

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc.**

**Medical Imaging Technology(MI)**

**Branch Code:112**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

## **1. 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.
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## Curriculum

<b>Semester-I(NSQF Level-5)</b>											
<b>S. N.</b>	<b>Code</b>	<b>Subject</b>	<b>Total Teaching/ Training Hours</b>	<b>Internal Evaluation Scheme</b>				<b>End Sem</b>		<b>Total</b>	<b>Credit</b>
				<b>CT</b>	<b>TA</b>	<b>AT</b>	<b>Total</b>	<b>TE</b>	<b>PE</b>		
1	BMIV511	Electronic Measurement and Instrumentation -I	30	10	5	5	20	30		50	2
2	BMIV512	Basic Anatomy (Cross Sectional Anatomy-II)	30	10	5	5	20	30		50	2
3	BMIV513	Tools, Equipment & Safety Measures -I	30	10	5	5	20	30		50	2
4	BMIV514	Soldering & De-Soldering of Components -I	30	10	5	5	20	30		50	2
5	BMIP511	Identification of Components, Tools, Equipment and its working -Lab	30				20		30	50	2
6	BMIP512	Basic diagnostics (Lab)	30				20		30	50	2
7	BMIP513	Language Lab	30				20		30	50	2
8	On-Job-Training (OJT)/Qualification Packs		400hr/8 weeks							150	12
	<b>Total</b>		580							500	24

Semester-II(NSQF Level-5)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV521	Electronic Measurement and Instrumentation –II	30	10	5	5	20	30		50	2
2	BMIV522	Basic Imaging	30	10	5	5	20	30		50	2
3	BMIV523	Tools, Equipment & Safety Measures –II	30	10	5	5	20	30		50	2
4	BMIV524	Soldering & De-Soldering of Components & Emergency actions II	30	10	5	5	20	30		50	2
5	BMIP521	Soldering & De-Soldering of Components-Lab	30				20		30	50	2
6	BMIP522	Basic Imaging Practical Lab	30				20		30	50	2
7	BMIP523	IT Tool Lab	30				20		30	50	2
8	<b>On-Job-Training (OJT)/Qualification Packs</b> (To continue with the same QP as opted in Level 5 First semester)		400hr/8 weeks							150	12
	<b>Total</b>		580							500	24

**Semester-III(NSQF Level-6)**

S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV631	Fault analysis & Repairs	30	10	5	5	20	30		50	2
2	BMIV632	Cross Sectional Anatomy-II	30	10	5	5	20	30		50	2
3	BMIV633	Electronics Devices Circuit -I	30	10	5	5	20	30		50	2
4	BMIV634	Radiation and administrative Issues	30	10	5	5	20	30		50	2
5	BMIP631	Electronics Devices Circuits Lab	30				20		30	50	2
6	BMIP632	Fault analysis & Repairs - Lab	30				20		30	50	2
7	BMIP633		30				20		30	50	2
7	<b>On-Job-Training (OJT)/Qualification Packs</b> Assistant Duty Manager - Patient Relation Services (HSS/Q6103)		400hr/8 weeks							150	12
<b>Total</b>			580							500	24

**Semester-IV(NSQF Level-6)**

S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV641	CT and Ultrasound	60	20	10	10	40	60		100	4
2	BMIV642	Manufacturing & Quality Norms	30	10	5	5	20	30		50	2
3	BMIV643	Electronics Devices Circuit -II	30	10	5	5	20	30		50	2
4	BMIP641	Electronics Devices Circuit -II Lab	30				20		30	50	2
5	BMIP642	Manufacturing Practices	30				20		30	50	2
6	BMIP643		30				20		30	50	2
7	<b>On-Job-Training (OJT)/Qualification Packs</b> (To continue with the same QP as opted in Level 6 First semester)		400hr/8 weeks							150	12

	<b>Total</b>	580							500	24
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Semester-V(NSQF Level-7)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV751	MRI, Image Processing and Recording	60	20	10	10	40	60		100	4
2	BMIV752	Advanced Imaging	60	20	10	10	40	60		100	4
3	BMIP751	MRI, Image Processing and Recording	30				20		30	50	2
4	BMIP752	Advanced Imaging	30				20		30	50	2
5	<b>On-Job-Training (OJT)/Qualification Packs</b> (Duty Manager - Patient Relation Services (HSS/Q6104))		400hr/8 weeks							200	12
<b>Total</b>			580							500	24

Semester-VI(NSQF Level-7)											
S. N.	Code	Subject	Total Teaching/ Training Hours	Internal Evaluation Scheme				End Sem		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BMIV761	Admin, Medico Legal and interventional Procedures	60	20	10	10	40	60		100	4
2	BMIV762	Project	60	20	10	10	40	60		100	4
3	BMIP761	Admin, Medico Legal and Interventional Procedures	60				40		60	100	4
4	<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		400hr/8 weeks							200	12
<b>Total</b>			580							500	24

**Detailed**  
**Curriculum(Semester I)**  
**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.

**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 bloodvessels
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

**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



## **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

### **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.

## 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 aesthetized patient, moving chair & stretcherpatients.
- Tubes & catheters, Nasogastric, chest, Urinary, intravenous, oxygen & other (Castsurgical & cardiac) Alcoholic, bed pans & urinals.
- Assessment.

## (Semester II)

### 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

### 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 lightleakage.
- 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.

## **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

## **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

### **Soldering & De-soldering components - Lab**

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

### **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

### **IT Tools Lab.**

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

## **(Semester III)**

### **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

### **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 bloodvessels
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

## 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 Revers Biased Junctions; Steady State Conditions. Optoelectronic Devices: Photodiode V-I characteristic, Photodetector, Solar Cells, Light Emitting Diode.

## 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.

### **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.

### **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



*(Semester IV)*  
**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.

### **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

### **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

### **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.

### **Manufacturing Practices**

1. Work study concepts
2. Team work concepts

## *(Semester V)*

### **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

### **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

### **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

### **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

## (Semester VI)

### 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).

### Project

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

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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.