) HSS/N 9462
(xiii) HSS/N 9463
(xiv) HSS/N 9464
(xv) HSS/N 9465
(xvi) HSS/N 9466

4. GENERAL INFORMATION

Name of the Trade	**RADIOLOGY TECHNICIAN**
Trade Code	DGT/1059
NCO - 2015	3211.0101, 3211.0100
NOS Covered	HSS/N9451, HSS/N 9452, HSS/N 9453, HSS/N 9454, HSS/N 9455, HSS/N 9456, HSS/N 9457, HSS/N 9458, HSS/N 9459, HSS/N 9460, HSS/N 9461, HSS/N 9462, HSS/N 9463, HSS/N 9464, HSS/N 9465, HSS/N 9466
NSQF Level	Level 4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	Not suitable. Not considered as medical trade
Unit Strength (No. of Students)	20 (There is no separate provision of supernumerary seats)
Space Norms	75 Sq. m
Power Norms	4.0 KW
Instructors Qualification for:	
(i) Radiology Technician	B.Voc/Degree in Radiology Technician/Radiation therapy technician from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** Diploma(Minimum 2 years) in Radiology Technician from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Radiology Technician" with three-year post qualification experience in the relevant field. **Essential Qualification:**

	Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade. **Note: Out of two Instructors required for the unit of 2 (1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess NCIC in any of its variants.**
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs withshort term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR:

1. Apply atomic and nuclear physics concept of Rutherford Bohr Model and relate it to Thomson's model of the atom following safety precautions. HSS/N9451
2. Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter. HSS/N9452
3. Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel. HSS/N9453
4. Perform radiation protection and operate radiation measuring devices and understand Radio Therapy. HSS/N9454
5. Assemble General &radiographic anatomy, bones, joints and body systems using mannequins and skeletons. HSS/N9455
6. Execute the radiographic and darkroom techniques, perform the radiographic film processing. HSS/N9456
7. Demonstrate the Radiographic contrast media and perform the radiographic positioning and special procedures. HSS/N9457

SECOND YEAR:

8. Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality. HSS/N9458
9. Operate MRI scan and perform patient positioning, review protocols for MRI scanning. HSS/N9459
10. Analyze USG scans patient positioning,preparation, techniques, general care. HSS/N9460
11. Analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality. HSS/N9461
12. Interpret the factors, tools and techniques affecting the radiographic image quality. HSS/N9462
13. Illustrate the general patient care in handling and preparation of patients during radiological examination. HSS/N9463
14. Select and plan the radiographic calibration and Tube rating charts. HSS/N9464

15. Analyze the emergency conditions and demonstrate their remedy. HSS/N9465
16. AnalyzeOperation of radiotherapy units and understand the basics of Humanradiobiology, effects of radiation, protection in radiotherapy. HSS/N9466

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Apply atomic and nuclear physics concept of Rutherford Bohr Model and relate it to Thomson's model of the atom following safety precautions. HSS/N9451	Identify the basic structure of atom and nuclei.
	Perform a presentation on atom.
	Determine the half-life& decay constant for various radioactive materials.
	Differentiate between the properties of alpha, beta, gamma particles and fusion &fission.
2. Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter. HSS/N9452	Identify the type of radiation based on the Order of wavelengths, frequencies, amplitude and energy.
	Determine the properties and production of x-rays.
	Recognize the parts of x-ray tube and their functions.
	Identify the types of interaction of x-ray with matter and their probability of occurrence.
3. Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel. HSS/N9453	Identify the parts of x-ray circuit and unit.
	Operate the parts of the control panel.
	Measure the major parameters responsible for the production of x-ray.
	Identify and use the beam restricting devices.
	Check and perform the use of grid devices.
	Select and choose the grid & the Bucky factor.
4. Perform radiation protection and operate radiation measuring devices and understand Radio Therapy. HSS/N9454	Understand the public & occupational radiation protection.
	Identify the radiation protection equipments.
	Measure the dose levels by using dissymmetric instruments.
	Check and calculate the accuracy of different radiation safety equipments.
	Compute the dose measurement and dose limits.
	Identify the type of therapy.

	Identify the various types of machines used in radiotherapy.
5. Assemble General &radiographic anatomy, bones, joints and body systems using mannequins and skeletons. HSS/N9455	Identify the bones, joints, muscles and their types.
	Analyze the body positions, planes and movements.
	Identify the different body organs and cavities.
	Perform the general radiographic positioning.
	Perform and select the darkroom techniques.
6. Execute the radiographic and darkroom techniques, perform the radiographic film processing. HSS/N9456	Identify the types of x-ray film, screen and cassettes.
	Prepare the x-ray film processing chemicals.
	Perform the use of x-ray film, screen and cassettes.
	Execute the handling and storage of radiographic film, screen and cassettes.
7. Demonstrate the Radiographic contrast media and perform the radiographic positioning and special procedures. HSS/N9457	Identify the difference between ionic and non-ionic contrast media.
	Perform and select the contrast for appropriate examination and care during contrast injection.
	Perform the routine radiographic positioning.
	Select the correct radiographic technical factors and analyze the x-ray film for image quality.
	Perform the radiographic positioning of special patients.
	Perform the radiographic procedures with appropriate techniques, patient care and handling.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
SECOND YEAR	
8. Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of	Perform the patient positioning correctly for a CT scan.
	Illustrate the use of contrast medium in CT.
	Operate CT console for selection of suitable technical factors and protocols.
	Illustrate the radiographic appearance of both normal and abnormal conditions.

desired quality. HSS/N9458	
9. Operate MRI scan and perform patient positioning, review protocols for MRI scanning. HSS/N9459	Perform the patient positioning correctly for MRI scan.
	Identify the use of contrast medium in MRI scan.
	Operate MRI console for selection of suitable technical factors and protocols.
	Illustrate the radiographic appearance of both normal and abnormal conditions.
	Plan general safety rules in MRI practice.
10. Analyze USG scan patient positioning,Preparation, techniques, general care. HSS/N9460	Understand the USG techniques.
	Illustrate the use of contrast medium in USG.
	Performthe patient positioning and preparation correctly for USG scan.
	Understand the USG Doppler techniques.
11. Analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality. HSS/N9461	Operate CR, DR and Fluoroscopy system.
	Illustrate the difference between the working of CR, DR and Fluoroscopy system.
	Compare the technical factors in the operation of different digital modalities.
	Analyze the scanned images to determine image quality and clarity.
	Care and maintenance of CR, DR and Fluoroscopy system.
12. Interpret the factors, tools and techniques affecting the radiographic image quality. HSS/N9462	Understand radiographic quality, resolution, noise and speed.
	Differentiate between the geometric factors affecting radiographic quality.
	Analyze the subject factors affecting radiographic quality.
	Analyze the tool and technique available to create high quality films.
13. Illustrate the general patient care in handling and preparation of	Execute and schedule patient-load based on emergency or appointment priority.
	Perform documentation required for medical history, procedures.
	Understand how to manage a patient with contrast media.

patients during radiological examination. HSS/N9463	Understand care and handling of patients in special cases.
14. Select and plan the radiographic calibration and tube rating charts. HSS/N9464	Understand and sketch tube rating charts.
	Assess application of tube rating charts in radiology.
	Illustrate the radiographic calibration.
15. Analyze theemergency conditions and demonstrate their remedy. HSS/N9465	Plan and perform the first aid in required conditions.
	Perform & operate the BP machine.
	Calculate &analyzes the heart rate.
	Select & perform the techniques of Bandage & dressings.
	Plan & perform the energy treatment, according to the conditions.
16. AnalyzeOperation of radiotherapy units and understand basic of human radiobiology, effects of radiation, protection in radiotherapy. HSS/N9466	Identify the types of biological effects.
	Identify the different types of radiotherapy units.
	Operate the radiotherapy units.
	Execute planning set up for radiotherapy examination.
	Perform shielding methods for radiotherapy.
	Understand working and construction of LINAC.
	Calculate relative biological effectiveness and LET.
	Execute the treatment planning.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

7. TRADE SYLLABUS

SYLLABUS FOR RADIOLOGY TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 35 Hrs; Professional Knowledge 12 Hrs	Apply atomic and nuclear physics concept of Rutherford Bohr Model and relate it to Thomson's model of the atomfollowing safety precautions. HSS/N9451	1. Demonstrate atomic and nuclear structure through Videos and models (04 hrs) 2. Understand and sketch of Rutherford's x-ray scattering experiment and relate it to Thomson's model of the atom. (11 hrs) 3. Practice and represent graphically the energy level diagram.(08 hrs) 4. Illustrate the property of alpha, beta and gamma radiation, though videos. (06 hrs) 5. Relate the half-life of different radioactive material by the help of decay curve.(06 hrs)	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. (12 hrs)

Professional Skill 65 Hrs; Professional Knowledge 18 Hrs	Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter. HSS/N9452	6. Demonstrate different types of radiation through videos.(06 hrs) 7. Demonstrate and sketch the EMR spectrum.(07 hrs) 8. Compute the frequency of oscillation by rope.(05 hrs) 9. Illustrate the different parts of x-ray machine.(10 hrs) 10. Practice the x-ray component with the help of sketch.(06 hrs) 11. Evaluate total filtration of an x-ray tube using HVL method.(14 hrs) 12. Check the alignment of radiation beam using beam alignment test tool.(10 hrs) 13. Understand x-ray interaction with matter, ionization and excitation.(11 hrs)	Definition of radiation and its types, electromagnetic radiation, Radiation as a wave-motion, wavelength, frequency Magnitude, velocity and their relations, electro-magnetic spectrum, common properties of electromagnetic radiation. X-ray:principles of 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. (18 hrs)
Professional Skill 65 Hrs; Professional Knowledge 18 Hrs	Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel. HSS/N9453	14. Execute the operation of the x-ray circuit, controlling of different parameters. (15hrs) 15. Check KVP accuracy, usingthe digital KVP meter.(08hrs) 16. Measure effective focal spot size of x-ray tube using bas pattern test tool. (10hrs) 17. Test the alignment of grid using grid alignment test tool.(10hrs)	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

		18. Check the consistency of timer.(08hrs) 19. Check the consistency of mA loading stations. (07hrs) 20. Check the consistency of x-ray tube output.(07hrs)	Instruments voltmeter, mill-ampere meter Control of scattered Radiation, beam modification devices. (18 hrs)
Professional Skill 65 Hrs; Professional Knowledge 18 Hrs	Perform radiation protection and operate radiation measuring devices and understand Radio Therapy. HSS/N9454	21. Compute the intensity of x-ray by using the inverse square law. (07 hrs) 22. Predict the radiation level in the vicinity of exposure area by using survey meter.(12 hrs) 23. Check the accuracy of lead aprons by using survey meters.(08 hrs) 24. Test and calculate the thickness of protective barrier.(06 hrs) 25. Calculate the entrance surface dose by using water phantom.(08 hrs) 26. Measure the personnel dose on different modalities by using personal dosimeters. (12 hrs) 27. Understand and sketch the treatment units, simulators and making of thermoplastic mould of radiotherapy. (12 hrs)	Radiation protection:code of practice for the protection of person against ionizing radiation, 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. (18 hrs)
Professional Skill 40 Hrs; Professional Knowledge 12 Hrs	Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and	28. Practice the region of body by using mannequins.(12hrs) 29. Identify and place the bone & joint by using a skeleton. (08 hrs)	i) Cell-Types, structure, function, reproduction, structure of general tissues. ii) General anatomy –language of anatomy: position, planes, terms in relation to various

	skeletons. HSS/N9455	30. Practice the radiographic positioning on x-ray table.(10 hrs) 31. Identify and place the body organs by using mannequins and also relate their surface anatomy.(10 hrs)	regions and movements, term used to describe the bone features. General terminology. iii)Skeleton: classification of bone and cartilage. Joints and their classification. Types of muscles. iv) General introduction of body systems-nervous, circulatory, lymphatic. Skin fasciae. v) Radiographic anatomy and positioning terminology. Radiographic projections. Topographic landmarks of radiography. (12hrs)
Professional Skill 120 Hrs; Professional Knowledge 30 Hrs	Execute the radiographic and darkroom techniques, perform the radiographic film processing. HSS/N9456	32. Practice on radiographic and darkroom techniques.(09 hrs) 33. Check the safeness of safe lightby performing the coin test.(11 hrs) 34. Check proper film screen contact by using wire mesh method.(11 hrs) 35. Identify the size of x-ray film and cassette.(09 hrs) 36. Perform a workshop to prepare processing chemicals and check the PH value.(09 hrs) 37. Practice the general cleaning and care of screen & cassette.(22 hrs) 38. Measure the sensitivity and density of x-ray film by using densitometer & sensitometer. Plot the H&D curve.(20 hrs)	**Radiographic Photographic and Dark room technique**- X-ray dark room construction, radiographic films- types, characteristics, handling and storage. Intensifyingscreens- construction types, characteristics, screen film combination, care and maintenance. X-ray cassettes: construction, types and general care. The development of radiographic film, processing chemistry, components of the automatic processor, alternative processing methods. (30hrs)

		39. Analyze the luminescence property of IF screen.(14 hrs) 40. Identify the radiographic image artifacts.(15 hrs)	
Professional Skill 450 Hrs; Professional Knowledge 132 Hrs	Demonsratethe Radiographic contrast media and perform the radiographic positioning and special procedures. HSS/N9457	41. Understand the type of contrast.(10 hrs) 42. Perform and practice the ECG.(08 hrs) 43. Perform and practice the radiographic positioning of the chest.(20 hrs) 44. Perform and practice the radiographic positioning of the upper extremity. (20 hrs) 45. Perform and practice the radiographic positioning of the lower extremity. (20 hrs) 46. Perform and practice the radiographic positioning of the vertebral column. (25 hrs) 47. Perform and practice the radiographic positioning of the digestive system.(25 hrs) 48. Perform and practice the radiographic positioning of the urinary system. (25 hrs) 49. Perform and practice the radiographic positioning of the skull. (25 hrs) 50. Perform and practice the radiographic positioning of the breast.(25 hrs) 51. Perform and practice the	Contrast media:classification, chemistry, physiology, toxicity, mild, moderate severe reactions. Contrast media used in X-RAY ultrasound, CT and MRI. 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. 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. Digestive system: moth and esophagus, salivary glands, stomach, small intestine, large intestine, liver, pancreas, gall bladder, general principle of digestion. Excretory system: functional anatomy of kidney, functions, formation and excretion of urine, nephrons, ureters, urinary bladder, urethra,

		radiographic positioning of special patient.(32 hrs) 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. (26 hrs) 53. Perform and practice the radiographic special procedures ofBiliary system- Cholecystography, Cholangiography, T-tube, cholangiography ERCP, PTC, splenoportovenograp.(26 hrs) 54. Perform and practice the radiographic special procedures ofCirculatory and lymphatic system: angiography Lymphangiography. (26 hrs) 55. Perform and practice the radiographic special procedures of Special sense- dacrocystography. (16 hrs) 56. Perform and practice the radiographic special procedures ofFemalereproductive- hysterosalpingographypla centography.(27 hrs) 57. Perform and practice the	micturition. Male Reproductive System: testes, scrotum, spermatic cord, spermatogenesis, epididymis, prostate, seminal vesicles, vas deferens. Female reproductive system: ovaries, fallopian tubes, uterus, vagina, perineum, female reproductive cycle, oogenesis. Lympathic system: lymphatic organs, lymph, lymph nodes, lymphatic vessels and circulations. Endocrine glands: pituitary, adrenal, thyroid, pancreas and gonads (secretions and functions) 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) 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. Radiographic procedures:G.I SYSTEM barium suspension, barium swallow, barium meal and barium meal follow

		radiographic special procedures ofExcretory system- MCU, RGU, AGP, RGP, IVP, IVU. (32 hrs) 58. Perform and practice the radiographic special procedures of Brain- ventriculography cerebral angiography myelography. (26 hrs) 59. Perform and practice the radiographic special procedures ofMammary gland-Mammography. (18 hrs) 60. Perform and practice the radiographic special procedures ofJoint- arthrography. (18 hrs)	through, enteroclysis, barium enema, and hypotonic duodenography. Respiratory system- bronchography, artificial pneumothorax. Biliary system- cholecystography, cholangiography, T-tube cholangiography, ERCP, PTC, splenoportovenography. Salivary gland- sialography. Circulatory and lympathtic system: angiography, lympathnigiography. Special sense- dacrocystography. Femalereproductive- hysterosalpingography, placentography. Excretory system- MCU & RGU, AGP, RGP, IVP, IVU. Brain- ventriculography, cerebral angiography, myelography. Mammary gland- mammography. Joint-arthrography. (132 hrs)
Project work/ Industrial visit/Reports **Broad Areas:** a) Electrocardiogram b) Radiographic positioning c) Radiographic special procedures of excretory system MCU, RGU, AGP, RGP, IVP, IVU			

SYLLABUS FOR RADIOLOGY TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 120 Hrs; Professional Knowledge 36Hrs	Analyze CT patient positioning, manipulate parameters associated with exposure and processing to produce a required image of desired quality. HSS/N9458	61. Prepare the room, apparatus and instruments for CT scan. (08 hrs) 62. Set up the CT scan machine and preparation of the patient for the procedure. (08 hrs) 63. Position the patient correctly for the following CT positions: i) Supine ii) Prone iii) Lateral iv) Oblique(12 hrs) 64. Illustrate the relative position for CT tube and the patient for the relevant exposure factors related to these. (12 hrs) 65. Understand the CT components. (05 hrs) 66. Execute the use of	CT-SCAN: Principle, equipments, Generation, scan parameters, Image reconstruction, Image display, Image Quality, artefacts, control console etc. Recent in advancement in CT: • PET-CT • SPECT • CT-Biopsy • CT-Angiography • CT-Special Procedures (36 hrs)

		contrast material for a CT scan and how to administer them under supervision of a radiologist. (12 hrs) 67. Illustrate the radiographic appearance of CT both normal and common abnormal conditions. (08 hrs) 68. Plan and apply radiation protection and principles code of practice. (08 hrs) 69. Practice the routine procedures associated with maintenances of imaging and processing systems. (12 hrs) 70. Perform and practice the protocols for the CT scanning. (08 hrs) 71. Understand the recent techniques of CT scan. (15 hrs) 72. Understand the types of artefact on CT image.(12 hrs)	
Professional Skill 60 Hrs; Professional	Operate MRI scan and perform patient positioning,	73. Prepare the room, apparatus and instruments for MRI Scan. (08 hrs)	MRI- SCAN: Basic physics, principles, NMR, Image processing and display, safety, artifacts.

Knowledge 22Hrs	review protocols for MRIscanning. HSS/N9459	74. Set up the MRI scan machine and preparation of the patient for the procedure. (08 hrs) 75. Understand the MRI components.(08 hrs) 76. Execute the use of contrast material for an MRI scan and how to administer them under supervision of a radiologist. (08 hrs) 77. Illustrate the radiographic appearance of MRI both normal and common abnormal conditions.(12 hrs) 78. Plan and perform the MRI safety. (06 hrs) 79. Understand the MRI, recent techniques. (10 hrs)	MRI Recent Advancements: • Dynamic MR • MR Angiography • MR Urography • MR Venography • MRCP • PET MRI • Cardiac MR (Basics only) (22 hrs)
Professional Skill 60 Hrs; Professional Knowledge 22Hrs	Analyze USG scans patient positioning, preparation, techniques, general care. HSS/N9460	80. Prepare the room, apparatus and instruments for USG scan. (10 hrs) 81. Select and perform the appropriate USG techniques.(08 hrs) 82. Documentation required of medical history of patient, procedure undertaken and reports.(17 hrs) 83. Plan and perform the care of USG equipments (transducer). (17 hrs) 84. Illustrate the techniques and general patient care	USG: Physics, basic principle, Techniques, equipments Processing, Piezo-electricity. Application safety. Ultrasonography Recent Advancement: • 3-D/4-D USG • Doppler • Colour Flow Imaging Doppler • US Guided Biopsy (Basics only) Mammography: tube techniques, patient care, recent advancement. (22 hrs)

		during mammography. (08 hrs)	
Professional Skill 60 Hrs; Professional Knowledge 22Hrs	Analyze working of CR, DR and fluoroscopy system manipulate parameters associated with exposure and processing to produce a required image of desired quality. HSS/N9461	85. Understand the construction and working of CR system. (08 hrs) 86. Select the required exposure factor for the CR examination. (17 hrs) 87. Understand the construction and working of DR system. (09 hrs) 88. Evaluate the quality of digital image quality. (04 hrs) 89. Understand the construction and working of fluoroscopy system. (14 hrs) 90. Select the required exposure factor for the fluoroscopic examination. (08 hrs)	Computed Radiography: Construction of PSP plate, detectors, screen films, cassettes, methods of display, image quality Digital Radiography:films, detectors, TFC, CCD, direct and indirect radiography. Artefacts and image quality. Fluoroscopy:Image intensifier, spot film devices, details & devices (22 hrs)
Professional Skill 60 Hrs; Professional Knowledge 22 Hrs	Interpret the factors, tools and techniques affecting the radiographic image quality. HSS/N9462	91. Understand the factors affecting the radiographic image quality. (12 hrs) 92. Understand the effect on image due to variation in focal object distance, object film distance, exposure angle, due tube movement pattern. (14 hrs) 93. Understand the technical aspect of quality assurance. (14 hrs) 94. Understand the quality assurance of the related equipments and its benefits with respect to	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. Identification of films, film cutters, Trimmers, corner cutters, viewing box, illuminators, projector, portable units, image intensifier (Basics only) (22 hrs)

		visual assessment. (20 hrs)	
Professional Skill 35 Hrs; Professional Knowledge 16 Hrs	Illustrate the general patient care in handling and preparation of patients during radiological examination. HSS/N9463	95. Understand the internal procedures and policies on safety precaution to be taken when operating radiological equipment. (06 hrs) 96. Illustrate the scheduling, treatment, room assignment and workload responsibilities with employee's co- workers. (10 hrs) 97. Plan the emergency trolley. (05 hrs) 98. Practice and perform the method of patient care and handling. (06 hrs) 99. Practice and perform the patient care in ICU, OT and NICU. (08 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. (16 hrs)
Professional Skill 20 Hrs; Professional Knowledge 08 Hrs	Select and plan the radiographic calibration and Tube rating charts. HSS/N9464	100. Understand and sketch tube rating charts. Radiographic calibration. (10 hrs) 101. Understand methods of radiographic calibration. (10 hrs)	**Care and maintenance of equipment** General principles and routine use of charts supplied by manufacturer, Radiographic calibration procedure, Tube rating chart. (08 hrs)
Professional Skill 60 Hrs; Professional Knowledge 22 Hrs	Analyze medical emergency conditions and demonstrate their remedy. HSS/N9465	102. Understand basics of first aid. (06 hrs) 103. Practically understand how to tie a tourniquet to a patient. (10 hrs) 104. Practically understand how to measure BP. (07 hrs) 105. Perform and execute how to administer oxygen to in case of	**First Aid:** Shock, convulsion, asphyxia, artificial respiration, Administration of Oxygen, Burns Electric shock & burns, wound, haemorrhage, pressure points, Tourniquet. Injuries to bone joints and muscles. Dressing or bandages, Plaster of Paris technique, splints, Drug

		respiratory emergency. (14 hrs) 106. Perform how to calculate pulse rate. (07 hrs) 107. Perform techniques of application of bandages and dressing of wounds. (09 hrs) 108. Understand how to prepare a first aid kit. (07 hrs)	reaction, Poisons. (22 hrs)
Professional Skill 365 Hrs; Professional Knowledge 130 Hrs	Analyze Operation of radiography units and understand basic human radiobiology, effects of radiation, protection in radiotherapy. HSS/N9466	109. Basic Familiarization (along with Doctor). (07 hrs) 110. Demonstration of Patient treatment Telecobalt unit & Linear Accelerator using different treatment techniques. (15 hrs) 111. Calculate the fetal dose limit of a pregnant female. (06 hrs) 112. Plot cell survival curves to understand relationship between no. of cell survival and radiation exposure. (18` hrs) 113. Plot cell survival curves to understand the effect of the Cell survival curves of oxygen, LET, and cell cycle, sub lethal damage. (06 hrs) 114. Understand the effect of radiation on cell through video. (06 hrs) 115. Understand the effect of radiation on DNA	**Radiotherapy** i) Elementary Pathology-Health and disease. Degeneration, repair of wounds, inflammation, infection, immunity. ii) Tumors - Definitions, Classifications, causes, spread, General effects. iii) Methods of diagnosis (Elementary principles)-Clinical, Radiographic, histological and biochemical methods. iv) Treatments - Radical and Palliative, treatment. GeneralPrinciples of medical, surgical, radio therapeutic methods, including anti-cancer drugs, hormones. v) Biological effects of radiation: Physical and chemical effects of radiation, General effects on cells and tissues.

		through video. (10 hrs) 116. Plot a curve between RBE and LET and understand it. (06 hrs) 117. Operate pocket dosimeter for the calculation of instant radiation dose. (14 hrs) 118. Understand radiotherapy units. (08 hrs) 119. Dosimetric calculation for different protocols of cancer treatment.(14 hrs) 120. Calculation methods applied in the studies of cancer surviving patients. (17 hrs) 121. Measurement of output from teletherapy installation. (14 hrs) 122. Understand calibration procedure for measuring and monitoring instruments. (14 hrs) 123. Understand AERB safety codes. (10 hrs) 124. Execute shielding in radiotherapy room.(12 hrs) 125. Calculate the thickness of protective barriers in radiology room by HVL method. (14 hrs) 126. Plan patient set up for teletherapy. (14 hrs) 127. Measurement and calculation of depth dose. (11 hrs) 128. Plan radiation protection	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. 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. vii) Clinical aspects of radiation reaction - care of patients undergoing radiotherapy (including the use of blood counts). Care of reactions. Consequence of technical errors. viii) Absorption of X Rays and Gama Rays, Linear attenuation coefficient, Mass, Atomic absorption coefficient. Energy transfer and absorption co-efficient.

		survey in and out of radiotherapy premises. (14 hrs) 129. Plan patient set up for brachytherapy. (08 hrs) 130. Understand various simulation techniques (localization x rays, barium swallow, etc.) (14 hrs) 131. Plan radiological survey of radiotherapy equipments. (12 hrs) 132. Preparation of POP moulds. Preparation of acrylic moulds. (09 hrs) 133. Graphical demonstration of iso-dose curves. (08 hrs) 134. Preparation of mantle blocks. (04 hrs) 135. Patient setup in different radiotherapy techniques. (12 hrs) 136. Plan treatment via computer. (10 hrs) 137. Understand calibration of tele cobalt unit. (08 hrs) 138. Plan and execute quality assurance for telecobalt machine. (11 hrs) 139. HDR brachytherapy unit-programming and source loading/unloading.(12 hrs) 140. Understand care of applicators used in brachytherapy. (08 hrs) 141. Execute CT simulation	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. Dosimeters. Quality of radiation, Half value layer, etc. x) Radiotherapy treatment machines:Telecobalt units, Linear accelerators, Brachy therapy units, Simulator,TPS etc. xi) Radio therapeutic practices: a) Teletherapycalculations: 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. 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 thetissueusingcurves, tissue inhomogeneity

		planning. (08 hrs) 142. Understand procedure to be followed in source stuck situations. (11 hrs)	correction, correction for curvature of body contour. 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 techniquesetc. 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. (130 hrs)
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			

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all trades) (120Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in / dgt.gov.in

ANNEXURE-I

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 ii) Linear accelerator iii) Betatron iv) Cyclotron v) Geiger Muller Counter vi) Scintillation Counter vii) Safety precaution chart viii) Human Organs ix) Telecobalt Unit		
			1 no.
			1 no.
			1 no.
			1 no.
			1 no.
			1 no.
			1 no.
			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.

NOTE:

1. Internet facility is desired to be provided in the class room.

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्