

# **SYLLABUS**

**For the trade of**

## **RADIOLOGY TECHNICIAN (RADIO DIAGNOSIS & RADIOTHERAPY)**

**Under**

### **Craftsmanship Training Scheme**

**Designed in  
2005**

**Government of India  
Ministry of Labour (DGE&T)  
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE  
EN-Block, Sector-V, Salt Lake City, Kolkata-700 091**

**List of members attended Trade Committee Meeting to finalize the draft syllabus held on 23.09.2004 for the trade of Radiology Technician ( Radio Diagnosis & Radiotherapy) under C.T.S.**

<b>Sl.No.</b>	<b>Name</b>	<b>Office</b>	
1	Sri M.S. Lingaiah, Director	CSTARI, Salt Lake, Kolkata – 91	<b>Chairman</b>
2	Prof. S. K. Basu, Special Secretary Health and Family Welfare.	Govt. of West Bengal, Deptt. Of Health.	Member
3	Dr. Prabir Chowdhury, Radiation Oncologist.	Chittaranjan National Cancer Institute	Member
4	Dr. Soumitra Kr. Chowdhuri, Head,	Chittaranjan National Cancer Institute	Member
5	Dr. Suparna Majumdar, HOD/Deptt. Deptt. Of Radiology.	Chittaranjan National Cancer Institute	Member
6	Dr. P.K.Sarkar, Head, Health Physics Unit.	Variable Energy Cyclotron Centre.	Member
7	Prof. S. Pal, Professor, Biomedical Engg.	Jadavpur University, Kolkata-72	Member
8	Dr. Jyanta Kr. Paul, physicist cum RSO.	Nilratan Sarkar Medical College Hospital, Kolkata.	Member
9	Prof. Anjali Mukherjee, Sivatosh Mukherjee Science Centre	S .M. Sc., Kolkata - 25	Member
10	Sri Aminul Ahsan,	West Bengal Voluntary Health Association	Member
11	Sri Jnan Praakash Poddar	Indian Institute of Training & Dev. SRIJAN, Kolkata.	Member
12	Sri Moslem Tarafder	Indian Institute of Trg. & Dev.	Member
13	Sri R. Senthil Kumar, JDT	CSTARI, Salt Lake, Kolkata-91	Member
14	Sri M.M. Gera, DDT	CSTARI, Salt Lake, Kolkata-91	Member
15	Sri T. Mukhopadhyay, DDT.	CSTARI, Salt Lake, Kolkata-91	Member
16	Sri S.Kumar, DDT	CSTARI, Salt Lake, Kolkata-91	Member
17	Sri S.B.Sardar, T.O	CSTARI, Salt Lake, Kolkata-91	Member
18	Sri Surojit Pal	VECC, Kolkata	Special contributor

### **GENERAL INFORMATION**

1. Name of the Trade : Radiology Technician  
(Radio Diagnosis & Radiotherapy)
2. N.C.O. Code No. :
3. Duration : 2 years
4. Entry Qualification : Passed 12<sup>th</sup> Class Examination  
under (10 + 2) System of Education  
with Physics, Chemistry & Biology.

**N.B.** Radiotherapy Physics : Introduction : The subject should be taught of an elementary level. The treatment should be descriptive & Qualitative rather than quantitative. Principles and practical applications should be emphasized throughout .



**SYLLABUS FOR THE**  
**TRADE OF “RADIOLOGY TECHNICIAN”(RADIO DIAGNOSIS & RADIO THERAPY)**  
**UNDER CRAFTSMAN TRAINING SCHEME (CTS)**

Duration: 2 years.

<b>WEEK NO .</b>	<b>THEORY</b>	<b>PRACTICAL</b>	<b>WORKSHOP CAL. &amp; Sc .</b>	<b>ENGG. DRAWING .</b>
1-2	Radiotherapy, Radio activity, Radio active materials, Radioisotopes, Characteristics of $\alpha$ , $\beta$ , and $\gamma$ rays – Physical properties, X-rays, physical Properties	Hazards & observing safety measures associated with Radioactivity & X-rays Plateau determination using. Surveymeter – with source. Survey at different distances.	<b><u>Physics:</u></b> General properties of Matter, Surface tension, Viscosity, Bernoulli’s Theorem Heat (thermometry and calorimetric), Acoustics, Geometrical and physical optics (Interference, Diffraction, Polarization	Basic concept of Engineering Drawing, Ist & 3 <sup>rd</sup> angle projection.
3-5	Diagnostic H.T. Circuits, high tension generators, Half wave & Full wave rectifiers, Three phase circuits, Constant voltage regulator H.T. switches, , Measuring Instruments, Voltmeters, Milliamp meter	Study of X-ray m/c, circuits, controlling of different parameters	<b><u>Atomic Physics</u></b> Semi conductors, photo-electricity, X-Ray, Radio activity.	Free hand sketches of bones, spinal cord, joints.
6-9	Focal spot, inherent filtration, tube holders, MAS meter, compensator, exposure timer, Interlock and safety devices. Grid, Ratio in relation to KV. Reciprocating and oscillating. Potter bucky diaphragms, stationary grids.	Study of MAS metre, Interlock Mechanism	Revision of mathematics	Free hand drawing of skeleton of human body
10-11	Control of scattered radiation, beam modification devices.		Calculation of percentages, proportion , Inverse proportion , Inverse square law, geometric of triangles ,	Drawing of major muscles , nerve supplies & blood supply & action

			properties of similar Triangles. Logarithmic & Exponential functions and inverse Exponential function and their graphical representation. Linear and semi log plotting	Drawing of Digestive, Respiratory & Excretory system Drawing of different joints of human organ. Different drawing of bones, nerve roots & muscle attachment
			<p><b><u>Electromagnetism</u></b></p> <p>Units used in Electrostatics. Magnetism and current electricity Elementary principles of magnetism as an electrical effect, magnetization of materials by electric current, the right hand rule, solenoids, electromagnets. Force on conductor in magnetic field , the motor principle, the left hand rule . Instruments:- Ammeter, voltmeter, electromagnetic induction. Principles, mutual and self induction. Wave form, peak and mean values, frequency, power and power factor. Conduction of electricity through gases, effect of varying pressure, cathode rays, X-rays</p>	Sketches of heart Sketches of Neurons and nerves
12-15	<p>i) Flow of electricity through gases, effect of varying pressure, cathode rays and x-rays. ii) Definition of radiation and its types.</p>	A.V.Demo.	<p><b><u>Physics of Radiation</u></b></p> <p>Definition of radiation and its types. Electromagnetic (EM) radiation. Radiation as a wave motion. Wave</p>	Sketches of excretory system

<p>Electromagnetic radiation, Radiation as a wave motion, wave length, frequency magnitude, velocity and their relations, Electromagnetic spectrum, common properties of electromagnetic radiation.</p> <p>iii) Sources of radiation- Natural and artificial.</p> <p>iv) Radioactivity- atomic and nuclear structures, Atomic number, Isotopes, Mass number, Atomic mass, Binding energy, Energy level, Nuclear binding energy, Nuclear Stability, NP- ratios, Radioactive decay, Half life, Decay constant, Mean life and their relation. Specific activity, Alpha and Beta particles, Gamma radiation and their properties. Properties of Radium, Production of Radioisotopes, Natural &amp; Artificial radioactivity, Radioactive equilibrium, Units of activity- curie and Bequerel. Specific gamma ray constant.</p> <p>v) Fusion &amp; Fission..</p> <p>vi) X-rays: Principles of production of X-ray, Intensity, continuous and characteristic spectrum. Basic circuit of X-ray tube. Construction of modern X-ray tubes, filaments, anode, cathode, methods of cooling anode, Inherent filtration, added filtration and their effect on quality of spectrum. Rectification. CT Scan, MRI Scan, USG</p>	<p>Demo on X-ray m/c, portable unit</p> <p>Study of different parts of x-ray m/c.</p> <p>Demo on C.T.Scan, MRI, USG m/c</p>	<p>length, frequency, amplitude, velocity and their relation. Concept of Quanta. Energy of radiation . Electro magnetic spectrum , common properties of radiation</p>	
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	<p>etc. (Principles only).</p> <p>vii) Interaction of X Rays and Gamma rays with matter, Ionisation &amp; excitation, Attenuation and absorption co-efficient, Modes of interaction. Energy absorption from X-rays, Half value Layer Roentgen and Rad. Simple principles of decimeters, fluorescent effect, photographic effect.</p> <p>viii) Radiation protection: Code of practice for the protection of persons against ionizing radiation, protective materials, Lead, lead equivalent, Building materials, personnel monitoring, international recommendations against hazards in ionizing radiation (Internal &amp; External.), Units of Dose limit, ALARA principle, operational dose limits for radiation worker &amp; public.</p> <p>ix) Calculations of barrier thickness. Film badges and TLD badges, Survey meter, Gamma zone monitor. Pocket dosimeters.(Basic principle)</p>	<p>Study of radiation protection. Familiarization with code of practice</p> <p>Study of Dosimeters. TLD badges, Survey meter, Gamma zone monitor &amp; calculation of barrier thickness</p>		
16-25	<p><b><u>ANATOMY</u></b></p> <p><b><u>The Cell-</u></b> Types, structure, function reproduction , structure of general tissues.</p> <p><b><u>General Anatomical terms-</u></b> Regions of the body. Bones and joints. Skull, spine,</p>	Demonstration	<p><b><u>Sources of radiation -Natural and Artificial</u></b></p> <p>Radioactivity – Atomic and Nuclear structures. Rutherford, Bohr model. Atomic Number. Mass Number. Atomic Mass. Binding energy. Energy level. Nuclear binding energy. NP ratio</p>	

<p>pelvis , bones of upper and lower extremities. Structure of a typical joint and general description of main joints, movements in joints and their limitations, group movement of joints.</p> <p><b><u>Thorax and abdomen:</u></b></p> <p>Structure of thoracic cage; abdominal cavity. Diaphragm and mediastinum. Heart – structure and function of heart. Names of main arteries and function of heart. Names of main arteries and veins.</p> <p><b><u>Brain:</u></b></p> <p>Main subdivisions and lobes, ventricles , spiral cord.</p> <p><b><u>Respiratory system:</u></b></p> <p>Sinuses, trachea, tonsils, larynx , lungs, bronchi, pleura</p> <p><b><u>Reproductive system:</u></b></p> <p>(a) Female genital tract fallopian tubes, ovaries, uterus , vagina (b) Male genital tract:- Testis, epididymis , prostate.</p> <p><b><u>Alimentary system :</u></b></p> <p>Mouth, tongue, salivary glands, esophagus, pharynx, stomach, small and large intestine, liver and biliary tract spleen, Pancreas , mesentery, omentum, Gall Bladder</p> <p><u>Urinary tract:</u></p> <p>Kidney, ureters, bladder,</p>		<p>energy. NP ratio. Definition of radioactivity. Natural radioactivity. Radioactive decay. Half-life, decay constant. Mean life and their relation. Specific activity.</p> <p>Radiation from radioactive elements. Alpha and beta particles. Gamma radiation and their properties. Radioactive series. Properties of Radium and its daughter products. Radioactive equilibrium,. Units of activity. The Curie and Becquerel. Specific Gamma Ray constant.</p>	
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	<p>urethra</p> <p><u>Special sense organs</u> (Broad outlines only)- Structure and function of eye, structure and function of ear.</p> <p><b><u>Lymphatic system and reticule- endothelial system</u></b></p> <p>Position of main lymphatic structures, tonsils, spleen and Liver, Bone marrow. Functions of Red and white corpuscles of Blood.</p> <p><b><u>Ductless glands :</u></b></p> <p>(Broad principles only): Macroscopic anatomy and function of Pituitary, Thyroid , Pancreas, gonads etc.</p>			
26-40	<p><b><u>RADIO DIAGNOSTICS</u></b></p> <p><b>a) <u>Special equipments:</u></b> <b>Topography-</b></p> <p>Magnification technique , Mobile units, Portable units, Image intensifier, Tele- radiography, Spot film devices, stereoscopy.</p> <p><b>b) <u>Radiographic Technique</u></b></p> <p>i) Contrast media: Barium preparation, iodine preparation, Air-oxygen.</p> <p>ii) Skeletal system: Upper limb, lower limb, shoulder girdle and thorax, vertebral column, pelvic girdle. Hip region, Teeth jaw.</p> <p>iii) Respiratory system: Upper respiratory passage,</p>	<p>Demo &amp; Practice on x-rays Magnification practice on radiography &amp; image intensifier</p> <p>Practice on IVP ,IVU ,Peroperative Calangiogram, ERCP, Ba-Meal, Ba-follow through ,Ba-swallow ,Ba-Enema etc.</p>	<p><b><u>Fission, Fusion, Artificial radioactivity</u></b></p> <p>X-Ray – Principles of production of X-rays, Intensity, continuous and characteristic spectrum. Basic Circuit of X-ray tube. Construction of modern X-ray tubes, Filament, Anode, Cathode, Methods of cooling anode, Inherent filtration and their effect on quality of spectrum, Rectification. Semi conductors- Diode, Transistors.</p>	<p>Sketches of digestive system</p> <p>Sketches of respiratory system</p>

	<p>lungs, Pleura, diaphragm, media strum, bronchography , artificial pneumothrorax</p> <p>iv) Gynecology: Radiation protection, pregnancy, hysterosalipingography, plaxentography</p> <p>v) CNS: Routine and special projections of skull, ventriculography, cerebral angiographies, xylograph.</p> <p>vi) G.I. System:- Barium , suspension, Barium swallow, Barium meal and follow through Barium enema</p> <p>vii) Bleary system: Cholecystography, oral and I.V. cholangiography-direct and indirect</p> <p>viii) Liver and spleen: Splemoportal renography</p> <p>ix) Salivary glands: Calligraphy</p> <p>x) Orthography, Lymphangiography, operation theatre technique and ward radiography. Magnification, High and low K.V. technique and mammography .</p>	<p>Practice on Barium swallow</p> <p>Practice on mammography.</p>		
41-50	<p><b><u>Radiographic Photographic and Dark room technique</u></b></p> <p>Types of emulsion-Characteristic and control,</p>	<p>Practice on Photography &amp;Dark room technique</p>	<p><b><u>Bio chemistry:</u></b> Chemistry of water, Mineral, Vitamins, Protein, Carbohydrate, Lipids, Nucleic acids, Enzymes, Blood, Extra</p>	





71-73	<p>accordance with quality of radiation fillers, distance, intensifying screens, grids, film speed, developer and development.</p> <p><b><u>Attenuation of Radiograph:</u></b> Identification of films, aspect for direct and stereo viewing, mounting dental films.</p>			
74-75	<p><b><u>Accessories:</u></b></p> <p>Viewing boxes, spot light, illuminators, projectors and viewing screens for miniature and cine radiography, magnifiers, film identification, lead letters and numbers, actinic markers embossing machine, film trimmers, corner cutters, dental mounts and cutter, filling units.</p>			
76-77	<p><b><u>Care and maintenance of equipment</u></b></p> <p>General principles and routine use of charts supplied by manufacturer, Radiographic calibration procedure, Tube rating chart.</p>	<p>Practice on maintenance of charts ,radiographic calibration</p>	<p><b><u>Bio chemistry:</u></b> Chemistry of water, Mineral, Vitamins, Protein, Carbohydrate, Lipids, Nucleic acids, Enzymes, Blood, Extra cellular fluids. Metabolism of Carbohydrate, Proteins, Lipids, Amino acids ,</p>	
78-79	<p><b><u>First Aid:</u></b> -</p> <p>Shock, convulsion, asphyxia, artificial respiration , Administration of Oxygen, Burns Electric shock &amp; burns, wound, hemorrhage, pressure points , Tourniquet.</p>	<p>Practice on First Aid in case of shock etc.</p>	<p>Hemins, Purimes, Pyrimidies and Nucleic Acids.</p> <p>Nature, properties, Kinetics and mechanism of action of energy and co-enzymes, Biological oxidation and bio-</p>	

<p>80-83</p>	<p><u>Injuries to bone</u>, joints and muscles. Dressing or bandages, Plaster of Paris technique, splints, Drug reaction, Poisons.</p> <p><b><u>CT Scan</u></b> – Principles, Scan parameters, Image reconstruction Image display, Image quality, computer system CT guided biopsy , contrast media etc.</p>	<p>Demonstration &amp; practice on CT SCAN</p>	<p>energetic.</p> <p>Basic Ideas of Chemical Reactions</p>	
<p>84-86</p>	<p><b><u>MRI Scan-</u></b> Basic Physics, Imaging process, dynamic MR, MR angiography etc. safety</p>	<p>Demonstration &amp; practice on MRI</p>		
<p>87-90</p>	<p>Ultrasonography - Physics, Techniques, Application , Safety.</p>	<p>Demonstration &amp; practice on USG</p>		
<p>91-100</p>	<p><b><u>RADIOTHERAPY :-</u></b></p> <p>i) Elementary Pathology-Health and disease. Degeneration, repair of wounds, inflammation, infection, immunity.</p> <p>ii) Tumors - Definitions, Classifications, causes, spread, General effects.</p> <p>iii) Methods of diagnosis (Elementary principles)-Clinical, Radiographic, histological and biochemical methods.</p> <p>iv) Treatments - Radical and Palliative, treatment. General</p>	<p>Basic familiarization (along with Doctor)</p>	<p>i) Calculations of percentages, proportion, Inverse-square law.</p> <p>ii) Geometry of triangles. Logarithmic and Exponential functions. Linear and semi log plotting.</p> <p>iii) Elementary principles of – Magnetism as an electrical effect, magnetization of materials by electric current, the right hand rule, electromagnets. Force on conduction in magnetic field, Left hand rule. Voltmeter, Electromagnetic</p>	

<p>principles of medical , surgical, radio therapeutic methods including anti-cancer drugs, hormones.</p> <p>v) Biological effects of radiation: Physical and chemical effects of radiation, General effects on cells and tissues. Recovery, sensitivity. Special effects on skin, mucous membrane, bone, lymph nodes, bone marrow, blood, eyes, goudas, spinal cord, lung. Effects of acute and chromic exposures. Whole body effects, radiation syndrome- Lethal dose.</p> <p>vi) Factors modifying radiation effect- Dose, type of radiation, area, volume, total time and fractionation of treatment. Local factors in tissue and tumors –type, site, blood supply, oxygenation, infection, previous treatment. Constitutional factors – age, state of health.</p> <p>vii) Clinical aspects of radiation reaction – care of patients undergoing radiotherapy(including use of blood counts) . Care of reactions. Consequence of technical errors.</p> <p>viii) Absorption of X Rays and Gama Rays, Linear attenuation coefficient, Mass, Atomic absorption coefficient. Energy transfer and absorption co-efficient.</p> <p>ix) Measurement of X rays and Gamma rays- Ionizing</p>	<p>Demonstration</p>	<p>Electromagnetic induction, wave form, peak and mean values, frequency, power and power factor</p>	
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<p>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.</p> <p>x) Radiotherapy treatment machines:-</p> <p>Telecobalt units , Linear accelerators, Brachy therapy units, Simulator, TPS etc.</p> <p>xi) Radio therapeutic practices:</p> <p>a) Teletherapy calculations: SSD and SAD techniques. Use of charts and graphs for free air dose rate, back scatter factors, percentage depth dose, tissue air ratio, equivalent squares, wedges and compensator.</p> <p>b) Planning procedures: Construction of contour diagrams for plans. Tumor localization, field selection. Use of Isodose curves on body contours. Estimation of dose at different depth within the tissue using ..... curves, tissue inhomogeneity correction, correction for curvature of body contour.</p> <p>c) Treatment techniques-treatment techniques</p>	<p>Patient treatment Telecobalt unit &amp; Linear Accelerator using different treatment techniques like SSD,SAD,Wedge,rotation compensator.</p> <p>Treatment Compensator design.</p> <p>Preparation of thermoplastic mould.</p>		
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	<p>commonly used in lesions of skin, breast, pelvis, abdomen, thorax, spine, gland areas, limbs, larynx, ant rum, nasopharynx, testis, bladder, penish, tonsil, tongue etc. The use of single and multiple field arrangements, wedge filters, compensators, breast device, ROT, ARC, SKIP techniques etc.</p> <p>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.</p>			
101-102	Visit to different Hospitals, Radiation Medicine Centre (RMC)			
103	Revision			
104	Class Test			

**\*\* All practical regarding the instruments and technique procedure (for both diagnostics and therapeutics) to be planned and carried out according to the facilities available in the Training Institute.**

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## LIST OF TOOLS AND EQUIPMENTS

### Unit Size-16

<b>SL.NO.</b>	<b>ITEMS</b>	<b>QUANTITY</b>
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 Set
	ix) Telecobalt Unit	1 Set
2	Pocket Dosimeter	16 Nos.
3	TLD Badges	16 Nos.
4.	Continuation monitor	2 Nos.
5.	X-ray Unit 500 MA, 80 KVP	1 No.
6.	Darkroom facility	1No.
7.	G.M B. $\gamma$ counting set up	1No
8	Gamma Survey meter (Range 0-20m R/hr or 0-100 mR/hr).	1No
9	Jacket and Shoes	16.Nos
10.	Fire Extinguisher	1 No.
11	.Lead Bricks	10 No.

Social Studies - Syllabus is Already Approved and common for all trades.