

**Model Curriculum for**  
**B.Voc/ D.Voc**  
**in**  
**Medical Image Technology**



**All India Council for Technical Education**  
**Nelson Mandela Marg, New Delhi**

## 1. Introduction

All India Council for Technical Education (AICTE) Ministry of HRD, Government of India has introduced Entrepreneurship oriented Skill development courses of B.Voc/D.Voc/Skill Diploma. These courses will be run by AICTE approved institutes by using available infrastructure and facilities. In these courses the institute will conduct general education content and sector specific skills will be imparted by Skill Knowledge Providers/ Training Providers/ Industries.

### 1.1 Key Features:

#### Objectives

- To provide judicious mix of skills relating to a profession and appropriate content of General Education.
- To ensure that the students have adequate knowledge and skills, so that they are work ready at each exit point of the programme.
- To provide flexibility to the students by means of pre-defined entry and multiple exit points.
- To integrate NSQF within the undergraduate level of higher education to enhance employability of the students and meet industry requirements. Such student apart from meeting the needs of local and national industry are also expected to be equipped to become part of the global workforce.
- To provide vertical mobility to students admitted in such vocational courses.
- The certification levels will lead to Diploma/Advanced Diploma/B. Voc. Degree in Electronic Manufacturing Services and will be offered by respective affiliating University/Board of Technical Education.
- Students may be awarded Level Certificate/Diploma/Advance Diploma /Degree as out-lined in the Table below:

Award	Duration after class X	Corresponding NSQF level
Level 3 Certificate	1 Year	3
Level 4 Certificate	2 Years	4
Diploma	3 Year	5
Advance Diploma	4 Years	6
B.Voc Degree	5 Years	7

## 2. Course Objectives

After successfully completing the vocational course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Medical Imaging Technology so that he/she is properly equipped to take up gainful employment in this Vocation. Thus he/she should

have acquired.

#### **A. Understanding of**

- (a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Biology) so that he/she is able to understand the different vocational subjects.
- (b) The basic concepts in engineering drawing.
- (c) The concepts, principles of working of basic electronic devices and circuits.
- (d) The knowledge of procedures of medical imaging.
- (e) The procedure of operation and upkeep of Medical Imaging equipments.
- (f) The concepts and principles used in safety while using equipments.

#### **B. Adequate Professional Skills and Competencies in**

- (a) Testing different electronic components.
- (b) Testing the performance of electronic circuits.
- (c) Locating the fault at component level and at the stage level.

#### **C. A Healthy and Professional Attitude so that He/She has**

- (a) An analytical approach while working on a job.
- (b) An open mind while locating/rectifying faults.
- (c) Respect for working with his/her own hands.
- (d) Respect for honesty, punctuality and truthfulness.

#### **D. NSQF compliant skills in Qualification developed by sector skill council in Electronic sector**

### **3. Course Structure**

The course will consist of combination of practice, theory and hands on skills in the electronics sector.

#### **Curriculum**

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

#### **Skill Development Components:**

- The focus of skill development components shall be to equip students with appropriate knowledge, practice and attitude, to become work ready. The skill development components will be relevant to the industry as per its requirements.
- The curriculum will necessarily embed within itself, National Occupational Standards (NOSs) of specific job roles within the industry. This would enable the students to meet the learning outcomes specified in the NOSs.
- The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in few domains.
- The curriculum will focus on work-readiness skills in each of the year of training.

- Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work.

**General Education Component:**

- The general education component adheres to the normal senior secondary and university standards. It will emphasize and offer courses which provide holistic development. However, it will not exceed 40% of the total curriculum.
- Adequate emphasis is given to language and communication skills.

The curriculum is designed in a manner that at the end of year-3, year-4 and year-5, students can meet below mentioned level descriptors for level 5, 6 and 7 of NSQF, respectively:

Level	Process required	Professional Knowledge	Professional skill	Core skill	Responsibility
Level 3	Person may carry put a job which may require limited range of activities routine and predictable	Basic facts, process and principle applied in trade of employment	Recall and demonstrate practical skill, routine and repetitive in narrow range of application	Communication written and oral with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment	Under close supervision some responsibility for own work within defined limit
Level 4	Work in familiar, predictable, routine, situation of clear choice	Factual knowledge of field of knowledge or study	Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	Language to communicate written or oral, with required clarity, skill to basic arithmetic and algebraic principles, basic understanding of social political and natural environment	Responsibility for own work and learning

<p>Level 5</p>	<p>Job that requires well developed skill, with clear choice of procedures in familiar context</p>	<p>Knowledge of facts, principles, processes and general concepts, in a field of work or study</p>	<p>A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools materials and information</p>	<p>Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.</p>	<p>Responsibility for own work and learning and some responsibility for other's works and learning</p>
<p>Level 6</p>	<p>Demands wide range of specialized technical skill, clarity of knowledge and practice in broad range of activity involving standard/ non-standard practices</p>	<p>Factual and theoretical knowledge in broad contexts within a field of work or study</p>	<p>A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study</p>	<p>Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting organizing information, and logical communication</p>	<p>Responsibility for own work and learning and full responsibility for other's works and learning</p>
<p>Level 7</p>	<p>Requires a command of wide ranging specialized theoretical and practical skill, involving variable routine and non-routine context</p>	<p>Wide ranging, factual and theoretical knowledge in broad contexts within a field of work or study</p>	<p>Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study</p>	<p>Good logical and mathematical skill understanding of social political and natural environment good in collecting and organizing information, communication and presentation skill</p>	<p>Full responsibility for output of group and development</p>

## Curriculum

Level	Code	Educational Component	Credit	Marks
3 Semester I	<b>Theory</b>			
	3.GE.01	Language – I	3	50
	3.GE.02	Applied Chemistry	3	50
	3.GE.03	Applied Physics	3	50
	3.GE.04	Applied Biology –I	3	50
	<b>Lab/Practical</b>			
	3.GP.01	Applied Chemistry Lab	1.5	50
	3.GP.02	Applied Physics Lab	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	Pharmacy Assistant (HSS/Q5401)		(Any one)	15
Medical Equipment Technician (Basic Clinical Equipment) (HSS/Q5601)				
3 Semester II	<b>Theory</b>			
	3.GV.01	General Foundation Course –I	3	50
	3.GV.02	Basic Electricity	3	50
	3.GV.03	Basic Electronics	3	50
	3.GV.04	Applied Biology – II	3	50
	<b>Lab/Practical</b>			
	3.VP.01	Basic Electricity – Lab	1.5	50
	3.VP.02	Basic Electronics – Lab	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	Any One of the QP's to be opted from the ones mentioned in Level 3 First semester		(Any one)	15
4 Semester I	<b>Theory</b>			
	4.GV.01	Engineering Science	3	50
	4.GV.02	Trouble Shooting & Maintenance of Electronics Equipment-I	3	50
	4.GV.03	IT Tools-I	3	50
	4.GE.01	Language – II	3	50
	<b>Lab/Practical</b>			
	4.VP.01	Engineering Science – Lab	1.5	50
	4.VP.02	Trouble Shooting & Maintenance of Electronics Equipment's- Lab	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	X- ray Technician (HSS/Q0701)		(Any one)	15

Level	Code	Educational Component	Credit	Marks
		Radiation Therapy Technologist (HSS/Q0601)		
4 Semester II	<b>Theory</b>			
	4.GV.04	Physics and Technology in Imaging	3	50
	4.GV.05	Digital Electronics	3	50
	4.GV.06	Trouble Shooting & Maintenance of Electronics Equipment's-II	3	50
	4.GV.07	IT Tools -II	3	50
	<b>Lab/Practical</b>			
	4.VP.03	IT Tools - Lab	1.5	50
	4.VP.04	Digital Electronics - Lab	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
Any One of the QP's to be opted from the ones mentioned in Level 4 First semester		(Any one)	15	200
5 Semester I	<b>Theory</b>			
	5.GV.01	Electronic Measurement and Instrumentation -I	3	50
	5.GV.02	Basic Anatomy (Cross Sectional Anatomy-II)	3	50
	5.GV.03	Tools, Equipment & Safety Measures -I	3	50
	5.GV.04	Soldering & De-Soldering of Components -I	3	50
	<b>Lab/Practical</b>			
	5.VP.01	Identification of Components, Tools, Equipment and its working -Lab	1.5	50
	5.VP.02	Basic diagnostics (Lab)	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
Radiology Technician (HSS/Q0201)		(Any one)	15	200
5 Semester II	<b>Theory</b>			
	5.GV.05	Electronic Measurement and Instrumentation -II	3	50
	5.GV.06	Basic Imaging	3	50
	5.GV.07	Tools, Equipment & Safety Measures -II	3	50
	5.GV.08	Soldering & De-Soldering of Components & Emergency actions II	3	50
	<b>Lab/Practical</b>			
	5.VP.03	Soldering & De-Soldering of Components-Lab	1.5	50
5.VP.04	Basic Imaging Practical Lab	1.5	50	

Level	Code	Educational Component	Credit	Marks
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	To continue with the same QP as opted in Level 5 First semester	(Any one)	15	200
<b>6</b> <b>Semester I</b>	<b>Theory</b>			
	6.GV.01	Fault analysis & Repairs	3	50
	6.GV.02	Cross Sectional Anatomy	3	50
	6.GV.03	Electronics Devices Circuit –I	3	50
	6.GV.04	Radiation and administrative Issues	3	50
	<b>Lab/Practical</b>			
	6.VP.01	Electronics Devices Circuits Lab	1.5	50
	6.VP.02	Fault analysis & Repairs - Lab	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	Assistant Duty Manager - Patient Relation Services (HSS/Q6103)	(Any one)	15	200
<b>6</b> <b>Semester II</b>	<b>Theory</b>			
	6.GV.05	CT and Ultrasound	6	100
	6.GV.06	Manufacturing & Quality Norms	3	50
	6.GV.07	Electronics Devices Circuit –II	3	50
	<b>Lab/Practical</b>			
	6.VP.03	Electronics Devices Circuit –II Lab	1.5	50
	6.VP.04	Manufacturing Practices	1.5	50
	<b>On-Job-Training (OJT)/Qualification Packs</b>			
	To continue with the same QP as opted in Level 6 First semester	Any one)	15	200
	<b>7</b> <b>Semester I</b>	<b>Theory</b>		
7.GV.01		MRI, Image Processing and Recording	6	100
7.GV.02		Advanced Imaging	6	100
<b>Lab/Practical</b>				
7.VP.01		MRI, Image Processing and Recording	1.5	50
7.VP.02		Advanced Imaging	1.5	50
<b>On-Job-Training (OJT)/Qualification Packs</b>				



Level	Code	Educational Component	Credit	Marks
	Duty Manager - Patient Relation Services (HSS/Q6104)	(Any one)	15	200
<b>7</b> <b>Semester</b> <b>II</b>	<b>Theory</b>			
	7.GV.03	Admin, Medico Legal and interventional Procedures	6	100
	7.GV.04	Project	6	100
	<b>Lab/Practical</b>			
	7.VP.03	Admin, Medico Legal and Interventional Procedures	3	100
	<b>On-Job-Training (OJT)/Qualification Packs</b> (The practical and theory need to be performed in a hospital/radiological centre)			
	To continue with the same QP as opted in Level 7 First semester			15

## Detailed Curriculum

### Level 3 (Semester I)

#### (3.GE.01) Language – I

#### **Module 1: Reading comprehension (prescribed texts) and functional grammar**

A variety of genres – short stories, expository pieces, biographies, poems, plays, newspaper and magazine excerpts have been included. Teaching of grammar has been integrated with the reading texts. The emphasis is on functional grammar.

The following ten prose texts and five poems have been selected for development of different reading skills.

#### **Prose texts (Prescribed)**

1. A warmer or a colder earth (popular science) Arthur – C. Clark
2. The tiger in the tunnel (narrative) – Ruskin Bond.
3. First two or four pages from Sunny Days (autobiographical) – By Sunil Gavaskar
4. Case of suspension (narrative)
5. Big brother (narrative) Shekhar Joshi
6. Father, dear father (news paper article form the Hindu)
7. Face to face (autobiographical) Ved Mehta
8. I must know the truth (narrative) Sigrun Srivastva
9. If I were you (play) Douglas James
10. India, her past and her future (speech) Jawahar Lal Nehru

#### **Poems**

1. Leisure – W H Davis
2. The road not taken – Robert Frost
3. Where the mind is without fear- Tagore
4. My grandmother's house – Kamla Das
5. The night of the scorpion – Nissi, Ezekiel

#### **Non prescribed**

In this section learners will be exposed to newspaper, articles, tables, diagrams, advertisements etc. which they have to read carefully and interpret. In the examination similar pieces will be used.

#### **Grammar and usage:**

The following points of grammar and usage have been selected from the reading passages.

1. agreement/concord: number – gender etc.
2. Tenses: simple past (negatives/interrogatives) present perfect, past perfect continuous, past perfect, expressing future time (will and going to)
3. Passive voice (perfect tenses and modals)
4. Modals (must, should ought to, would)

5. Linking words (to like because although, instead of, if, as, since, who, which that, when however, in spite of)
6. Reported speech, statements, questions (yes/no)

### **Module 2: Functional writing and study skills**

This module helps the learner to write descriptive and narrative paragraph, letters, reports notices etc. and also practice skills of note making

1. Paragraph writing
  - Describing objects
  - Describing people
  - Narrating events, stories
2. Letter writing
  - Application for leave
  - Application for jobs
  - Asking for information from various agencies (e.g. Last date for getting prospects; price of items before placing orders etc.)
3. Note making
  - Ending (punctuation, spelling, appropriate vocabulary, structures)

### **(3.GE.02) Applied Chemistry**

#### **1. Structure of Atom:**

Rutherford model of the structure of atom, Bohr's theory of electrons, quantum numbers and their significance, de-Broglie equation and uncertainty principle, electronic configuration of 1 to 30 elements.

#### **2. Periodic Properties of Elements:**

Periodic law, periodic table, periodicity in properties like atomic radii and volume, ionic radii, ionization energy and electron affinity. Division of elements into s, p, d and f blocks.

#### **3. Chemical Bonds:**

Electrovalent, covalent and coordinate bond and their properties. Metallic bonding (electron cloud model) and properties (like texture, conductance, luster, ductility and malleability).

#### **4. Fuel and their Classification:**

Definition, characteristics, classification into solid, liquid and gaseous fuel. Petroleum and brief idea of refining into various fractions and their characteristics and uses. Calorific value of fuel, Gaseous fuels- preparation, properties, composition and use of producer gas, water and oil gas.

#### **5. Water:**

Impurities in water, methods of their removal, hardness of water, its types, causes and removal, disadvantages of hard water in boilers, pH value and its determination by calorimetric method.

#### **6. Corrosion:**

Its meaning, theory of corrosion, prevention of corrosion by various methods using metallic and non-metallic coatings.

#### **7. Plastic and Polymers:**

Plastic-thermo-plastic and thermo-setting. Introduction of Polythene. P.V.C. Nylon, synthetic rubber and phenol-formal-dehyde resin, their application in industry.

### **(3.GE.03) Applied Physics**

1. **Units & Dimensions:** M.K.S. fundamentals & derived units, S.I. base units supplementary units and derived units, Dimensions of various physical quantities, uses of dimensional analysis.
2. **Surface Tension and Viscosity:** molecular forces, molecular theory of surface tension, surface energy, capillary action, concept of viscosity, coefficient of viscosity, principle and construction of viscometers.
3. **Vibrations:** Vibration as simple spring mass system, elementary and qualitative concept of free and forced vibrations, resonance. Effects of vibrations on building bridges and machines members.
4. **Heat:** Temperature and its measurement, thermoelectric, platinum resistance thermometers and pyrometers. Conduction through compound media and laws of radiations.
5. **Ultrasonics:** Productions of ultrasonic waves by magnetostriction and piezo-electric effect, application of ultrasonics in industry.
6. **Optics:** Nature of light, reflection and refraction of a wave from a plane surface. Overhead projector and Epidiascope.

### **(3.GE.04) Applied Biology – I**

1. **Cell-The Unit of Life** Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall; cell organelles - structure and function; endomembrane system, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus.
2. **Biomolecules** Chemical constituents of living cells: Structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action.
3. **Cell Cycle & Cell Division:** Cell Cycle, Mitosis, Meiosis and their function
4. **Cellular Respiration** - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient.
5. **Anatomy & Physiology of Human Body:** Definition, Anatomical terms, Tissues, Glands and membranes, Homeostasis
6. **Blood & its Components:** Different Blood Components and their functions, Coagulation of Blood, Blood Grouping
7. **Human Skeleton:** Identification, Classification and functions of bones, joints and muscles, Physiology of muscle contraction
8. **Sensory Organs:** Eye, Ear, Nose, Tongue and Skin – Structure

**(3.GP.01) Applied Chemistry – Lab**

1. Proximate analysis of solid fuel.
2. Experiments based on Bomb Calorimeter.
3. Determination of turbidity in a given sample.
4. To determine the flash and fire point of a given lubricating oil.
5. To determine the viscosity of a given lubricating oil by Redwood viscometer.
6. To determine cloud and pour point of a given oil.

**(3.GP.02) Applied Physics – Lab**

1. To determine the surface tension of a liquid by rise in capillary.
2. To determine the viscosity of a given liquid.
3. To determine the frequency of tuning fork using a sonometer.
4. To determine the frequency of AC main using sonometer.
5. Time period of a cantilever.

## **Level 3 (Semester II)**

### **(3.GV.01) General Foundation Course – I**

#### **1. Introduction to National Health Care System:**

- Introduction to healthcare delivery system
- National Health Mission
- National Health Policy
- Issues in Health Care Delivery System in India
- National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programme.
- Health scenario of India- past, present and future
- Demography & Vital Statistics-
- Demography – its concept
- Vital events of life & its impact on demography

#### **2. Medical terminologies and record keeping**

- Derivation of medical terms.
- Define word roots, prefixes, and suffixes.
- Basic medical terms.
- Interpret basic medical abbreviations/symbols.
- Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
- Data entry and management on electronic health record system.

#### **3. Medical Law and Ethics**

- Medical ethics - Definition - Goal - Scope
- Introduction to Code of conduct
- Basic principles of medical ethics – Confidentiality
- Autonomy and informed consent - Right of patients
- Care of the terminally ill- Euthanasia
- Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
- Professional Indemnity insurance policy
- Development of standardized protocol

#### **4. Professionalism and Values**

- Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
- Personal values- ethical or moral values

- Attitude and behavior- professional behavior, treating people equally
- Code of conduct, professional accountability and responsibility, misconduct
- Differences between professions and importance of team efforts
- Cultural issues in the healthcare environment

## 5. Principals of Management

- Introduction to management
- Strategic Management
- Foundations of Planning
- Planning Tools and Techniques
- Decision Making, conflict and stress management
- Managing Change and Innovation
- Understanding Groups and Teams
- Leadership
- Time Management
- Cost and efficiency

### **(3.GV.02) Basic Electricity**

1. **Current Electricity:** Definition of Resistance, Voltage, Current, Power, Energy and their units, Relation between electrical, mechanical and thermal units, Temperature variation of resistance, Difference between AC and DC voltage and current.
2. **D.C. Circuits:** Ohm's Law, Series – parallel resistance circuits, calculation of equivalent resistance, Kirchhoff's Laws and their applications.
3. **Electric Cells:** Primary cell, wet cell, dry cell, battery, Li-ion battery, series and parallel connections of cells, Secondary cells, Lead Acid Cell, Discharging and recharging of cells, preparation of electrolyte, care and maintenance of secondary cells.
4. **Lighting Effects of Current:** Lighting effect of electric current, filaments used in lamps, and Tubelight, LED, their working and applications.
5. **Capacitors:** Capacitor and its capacity, Concept of charging and Discharging of capacitors, Types of Capacitors and their use in circuits, Series and parallel connection of capacitors, Energy stored in a capacitor.
6. **Electromagnetic Effects:** Permanent magnets and Electromagnets, their construction and use, Polarities of an electromagnet and rules for finding them.  
Faraday's Laws of Electromagnetic Induction, dynamically induced e.m.f., its magnitude and induction, inductance and its unit. Mutually induced e.m.f., its magnitude and direction, Energy stored in an inductance.

Force acting on a current carrying conductor in magnetic field, its magnitude and direction, Principles and construction of dynamo.

## 7. A.C Circuits

Generation of A.C. voltage, its generation and wave shape. Cycle, frequency, peak value R.M.S. value, form factor, crest factor, Phase difference, power and power factor, A.C. Series Circuits with (i) resistance and inductance (ii) resistance and capacitance and (iii) resistance inductance and capacitance, Q factor of R.L.C. series circuits.

### **(3.GV.03) Basic Electronics**

#### **1. Overview of Atom, Sub-Atomic Particles and CRO**

- Brief History of Electronics.
- Atom and its elements,
- Electron, Force, Field intensity, Potential, Energy, current
- Electric field, Magnetic field, Motion of charged particles in electric and magnetic field.
- Overview of CRO, Electronic and Magnetic deflection in CRO, Applications.

#### **2. Voltage and Current**

- Resistance, Ohm's law, V-I Characteristics, Resistors, Capacitors, Inductors.
- Voltage and Current sources, Symbols and Graphical representation
- Overview of AC, DC, Cells and Batteries, Energy and Power.

#### **3. Basics of Semiconductor**

- Semiconductor materials, Metals and Semiconductors and Photo-electric emission.
- N-type and P-type semiconductor, Effects of temperature on Conductivity of semiconductor.
- PN junction diode, depletion layer, Forward & Reverse bias, V-I Characteristic, Effects of temperature, Zener diode, Photo diode, LED, Types and applications of diode.
- Diode as a rectifier, Half wave and full wave rectification, Zener diode Regulator.
- Introduction to Filters, Clippers, Clampers

#### **4. Bipolar Junction Transistor**

- Operation of NPN and PNP transistors, Biasing of BJT.
- CB, CE and CC configuration
- Introduction to FET, JFET, MOSFET, CMOS and VMOS

#### **5. Transistor Amplifier and Applications**

- Introduction, Single and Multi-stage amplifiers
- Introduction to Oscillators
- Introduction to Thyristors, PNPN diode, SCR, LASCR, DIAC, TRIAC



**(3.GV.04) Applied Biology –II**

- 1. Nervous System:** Introduction to nervous system, Classification of nerve fibres, Physiology of nerve transmission, Neurotransmitters, Human Brain, Spinal Cord, Reflexes, Epilepsy, Electroencephalogram, Autonomic Nervous System, Peripheral Nervous System
- 2. Renal Physiology:** Kidney, Nephron, Urine Formation, Renal Function Test, Dialysis
- 3. Reproductive System:** Male reproductive system, Female reproductive system, Menstrual Cycle, Fertility Control
- 4. Endocrinology:** Hormones, Homeostasis, Pituitary Gland, Thyroid Gland, Parathyroid Gland, Endocrine function of pancreas, Adrenal hormones, Local Hormones
- 5. Digestive System:** Introduction, structure and function of digestive organs Pharynx, esophagus, Stomach, Intestines, Liver & Pancreas.
- 6. Respiratory System:** Physiological Anatomy of respiratory tract, physiology of respiration, different pulmonary volumes, Artificial respiration
- 7. Cardiovascular System:** Structure and physiology of Human Heart, cardiac muscles and cardiac cycle
- 8. Genetics:** Mendelian inheritance; deviations from Mendelism – incomplete dominance, codominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination - in humans, birds and honey bee; linkage and crossing over; sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans - thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.
- 9. Genetic Materials:** Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; transcription,
- 10. Genetic code, translation; gene expression and regulation - lac operon; genome and human and rice genome projects; DNA fingerprinting.**

**(3.VP.01) Basic Electricity Lab**

1. Verify that resistance of conductor is directly proportional to resistivity and length and inversely proportional to cross-sectional area of the conductor.
2. Verification of Ohm's Law.

3. Verification of temperature co-efficient of resistance:
  - (i) Positive for Tungsten and Nichrome and
  - (ii) Negative for carbon.
4. Study of series resistive circuits.
5. Study of parallel resistive circuits.
6. Study of series and parallel connection of cells in circuits.
7. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
8. To find heat efficiency of an electric kettle.
9. Charging and Discharging of a capacitor.
10. Verification of magnetic field of a Solenoid with:
  - (i) Iron core and
  - (ii) Air core.
11. Verification of Faraday's Laws of electromagnetic induction.
12. Verification of Torque development in a current carrying coil in magnetic field.
13. Study of R.L. series circuit and measurement of power and power factor.
14. Study of R.C. series circuit and measurement of power and power factor.
15. Study of R.L.C. series circuit and measurement of power and power factor.
16. Study of R.L.C. series circuit for calculation of inductive reactance, capacitive reactance, impedance and Q- Factor.

### **Instruments Required**

- Trainer kit for verifying ohm's law,
- Trainer kit for measuring TCR
- Lead acid battery,
- Hydrometer,
- Electric kettle,
- Trainer kit for measuring power and power factor in RLC circuits

### **(3.VP.02) Basic Electronics - Lab**

1. Study of current and voltage measurement using Ammeter and Voltmeter.
2. Study of current and voltage measurement using Galvanometer.
3. Study of current, voltage and resistance measurement using of Multi-meter
4. Study of Power and Energy measurement using Wattmeter and Energy meter.
5. Study of working principle of Signal Generator and measurement of amplitude, time period and frequency of signal using Oscilloscope.
6. Study of V-I Characteristic of Diode.
7. Study of V-I Characteristic of Zener Diode. And use of Zener Diode as voltage regulator.
8. Study of Half wave rectifier with and without filter circuit.

9. Study of Full wave rectifier with and without filter circuit.
10. Study CE configuration for NPN and PNP transistors and measurement of voltage and current gain.
11. Study CB configuration for NPN and PNP transistors and measurement of voltage and current gain.
12. Study CC configuration for NPN and PNP transistors and measurement of voltage and current gain.
13. Study of working of single layer PCB manufacturing
14. Study of working of double layer PCB manufacturing.
15. Design of 7 segment display using LED and bread board.

### **Instruments Required**

- Ammeter
- Voltmeter,
- Multimeter,
- Galvanometer,
- Energy Meter,
- CRO,
- Diode Trainer kit
- Zener diode Trainer kit
- Rectifier trainer kit
- Transistor characteristics trainer kit,
- PCB manufacturing Lab
- Bread board trainer kit to design 7-segment display.

## **Level 4 (Semester I)**

### **(4.GV.01) Engineering Science**

#### **1. Soldering and Brazing**

General characteristics of soldering, brazing joints, processes and their characteristics, brief description of soldering and brazing tools equipment, types of solders and fluxes and their uses, soldering defects and their remedies, brazing materials, advantages and disadvantages of soldering and brazing. Introduction to PCB, PCB designing, wet etching, dry etching, track correction, wiring, single sided and double sided PCB.

#### **2. Measuring Instruments**

Construction and working principles of moving iron and moving coil voltmeters and ammeters, dynamometer type wattmeter, ohm meter, megger and induction type energy meter- their circuit connection and application for measurement of electrical quantities.

#### **3. Electrical Engineering Drawing**

Schematic and wiring diagram for domestic simple wiring, symbols used for different electrical devices and equipments.

#### **4. Electrical wiring**

Types of wiring – cleat wiring, casing and capping, C.T.S./T.R.S. wiring, metal sheath wiring, conduit wiring and concealed wiring – their procedure. Factors of selection of a particular wiring system, importance of switch, fuse

#### **5. Earthing**

Earthing of wiring system, types of faults, their causes and remedies. Types of earthing- plate earthing and Pipe earthing, their procedure and application. Methods of finding numbers of circuits and circuit distribution by distribution board system, loop in system of wiring connections IE rules related to wiring.

### **(4.GV.02) Trouble Shooting & Maintenance of Electronic Equipment's-I**

#### **1. Basic Occupational Safety and Precautions**

#### **2. Microphones and Loudspeakers**

- Construction, working principle and frequency response of Carbon Microphone, Variable Reactance Microphone, Capacitance Microphone, Piezo-Electric Microphone, Moving Coil Microphone.
- Frequency ranges of musical instruments, Intensity and Dynamic Range, Constructions and working principles of Moving Coil Loudspeaker, Impedance and Power Level of loudspeaker, Frequency characteristics of Practical Loudspeakers: Woofer, Tweeter, Squawker

#### **3. Recorder**

- Block diagram of disk recording and reproduction.
- Principle of optical recording, CD/ DVD manufacturing and recording, CD/ DVD player system, Advantages/ Disadvantages.
- Steps for Fault finding & Analysis.

**(4.GV.03) IT Tools-I**

- I. Computer Organization & OS: User perspective.
  - Understanding of Hardware.
  - Basics of Operating System.
- II. Networking and Internet.
  - Network Safety concerns.
  - Network Security tools and services.
  - Cyber Security.
  - Safe practices on Social networking.
- III. Office automation tools:
  - Spreadsheet.
  - Word processing.
  - Presentation.

**(4.GE.01) Language - II****Module - 3: Listening and speaking skills**

In this module the learners will be exposed to a variety of listening activities recorded on audiotapes. These will be samples of good spoken English, which the learners can use as models. Work sheets will accompany the listening material.

This module will include the following:

1. Introducing yourself/friends in formal and informal situations.
2. Inviting people (over the phone and face to face) giving details of occasion, time place and date. Acceptance and refusal of invitation – formal and informal.
3. Seeking and supplying information (example opening an account in a bank, applying for loans etc.)
4. Talking and conveying messages (over the phone and face to face).
5. Giving directions / instruction.
6. Discussing contemporary issues related to environment, child labour, gender bias etc.
7. Listening to excerpts form television and radio.
8. Listening to poems/plays (prescribed).
9. Listening to speeches / talks.
10. Listening to songs like “We shall overcome”.

**Module - 4 to 6: (English for specific purposes) (opt any one)**

There modules are being offered. A learner has to opt for any one. The first is for academic purposes and the next two are for vocational purposes. The focus is not on the teaching of the subject matter like science and literature but on the way in which language is used in the deferent subjects.

**Module 4: English for Science**

This course will introduce learners to some interesting pieces of popular science

1. Health and hygiene
2. Conservation of (nearly extinct) animals.

3. Plant life.
4. Bio gas / solar energy.

These pieces illustrate the use of English in scientific writing: giving information factually, logically and objectively.

#### **Module 4: English for Receptionist**

This module will introduce the learners to a variety of exercises, tasks and meaningful activities related to the receptionist's use of English. The printed course materials will be supported by tapes.

The following competencies be developed:

1. Receiving messages, making request etc.
2. Supplying information
3. Giving advice and making suggestions
4. Dealing with complaints
5. Making entries in an appointment book, register etc.

#### **Module 4: English for Office Use**

This course will help the learner to use English effectively and appropriately in the office environment. The competencies will be developed.

1. Using the telephone taking and passing messages.
2. Receiving messages
3. Marking noting on files and circular.
4. Writing office notes, memos, notices, agendas for meetings.
5. Telegrams and fax messages.
6. Writing business letters, application enquires, complaints.
7. Filling in forms, cheques, pay in slips etc.

#### **(4.VP.01) Engineering Science - Lab**

1. Introduction to tools and measuring instruments, their safe keeping, safety
2. precautions
3. Measurement of resistance by ammeter and voltmeter method and Ohm meter.
4. Dismantling and reassembly of dynamo.
5. Calibration of ammeter, voltmeter and wattmeter with the help of standard meters.
6. Calibration of single phase energy meter with the help of standard wattmeter and stop watch.
7. Controlling lamps in series, parallel and series parallel.
8. Controlling lamps for two or three places.
9. Drawing schematic diagram to give supply to consumers.
10. Practice on casing and capping wiring.
11. Practice on cleat wiring.
12. Practice on CTS/TRS wiring.
13. Practice on metal sheet weather proof rigid PVC wiring.
14. Practice on conduit wiring.
15. Practice on concealed wiring.
16. Measurement of insulation resistance of wiring installation by megger.
17. Polarity test of wiring installation.
18. Testing of wiring installation.

19. Installation of pipe earthing for wiring installation.
20. Installation of plate earthing for wiring installation.

### **Instruments Required**

- Ammeter
- Voltmeter
- Ohm meter
- Dynamo
- Wattmeter,
- Stop watch controlling lamp
- Different types of wire for practice on wiring,
- Conduit pipes
- Megger
- Materials for earthing

### **(4.VP.02) Trouble Shooting & Maintenance of Electronic Equipment's Lab**

1. Assembly study and fault finding of an audio amplifier.
2. Assembly, study and fault finding of a graphic equaliser.
3. Study working, assembly & fault finding of Colour TV.
4. Study working, assembly & fault finding of LCD TV.
5. To trace the fault in the following panel controls and correct them:
  - Volume control.
  - Brightness control.
  - Contrast control.
  - Vertical hold control.
6. To trace the following stages of T.V. set: Tuner, MF stage, Video detector, Video amplifier.
  - Sound I.T. Sound output stage.
  - Syne separator.
  - Vertical oscillator.
  - Horizontal oscillator.
  - Line Driver Stage.
  - Line output transformer.
  - Power supply.
7. To find fault for the following defects:
  - No picture no sound.
  - Sound present, picture missing.
  - Picture rolls vertically.
  - Picture tears (Horizontal oscillator).
  - Faults in tuner/IF/power supply.
8. Study working, assembly & fault finding of tape recorder system.
9. Study working, assembly & fault finding of CD/DVD player system.
10. Study working, assembly & fault finding of Printer.

11. Study working, assembly & fault finding of Scanner.
12. Study working, assembly & fault finding of Microwave oven.
13. Study working, assembly & fault finding of Telephone.
14. Study working, assembly & fault finding of Fax Machine.
15. Study working, assembly & fault finding of UPS system.
16. Study working, assembly & fault finding of DTH kit.

### **Equipment's Required**

1. Demo kit to understand the working of different section of color TV and to create the fault and rectifying the faults.
2. Trainer kit/ demo module to understand the working and fault finding of tape recorder system
3. Trainer kit/ demo module to understand the working and fault finding of CD/ DVD system
4. Trainer kit/ demo module to understand the working and fault finding of Printer system
5. Trainer kit/ demo module to understand the working and fault finding of Scanner system
6. Trainer kit/ demo module to understand the working and fault finding of Microwave oven system
7. Trainer kit/ demo module to understand the working and fault finding of Telephone system
8. Trainer kit/ demo module to understand the working and fault finding of Fax Machine system
9. Trainer kit/ demo module to understand the working and fault finding of UPS system
10. Trainer kit/ demo module to understand the working and fault finding of DTH kit



## Level 4 (Semester II)

### (4.GV.04) Physics and Technology in Imaging

1. **Physical Quantity, its unit and measurement:** Fundamental and derived quantity, SI unit, various physical/radiation quantity used in Diagnostic Radiology and its unit (for example, KVp, mA, mAS, Heat unit (HU))
2. **Radiation quantities and units:** Radiation intensity-exposure, roentgen, its limitations-kerma and absorbed dose-electronic equilibrium-rad, gray, conversion factor for roentgen to rad-quality factor-dose equivalent-rem, Sievert. Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.
3. **Radiation detection and measurements:** Principle of radiation detection-Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors. Measuring system: free ionization chamber-thimble ion chamber-condenser chamber-secondary standard dosimeter-film dosimeter-chemical dosimeter-Thermo Luminescent Dosimeter-Pocket dosimeter.
4. **Radiation intensity** and exposure, photon flux and energy flux density.
5. **Photochemistry:** Principles: Acidity, alkalinity, pH, the processing cycle, development, developer solution. Fixing, fixer solution, washing, drying replenishment, checking and adjusting-latent image formation--nature of development-constitution of developer-development time-factors in the use of developer. Fixers-constitution of fixing solution-factors affecting the fixer-replenishment of fixer-silver conservation-Drying-developer and fixer for automatic film processor-rinsing-washing and drying. Replenishment rates in manual and automatic processing-Silver recovery-Auto and manual chemicals.
6. **X-rays:** Discovery of x-rays-X-ray production and properties: Bremsstrahlung radiations-Characteristics X-Rays, factors affecting X-ray emission spectra, X-ray quality and quantity, HVL measurements, heel effect, soft and hard X-Rays, added and inherent filtration, reflection and transmission targets.
7. **Fluoroscopy:** Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Basic principles of cine fluoroscopy and angiography use of grid controlled x-ray tube.

### (4.GV.05) Digital Electronics

1. **Number Systems and Boolean Algebra**
  - Basics of Analog and Digital.
  - Boolean algebra, De-morgan's law, Truth tables.
2. **Logical Circuits**
  - Logic gates: AND, OR, NOT, NOR, NAND, XOR, XNOR.
  - Combinational Circuits:
  - Arithmetic Circuits: Half adders, Full adders, sub tractors,
  - Data Processing Circuits: Encoders, Decoders, Multiplexers, De-Multiplexers
3. **Latches and Flip-Flops**
  - Concept of Latches, Types of Latches, SR latch.

- SR Flip Flop, JK Flip Flop, D Flip flop, T Flip Flop, Flip Flop.
- Introduction to counters, Types of counters Asynchronous and Synchronous.
- Introduction to shift registers, types of shift registers,

#### **4. Introduction to Display Devices**

- LED, LCD, 7 segment display

#### **5. Integrated Circuits and Memories**

- Introduction to IC's, Importance and applications, Linear and Digital IC's.
- Introduction to SSI, MSI, LSI and VLSI (Terminology & Definitions).
- Memory Organisation and Operations, RAM, ROM.

### **(4.GV.06) Trouble Shooting & Maintenance of Electronics Equipment's-II**

#### **1. TV System**

- Working principle with block diagram of TV transmitter and receiver, Brief description with circuit diagram: TV Tuner, Video IF stage, Sound stage, Picture tube & its associated circuit, synchronizing circuits, Horizontal & vertical deflection circuits, Remote control of a TV receiver, Idea of bandwidth, blanking and synchronization pulses, modulation scheme, colour transmission.
- Cable type TV system, Head end processor, Trunk & cable distribution system with block diagram, Scrambling.
- Introduction to LCD and LED TV systems, Introduction to high definition systems. Steps for Fault finding & Analysis.

#### **2. Modern Appliances**

Working principle and block diagram of following: Microwave oven, Telephone, Fax machine, Printers, Scanners. Steps for Fault finding & Analysis. Working principle and block diagram of following: Microwave oven, Telephone, Fax machine, Printers, Scanners. Steps for Fault finding & Analysis. Working principle and block diagram of following: Microwave oven, Telephone, Fax machine, Printers, Scanners. Steps for Fault finding & Analysis.

### **(4.GV.07) IT Tools-II**

#### **I. Multi Media Design: (Open Source Design Tools).**

- Interface and Drawing Tools in GIMP.
- Applying Filters.
- Creating and handling multiple layers.
- Using Stamping and Smudging tools.
- Importing pictures.

#### **II. Troubleshooting: Hardware, Software and Networking.**

- Commonly encountered problems.
- (Monitor: No display, KB/Mouse not responding, monitor giving beeps, printer not responding, check for virus, delete temporary files if system is slow, adjust mouse speed).

#### **III. Work Integrated Learning IT – ISM**

- Identification of Work Areas.

- Work Experience.

#### **(4.VP.03) IT Tools – Lab**

- Spreadsheets, Word, Presentation
- Multimedia Design
- Troubleshooting
- Project / Practical File
- Viva Voce

#### **(4.VP.04) Digital Electronics – Lab**

1. Verification of truth tables for AND, OR, NOT and NAND logic gates.
2. Verification of truth tables for NOR, XOR and XNOR logic gates.
3. Construction and verification of operations of half adder and full adder circuits using basic gates.
4. Construction and verification of operations of half adder and full adder circuits using XOR gates.
5. Construction and verification of operations of full adder and full adder circuits using NAND gates.
6. Construction and verification of operations of half & full Subtractor circuit using basic gates.
7. Construction and verification of operations of half & full Subtractor circuit using XOR gates.
8. Construction and verification of operations of half & full Subtractor circuit using NAND gates.
9. Study and verification of truth tables for 3 line to 8-line decoder.
10. Study and verification of truth tables for 8 line to 3 line and 10 line to 4-line encoder.
11. Study and verification of truth tables for 4:1 MUX using gates
12. Study and verification of truth tables for 1:4 DEMUX using gates.
13. Study and verification of truth tables for 8:1 MUX using IC 74151.
14. Study and verification of truth tables for 1:8 DEMUX using IC 74138.
15. To study and verify the truth table of excess-3 to BCD code converter.
16. To study and verify the truth table of binary to gray code converter.
17. Construction and verification of truth tables for S-R, D and J-K flip flops.
18. Study working of various display devices. (LED, Common anode, Common cathode 7 segment display)
19. Study and verification of truth table for universal shift register.
20. Study the operation of a synchronous counter.

## **Level 5 (Semester I)**

### **(5.GV.01) Electronic Measurements and Instrumentation-II**

Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, Other unit systems, dimension and standards.

Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis.

PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter

Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multimeters, digital frequency meter system.

### **(5.GV.02) Basic Anatomy (Cross Sectional Anatomy-II)**

1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax and mid thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels, Lungs, heart and great vessels, Esophagus
3. Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels
4. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems
5. Neuro Anatomy- Scan planes
6. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
7. Spine- Vertebra and disc, Spinal cord and meninges
8. Neck- Arterial/venous systems, Muscles, Glands and pharynx

### **(5.GV.03) Tools, Equipment and Safety Measures-I**

#### **1. Cables & Connectors**

- Non-Metallic Sheathed Cable
- Un grounded & Grounded Power Supply Cable
- Metallic Sheathed Cable
- Multi-Conductor Cable
- Coaxial Cable
- Unshielded Twisted Pair Cable
- Shielded twisted pair cable
- Ribbon Cable
- Armoured & Unarmoured Cable
- Twin-Lead Cable
- Twin axial Cable
- Optical fiber cable
- Connectors

#### **2. ESD Clothing**

- What to wear, how to wear

### **(5.GV.04) Soldering & De-Soldering of Components-I**

#### 1. Soldering & De Soldering of Basic Components

- Soldering Tools
- Different types of Soldering Guns related to Temperature and wattages, types of tips
- Solder materials and their grading
- Soldering and De Soldering Stations and their Specifications
- Preparing Component for Soldering
- PCB Applications
- Types of PCB
- Soldering Basic Components on PCB
- De soldering Basic Components
- Safety precautions while Soldering & De soldering
- Check for cold continuity of PCB
- Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
- Join the broken PCB track and test
- De soldering using Pump and wick
- Introduction of SMD Components

### **(5.VP.01) Identification of Components, Tools, Equipment's & working – Lab**

1. Identification & working of various electronic components
2. Working of testing equipment
3. Measurement using Multimeter & Clamp meter
4. Battery health check-up
5. Measure and test the voltage of given cells.

### **(5.VP.02) Basic Diagnostics (Lab)**

#### 1. X-Ray Imaging

- X-Ray Tubes.
- Stationary & Rotation Anode.
- X-ray Consolestation (Demo of KV, MA and exposure time settings).
- Procedures to reduce Scattered Radiation.
- Focus Principle.
- Grids.
- Screen.
- Image intensifiers.
- Use of contrast materials.

#### 2. Dark Room Technique

- Images to ring devices.
- Film cassette construction.
- Duplicating a films
- Spectrum.
- Films types - Specialized use.
- Operation, storage.
- Photo chemistry.
- Development.
- Fixing.
- Radiation protection, counters.
- Assessment.

### **3. Radiological Positioning**

- Patient transfer technique.
- Turning the patient.
- Restraint techniques - Trauma, Pediatric, Geriatric, physically handicapped, disturbed patients, an anesthetized patient, moving chair & stretcher patients.
- Tubes & catheters, Nasogastric, chest, Urinary, intravenous, oxygen & other (Castsurgical & cardiac) Alcoholic, bed pans & urinals.
- Assessment.

## **Level 5 (Semester II)**

### **(5.GV.05) Electronic Measurements and Instrumentation – II**

Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter

CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications

Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters

### **(5.GV.06) Basic Imaging**

- 1. The photographic Process:** Introduction, visible light, images produced by radiation, light sensitive photographic materials.
- 2. Image Characteristic:** Real and mental images, reflected, transmitted and emitted light images Photographic emulsions. The photographic latent image. Positive process
- 3. Film materials in X-ray:** History, structure of an x- ray film, single and double emulsion films, types of films, cross over effect.
- 4. Spectral sensitivity** of film material, graininess of film material, speed and contrast of photographic materials.
- 5. Sensitometry:** Photographic density, characteristic curves, features of the characteristic curve.
- 6. Intensifying screens and cassettes.** Cassette design, care of cassettes, types of cassettes, and mounting of intensifying screens, loading and unloading of cassettes, Care of intensifying screens, tests to check screen film contact and light leakage.
- 7. The fluorescent materials,** types of intensifying screens, intensification factor. The influence of KV, scattered radiation. Detail, sharpness and speed, size of the crystals, reciprocity failure, and quantum mottle.
- 8. Film processing:** Development. The nature of development-manual or automatic. The PH scale, constitution of developing solutions both in manual and automatic processing and properties of developing chemicals, development time, factors in the use of a developer, developer activity.
- 9. Dark Room:** Layout and planning. Dark room construction - Nature of floor, walls, ceiling and radiation protection, Dark room equipment and its layout. Location of pass through boxes or cassette hatches.
- 10. Radiographic Image:** Components in image quality-density, contrast and detail.
- 11. Photo Fluorography:** Cine cameras, cine fluorography, cine film, serial cameras, processing of cine films, flurographic films.

### **(5.GV.07) Tools, Equipment & Safety Measures-II**

1. Tools & Equipment
  - Types of tools & equipment required and deployed in manufacturing, installing & servicing
    - Identification and termination process
    - General maintenance of tools/equipment and recalibration of Test equipment
    - General safety and common-sense safety
2. PPE
  - Usage & benefits of PPE
  - Types & usage of various PPE
  - Maintenance of PPE
3. Clean Room Environment
  - Do's and Don't
  - Shop Floor Discipline

### **(5.GV.08) Soldering & De-soldering components & Emergency actions**

#### **1. Introduction to SMD Components**

- Identification of 2, 3, 4 terminal SMD components
- Soldering the SMD components on the PCB
- Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
- Identify various connections and the setup required for SMD soldering station
- De solder the SMD components from the given PCB
- Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
- Make a panel board using different types of switches for a given application
- Identification of crimping tools for various IC packages
- Reliable Soldering Practices

#### **2. Emergency actions**

- Minimum Requirements
- Reporting Emergencies
- Emergency exits
- Primary and secondary evacuation routes
- Locations of fire extinguishers
- Fire alarm pull stations' location
- Assembly points
- Medical Services



**(5.VP.03) Soldering & De-soldering components - Lab**

1. Assemble the product
2. Dis-assemble the product
3. Safety Precautions & emergency plans

**(5.VP.04) Basic Imaging Practical's Lab**

1. Test to check the x-ray films and screen contact in the cassette
2. Test to check light leakage in the cassette.
3. To check the effect of safe light on exposed as well as unexposed x-ray film

## **Level 6 (Semester I)**

### **(6.GV.01) Fault Analysis & Repairs**

1. Classification of fault
2. Identification of fault
3. Rectification of fault
4. Repairing/Replacing Module
5. Analysis for the different types of equipment's
  - Smartphones
  - Air Conditioning
  - Security systems
  - Electronically controlled doors
6. Fault analysis based on hardware and software component
7. Diagnostic and Testing Methods
8. Visual Inspection
9. Earth Continuity Test
10. Insulation Resistance Test

### **(6.GV.02) Cross Sectional Anatomy-II**

1. Introduction to Sectional Anatomy & Terminology- Sectional planes, Anatomical relationships/terminology
2. Anatomy of the upper thorax- Surface anatomy relationships, Bony structures and muscles, Blood vessels.
3. Divisions of the mid-thorax, heart and great vessels- Lungs, heart and great vessels, Esophagus
4. CT/MRI Images of the Thorax - Normal and pathologic
5. Anatomy of the Abdomen- Major organs and their accessories, Abdominal blood vessels
6. CT/MR Images of Abdomen - Normal and pathologic
7. Anatomy of the Pelvis- Bony structures and associated muscles, Digestive and urinary systems
8. Reproductive Organs
9. CT/MR Images of the Male/Female Pelvis- Normal and pathologic
10. Neuro Anatomy- Scan planes
11. Brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
12. Spine- Vertebra and disc, Spinal cord and meninges
13. Neck- Arterial/venous systems, Muscles, Glands and pharynx

### **(6.GV.03) Electronics Devices Circuit-I**

#### **Unit I**

Energy Bands and Charge Carrier in Semiconductor: Bonding forces and energy bands in solids, Charge Carriers in Semiconductors, Carrier Concentrations, Drift Mechanism. Excess carriers in Semiconductors: Optical Absorption, Carrier Lifetime: Direct Recombination, Steady State Carrier Generation, Quasi-Fermi Level, Diffusion of carriers and Einstein

relation.

**UNIT II Junctions:** Equilibrium Conditions, Forward and Reverse Biased Junctions; Steady State Conditions. Optoelectronic Devices: Photodiode V-I characteristic, Photodetector, Solar Cells, Light Emitting Diode.

### **(6.GV.04) Radiation & Administrative Issues**

1. **Quality Assurance:** General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually – machine calibration. Basic concepts of quality assurance, Radiation proof test; Resolution test; Phantom measurements - CT, US and MRI, Sensitometry, State and local regulations governing radiation protection practice.
2. **Maintenance and care of equipment:** Safe operation of equipment, Routine cleaning of equipment and instruments, Cassette, screen maintenance, Maintenance of automatic processor and manual processing units, Routine maintenance of equipment.
3. **Radiation protection:** Somatic and genetic radiation effects, Basis for occupational exposure limits, Ionizing radiation from natural and man-made source and their approximate dose equivalent contribution. Legal and ethical radiation protection responsibilities of radiation workers.
4. **Units detection and measurement:** Units of radiation for exposure, absorbed dose, dose equivalent, and radio- activity, Quality factor to determine the dose equivalent.
5. **Radiation detection devices:** Ion-Chambers, Proportional counter, Thermo-luminescent dosimeters (TLD), Appropriate application and limitation of each radiation detection device.
6. **Personal monitoring and occupational exposures:** Monitoring devices, Body badges and ring badges. Thermo-luminescent dosimeters. Pocket ionization chambers. Applications, advantages and limitations of each device, Values for dose equivalent limits for occupational radiation exposures. Structures critical for potential life effect for whole body irradiation. Age proportion formula for the determination of a maximum accumulated dose equivalent.
7. **Patient Protection:**  
Relationship of beam limiting devices with radiation protection of patients, Added and inherent filtration, Purpose and importance of patient shielding, Patient shielding devices and radiographic procedures shielding to the radiographic procedures, Protection of women at child- bearing age, Methods to avoid repeat radiographs, Importance of clear, concise, instruction (effective communication skills) as a method of radiation protection, Effects of immobilization techniques to eliminate voluntary motions
8. **AERB specifications:** Radiation safety (lead glass equivalence, lead lined doors) - room size - type approval – registrations & licenses - selection of exposure parameter for various protocols – diagnostic reference levels.

### **(6.VP.01) Electronic Devices and Circuits Lab**

1. Study of Lab Equipments and Components: CRO, Multimeter, and Function Generator, Power supply- Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.

3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of  $V_{rms}$ ,  $V_{dc}$ , and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.

### **(6.VP.02) Fault Analysis & Repairs - Lab**

1. Categorization of faults
  - Hardware/Software, User Induced, Component Failures
  - L0 to L4 repairs
2. Testing electrical/electronic components in the product
3. Troubleshoot and repair of the faults identified in the product
4. Preventive Maintenance Services

## Level 6 (Semester II)

### (6.GV.05) CT and Ultrasound

#### 1. Computed Tomography (CT)

- **Basic Computed Tomography:** Basic principles of CT, generations of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display
- **X-ray tube:** Construction working and limitations, generations, methods of cooling the anode, anode rating chart, speed of anode rotation, angle of anode inclination, Focus, anode heel effect, Effect of variation of anode voltage and filament temperature, inherent filter and added filter, bow tie filter, effect on quality of the spectrum.
- **Collimator designs:** Pencil beam, Fan beam, Cone beam CT, Z-axis collimation, detector design – construction and working - Gas filled detectors – solid state detectors – flat panel detectors.
- **Principles of tomography:** advantages and limitations – generations – spiral CT – slip ring technology - Multislice CT – dual source CT - pitch – rotation time.
- **Basic principles of Image Reconstruction:** Back projection, analytical and iterative methods – MPR – MIP – volume rendering – surface shaded display (SSD) – bone reconstruction.
- **CT artefacts:** motion artefacts, streak artefacts, ring artefacts, partial volume artefacts etc. causes and remedy.
- **Dose and Dosimetry:** CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD), Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurement Methods, Dose for Different Application Protocols, Technique Optimization
- **Advanced Computed Tomography:** Helical CT scan: Slip ring technology, advantages, multi detector array helical CT, cone – beam geometry, reconstruction of helical CT images, CT artifact, CT angiography, CT fluoroscopy, HRCT, post processing techniques: MPR, MIP, Min IP, 3D rendering: SSD and VR, CT Dose, patient preparation, Imaging techniques and protocols for various parts of body, CT contrast enhanced protocols – CT angiography – (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.
- **Technical Assessment and Equipment Purchase Recommendations**

#### 2. Ultrasonography

- **Basic Acoustics, Ultrasound terminologies:** acoustic pressure, power, intensity, impedance, speed, frequency, dB notation: relative acoustic pressure and relative acoustic intensity.
- **Interaction of US with matter:** reflection, transmission, scattering, refraction and absorption, attenuation and attenuation coefficients, US machine controls, US focusing.
- **Production of ultrasound:** Piezoelectricity, Medical ultrasound transducer: Principle, construction and working, characteristics of US beam.
- **Ultrasound display modes:** A, B, M

- **Real-time ultrasound:** Line density and frame rate, Real-time ultrasound transducers: mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area & volume measurements.
- **Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.**
- **Doppler Ultrasound:** Doppler Theory, Doppler-Frequency Shift, Reflector Velocity Dependence, Doppler Angle Dependence, Spectral Analysis, Continuous Wave (CW) Doppler, Pulsed Doppler, Pulse Transmission and Range Gating, Aliasing, Duplex Scanning, Color Flow Imaging, Power Doppler, Patient preparation for Doppler, Doppler artifacts, vascular sonography.

### **(6.GV.06) Manufacturing & Quality Norms**

1. Manufacturing & Quality Norms- keep it differently according to all applications
  - Manpower Deployment and Operations as per Work Instructions and criticality of the process Understanding how to form each operation and practical training of operation
  - Understanding accept and reject criterion of a particular operation. Practical training of testing/checking each operation
  - Quality Norms of accept and practical training of electronic equipment's/Devices Acceptance/Rejection training of various defects
2. Manufacturing & Quality Norms – II
  - Process in packing line-packing line Operations sequence flow and its importance
  - Quality Systems - Accept, Reject criterion of various tests at OQA
  - Training of Assembly of electronic components - Assemble, Check, test electronic components
  - Various Labels and their Importance - Understanding Labels, Scanning and its importance
  - Packing of components/devices - Various Stages of packing
  - Acceptance, Reject and sampling following QA norms - AQL level, Sampling techniques, as per QA sampling accept, reject numbers

### **(6.GV.07) Electronics Devices Circuit-II**

1. Good Manufacturing Concepts & Practices - II
  - Brief Introduction
  - Total Quality Management
  - ISO Standards
2. Kaizen
3. Toyota Production System
4. Lean Manufacturing
  - Combination of Inventory
  - Supply Chain
5. Quality and Inspection
  - 3 Sigma and 6 Sigma Orientation

**(6.VP.03) Electronic Devices and Circuits –II Lab**

1. Characteristic of BJT: BJT in CE configuration- Graphical measurement of parameters from input and output characteristics. Measurement of  $A_v$ ,  $A_i$ ,  $R_o$  and  $R_i$  of CE amplifier with potential divider biasing.
2. Measurement of Operational Amplifier Parameters: Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.
3. Applications of Op-amp: Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator.
4. Field Effect Transistors: Single stage Common source FET amplifier –plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
5. Oscillators: Sinusoidal oscillators. Wein's bridge oscillator b. phase shift oscillator.

**(6.VP.04) Manufacturing Practices**

1. Work study concepts
2. Team work concepts

## ***Level 7 (Semester I)***

### **(7.GV.01) MRI, Image Processing and Recording**

- 1. Basic concepts of Magnetic resonance imaging (MRI):** Atomic structure, Hydrogen as imaging medium, magnetism, precession, resonance, Electromagnetic radiation, NMR - basic concepts of MRI, Faraday's cage.
- 2. Basic MR Image formation:** RF Excitation, Relaxation (T1 and T2), Computation and display, Free induction decay, RF wave form designs.
- 3. Introduction to MR coils:** Volume coils, Gradient coils, Slice selection, phase encoding, frequency encoding
- 4. Artifacts:** Cause of artifacts, Image quality, image contrast, signal to noise ratio, resolution, artefacts, MR contrast agents, Advanced MR techniques, flow effects, MR angiography echo planner imaging, magnetization transfer, fat suppression, MR spectroscopy, functional imaging, Magnetic resonance hazards and safety, Recent development.
- 5. MRI Scanners:** Methods of MRI imaging methods; Head and Neck ,Thorax, Abdomen, Musculoskeletal System imaging; Clinical indications and contraindications; types of common sequences effects of sequence on imaging; Protocols for various studies, slice section, patient preparation; positioning of the patient; patient care-calibration - paramagnetic agents and dose, additional techniques and recent advances in MRI; image acquisition-modification of procedures in an unconscious or un co-operative patient; plain studies; contrast studies; special procedures; reconstructions; 3D images; MRS blood flow imaging, diffusion/perfusion scans; strength and limitations of MRI; role of radiographer.
- 6. MR safety:** instrumentation and biological effects

### **(7.GV.02) Advanced Imaging**

1. Computed Tomography its principle, various generations and advancements.
2. Ultrasonography, Color Doppler- its principle, advancements and applications.
3. Digital Radiography and Digital subtraction angiography equipment- principle, advancements and applications.
4. Fusion Imaging including PET-CT, PET- MRI.
5. Digital Mammography, DEXA equipment- principle, advancements and applications.
6. Tele radiology HIS, RIS and PACS
7. Image processing in digital radiography systems: Post processing techniques in console using CR, DR and flat panel fluoroscopy systems
8. Basic angiography and DSA

### **(7.VP.01) MRI, Image Processing and Recording**

1. MRI Images of the Thorax - Normal and pathologic
2. MR Images of Abdomen - Normal and pathologic
3. MR Images of the Male/Female Pelvis- Normal and pathologic
4. Neuro Anatomy- Scan planes brain - Cerebral hemispheres, Sinuses, Ventricles, Brainstem and associated parts, Arterial/venous systems, Basal ganglia, Cranial nerves
5. Spine- Vertebra and disc, Spinal cord and meninges



**(7.VP.02) Advanced Imaging**

1. Central Nervous System: Myelography, Cerebral studies, Ventriculography
2. Arthrography: Shoulder, Hip, Knee, Elbow
3. Angiography: Carotid Angiography (4 Vessel angiography), Thoracic and Arch Aortography, Selective studies: Renal, SMA, Coeliac axis, Vertebral angiography, Femoral arteriography, Angiocardiography
4. Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography, Relevant visceral phlebography
5. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophysiology
6. Gynaecology: Hysterosalpingography
7. Biliary system: Plain film radiography, Intravenous cholangiography, percutaneous cholangiography, Endoscopic retrograde cholangio-pancreatography. (ERCP), Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography)
8. Gastrointestinal tract: Barium meal, Barium swallow, Small bowel enema, Barium enema.
9. Renal tract: Intravenous urography, retrograde pyelography, micturating cystourethrography.
10. Other: Sialography

## **Level 7 (Semester II)**

### **(7.GV.03) Admin, Medico Legal and Interventional Procedures**

- 1. Principals of Management:** Introduction to management, Strategic Management, Foundations of Planning, Planning Tools and Techniques, Decision Making, conflict and stress management, Managing Change and Innovation, Understanding Groups and Teams, Leadership, Time Management, Cost and efficiency.
- 2. Medical law and ethics:** Medical ethics; Definition, Goal, Scope; Introduction to Code of conduct; Basic principles of medical ethics – Confidentiality; Malpractice and negligence; Autonomy and informed consent - Right of patients; Care of the terminally ill-Euthanasia ; Organ transplantation; Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects; Professional Indemnity insurance policy; Development of standardized protocol to avoid near miss or sentinel events; Obtaining an informed consent.
- 3. Quality and patient safety:** Quality assurance; Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, Introduction to NABH guidelines; AERB specifications, radiation safety (lead glass equivalence, lead lined doors), room size, type approval, registrations & licenses, selection of exposure parameter for various protocols, diagnostic reference levels.
- 4. Basics of emergency care and life support skills:** Basic life support (BLS), sudden Cardiac Arrest (SCA), cardiopulmonary resuscitation (CPR), Automated External Defibrillator (AED).

### **(7.GV.04) Project**

Project work may include case study related to Newer Imaging Technology.

### **(7.VP.03) Admin, Medico Legal and Interventional Procedures**

1. Quality assurance and Radiation safety survey in diagnostic X-ray installations.
2. Community orientation and clinical visit: Visit will include visit to the entire chain of healthcare delivery system - sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
3. Governance at village level including interaction and group discussion with village panchayat and front line health workers.
4. Clinical visit to their respective professional department within the hospital.