



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

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

Kolkata-700091

RADIOLOGY TECHNICIAN

(Non-Engineering Trade)

(Revised in August 2025)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 5



Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During two year duration of “Radiology Technician” trade, a candidate is trained on Professional Skill, Professional Knowledge and Employability Skill related to job roles. 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 radiology.

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 programs of DGT 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.

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 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 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	
		1 st Year	2 nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
Total		1200	1200
On the Job Training (OJT)/ Group Project *		150	150
Optional Courses**		240	240
Grand Total		1590	1590

* The trainee has to undergo 150 hours of mandatory OJT (On the Job Training) at nearby industry or wherever industry not available then group project has to be done with the supervision of the trade instructor for every year.

** Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for obtaining 10th/ 12th class certificate from NIOS along with ITI certification, or, short term courses for extra skills/knowledge.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his/ her 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 DGT from 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 individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.cstaricalcutta.gov.in or www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by 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 basis for setting question papers for final assessment. The examiner during**

final examination will also check 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 percentage for Trade Practical and Formative assessment are 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 assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards Occupational Safety, Health and Environment (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:

Marks Allotted during Assessment	Performance Level	Evidence
Marks between 60% to 75%	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.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
Marks above 75% to 90%	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 in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
Marks Above 90%	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 in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

Brief Description of Job Roles:

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
Trade Code	DGT/1059
NCO - 2015	3211.0101, 3211.0100
NSQF Level	Level 5
Duration of Craftsmen Training	Two Years
Entry Qualification	Passed 12 th class examination with Science Stream.
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 of teaching or industry experience in the Radiology Technician field. OR Diploma (Minimum 2 years) in Radiology Technician from AICTE recognized board of technical education with two years of teaching or industry experience in the Radiology Technician field. OR NTC/NAC passed in the Trade of "Radiology Technician" with three years of teaching or industry experience in the Radiology Technician field. <u>Essential Qualification:</u> 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.
(ii) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' of teaching or industry experience with short term ToT Course in Employability Skills conducted by DGT institutions. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills conducted by DGT institutions.
(iii) 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:

Sl. No.	Learning Outcome	Duration		
		Practical	Theory	Total
FIRST YEAR				
1.	Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter.	55	35	90
2.	Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel.	55	20	75
3.	Perform radiation protection and operate radiation measuring devices and understand Radiology.	55	20	75
4.	Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons.	35	10	45
5.	Execute the radiographic and darkroom techniques, perform the radiographic film processing & check radiographic image quality.	150	45	195
6.	Demonstrate understanding of contrast media and perform radiographic positioning of body systems.	180	30	210
7.	Perform advanced radiographic special procedures and understand systemic anatomy & physiology.	180	30	210
8.	Analyze CR, DR, OPG, and fluoroscopy systems, adjusting exposure and processing to achieve desired image quality.	65	25	90
9.	Interpret the factors, tools and techniques affecting the radiographic image quality.	65	25	90
Employability Skills			120	120
Total		840	360	1200
Second Year				
10.	Perform basic CT scan positioning and imaging procedures safely.	90	30	120
11.	Perform advanced CT procedures and assist in special imaging techniques.	95	40	135
12.	Operate MRI scan and perform patient positioning, review protocols for MRI scanning.	55	20	75
13.	Analyze USG and mammography scans patient	55	20	75

	positioning, preparation, techniques, general care.			
14.	Illustrate patient care and preparation for CT, MRI, DEXA, mammography, USG, oral radiography, and emergency trolley use.	35	10	45
15.	Select and plan the radiographic calibration and Tube rating charts.	35	10	45
16.	Analyze medical emergency conditions and demonstrate their remedies.	55	20	75
17.	Interpret basic radiotherapy procedures, radiation biology, and radiation effects.	140	40	180
18.	Perform basic dosimetry, radiation safety, and radiotherapy treatment planning procedures.	130	50	180
19.	Perform nuclear medicine procedures and ensure patient safety & quality control.	150	60	210
Employability Skills			60	60
Total		840	360	1200
Grand Total		1680	720	2400

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter.	- 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. - Demonstrate types of x-ray tubes & explain x-ray spectrum. - Identify the types of interaction of x-ray with matter and their probability of occurrence. - History of x-ray discovery.
2. Identify the X-ray circuit and units, radiographic grid and beam restricting devices and operate the console panel.	- Factors affecting kVp, mAs, filter & target. - Operate the parts of the control panel. - Identify the parts of x-ray circuit and unit. - Measure the major parameters responsible for the production of x-ray. - x-ray generator, filtration & types. - Identify and use the beam restricting devices. - Check and perform the use of grid devices. - Select and choose the grid & the Bucky factor.
3. Perform radiation protection and operate radiation measuring devices and understand Radiology.	- 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. - Radiation hazards & effects of radiation (somatic & deterministic) - Identify the type of therapy. - Identify the various types of machines used in radiotherapy.

4. Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons.	• Identify the bones, joints, muscles and their types. • Analyze the body positions, planes and movements. • Skeleton system (Types). • Classification of joints • General features, side- determination & ossification of bones including clinical anatomy.
5. Execute the radiographic and darkroom techniques, perform the radiographic film processing, radiographic image quality.	• Identify the types of x-ray film, screen, cassettes&aftefacts. • Prepare the x-ray film processing chemicals& types of processing (Manual & Automatic). • Perform the use of x-ray film, screen and cassettes. • Execute the handling and storage of radiographic film, screen and cassettes. Characteristic curve. • Radiographic image quality, speed, geometry, noise etc. • Prepare history taking format • Day light system of film processing a recent advancement.
6. Demonstrate understanding of contrast media and perform radiographic positioning of body systems.	• Identify the difference between ionic and non-ionic contrast media. • Perform and select the contrast for appropriate examination and care during contrast injectionwith side effects. • Perform the routine radiographic positioning& special views with clinical/ pathological conditions. • Select the correct radiographic technical factors and analyze the x-ray film for image quality.
7. Perform advanced radiographic special procedures and understand systemic anatomy & physiology.	• 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.

8. Analyze CR, DR, OPG, and fluoroscopy systems, adjusting exposure and processing to achieve desired image quality.	• Demonstrate the construction and working of CR system. • Select the required exposure factor for the CR examination. • Demonstrate the construction and working of DR system with DICOM. • Evaluate the quality of digital image quality. • Demonstrate the construction and working of fluoroscopy system. • Select the required exposure factor for the fluoroscopic examination.
9. Interpret the factors, tools and techniques affecting the radiographic image quality.	• 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.
SECOND YEAR	
10. Perform basic CT scan positioning and imaging procedures safely.	• Prepare the room, apparatus and instruments for CT scan. • Identify the CT components. • 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.
11. Perform advanced CT procedures and assist in special imaging techniques.	• Execute the use of contrast material for a CT scan and how to administer them under supervision of a radiologist. • Illustrate the radiographic appearance of CT both normal and common abnormal conditions. • Apply the recent techniques of CT scan. • Identify the types of artefact on CT image.
12. Operate MRI scan and perform patient positioning, review protocols for MRI scanning.	• 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, instrumentation, artefacts etc. • Illustrate the radiographic appearance of both normal and abnormal conditions. • Plan general safety rules in MRI practice and zones of MRI.

13. Analyze USG mammography scan patient positioning, Preparation, techniques, general care.	• Understand the USG techniques. • Illustrate the use of contrast medium in USG. • Perform the patient positioning and preparation correctly for USG scan. • Apply the USG Doppler techniques. • Perform the filling up of pre requisite forms like PCPNDT Act, F-form etc.
14. Illustrate patient care and preparation for CT, MRI, DEXA, mammography, USG, oral radiography, and emergency trolley use.	• Execute and schedule patient-load based on emergency or appointment priority. • Perform documentation required for medical history, consent form & procedures. • Understand how to manage a patient with contrast media. • Understand care and handling of patients in special cases.
15. Select and plan the radiographic calibration and tube rating charts.	• Understand and sketch tube rating charts. • Assess application of tube rating charts in radiology. • Illustrate the radiographic calibration.
16. Analyze the emergency conditions and demonstrate their remedies.	• Plan and perform the first aid in required conditions. • Perform & operate the BP machine. • Calculate & analyze the heart rate. • Select & perform the techniques of Bandage & dressings. • Plan & perform the energy treatment, according to the conditions.

17. Interpret basic radiotherapy procedures, radiation biology, and radiation effects.	• Demonstrate Patient treatment Telecobalt unit & Linear Accelerator using different treatment techniques. • 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.
18. Perform basic dosimetry, radiation safety, and radiotherapy treatment planning procedures.	• Dosimetric calculation for different protocols of cancer treatment. • Calculation methods applied in the studies of cancer surviving patients. • Measurement of output from teletherapy installation. • Execute calibration procedure for measuring and monitoring instruments. • Identify AERB safety codes. • Preparation, setup & plan of treatment of teletherapy & brachytherapy.
19. Perform nuclear medicine procedures and ensure patient safety & quality control.	• Plan and execute the nuclear medicine modalities calibration along with patient preparation. • Preparation of QA & QC – SPECT & PET and hybrid image with CT & MRI. • Follow up of patients undergoing nuclear medicine modalities. • Handle & discard radio-pharmaceuticals.

7. TRADE SYLLABUS

SYLLABUS FOR RADIOLOGY TECHNICIAN TRADE			
FIRST YEAR			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Professional Skill 55 Hrs; Professional Knowledge 35 Hrs	1. Demonstrate Electromagnetic radiation, production of x-ray, construction of modern x-ray tube, and Interactions of x-ray with matter.	1. Demonstrate different types of radiation through videos. 2. Demonstrate and sketch the EMR spectrum. 3. Compute the frequency of oscillation by rope. 4. Explain history of x-rays discovery. 5. Illustrate the different parts of x-ray machine. 6. Practice the x-ray component with the help of sketch. 7. Evaluate total filtration of an x-ray tube using HVL method. 8. Check the alignment of radiation beam using beam alignment test tool. 9. Understand x-ray interaction with matter, ionization and excitation. 10. Elaborate on types of x-ray tubes. 11. Observation related to x-ray spectrum & factors affecting it.	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.
Professional Skill 55 Hrs;	2. Identify the X-ray circuit and	12. Factors affecting kVp, mAs, filter & target.	Focal spot, tube holders, grid ratio in relation to KV.

Professional Knowledge 20 Hrs	units, radiographic grid and beam restricting devices and operate the console panel.	13. X-ray generators. 14. Execute the operation of the x-ray circuit, controlling of different parameters. 15. Check KVP accuracy, using the digital KVP meter. 16. Measure effective focal spot size of x-ray tube using bas pattern test tool. 17. Test the alignment of grid using grid alignment test tool. 18. Check the consistency of timer. 19. Check the consistency of mA loading stations. 20. Check the consistency of x-ray tube output.	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.
Professional Skill 55 Hrs; Professional Knowledge 20 Hrs	3. Perform radiation protection and operate radiation measuring devices and understand Radiology.	21. Compute the intensity of x-ray by using the inverse square law. 22. Predict the radiation level in the vicinity of exposure area by using survey meter. 23. Check the accuracy of lead aprons by using survey meters. 24. Test and calculate the thickness of protective barrier. 25. Calculate the entrance surface dose by using water phantom. 26. Measure the personnel dose on different modalities by using personal dosimeters.	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.

		27. Understand the radiation hazards stochastic (cancer), deterministic (burns), safety precautions.	General patient care. Radiation hazards and its effects and its types.
Professional Skill 35 Hrs; Professional Knowledge 10 Hrs	4. Assemble General & radiographic anatomy, bones, joints and body systems using mannequins and skeletons.	28. Practice the region of body by using mannequins. 29. Identify and place the bone & joint by using a skeleton. 30. Practice the radiographic positioning on x-ray table. 31. Identify and place the body organs by using mannequins and also relate their surface anatomy.	i) Cell-Types, structure, function, reproduction, structure of general tissues. 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. 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.
Professional Skill 150 Hrs; Professional Knowledge 45 Hrs	5. Execute the radiographic and darkroom techniques, perform the radiographic film processing & check radiographic image quality.	32. Practice on radiographic and darkroom techniques. 33. Check the safeness of safe light by performing the coin test. 34. Check proper film screen contact by using wire mesh method. 35. Identify the size of x-ray film and cassette. 36. Perform a workshop to prepare processing chemicals and check the	<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.

		PH value. 37. Practice the general cleaning and care of screen & cassette. 38. Measure the sensitivity and density of x-ray film by using densitometer & sensitometer. Plot the H&D curve. 39. Analyze the luminescence property of IF screen. 40. Identify the radiographic image artifacts.	The development of radiographic film, processing chemistry, components of the automatic processor, alternative processing methods. Characteristic curve, radiographic image quality, speed, grain, geometry, noise etc. Learn taking patient history (past & present) on patient requisition form.
Professional Skill 180 Hrs; Professional Knowledge 30 Hrs	6. Demonstrate understanding of contrast media and perform radiographic positioning of body systems.	41. Understand the type of contrast. 42. Perform and practice the radiographic positioning of the chest. 43. Perform and practice the radiographic positioning of the upper extremity. 44. Perform and practice the radiographic positioning of the lower extremity. 45. Perform and practice the radiographic positioning of the vertebral column. 46. Perform and practice the radiographic positioning of the digestive system. 47. Perform and practice the radiographic positioning of the urinary system. 48. Perform and practice the radiographic positioning of the skull. 49. Perform and practice the radiographic positioning of the breast.	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: mouth and esophagus, salivary glands, stomach, small intestine, large

		50. Perform and practice the radiographic positioning of special patient.	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, micturition.
Professional Skill 180 Hrs; Professional Knowledge 30 Hrs	7. Perform advanced radiographic special procedures and understand systemic anatomy & physiology.	51. Perform and practice the radiographic special procedures of G.I system- barium swallow, barium meal barium meal follow through, Enteroclysis, loopogram (complete) barium enema, Hypotonic duodenography. 52. Perform and practice the radiographic special procedures of Biliary system- Cholecystography, Cholangiography, T-tube, cholangiography ERCP, PTC, splenoportovenograp. 53. Perform and practice the radiographic special procedures of Circulatory and lymphatic system: angiography Lymphangiography. 54. Perform and practice the radiographic special procedures of Special sense- dacrocystography, sialography, bronchography, fistulography and sinography.	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. Lymphatic 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

		55. Perform and practice the radiographic special procedures of Female reproductive- hysterosalpingography plac entography and fallopian tube recanalization. 56. Perform and practice the radiographic special procedures of Excretory system- MCU, RGU, AGP, RGP, IVP, IVU. 57. Perform and practice the radiographic special procedures of Brain & spinal cord- ventriculography cerebral angiography myelography. 58. Perform and practice the radiographic special procedures of Mammary gland-Mammography. 59. Perform and practice the radiographic special procedures of Joint- arthrography.	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 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 lymphatic system: angiography, lymphangiography. Special sense- dacryocystography. Female reproductive- hysterosalpingography & fallopian tube recanalization, Excretory system- MCU & RGU, AGP, RGP, IVP, IVU. Brain- ventriculography, cerebral angiography, myelography. Mammary gland- mammography. Joint-arthrography.
Professional Skill 65 Hrs;	8. Analyze CR, DR, OPG, and fluoroscopy	60. Understand the construction and working of CR system.	Computed Radiography: Construction of PSP plate, detectors, screen films,

Professional Knowledge 25 Hrs	systems, adjusting exposure and processing to achieve desired image quality.	61. Select the required exposure factor for the CR examination. 62. Understand the construction and working of DR system with DICOM. 63. Evaluate the quality of digital image quality. 64. Understand the construction and working of fluoroscopy system. 65. Select the required exposure factor for the fluoroscopic examination.	cassettes, methods of display, image quality Digital Radiography: films, detectors, TFC, CCD, direct and indirect radiography. Artefacts and image quality. DIACOM - PACS Fluoroscopy: Image intensifier, spot film devices, details & devices OPG – Basic physics, RVG - protocols and routine view.
Professional Skill 65 Hrs; Professional Knowledge 25 Hrs	9. Interpret the factors, tools and techniques affecting the radiographic image quality.	66. Understand the factors affecting the radiographic image quality. 67. Understand the effect on image due to variation in focal object distance, object film distance, exposure angle, due tube movement pattern. 68. Understand the technical aspect of quality assurance. 69. Understand the quality assurance of the related equipments and its benefits with respect to visual assessment.	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)
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)	Professional Knowledge (Trade Theory)
Professional Skill 90 Hrs; Professional Knowledge 30 Hrs	10. Perform basic CT scan positioning and imaging procedures safely.	70. Prepare the room, apparatus and instruments for CT scan. 71. Set up the CT scan machine and preparation of the patient for the procedure. 72. Position the patient correctly for the following CT positions: i) Supine ii) Prone iii) Lateral iv) Oblique 73. Illustrate the relative position for CT tube and the patient for the relevant exposure factors related to these. 74. Understand the CT components. 75. Plan and apply radiation protection and principles code of practice. 76. Practice the routine procedures associated with maintenances of imaging and processing systems. 77. Perform and practice the protocols for the CT scanning.	CT-SCAN: Principle, equipments, Generation, scan parameters, Image reconstruction, Image display, Image Quality, artefacts, control console etc.
Professional Skill 95 Hrs;	11. Perform advanced CT procedures and assist in special	78. Execute the use of contrast material for a CT scan and how to administer them	Recent in advancement in CT: • PET-CT • SPECT

Professional Knowledge 40 Hrs	imaging techniques.	under supervision of a radiologist. 79. Illustrate the radiographic appearance of CT both normal and common abnormal conditions. 80. Understand the recent techniques of CT scan. 81. Understand the types of artefact on CT image.	• CT-Biopsy • CT-Angiography • CT-Special Procedures • CBCT • TPCT
Professional Skill 55 Hrs; Professional Knowledge 20 Hrs	12. Operate MRI scan and perform patient positioning, review protocols for MRIs scanning.	82. Prepare the room, apparatus and instruments for MRI Scan. 83. Set up the MRI scan machine and preparation of the patient for the procedure. 84. Understand the MRI components. 85. Execute the use of contrast material for an MRI scan and how to administer them under supervision of a radiologist. 86. Illustrate the radiographic appearance of MRI both normal and common abnormal conditions. 87. Plan and perform the MRI safety. 88. Understand the MRI, recent techniques.	MRI- SCAN: Basic physics, principles, NMR, Image processing and display, safety, artifacts. MRI Recent Advancements: • Dynamic MR • MR Angiography • MR Urography • MR Venography • MRCP • PET MRI • Cardiac MR (Basics only)
Professional Skill 55 Hrs; Professional Knowledge 20 Hrs	13. Analyze USG and mammography scans patient positioning, preparation, techniques, general care.	89. Prepare the room, apparatus and instruments for USG scan. 90. Select and perform the appropriate USG techniques. 91. Documentation required of	USG: Physics, basic principle, Techniques, equipments Processing, Piezo-electricity. Application safety. Ultrasonography Recent Advancement:

		medical history of patient, filling of PC-PNDT & F-form, pre & post procedure stems & reports, procedure undertaken and reports. 92. Plan and perform the care of USG equipments (transducer). 93. Illustrate the techniques and general patient care during ultrasound guided procedures and mammography.	• 3-D/4-D USG • Doppler • Colour Flow Imaging Doppler • US Guided Biopsy (Basics only) Mammography: tube techniques, patient care, recent advancement – physics (Basic) and routine & special positioning – BIRADS – scoring in mammography.
Professional Skill 35 Hrs; Professional Knowledge 10 Hrs	14. Illustrate patient care and preparation for CT, MRI, DEXA, mammography, USG, oral radiography, and emergency trolley use.	94. Understand the internal procedures and policies on safety precaution to be taken when operating radiological equipment. 95. Illustrate the scheduling, treatment, room assignment and workload responsibilities with employee's co-workers. 96. Plan the emergency trolley. 97. Practice and perform the method of patient care and handling. 98. Practice and perform the patient care in ICU, OT and NICU.	General patient care: responsibilities of radiographer, legal, medico legal and ethical codes & consent form 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. Pre & Post procedural Care in oral radiography.
Professional Skill 35 Hrs; Professional Knowledge 10 Hrs	15. Select and plan the radiographic calibration and Tube rating charts.	99. Understand and sketch tube rating charts. Radiographic calibration. 100. Understand methods of radiographic calibration.	Care and maintenance of equipment General principles and routine use of charts supplied by manufacturer, Radiographic calibration procedure, Tube rating chart.
Professional	16. Analyze medical	101. Understand basics of first	First Aid:

Skill 55 Hrs; Professional Knowledge 20 Hrs	emergency conditions and demonstrate their remedies.	aid. 102. Understand how to prepare a first aid kit. 103. Practically understand how to measure BP. 104. Perform and execute how to administer oxygen to in case of emergency. 105. Perform how to calculate pulse rate. 106. Perform techniques of application of bandages and dressing of wounds.	Shock, convulsion, asphyxia, artificial respiration, Administration of Oxygen, Burns Electric shock & burns, wound, haemorrhage, pressure points, Handling of patients with injuries to bone joints and muscles. Dressing or bandages.
Professional Skill 140 Hrs; Professional Knowledge 40 Hrs	17. Interpret basic radiotherapy procedures, radiation biology, and radiation effects.	107. Basic Familiarization (along with Doctor). 108. Demonstration of Patient treatment Telecobalt unit & Linear Accelerator using different treatment techniques. 109. Calculate the fetal dose limit of a pregnant female. 110. Plot cell survival curves to understand relationship between no. of cell survival and radiation exposure. 111. Plot cell survival curves to understand the effect of the Cell survival curves of oxygen, LET, and cell cycle, sub lethal damage. 112. Understand the effect of radiation on cell through video. 113. Understand the effect of radiation on DNA through video. 114. Plot a curve between RBE and LET and understand it.	Radiotherapy i) Elementary Pathology- Health and disease. Degeneration, repair of wounds, inflammation, infection, immunity. ii) Tumors - Definitions, Classifications, causes, spread, General effects. iii) Treatments - Radical and Palliative, treatment. General Principles 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. Recovery, sensitivity. Special effects on skin, mucous membrane, bone, lymph nodes, bone marrow, blood, eyes,

		115. Operate pocket dosimeter for the calculation of instant radiation dose. 116. Understand radiotherapy units.	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.
Professional Skill 130 Hrs; Professional Knowledge 50 Hrs	18. Perform basic dosimetry, radiation safety, and radiotherapy treatment planning procedures.	117. Dosimetric calculation for different protocols of cancer treatment. 118. Calculation methods applied in the studies of cancer surviving patients. 119. Measurement of output from teletherapy installation. 120. Understand calibration procedure for measuring and monitoring instruments. 121. Understand AERB safety codes. 122. Preparation, setup & plan of treatment of teletherapy & brachytherapy.	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 Gamma Rays, Linear attenuation coefficient, Mass, Atomic absorption coefficient. Energy transfer and absorption co-efficient. 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) Types of radiotherapy (all modalities) i) external beam radiotherapy (EBRT) ii) internal beam radiotherapy (IBRT) xi) Basic physics of nuclear, medicine, interactions with matters and briefing of modalities like scintigraphy, SPECT and PET (Position Emission tomography).
Professional Skill 150 Hrs; Professional Knowledge 60 Hrs	19. Perform nuclear medicine procedures and ensure patient safety & quality control.	<u>NUCLEAR MEDICINE -</u> 123. Plan and execute the nuclear medicine modalities calibration along with patient preparation. 124. Preparation of QA & QC – SPECT & PET and hybrid imaging with CT & MRI. 125. Follow up of patients undergoing nuclear medicine modalities. 126. Handling & discarding of radio-pharmaceuticals.	<u>NUCLEAR MEDICINE -</u> Understand and explain the principles behind the calibration of nuclear medicine equipment. Learn how to plan and systematically execute calibration procedures for various imaging modalities. Prepare patients appropriately for nuclear medicine scans, ensuring their safety and compliance with protocols. Develop knowledge of QA and QC procedures specific to Single Photon Emission Computed Tomography

			(SPECT), Positron Emission Tomography (PET), and hybrid imaging techniques. Gain skills to carry out routine and periodic checks to ensure accurate and reliable imaging results. Learn to troubleshoot common equipment issues and maintain imaging systems in collaboration with radiological tools such as CT and MRI. Understand the importance of monitoring patients undergoing nuclear medicine scans. Learn methods for observing and documenting patient responses during and after imaging. Recognize adverse reactions and take appropriate actions to ensure patient safety and comfort. Learn the proper techniques for handling radioactive substances used in imaging procedures.
Project work/ Hospital visit Broad Areas: a) Tube rating charts and radiographic calibration b) Blood Pressure measurement c) Cell survival curves and radiation exposure d) Pocket dosimeter e) 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

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.
	x) Skeleton system		1 no.
	xi) Dummy/ Maniquine (Human Organs)		1 no.
2.	Pocket Dosimeter		05 nos.
3.	TLD Badges		05 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.	Shoes (Rubber)		05 nos.
10.	Fire Extinguisher		1 no.
11.	Lead Bricks		05 nos.
12.	Lead Apron		02 nos.
NOTE: 1. Internet facility is desired to be provided in the class room.			

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

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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

