B. Voc. (Medical Imaging Technology)
SEMESTER- III

S. No.	Component	Title of The Paper	Paper Code	Credits	Marks (Theory)		Marks (Practical)		Total
					External Assessment	Internal Assessment	External Assessment	Internal Assessment	
1.	Skill Paper - 1	Clinical Radiography – Positioning Part-I (Theory)	BVMI311CCT	04	70	30	---	---	100
		Clinical Radiography – Positioning Part-I (Lab.)	BVMI311CCP	02	---	---	35	15	50
2.	Skill Paper - 2	Clinical Radiography – Positioning Part-II (Theory)	BVMI312CCT	04	70	30	---	---	100
		Clinical Radiography – Positioning Part-II (Lab.)	BVMI312CCP	02	---	---	35	15	50
3.	Skill Paper - 3	Newer modalities, Imaging Techniques including patient care (Theory)	BVMI313CCT	04	70	30	---	---	100
		Newer modalities, Imaging Techniques including patient care (Lab.)	BVMI313CCP	02	---	---	35	15	50
4.	Non-Skill Paper - 4	Electronic Measurements & Instrumentation (Theory)	BVMI314CCT	04	70	30	---	---	100
		Electronic Measurements & Instrumentation (Lab.)	BVMI314CCP	02	---	---	35	15	50
5.	Non-Skill Paper - 5	Electronic Devices and Circuits (Theory)	BVMI315CCT	04	70	30	---	---	100
		Electronic Devices and Circuits (Lab.)	BVMI315CCP	02	---	---	35	15	50
		Total		**30**					**750**

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SEMESTER-III

(Skill Paper - I) Clinical Radiography-Positioning Part-I (Theory)

Credits – 04

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1. Skeletal System:

a) Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. E.g. Carpal tunnel view, ulnar groove, head of the radius, supracondylar projections.

b) Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur. Supplementary techniques: Stress view for torn ligaments,

- Subtalar joint and talo calcaneal joint.
- Inter condylar projection of the knee.
- Tibial tubercle.
- Length measurement technique.

c) Shoulder girdle and thorax: Technique for shoulder joint, scapular, clavicle, acromio clavicular joints, sternum, ribs, sterno-clavicular joint Supplementary projections and techniques.

- Recurrent dislocation of shoulder.
- Traumatic dislocation of shoulder.
- Cervical ribs.

d) Vertebral column: Technique for atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumber spine, lumbo sacral spine, sacrum and coccyx. Supplementary techniques to demonstrate:

- Scoliosis
- Kyphosis
- Spondylolisthesis
- disc lesion
- Union of spinal graft.

e) Pelvic girdle and hip region: Technique for whole pelvis. Ilium, ischium, pubic bones, sacro iliac joint, symphysis pubis, hip joint, acetabulum neck of femur, greater and lesser trochanter. Supplementary techniques-

- Congenital dislocation of hips
- Epiphysis of femur
- Lateral prouons for lip joints to show femoral head and neck relationship

f) Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

g) Skull Basic projections for cranium, facial bones, nasal bones and mandible. Technique for

- Petrous temporal for mastoids. Internal auditory canal. - Accessory nasal sinuses'
- Tempero - mandibular joint. Orbits and optic foramen.. Zygomatic arches.
- Styloid process. - Pituitary fossa. - Jugular foramen.

2. Dental Radiography. Technique for intra oral full mouth. Occlusal projections.. Extra oral projections including orthopantomography.- Supplementary techniques.

3. Upper respiratory system- Technique for post nasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre. - Phonation.

4. Lungs and Mediastinum: Technique for routine projections- Supplementary projections: Antero posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior. projection. - Expiration technique. - Technique for pleural fluid levels and adhesioas.

5. Abdominal viscer- Technique for plain film examination. - Projection for acute abdomen patients. - Technique to demonstrate: Foreign bodies, Imperforate anus.

6. Radiography using mobile X-ray equipment- Radiography in the ward: Radiography in the specialized unit, such as: Intensive care unit, Coronary care, Neonatal unit Radiography in the operating theatre.

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SEMESTER-III

(Skill Paper - I) Clinical Radiography-Positioning Part-I (Lab/Practical)

Credits – 02

Special radiographic procedures

1. Responsibility of Radiographer during Radiological Procedures.
2. Preparation of Patient for Different Procedures.
3. Contrast Media - Positive and Negative, Ionic & Non-Ionic
4. Adverse Reactions To Contrast Media and Patient Management
5. Emergency Drugs in the Radiology Department
6. Emergency Equipment in the Radiology Department
7. Aseptic technique
8. Indications, contraindications, basic techniques and relationship to other techniques of the following special procedures

a. Gastrointestinal Tract:

• Fluoroscopy, general considerations, responsibility of radiographers
• Barium swallow, pharynx and oesophagus
• Barium meal and follow through
• Hypotonic duodenography

- Small bowel enema
- Barium Enema routine projections for colon and rectum, colonic activators; double contrast studies; colostomy. Special techniques for specific disease to be examined
- Water soluble contrast media - eg, gastrograftin studies

b. **Salivary glands:** Routine technique, procedure-sialography

c.

d. **Biliary system:**

- Plain film radiography
- Inuavenous cholangiography
- Percutaneous cholangiography
- Endoscopic retrograde cholangio-pancreatography (ERCP)
- Operative cholangiography
- Post-Operative cholangiography (T-tube cholangiography)

e. Urinary system:

- Intravenous urography
- Retrograde pyelography
- Antegrade pyelography
- Cystography and micturating cystouresthrography
- Urethrography (ascending)
- Renal puncture

f. Female reproductive system: Hysterosalpingography.
g. Mammography:

- Mammography: Basic views, special views, wire localization
- Ductography.

h. Respiratory system: Bronchography: Awareness.
i. Sinusography: Routine technique and procedure.
j. Tomography:

- General principles.
- Estimation, selection of depth of layer.
- Layer thickness required for different examination.
- Spacing of layers
- Types and advantages of various movements.
- Choice of tomographic movement- exposure factor.
- Sequential, horizontal and mult section tomography
- Application of tomography to specific regions

J. Macroradiography:

- General principles
- Requirement
- Equipment
- Technique

K. Soft Tissue Radiography

- High and low kilo voltage technique; differential filtration.
- Non – screen technique – simultaneous screen and non – screen technique.
- Multiple radiography.
- Uses of soft tissue radiography.

1. High kV Radiography:

- General principles
- Relation to patient dose
- Change in radiographic contrast.
- Scatter elimination; beam collimation; grid ratio
- Speed and type of grid movement
- Radiographic factor; application and uses.

m. Localization of foreign bodies:

- General location principles.
- Ingested; inhaled; inserted; embedded foreign bodies
- Foreign bodies in eye.
- Preparation of the area to be investigated.
- Appropriate projection for all
- Techniques to locate non-opaque foreign body

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SEMESTER-III

(Skill Paper - 2) Clinical Radiography Positioning Part-2 (Theory)

Credits – 04

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1. Radiography technique comprising of the complete.

2. Radiography of Skull and Radiography of cranial bones; including special techniques for sella turcica, orbits, opticforamina, superior orbital fissure and inferior orbital fissure etc.

3. Facial bones; Paranasal sinuses, Temporal bone and Mastoids.

4. Dental Radiography: Radiography of teeth-intra oral, extra oral and occlusal view.

5. Abdomen: Preparation of patient. General abdominal radiography and positioning for fluid and air levels. Plain film examination. Radiography of female abdomen to look for pregnancy. Radiography in case of acute abdomen.

6. Macroradiography: Principle, advantage, technique and applications.

7. Stereography – Procedure – presentation, for viewing, stereoscopes, stereometry.

8. High KV techniques principle and its applications.

9. Soft tissue Radiography including Mammography – its techniques, equipment, advancements and application.

10. Localization of foreign bodies. Various techniques

11. Ward / mobile radiography – electrical supply, radiation protection, equipment and instructions to be followed for portable/ ward radiography.

12. Operation theatre techniques: General precautions, Asepsis in techniques – Checking of mains supply and functions of equipment, selections of exposure factors, explosion risk, radiation protection and rapid processing techniques

13. Trauma radiography/Emergency radiography

14. Neonatal and Paediatric Radiography

15. Tomography and Tomosynthesis

16. Dual energy X-ray absorptiometry

17. Forensic Radiography

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SEMESTER-III

(Skill Paper - 2) Clinical Radiography Positioning Part-2 (Lab/Practical)

Credits – 02

Radiographic positioning of all parts of the body

1. Special radiological equipment: Portable and mobile x-ray units, dental X-ray machine, skull table mammographic device - Technical aspects of Mammography, Hi High Tension Generators, X-ray tubes-their types and advancements; Accessories, Resolution; Quality control; Application and role in medicine, digital radiography equipment digital subtraction techniques. Tomography: Body section radiography, basic principle and equipment, multi section tomography, various types of tomographic movements, tomosynthesis, Stich radiography, Dual energy X-ray absorptionometry (DEXA) scan.

2. Computed radiography: its principle, physics & equipment. Digital Radiography. Flat panel digital fluoroscopy and radiography system. Direct and indirect digital radiography and fluoroscopy system.Digital radiography and Computed radiography its advantages, disadvantages and applications.

3. Vascular Imaging Equipment: Introduction, historical developments, Principle, Scanned projection radiography, digital subtraction angiography, applications and definition of terms,

4. Picture archiving and communication system (PACS)

Practicals
Demonstration of basic procedures in all modem modalities.

Contrast & Special Radiography Procedures

For each of the examination the points listed below should be included:

1. Review the anatomy of the area.
2. State the clinical indication for the examination.
3. State contra indication if any for the examination.
4. Describe the preparation of the patient including the pre medication if appropriate.
5. Specify the type and quantity of contrast agent used.
6. Describe the method of introduction of the contrast agent.
7. Describe the series of projections taken during the examination.
8. Indicate the timings of the radiographs in relation to the administration of contrast agent.

9. Outline the practical problems and the way in which they may be overcome.
10. Explain the choice of exposure factor.
11. Detail the measures that should be taken for radiation protection.
12. Explain the after care of the patient.

B. Voc. (Medical Imaging Technology)

SEMESTER-III

(Skill Paper - 3) Newer Imaging Techniques including Patient Care (Theory)

Credits – 04

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1. Interventional Radiography:
Basic angiography and DSA:
a. History, technique, patient care
b. Percutaneous catherisation, catheterization sites, Asepsis
c. Guidewire, catheters, pressure injectors, accessories
d. Use of digital substraction-single plane and bi-plane
All forms of diagnostic procedures including angiography, angioplasty, bilary examination, renal evaluation and drainage procedure.

2. Central Nervous System:
a. Myelography
b. Cerebral studies
c. Ventriculography

3. Arthrography: Shoulder, Hip, Knee, Elbow

4. Angiography:
a. Carotid Angiography (4 Vessel angiography)
b. Thoracic and Arch Aortography
c. Selective studies: Renal, SMA, Coeliac axis
d. Vertebral angiography
e. Femoral arteriography
f. Angiocardiography

5. Venography:
a. Peripheral venography
b. Cerebral venography
c. Inferior and superior venocavography
d. Relevant visceral phlebography

6. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophyiology,

Patient care in Medical Imaging Department

Patient management is based on team work, it is essential that the student should appreciate the technologist's role and that the importance of co-operation with wards and other departments. The students should be attached to wards or the accidents and emergency department for a definite training period.

1. Hospital procedure: Hospital staffing and organization; records relating to patients and departmental statistics; professional attitude of the technologists to patients and other members of the staff; medico-legal aspects; accidents in the departments, appointments, organization; minimizing waiting time; out-patient and follow-up clinics; stock-taking and stock keeping.

2. Care of the patient: FIRST contact with patients in the department; management of chair and stretcher patients and aids for this, management of the unconscious patient; elementary hygiene; personal cleanliness; hygiene in relation to patients (for example clean linen and receptacles, nursing care; temperature pulse and respiration; essential care of the patient who has a tracheostomy; essential care of the patient who has a colostomy; bedpans and urinals; simple application of a sterile dressing.

3. First aid: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus, drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band. Fractures; splints, bandaging; dressing, foreign bodies; poisons.

4. Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; asepsis and antisepsis. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.

5. Principles of asepsis: Sterilization – methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filamented swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department (for study b radio imaging students only).

6. Departmental procedures: Department staffing and organizations; records relating to patients and departmental statistics; professional attitudes of the technologist to patients and other members of the staff, medico-legal aspects accidents in the department;

   Appointments; organizations; minimizing waiting time; out patient and follow-up clinics; stock taking and stock keeping.

7. Drugs in the department: Storage; classification; labeling and checking, regulations regarding dangerous and other drugs; units of measurement, special drugs, anti-depressive, anti-hypertensive etc.

Quality Control in Radiology and Radiation Safety

1. Objectives of quality Control: Improve the quality of imaging thereby increasing the diagnostic value; to reduce the radiation exposure; Reduction of film wastage and repeat examination; to maintain the various diagnostic and imaging units at their optimal performance.

2. Quality assurance activities: Equipment selection phase; Equipment installation and acceptance phase; Operational phase; Preventive maintenance.

3. Quality assurance programme at the radiological faculty level: Responsibility, Purchase; Specifications; Acceptance; Routine testing; Evaluation of results of routine testing, Quality assurance practical exercise in the X ray generator and tube; Image receptors from processing; Radiographic equipment; Fluoroscopic equipment; Mammographic equipment; Conventional tomography; Computed tomography; Film processing, manual and automatic; Consideration for storage of film and chemicals; Faults tracing: Accuracy of imaging-image distortion for digital imaging devices. LASER printer calibration

4. Quality assurance programme tests: General principles and preventive maintenance for routine, daily, weekly, monthly, quarterly, annually - machine calibration. Basic concepts of quality assurance - LASER printer - Light beam alignment; X-ray out-put and beam quality check; KVp check; Focal spot size and angle measurement; Timer check; mAs test; Grid alignment test; High and low contrast resolutions; Mechanical and electrical checks; Cassette leak check; Proper screen-film contact test; Safe light test; Radiation proof test; Field alignment test for fluoroscopic device; Resolution test; Phantom measurements - CT, US and MRI.

5. Quality assurance of film and image recording devices: Sensitometry; Characteristic curve; Film latitude; Film contrast; Film speed Resolution; Distortion; Artifacts of films and image recording. Monitor calibration. SMPTE pattern

6. 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; Record keeping and log book maintenance; Reject analysis and objectives of reject analysis programme.

7. Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment

Radiation safety in diagnostic Radiology

1. Radiation Quantities and Units: Radiation- Radioactivity- Sources of radiation – natural radioactive sources -cosmic rays terrestrial radiation -- man made radiation sources. Units of radiation - Quality factor - Flux- Fluence-Kerma- Exposure - Absorbed dose Equivalent Dose-Weighting Factors-Effective Dose - Occupational Exposure Limits - Dose limits to public.

2. Biological Effects of radiation: Ionization, excitation and free radical formation, hydrolysis of water, action of radiation on cell-Chromosomal aberration and its application for the biological dosimetry-Effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus-Somatic effects and hereditary effects-stochastic and deterministic effects-Acute exposure and chronic exposure-LD50 - factors affecting radio sensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.

3. Radiation detection and Measurements: Ionization of gases- Fluorescence and Phosphorescence -Effects on photographic emulsion. Ionization Chambers - proportional counters- G.M counters- scintillation detectors - liquid semiconductor detectors - Gamma ray spectrometer. Measuring systems - free air ionization chamber - thimble ion chamber - condenser chamber - Secondary standard dosimeters -- film dosimeter - chemical dosimeter- Thermoluminescent Dosimeter. -Pocket dosimeter Radiation survey meter- wide range survey meter-zone monitor-contamination monitor - their principle function and uses. Advantages & disadvantages of various detectors & its annropriateness of different detectors for different type of radiation measurement. Dose and Dosimetry, CT Dose Index (CTDI, etc.), Multiple Scan Average Dose (MSAD). Dose Length Product (DLP), Dose Profile, Effective Dose, Phantom Measurem Methods, Dose for Different Application

   Protocols, Technique Optimization. Dose area product in fluoroscopy and angiography systems, AGD in mammography.

4. Radiation protection: Radiation protection of self and patient- Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey - ALARA- personnel dosimeters (TLD and film batches) - occupational exposure.

5. Radiation Hazard evaluation and control: Philosophy of Radiation protection effect of time. Distance & Shielding. Calculation of Work load, weekly calculated dose to radiation worker & General public Good work practice in Diagnostic Radiology. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding material

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SEMESTER-III

(Skill Paper - 3) Newer Imaging Techniques including Patient Care (Lab/Practical)

Credits – 02

Interventional Radiography:
Percutaneous catherisation, catheterization sites, Asepsis
Guidewire and its types,
Catheters and its types,
Pressure injectors types and different types with accessories

Cerebral Angiography studies
Ventriculography

Arthrography of different joints : Shoulder, Hip, Knee, Elbow

Angiography:
Carotid Angiography (4 Vessel angiography)
Thoracic and Arch Aortography
Selective studies: Renal, SMA, Coeliac axis
Vertebral angiography
Femoral arteriography
Angiocardiography

Venography: Peripheral venography,Cerebral venography,Inferior and superior venocavography
Relevant visceral phlebography

Cardiac catheterization procedures: PTCA, BMV,CAG, Pacemaker, Electrophyiology,

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SEMESTER-III

(Non - Skill Paper - 4) Electronic Measurements And Instrumentation (Theory)

Credits – 04

UNIT-I:

Block Schematics of Measuring Systems Performance characteristics, static characteristics, Accuracy, Precision, Resolution, Types of Errors, Dynamic characteristics Repeatability, Reproducibility, Fidelity, Lag;

Measuring Instruments DC Voltmeters and Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter protection, extension of range, true RMS Responding Voltmeters, Specifications of instruments.

UNIT-II:

DC & AC Bridges Wheat Stone Bridge, Kelvin Bridge and Maxwell Bridge.

Signal Analyzers AF, HF Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Capacitance-Voltage Meters.

Signal Generators AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator.

UNIT-III:

Oscilloscopes CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO probes, High Frequency CRO considerations, Delay lines, Measurement of Time, Period and Frequency using CRO.

Special Purpose Oscilloscopes Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

UNIT-IV:

Transducers Stain Gauges, Bounded, Unbounded; Force and Displacement Transducers, Resistance Thermometers, Hot wire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Piezoelectric Transducers, Magnetostrictive Transducers.

Measurement of Physical Parameters Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture velocity, Pressure – High Pressure Vacuum level, Temperature-Measurements, Data Acquisition Systems.

Text Books:

1. Electronic Instrumentation H.S.Kalsi – TMH, 2nd Edition 2004.
2. Modern Electronic Instrumentation and Measurement Techniques A D Helbincs, W.D.Cooper, PHI, 5th Edition 2003.

B. Voc. (Medical Imaging Technology)

SEMESTER-III

(Non - Skill Paper - 4) Electronic Measurements And Instrumentation (Lab/Practical)

Credits – 02

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1. DC Voltmeters and Ameters,
2. AC Voltmeters and Ameters
3. Wheat Stone Bridge,
4. Kelvin Bridge and Maxwell Bridge
5. Dual Trace, Dual Beam CROs,
6. Sampling Oscilloscopes, Storage Oscilloscopes,
7. Digital Storage CROs.

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SEMESTER-III

(Non - Skill Paper - 5) Electronic Devices And Circuits (Theory)

Credits – 04

UNIT-I:

PN DIODES

Introduction on semiconductors, P and N-type semiconductors, PN Junction diode, Depletion region, Barrier potential, working in Forward and Reverse bias condition – Junction capacitance, diode current equation – Effect of temperature on reverse saturation current – construction, working, V-I characteristics and simple applications of Varactor diode, Zener diode and Tunnel diode.

UNIT-II:

BJT & FET

BJT Introduction, Construction, Operation and Characteristics of CB, CE and CC – Configurations, Transistor as a switch. Fixed bias circuit, Emitter-stabilized bias circuit, Voltage Divider Bias, Bias stabilization.

UNIT-III:

UJT, SCR & PHOTO DEVICES

UJT construction and working, V-I characteristics, UJT as a Relaxation Oscillator.
SCR construction and working, Two transistor representation, Characteristics of SCR, Applications of SCR for power control.
PHOTO DEVICES Light-Emitting Diodes (LEDs), IR Emitters, Photo diode, Photo transistors, Structure and operation of LDR and Opto-Isolators.

UNIT-IV:

POWER SUPPLIES

Half wave, Full wave and Bridge rectifiers – Efficiency – Ripple factor – Regulations, Types of filters – Choke input filter, shunt, L-section and Pi-section filters. Three terminal fixed voltage I.C. regulators (78XX and 79XX)- Principle and working of SMPS (Switch Mode Power Supply).

Text Books

1. Electronic Devices and Circuit Theory – Robert L. Boylestad & Louis Nashelsky.
2. Electronic Devices and Circuits I – T.L.Floyd – PHI Fifth Edition.

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SEMESTER-III

(Non - Skill Paper - 5) Electronic Devices And Circuits (Lab/Practical)

Credits – 02

ELECTRONIC DEVICES AND CIRCUITS LAB

1. Regulated Power Supply using Zener Diode.
2. BJT input and output characteristics.
3. FET input and output characteristics.
4. Application of UJT
5. Application of LDR .