



# ARYABHATTA KNOWLEDGE UNIVERSITY

Near Bus Stand, Mithapur, Patna - 800 001

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## Notification

The Syllabus of Post Graduate Courses in Para Medical Science has been approved by the Academic Council of the university in its 16<sup>th</sup> meeting held on 09.11.2019 is hereby notified.

This is subject to grant of permission to start/run the said Course by the State Government.

By order of the Vice-Chancellor

Sd./-

Registrar (I/c)

Aryabhatta Knowledge University, Patna

Memo no. : 012/Acad/01-08/AKU/2019- 4826

Date:13.12.2019

### **Copy to:**

(i)PA to the Vice-Chancellor, (ii) Pro Vice-Chancellor's Office, (iii) Registrar's Office, (iv) Controller of Examinations, AKU, Patna with copy of Syllabus AKU, Patna for information and (v) Shri Vishal Ratan Kumar with copy of Syllabus for uploading the information on University website.

Registrar (I/c)

Aryabhatta Knowledge University, Patna

SYLLABUS

Master of Medical Laboratory Technology Course

FIRST YEAR

- Paper - I - General Pathology & Haematology.
- Paper - II - Bio-chemistry
- Paper - III - Microbiology
- Paper - IV - Project Paper

SECOND YEAR

- Paper - I - Immunology & Clinical Pathology
- Paper - II - Histopathology & Cytology
- Paper - III - Recent Advancement in Pathology  
&  
Lab Management.
- Paper - IV - Project Paper

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Master of Medical Laboratory Technology Course  
FIRST YEAR  
GENERAL PATHOLOGY

Paper - I

1. Cellular Injury :-
  - (a) Necrosis
  - (b) Ischemic and Hypoxic Injury.
  - (c) Apoptosis
  - (d) Hyperplasia
  - (e) Hypertrophy
  - (f) Atrophy
  - (g) Metaplasia
  - (h) Gangrene
2. Inflammation and Repair :-
  - (a) Acute Inflammation
  - (b) Chronic Inflammation
  - (c) Wound Healing
3. Neoplasia :-
  - (a) Definition of Neoplasm
  - (b) Classification of Tumour
  - (c) Nomenclature- Benign Tumour & Malignant Tumour.
  - (d) Grading and Staging of Tumours.
  - (e) Spread of Tumour
4. Embolism :- Type & Effects.
5. Thrombosis Edema, Hyperemia.
6. Derangement of Fluids :- Pathogenesis, Different Type & Clinical manifestation.
7. Amyloidosis :- Chemical & Physical Nature, Special Stain & Pigment.

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**FIRST YEAR**  
**Master in Medical Lab Technology**  
**HAEMATOLOGY**

**Paper - I**

1. **Erythropoiesis:-** Development of RBC, Control of Erythropoesis, Biosynthesis of Hb.
2. **Disorder of RBC :-** Anemia - Bio-Synthesis of Hb. Definition, Patho Physiology Classification, Investigations, Morphologic & Hemolytic Anemia, Anaplastic Anemia- Classification, Features & Investigations.
3. **Disorder of WBC. :-** Leucocytosis, Leukemia- Definition, Clinical Features, classification, and investigations chronic myeloid Leukemia - Clinical presentation, Investigations chronic lymphocytic Leukemia.
4. **Plasma Cell Myeloma-** Definition, Clinical Features and Investigation.
5. Bone Marrow Examination.
6. **Hemorrhagic Disorders :-** Definition, Clinical fetures, Classification, Vascular Disorders, Platelets Disorders, Coagulation Disorders, Fibrinolysis.  
Test of Vasculer and Platelet functions - Bleeding time, Clot reaction Platelet count.
7. **Haemotopoiesis :-** Origin, Development and Function.
8. **Thrombotic Disorders :-** Classification, Pathogenesis & Investigations.
9. **Lympho Proliferative Disorders :-** General Features, Classification and Investigation.
10. Blood Banking - Blood Storage, Transfusion Reaction and Mismatched Transfusion.
11. Haemoparasites.
12. Biomedical Waste Management.
13. Leukemia Disorders :- Leukemia, Classification, Lab Diagnosis.

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UNIT 1  
Introduction to the course  
Objectives

Page 1

1. Introduction to the course - Objectives of the course

2. Introduction to the course - Objectives of the course

3. Introduction to the course - Objectives of the course

4. Introduction to the course - Objectives of the course

5. Introduction to the course - Objectives of the course

6. Introduction to the course

7. Introduction to the course - Objectives of the course

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FIRST YEAR

Master of Medical Lab Technology

Paper - II      BIO-CHEMISTRY

- I) Amino Acids & Proteins, Enzymes- Cardiac Markers (LDH, SGOT, SGPT, Alkaline Phosphatase).
- II) Electrolytes, Sodium, Potassium, Calcium, Chloride, Bicarbonate & Phosphorus.
- III) Lipids & Lipoproteins, Vitamins (Fat Soluble & Water Soluble and their Deficiency disorders, Hemoglobin & Myoglobin).
- IV) Renal Functions, Liver Functions, Pancreatic (Exocrine and Endocrine) Functions, Gastro-Intestinal Functions.
- V) Diseases of New Born and their Complications.
- VI) Laboratory Safety:- Toxic, Chemical and Bio-Hazards. Quality Control.
- VII) Water and Electrolytes :- Acid Base Balance, Dehydration, Acidosis, Alkalosis, Buffers.
- VIII) Bloodsugar, Urea, Uric acid, Creatinine, Cholesterol, Triglyceride, High Density Lipoproteins, Low Density - Lipoprotein.
- IX) Liver Function test :- Serum Bilirubin, Total Protein, AG Ratio, Electrophoretic Separation of Protein.

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FIRST YEAR

Master of Medical Lab Technology

Paper - III                      MICROBIOLOGY

- 1) Study of Systemic Bacteriology:- Haemophilus, Pseudomonus, Mycobacterium, Brucella, Clostridia, Rickettsia, Chlamydia, Neisseria.
- 2) Principles and Procedures of Serologic test:- Widal, CRP, Agglutination test and ASO Titre, Estimation, VDRL.
- 3) Introductions- Life Cycle, Mode of Transmission, Pathogenicity and Lab diagnosis of Tape worms or cestodes - T. Solium, T. Saginata, H. Nana, E. Granulosis.
- 4) Serological Test of Viral Infections.
- 5) Collection and Processing of clinical specimens for Fungi.
- 6) Hepes viruses, Enteroviroses, Human Immunodeficiency viruses.

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SECOND YEAR

Master Degree in Medical Lab Technology

Paper - I      IMMUNOLOGY & CLINICAL PATHOLOGY

1. Immune Deficiency Disorders.
2. **Immuno, Hematologic Disorders:-** Transfusion Reactions, Hemolytic Diseases, Agranulocytosis, Thrombocytopenic purpura.
3. **Connective Tissue Diseases:-** SLE, Dermato Myosis, Rheumatic Fever, Rheumatoid Arthritis.
4. **Atopic anaphylactic Reactions-** Food Allergy, insect Allergy, Viral Infections, Atopic Eczema, Delayed hyper sensitivity reactions.
5. **Allergic Diseases:-** Encephalomyelitis, Multiple Sclerosis, Orchitis, Thyoiditis.
6. Immunology of AIDS, Tumor Markers, Tumor.
7. Immunity against Viral, Bacterial and Parasitic Infections.
8. Granulomatous reactions - T.B., Leprosy
9. Autoimmune diseases - Organ specific & Systemic.

CLINICAL PATHOLOGY

- 1) Urine Examination- Physical, Chemical & Microscopic.
- 2) Renal Function Tests.
- 3) Sputum Examination- Physical, Microscopic & Chemical Examinations.
- 4) Gastric Analysis.
- 5) CSF - ~~Indications~~, Examination of CSF
- 6) Body Fluids- Microscopical Exam.  
Pleural, Pericardial, Ascitic, Peritoneal Fluids.

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SECOND YEAR  
HISTO PATHOLOGY & CYTOLOGY

Paper - II

- (i) Tissue Processing of Histological Tissues, Dehydration, Clearing, Wax Preparation.
- (ii) Microtome's - Various Types, Working Principle and Maintenance, Microtome's Knives & Knife Sharpening Procedure, ~~Practical~~ Section Cutting, Staining Preparation.
- (iii) Identification & demonstration of Different Metabolic Compounds, Mounting and Mounting Media.
- (iv) Ph, Buffer, Acid Base Equilibrium.
- (v) Labeling of Histology Specimens, Fixations and Various Fixatives & their Preparation.

CYTOLOGY :-

- (a) Fine Needle Aspiration Technique & Staining, <sup>CYTOTOLOGY</sup>
- (b) Cytology- Criteria of Malignancy.
- (c) Cytology in Cervical, Endometrial & Ovarian Cancer.
- (d) Tumor Marker (Malignant)
- (e) Cytology of C.S.F.
- (f) Body Fluid Cytopathology:- Pleural Fluid, ~~Ascitic Fluid~~, C.S.F. ~~Fluid~~, Peritoneal Fluid & Pericardial Fluid.

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SECOND YEARRECENT ADVANCEMENT IN PATH & LAB MANAGEMENT.Paper - III

1. Molecular Analysis of Chromosomal, aberrations in leukemia and lymphomas, Molecular diagnosis of genetic diseases.
2. Histo Pathology :-
  - (a) Fixation of Tissues, classification of Fixation.
  - (b) Section Cutting- Microtome & Knives, Techniques of Section Cutting.
  - (c) Tissue Processing, Collection, Step of Fixation.
3. Preservation of organs & Processing.
4. Hormones :- Thyroid Hormones, Growth Hormones, Insulin.
5. Handling and Quality Control of Lab :- Sterilization and Autoclave Tech, Disinfection Techniques and Waste Disposal.
6. Molecular Analysis of Chromosomal Alteration in leukemia and Lymphomas, Diagnosis of Molecules.
7. Care of Lab, Glassware, Equipments, Chemicals.
8. Laboratory Safety Programmes.
9. Care of Laboratory Glassware Equipments, Instruments & Chemicals.
10. First aid in Laboratory.
11. Planning for Hospital Lab Services.
12. Laboratory Hazards.

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## MASTER OF OPERATION THEATRE TECHNOLOGY

### SUBJECTS OF FIRST ACADEMIC YEAR-

1. PAPER 1- Surgical and anesthetic equipments
2. PAPER 2 -Operation theatre management
3. PAPER 3- General surgery.
4. PROJECT WORK

### SUBJECTS OF SECOND ACADEMIC YEAR-

1. PAPER 1-Clinical anaesthesia
2. PAPER 2- Clinical surgery
3. PAPER 3- Critical care and ICU
4. PROJECT WORK

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# MASTER OF OPERATION THEATRE TECHNOLOGY

## SYLLABUS AND COURSE DESCRIPTION

SUBJECT- Surgical and anaesthetic equipments- PAPER 1(FIRST YEAR)

Care, maintenance, sterilization and use of various equipments in surgery and anaesthesia-

- Micro surgical and titanium instruments
- Power surgical equipments
- General and specialized surgical instruments
- Endoscopes- laproscopes, gastroscopes, duodenoscope, sigmoidoscope, colonoscope, cystoscope, hysteroscope, colposcope, arthroscope
- Robotic equipments
- Laser and electric cautery
- Breathing circuits and ECG channels
- Boils apparatus, suction pump, nebulizer
- Laryngoscope
- Oropharyngeal airway
- Endotracheal tube and LMA
- Face mask and ambu bag
- Tracheostomy tube
- Gas cylinders and pipeline gas system
- Pulse oximeter, cardiac monitor, ventilator, defibrillator
- Cardio pulmonary bypass machine, cardiac pacemaker
- Vascular equipments
- Syringe pumps
- Infant warmer
- Newborn resuscitation set
- Fetal monitor
- Splint sets

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MASTER OF OPERATION THEATRE TECHNOLOGY

SUBJECT- OPERATION THEATRE MANAGEMENT -PAPER 2(FIRST YEAR)

- Source of infection in OT, infection process, portal of entry and exit, mode of transmission
- Nasocomial Infection
- Hospital infection control programme
- Infection control policy in theatre area
- Use of antiseptic agents in OT
- OT sterilization, fumigation of OT
- OT light
- Ventilation and electric supply in OT
- Designing zone, types and layout of operation theatres
- Safety measures in Operation theatre
- Septic theatre, prevention and management of infected surgical patients
- Modular operation theatre

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# MASTER OF OPERATION THEATRE TECHNOLOGY

## **SUBJECT- GENERAL SURGERY- PAPER 3 (FIRST YEAR)**

- Preoperative, OPERATIVE, POST OPERATIVE CARE OF SURGICAL PATIENTS
- Wounds and ulcer
- Abscess ,carbuncles,tetanus and gas gangrene
- Lipoma, sebaceous cyst,dermoid cyst and warts
- Breast abscess and breast neoplasm
- Electrolytes and nutrition
- Shock,hemorrhage and blood transfusion
- Burns
- Trauma- TRIAGE, bullet injury,blast injury
- Hand and foot infection
- Amputation
- Transplants-renal, liver and bone marrow
- Bites and stings

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## MASTER OF OPERATION THEATRE TECHNOLOGY

### **SUBJECT- Clinical anaesthesia - PAPER 1(SECOND YEAR)**

- Review of anatomy and physiology of respiratory system
- Pre anaesthetic assessment of patients
- Diagnostic preparation of patient before surgery
- Types and technique of anaesthesia
- Drugs used in anaesthesia
- Drugs used in resuscitation
- Anaesthesia in emergency surgery
- Anaesthesia in camps and field
- Anaesthesia in radiology and endoscopy
- Anaesthesia in obese and medical disease
- Labour analgesia
- Balance anaesthesia
- Difficult intubation
- Induced hypotension
- Care of patient during anaesthesia
- Respiratory failure
- Oxygen therapy

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# MASTER OF OPERATION THEATRE TECHNOLOGY

## **SUBJECT- CLINICAL SURGERY - PAPER 2(SECOND YEAR)**

- Review of anatomy and physiology of different systems of body
- GI SURGERY- vagotomy and pyloroplasty, gastrectomy, whipples operation, pancreatectomy, drainage of pancreatic cyst, cholecystectomy and laproscopic cholecystectomy, resection of small bowel, colostomy, hemi and total colectomy, closure of colostomy, rectopexy, laprotomy, liver transplant, herniotomy, splenectomy, special and laproscopic instruments used in GI SURGERY
- Obstretic surgery- normal labour, abnormal labour, third stage complication like PPH, inversion of uterus and retained placenta, rupture of uterus, cord prolapse, LSCS, hysterectomy, ectopic pregnancy, MTR and D and E.
- Gynaceological surgery- hystectomy, myomectomy, cystectomy, sacropexy and sling surgery, VVF repair, Werthiem's operation, D and C, cervical and endometrial biopsy, tuboplasty, tubectomy, bartholin cyst excision.
- Orthopedic surgery- fractures, open reduction and internal fixation of different types of fractures, arthroscopy, external fixation, traction, slabs and casts, amputation, joint replacement, operations on spine like laminectomy, instruments used in orthopedic surgery.
- Urological surgery- cystectomy, cystostomy, pyelolithotomy, pyloplasty, ureterolithotomy, nephrolithotomy, PCNL, illieal conduit, operations on vesical fistula, renal transplant, prostectomy
- Neurosurgery- review of nervous system, types of neurosurgery, craniotomy, ventriculoperitoneal shunt, cerebral abscess, equipments used in brain surgery, classification and management of nerve injury, carpal tunnel syndrome
- Cardio-thoracic surgery- cardiac surgery OT setup, preoperative assessment, valve replacement surgery, cardio pulmonary bypass surgery, pace maker and cardiac catheterization, thoracotomy, thoracoplasty, intercostals drainage, lobectomy, pericardiocentesis
- Plastic surgery

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## MASTER OF OPERATION THEATRE TECHNOLOGY

### SUBJECT- CRITICAL CARE AND ICU- PAPER 3(SECOND YEAR)

- CPR, BLS and ACLS, post resuscitation life support, resuscitation of new born.
- ICU- definition, duties and responsibilities, design of ICU, types of ICU, infection control in ICU, equipments in ICU, nutrition in ICU
- Airway management- definition, indication, roots of insertation, types of tubes, airway assessment and procedures
- Pain management- definition, types, signs and symptoms, pathophysiology of pain and management of pain
- Casualty management of patient- shock, dehydration, burns, and accidents
- Fluid and blood transfusion
- Management of head injuries and other neurological emergencies
- Management of unconscious patients
- Management in intensive cardiac care
- Intensive care of newborn and neonates
- Management of respiratory failure and heart failure, ARDS
- Management of metabolic acidosis and alkalosis
- Management of electrolyte imbalance
- Management of organophosphorus poisoning and corrosive poisoning
- Management of acute kidney and liver failure
- Management of electrical injuries

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Reference books for master of operation theatre technology

1. Textbook for operation theatre- PARMILA BHALLA
2. Textbook on operation theatre nursing- 1 CLEMENT
3. Short textbook of anaesthesia- AJAY YADAV
4. Operation theatre technique and management- DR G N SHARMA, DR A L AGRAWAL
5. Operation room technique- BRIGDEN
6. Operation room technique- BERRY AND KOHN'S
7. The operating room aids- CAREER PUBLISHERS
8. Operating theatre nursing- MC WARREN
9. Perioperative nursing- LINDA SHIELDS, HELEN WERDER

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MASTER OF OPTOMETRY &  
OPHTHALMIC TECHNOLOGY  
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Year 1<sup>st</sup>

Paper:-1

A&gt; Ocular diseases,

Paper:-11

A&gt; Optics and refraction.

Paper:-111

A&gt; Ophthalmic Instruments and Investigations.

Project:-1

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Year 11nd

Paper:-1

A> Contact lenes, I.O.L implant and refractive surgeries.

Paper:-II

A> Advance ocular diseases.

Paper:-III

A> Community Ophthalmology.

Project:-2

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DETAILED SYLLABUS

INSTRUCTIONAL METHOD : Personal contact programmes, Lectures (virtual and in-person), Assignments, Labs and Discussions, Learning Projects, Industrial Training Programmes and Dissertation.

Year : I

Paper : 1

“OCULAR DISEASES”

(A) OCULAR ANATOMY & PHYSIOLOGY

| Unit | Contents  |
|------|---|
| 1    | Gross Anatomy and Embryology fo Eye : Introduction<br>Gross Anatomy of Eyeball and Orbit-<br>General Anatomy of the Eyeball and Orbit<br>General Shape of the Eyeball<br>Layers of the Eyeball<br>General Concepts of the Structures within the Eyeball<br><br>Embryology of Eyeball-<br>Specific Embryological Stages of Eyeball<br>Embryology of Specific Ocular Structures<br><br>Growth and Development of Eye. |
| 2    | Anatomy of the Outer Coat of the Eyeball : Introduction<br><br>Anatomy of the Outer Coat of the Eyeball-<br>Anatomy of Conjunctiva<br>Coat of Eyeball<br>Anatomy of Cornea<br>Anatomy of Sclera   |
| 3.   | Anatomy of the Middle Coat of the Eyeball -: Introduction.<br><br>Anatomy of Uveal Tract -<br>Anatomy of Iris<br>Anatomy of Ciliary Body<br>Anatomy of Choroid<br><br>Anatomy of Anterior and Posterior Chambers  |
| 4    | Anatomy of Lens: Introduction   |

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|   | Anatomy of the Inner Coat of the Eyeball and Anatomy of Vitreous :<br>Introduction   |
| 5 | Anatomy of Retina and its Special Regions -<br>Anatomy of Retina<br>Special Regions of the Retina<br><br>Anatomy of Vitreous.  |
| 6 | Anatomy of Optic Nerve and the Visual Pathway : Introduction<br>Parts of Visual Pathways<br>Optic Nerve<br>Optic Chiasma<br>Optic Tract<br>Lateral Geniculate Nucleus<br>Visual Cortex<br>Arrangement of Fibres in Visual Pathway  |
| 7 | Anatomy of Lids and Lacrimal System : Introduction<br>Description of Eye Lids and Lacrimal System  |
| 8 | Eyelids, Lacrimal Apparatus and Tear Film Dynamics : Introduction<br><br>Structure and Functions of the Eyelids-<br>Functions of the Eyelids<br>Physiology of Eyelid Movements<br>Blinking and Peering<br><br>Functions of the Lacrimal Apparatus-<br>Tear Secretion<br>Control of Tear Production<br>Tear Drainage<br><br>Tear Film Dynamics-<br>Functions of Tear Film<br>Physical properties of Tear Film<br>Tear Dynamics<br>Tear Film Dysfunction<br>Treatment of Dry Eye |
| 9 | Aqueous Humour and Intra Ocular Pressure : Introduction<br>Structure and Functions of Aqueous Humour-<br>Formation of Aqueous Humour<br>Aqueous Movement and Outflow   |

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|    | <p>Aqueous Composition<br/>         Physio-chemical properties of Aqueous</p> <p>Intra-ocular Pressure-<br/>         Diurnal Variation of Intra-ocular pressure<br/>         Measurement of Intra-ocular Pressure<br/>         Increase in Intra-ocular Pressure<br/>         Lowering Intra-ocular Pressure<br/>         Factors Affecting intra-ocular pressure</p>  |
| 10 | <p>Pupil and Pupillary Reflexes : Introduction<br/>         Pupillary Reflexes<br/>         Pupil-<br/>         Appearances of the Pupil<br/>         Accommodation<br/>         Neuronal Pathways</p> <p>Pupillary Defects -<br/>         Marcus Gunn Pupil (RAPD)<br/>         Argyll Robertson Pupil (ARP)<br/>         Adie's (Tonic) Pupil<br/>         Homer's Pupil<br/>         Iris Coloboma</p>  |
| 11 | <p>Muscles and Movements of the Eye :</p> <p>Extra-ocular Muscles-<br/>         Recti and Oblique Muscles<br/>         Planes of Muscles</p> <p>Intra-ocular Muscles<br/>         Uni-ocular Movements</p> <p>Binocular Movements<br/>         Laws Governing Ocular Movements</p> <p>Abnormalities of Gaze-<br/>         Latent Squint (Anisophoria or Heterophoria)<br/>         Manifest Squint (Heterotropia)<br/>         Pseudosquint (Pseudo-false)</p> |
| 12 | <p>Vision : Light Sense, Night Vision and Colour Vision : Introduction.<br/>         Visual Impulse and Perception -<br/>         Initiation of Visual Impulse</p>   |

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|    | <p>Transmission of Visual Sensation<br/>Analysis of Visual perception</p> <p>Colour Vision :<br/>Young's Trichromatic Theory<br/>Details of Colour Vision.<br/>Defective Colour Vision</p> <p>Light Sense-<br/>Adaptation<br/>Dark Adaptation</p> <p>Contrast Sense</p>  |
| 13 | <p>Visual Pathway, Fields and Visual Cortex : Introduction<br/>Retina, Optic Nerve, Optic Chiasma, Optic Tract, Lateral Geniculate Body, Optic Radiations</p> <p>Visual Cortex-<br/>Physiological Aspects</p> <p>Visual Fields-<br/>Perimetry<br/>Methods of Visual Fields Examination</p>                           |
| 14 | <p>Visual Acuity, Uni-Ocular and Binocular Vision :<br/>Measurement of Visual Acuity-<br/>Test Types Snellen's and Landolt's</p> <p>Binocular Vision –<br/>Advantages of Binocular Vision<br/>Retinal Correspondence<br/>Horopter (Horizon of Vision)<br/>Pannum's Area</p> <p>Tests for Binocular Single Vision</p> |
| 15 | <p>Accommodation and Convergence : Introduction<br/>Accommodation –<br/>Mechanisms<br/>Theories of Accomodation</p>  |

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(B) EYE DISEASE - I

| Unit | Contents   |
|------|--|
| 1    | Disease of Lid:<br>Disease of Lid  |
| 2    | Disease of Conjunctiva:<br>Inflammation, Trauma, Degeneration, Tumors                              |
| 3    | Disease of Lacrimal apparatus:<br>Congenital, Inflammation of lacrimal sac, Tumors of lacrimal sac |
| 4    | Diseases of Cornea<br>Keratitis and Corneal ulcer, Corneal degeneration, Keratocornus              |
| 5    | Sclera<br>Inflammation, Scleritis, Episcleritis  |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. The Eye Book : Eyes and Eye Problems Explained by Ian Grierson
- B. Differential diagnosis of eye disease - Hans Pau-W.B. Saunders Co., 1978.

C. EYE DISEASE - II

| Unit | Contents   |
|------|--|
| 1.   | Uvea:<br>Etiopathogenesis<br>Clinical features<br>Routine investigation<br>Types of uveitis<br>Vascular and circulating disturbances<br>Degeneration, Congenital abnormalities   |
| 2.   | Lens :<br>Etiopathogenesis of cataract, Symptoms of cataract. Age related or senile cataract,<br>Cataract associated with ocular disease, cataract associated with systemic disease, cataract due to other causes<br>Development of cataract<br>Management of cataract<br>Complication of cataract surgery, secondary cataract |

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| 3. | Retina :<br>Examination of Fundus<br>Vascular retinopathies<br>Inflammation of retina<br>Degeneration of retina, Detachment of retina |
|----|---|

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. The Eye Book : Eyes and Eye Problems Explained By Ian Grierson
- B. Textbook of Ophthalmology by H V Nema

| Unit | Contents  |
|------|---|
| 1.   | Electro-Physiology of the Eye : Introduction<br>Electro-retinogram<br>Visual Evoked Response<br>Electro-oculogram |

LEARNING SOURCE : Self Learning Materials.

ADDITIONAL READINGS :

- A. Ocular Anatomy and Physiology -- By AI Lens, Count Comt. Sheila Coyne Nemeth, Janice K. Ledford-Slack Incorporated
- B. Ophth-Assistant Vol-V (Community Ophth) – Dr.L.P. Agarwal

Paper-II (OPTICS AND REFRACTION)

(A). NATURE OF LIGHT ,

| Unit | Contents   |
|------|--|
| 1    | Current concept of Light:<br>Origin of light<br>Travel of light<br>Arrival of light  |
| 2.   | Visible Light :<br>Visible light origin<br>Visible light sensing<br>Visible light receptor and ocular media<br>Light sensitivity |

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|   | Visible light receptor and ocular media<br>Light sensitivity<br>The receptor as light guide, Transparency or Dioptric Media                 |
| 3 | Physical Optics :<br>Intraocular scattering<br>Diffraction effects<br>Polarization Phenomenon<br>Eye Colors<br>The Doppler shift            |
| 4 | Light damage to Eye:<br>Ultraviolet light, Biochemical mechanism of light damage, Clinical example of ocular light damage, Light protectors |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. The Nature of light-Eugen Cornelius Joseph von Lommel – D. Appleton and Co., 1876.

**(B) OPTICS OF NORMAL EYE**

| Unit | Contents  |
|------|---|
| 1    | Individual optical elements of eye:<br>Normal eye<br>Abnormal eye<br>Donders eye<br>Reduced eye   |
| 2    | Visual Acuity Testing<br>For Distance-<br>Snellen's test<br>Keeler Elliot test<br>Kay Picture test<br>Ffooks Symbols<br><br>For Near-<br>Jaeger test<br>Reduced Snellen's test<br>Visual acuity testing in children |

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|   | Landolt Chart test<br>STY-CAR test<br>HOTV test<br>Photostress test<br>Pinhole examination            |
| 3 | Contrast Sensitivity Function :<br>Modulation transfer function<br>Retina Brain image processing      |
| 4 | Radioscopy:<br>Theory of Radioscopy<br>Practice of Retinoscopy<br>Subjective verification of reflexes |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. Optics of the Human Eye By David A. Atchison, David A., Atchison  
George Smith - BH

(C) SPECTACLES & LENSES

| Unit | Contents  |
|------|---|
| 1.   | Lens Materials:<br>Lens Material  |
| 2    | Types of Spectacle Lenses:<br>Spherical lens<br>Cylindrical lens<br>Concave lens<br>Convex lens<br>Plano-concave lenses<br>Plano convex lenses<br>Miscellaneous |
| 3.   | Fresnel Lenses & Prisms   |
| 4.   | Prism Correction  |
| 5.   | Absorptive Lenses   |
| 6.   | Safety Lenses   |
| 7.   | Frames  |
| 8.   | Dissatisfied Patients   |

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| 9.  | Spectacle & Lens in children for Near Vision-<br>Biofocal lens types, Progressive lens or multifocal lens |
| 10. | Aberration of lens  |
| 11. | Magnifying lens   |
| 12. | Single transposition  |
| 13. | Toric Transposition   |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. Spectacle Lenses : Theory and Practice By Colin Fowler. Colin Fowler  
Keziah Latham Petre
- B. Lenses, spectacles, eyeglasses and contacts : The story of vision aids -  
Alberta Kelley

PAPER - III

OPHTHALMIC INSTRUMENT & INVESTIGATIONS

| Unit | Contents  |
|------|---|
| 1.   | Corneal Measurement:<br>Measuring the corneal surface, Measuring corneal thickness<br>The specular microscope<br>Retinoscope-Plane mirror, Preistly Smity, Streak<br>Automated objective refractometer<br>The lensometer  |
| 2.   | Ophthalmoscope :<br>Indirect Ophthalmoscope<br>Direct Ophthalmoscope<br>Funds camera<br>Magnify device  |
| 3.   | Investigations:<br>Gonioscopy, Tonometry, Ultrasound/biomicroscopy<br>Ancillary investigations<br>Fluorescein Angiography<br>Indocyanine Green Angiography<br>Ultrasonography<br>Computerized Axial Tomography-CAT<br>Magnetic Resonance Imaging-MRI<br>Electrophysiological Response<br>Electrooculogram |

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|   | Magnetic Resonance Imaging-MRI<br>Electrophysiological Response<br>Electrooculogram<br>Electroretinogram<br>Visual evoked potential<br>Binocular vision & stereo acuity<br>Electromyography<br>Electronystagmography<br><br>Colour Vision-<br>Theory of colour vision<br>Disorder of colour vision<br>Testing of colour vision |
| 4 | Ophthalmic Instruments :<br>Synoptophore<br>Adaptation & Adaptometry<br>Ocular Photography<br>Pachymetry   |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. Textbook of Ophthalmology by H V Nema
- B. Moorfields manual of Ophthalmology By Timothy L. Jackson

2<sup>nd</sup> Year Paper - I (CONTACT LENSES, I.O.L. IMPLANT, AND REFRACTIVE SURGERIE)

(A) CONTACT LENS-LVA AND VISUAL FUNCTIONS ASSESSMENT

| Unit | Contents   |
|------|--|
| 1.   | Introduction, History, Lens types, Optics of contact lenses          |
| 2.   | Eye examination procedure in contact lens                            |
| 3.   | Lens care  |
| 4.   | Material used for contact lens                                       |
| 5.   | Type of contact lens   |
| 6.   | Fitting of contact lens  |
| 7.   | Extended wear contact lens   |
| 8.   | Bandage contact lens   |
| 9.   | Visual acuity<br>MARC maximum angle of resolution                    |
| 10.  | Field of vision -- Confrontation test, Perimetry, Kinetic Perimetry, |

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A. [http://www.centreforsight.net/content/148\\_54/contact-lens-and-low-vision-aids.html](http://www.centreforsight.net/content/148_54/contact-lens-and-low-vision-aids.html)

B. Ophthalmic Lenses & Dispensing By Mo Jalie

**(B) INTRAOCULAR IMPLANT & REFRACTORY SURGERIES**

| Unit | Contents  |
|------|---|
| 1    | Optics of Intraocular Implants : Introduction<br>Optical effects of intraocular implants<br>Calculating implant power<br>Types of implants<br>Material used for implants<br>Implant decentring<br>Implant tilt & Astigmatism<br>Implants for Presbyopia, Bifocal IOL, Multifocal IOL, Foldable IOL  |
| 2    | Optics of Corneal Refractive Surgery :<br>Corneal radius and index<br>Optical zone size<br>Corneal refractive surgery procedures ie. Radial Keratotomy PRK, LASIK, IV., LASEK,<br>Optical results of refractory surgery<br>Surgical correction of Astigmatism<br>Corneal Incision in Myopia and hypermetropia. Surgical correction for Presbyopia |

**LEARNING SOURCE :** Self Learning Materials

**ADDITIONAL READINGS :**

A. Ocular Anatomy and Physiology - AI Lens, Comt Comt. Sheila Coyne Nemeth, Janice K. Ledford-Slack Incorporated

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(C) ORTHOPTICS & PLEOPTICS

| Unit | Contents   |
|------|--|
| 1.   | Motor apparatus of eye:<br>Anatomy of ocular muscles<br>Actions of extra ocular muscles<br>Nervous control of ocular movement  |
| 2.   | Binocular Vision :<br>Versions, Grading of binocular vision  |
| 3.   | Fixation : Fixation  |
| 4.   | Conyergence & Accommodation  |
| 5.   | Strabismus<br>Comitant Strabismus<br>Comitant vs incomitant strabismus<br>Etiology of comitant strabismus<br>Symptom of comitant strabismus<br>Investigation<br>General principal of management of strabismus<br>Latent squint (strabismus) (Hetrophoria)<br>Maddox Rod<br>Maddox Wing<br>Heterotopia or manifest strabismus<br>A.V. Pattern<br>Misotropia Treatment<br>Incomitant strabismus<br>Paralytic Strabismus<br>Actiology Investigations-Diptopia, charting<br>Types of ocular muscle paralysis<br>restrictive strabismus, Synkineses, Synaptophore |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

A. Clinical Orthoptics By Fiona I. Rowe-Wiley Blackwell

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PAPER - II (ADVANCE OCULAR DISEASES)  
(A) EYE DISEASE

| Unit | Contents  |
|------|---|
| 1.   | Glaucoma : Introduction<br>Primary adult glaucoma<br>Intraocular Prism changes in glaucoma<br>Field changes in glaucoma<br>Secondary glaucoma, optic nerve based drugs<br>Secondary glaucoma<br>Pediatric glaucoma<br>Treatment of glaucoma |
| 2.   | Eye Injury :<br>Chemical Injury<br>Concussion Injury<br>Penetrating injury<br>Sympathetic Ophthalmitis  |
| 3.   | Disease of Optic Nerve :<br>Papilledema, Disturbances of circulation, Optic neuritis, Optic atrophy   |
| 4.   | Intraocular Tumors :<br>Tumors of uveal tract, Tumors of retina   |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. The Eyebook : Eye and Eye Problems Explained by Ian Grierson  
B. Differential diagnosis of eye disease - Hans Pau - W.B. Saunders Co., 1978.

(B) NEURO OPHTHALMOLOGY

| Unit | Contents   |
|------|--|
| 1.   | Visual pathways (Normal):<br>Neurological disorder, Hemiparesis, Lesions of various level of visual pathway, Optic nerve, Optic tract, Optic Chiasma, Nuclear lesion, Cortical lesion. |
| 2.   | Ocular motor system & Neurological disorder<br>Extraocular muscle paralysis, Nystagmus   |
| 3.   | Vascular Disorder<br>Intracranial Aneurysms, AV fistula, Sub Arachnoid Haemorrhage, Ischemic Syndrome, Cerebral Haemorrhage & thrombosis   |

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| 4. | Cortical Blindness   |
| 5. | Migraine   |
| 6. | Infections :<br>Meningitis, Encephalitis, Syphilitic Infection |
| 7. | Degenerating Disease<br>Multiple sclerosis                     |
| 8. | Intracranial tumors  |
| 9. | Head injury & ocular manifestations                            |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :- The practical Guide by Leonard A. Levin

(C) EYE & SYSTEMIC DISEASE

| Unit | Contents   |
|------|--|
| 1.   | Immunopathological reaction :<br>Acute anaphylactic reaction. Dependent eye. Immune complex types. Cell mediated, Stimulating  |
| 2.   | Ocular changes in various disorders:<br>Haematological Anaemia. Hypertension. Infection. Malaria. Meningitis, Encephalitis, Endocrine, Graves disease. Metabolic disease, Muscle disorder, Myasthenia gravis, Muscular dystrophy. Inherited disorder, Retinitis Pigmentosa. Down Syndrome. Stung Weber Syndrome, Albinism. Marfan's Syndrome. Van Hippel. Lindens Disease. |
| 3.   | Diabetes & Eye Diabetic Changes :<br>Diabetes & Eye Diabetic Changes   |
| 4.   | Various Retinopathies :<br>Hypertensive retinopathy, Occlusive retinopathies. Retinopathy of prematurity   |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. Handbook of Pediatric Eye and Systemic Disease by Kenneth Weston Wright - Sprinter
- B. The eye and systemic disease by Frederic A. Mausolf. Illustrated Publisher Mosby, 1975.

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PAPER - III

~~PHYSIOLOGY~~ COMMUNITY OPHTHALMOLOGY

| Unit | Contents   |
|------|--|
| 1.   | Blindness :<br>Definition, Causes, Aetiology, Control of blindness.  |
| 2.   | Eye Care types:<br>Primary eye care, secondary eye care, Tertiary eye care   |
| 3.   | Mobile eye services  |
| 4.   | Specific cause of blindness and approach to prevention of Blindness:<br>Cataract, Glaucoma, Diabetic retinopathy, Childhood blindness.<br>Nutritional Blindness, Trachoma, Onchocerciasis, Macular disorder. |
| 5.   | Eye Bank, Corneal preservation, Lid surgery, Corneal surgery.<br>Cataract surgery, Glaucoma surgery, Detachment surgery, Lacrimal<br>apparatus surgery, Squint surgery                                       |
| 6.   | Ocular anaesthesia:<br>Anaesthesia in eye - Topical anaesthesia, Blocks, Facial blocks,<br>Retro bulbar blocks, Peri bulbar blocks.  |

LEARNING SOURCE : Self Learning Materials

ADDITIONAL READINGS :

- A. Community Ophthalmology - P.J. Gnanaram
- B. Textbook of Ophthalmology by H V Nema

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# Masters of Radio Imaging Technology

## Course Curriculum -

### First Year

Paper I - Radiation Physics

Paper II - Radiographic Technique and procedure

Paper III - Radiation safety and Dark Room

Project Work

### Second year

Paper I - Technique of CT scan and Mam<sup>m</sup>ography

Paper II - Technique of MRI and Ultrasonography

Paper III - Nuclear Medicine and Advance Radiology

Project Work

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**MASTER OF RADIO IMAGING TECHNOLOGY**  
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**Course Curriculum**

**First Year**

**Paper -1 Radiation Physics**

**Radiation Physics ..**

**Introduction**

1. 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.
2. Interaction of ionizing radiation with matter-Types of interactions of X and gamma radiation, Photoelectric & Compton, Pair production, annihilation radiation.
3. Interaction of X and gamma rays: Transmission through matter, law of exponential attenuation, half value layer, and linear attenuation coefficient-coherent scattering-photonic disintegration-Particle interactions. Interactions of X rays and Gamma rays in the body; fat-soft tissue-bone-contrast media-total attenuation coefficient-relative clinical importance.
4. Radiation intensity and exposure, photon flux and energy flux density.
5. X-ray tube: historical aspects, construction of X-ray tubes, requirements for X-ray production (Electron source, target and anode material), tube voltage, current, space charge, early X-ray tubes (Coolidge tubes, tube envelop and housing) cathode assembly, X-ray production efficiency, advances in X-ray tubes, anode angulation and rotating tubes-line focus principle space charge effect, tube cooling-Modern X-ray tubes-stationary anode, rotating anode, grid controlled X-ray tubes, heel effect, off focus radiation, tube insert and housing-Tube rating-Quality and intensity of x-rays -factors influencing them.

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- 6. Grid controlled and high speed tubes, focal spot size, speed of anode rotation, target angle, inherent filtration, radiation leakage and scattered radiation). Interlocking and X-ray tube overload protection.
- 7. Heat dissipation on methods, tube rating, heat units, operating conditions and maintenance.
- 8. X-ray generator circuits: Vacuum tube diodes-semi-conductor diodes-transistor-Rectification-half and full wave-self rectification-X-ray generator; filament circuit-kilo Voltage circuit-single phase generator-three phase generator-constant potential generator-Fuses, switches and interlocks-Exposure switching and timers-HT cables-earthing.
- 9. 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).
- 10. 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.

**Conventional Radiological and Imaging Equipment**

- 1. Production of x-rays: X-ray tube, gas filled x-ray tube, construction working and limitations; stationary anode x - ray tube; construction, working, Omethods of cooling the anode, rating chart and cooling chart; rotating anode x - ray tube: construction, working rating chart, speed of anode rotation, angle of anode inclination, dual focus and practical consideration in choice of focus, anode heel effect, grid controlled x - ray tube; effect of variation of anode voltage and filament temperature; continuous and characteristics spectrum of x - rays, inherent filter and added filter, their effect on quality of the spectrum.
- 2. High tension circuits: H.T. generator for x-ray machines, three phase rectifier circuits, three phase six rectifier circuit, three phase 12 rectifier circuit, high'and medium

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frequency circuits; capacitance filter control and stabilising equipment; mains voltage compensator, mains resistance compensator, compensation for frequency variation, control of tube voltage.

3. Meters and exposure timers; Moving coil galvanometer; construction and working/conversion to milliammeter, ammeter and voltmeter, meters commonly used in diagnostic x-ray machines.

4. Interlocking circuits; Relays: description and working, use of relays in diagnostic machines for over load protection, circuit diagram; simplified circuit and block diagrams illustrating sequence of events from mains supply to controlled emission of x-rays.

5. Control of scattered radiation; Beam limiting devices: cones, diaphragms, light beam collimator, beam centring device, methods to verify beam centring and field alignment; grids; design and control of scattered radiation, grid ratio, grid cut-off, parallel grid, focused grid, crossed grid, grided cassettes, stationary and moving grid potter bucky diaphragms, various types of grid movements; single stroke movement, oscillatory movement and reciprocatory movement.

6. Fluoroscopy : Fluorescence and phosphorescence - description, fluorescent materials used in fluoroscopic screens, construction of fluoroscopic screen and related accessories, tilting table, dark adaptation. Image intensifier - Construction and working, advantages over fluoroscopic device, principles and methods of visualising intensified image, basic principles of closed circuit television camera and picture tube.

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Paper - II

Radiographic Technique and Procedure

Anatomy Related to Radiology

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, eg. 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 for 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. Adaptation of techniques to demonstrate specific pathologies.
  - 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 to demonstrate Congenital dislocation of hip joints, Epiphysis of femur, Lateral projections for hip joints to show femoral head and neck relationship.

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- 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 temporals for mastoids, Internal auditory canal, Accessory nasal sinuses, Temporo - 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 tract: Technique for post nasal airways, larynx, trachea, thoracic inlet, Valsalva manoeuvre, Phonation.
4. Lungs and Mediastinum: Technique for routine projections,
5. Supplementary projections: Antero-posterior, obliques, lordotic, apical projection, use of penetrated postero-anterior projection, Expiration technique, Technique for pleural fluid levels and adhesions.
6. Abdominal viscera: Technique for plain film examination.- Projection for acute abdomen patients. Technique to demonstrate: Foreign bodies, Imperforate anus.
7. Radiography using mobile Xray equipment: Radiography in the ward: Radiography in the specialised unit, such as: Intensive care unit, Coronary care, Neonatal unit, Radiography in the operating theatre.
8. Macroradiography: Principle, advantage, technique and applications.
9. Stereography: Procedure, presentation, for viewing, stereoscopes.
10. High KV techniques: Principle and its applications.
11. Soft tissue Radiography including Mammography : its techniques, equipment, advancements and applications.
12. Localization of foreign bodies: Various techniques
13. Operation theatre techniques: General precautions, Aspects in techniques, Checking of mains supply and functions of equipment, selection of exposure factors, explosion risk, radiation protection and rapid processing techniques.

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- 14. Trauma radiography/Emergency radiography,
- 15. Neonatal and Paediatric Radiography,
- 16. Tomography and Tomosynthesis
- 17. Dual energy X-ray absorptiometry
- 18. Forensic Radiography
- 19. Community Radiography.

**Radiological and Imaging Procedures**

- 1. Special Radiographic /Radiological procedures
- 2. Selection of Fluoroscopy Equipment, general considerations, responsibility of radiographers. Patient Preparation, Indications Contraindications Technique Post Care and Preparation of Drug Trolley/Tray, Radiation Safety. Contrast Media - Positive and Negative, Ionic & Non - Ionic, Adverse Reactions To Contrast Media and Patient Management, Emergency Drugs in the Radiology Department ^Aseptic technique for the following procedures.
- 3. Gastrointestinal Tract: 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. Including water soluble contrast media - eg. GastioGraffin.
- 4. Salivary glands : Routine technique, procedure - sialography.
- 5. Biliary system : Plain fika radiography. Intravenous cholangiography. Percutaneous cholangiography. Operative cholangiography, Post-Operative cholangiography (T-tube Cholangiography
- 6. Urinary system : Intravenous urography, Retrograde pyelography. Antegrade pyelography. Cystography and micturating cystouresthrography. Urethrography (ascending) Renal puncture.

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- 7. Reproductive system : All the Techniques relating to Male and Female reproductive system including Hysterosalpingography.
- 8. Breast Imaging : Mammography: Basic views, special views, wire localization, Ductography, Tomosynthesis, ABVS, Various Biopsy Techniques including Prone Table Biopsy.
- 9. Respiratory system : Bronchography :
- 10. Sinography : Routine technique and procedure.
- 11. Central Nervous System : Myelography, Cerebral studies, Ventriculography.
- 12. Arthrography : Shoulder, Hip, Knee, Elbow joints etc including CT, US and MRI Special Imaging Techniques.
- 13. Angiographic Studies : Carotid Angiography (4 Vessel angiography), Thoracic and Arch Aortography, Selective studies: Renal, SMA, Coeliac axis, Vertebral angiography, Femoral arteriography, Angiocardiography, Peripheral angiography
- 14. Venography: Peripheral venography, Cerebral venography, Inferior and superior venocavography, Relevant visceral phlebography.

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### Radiation Safety and Darkroom

#### Radiation safety in diagnostic Radiology

1. Introduction to Radiation protection-Need for protection,Aim of radiation protection.
2. Limits for radiation exposure: Concept of ALARA ,maximum permissible dose ,exposure in pregnancy, children. Occupational Exposure Limits - Dose limits to public
3. Radiation Protection in: Radiography, Fluoroscopy, Mammography, Mobile Radiography ,CT Scan ,DSA and Interventional Radiology.
4. Radiation measuring instruments : survey meters , area monitor , personnel dosimeters ,film, badge, thermo luminescent dosimeter, pocket dosimeter.
5. Radiation Quantities and Units: Radiation,Radioactivity,Sources of radiation - natural radioactive sources ,cosmic rays, terrestrial radiation, manmade radiation sources.Kerma, Exposure, Absorbed dose, Equivalent Dose, Weighting Factors, Effective Dose
6. Biological Effects of radiation: Direct & Indirect actions of radiation, concept of detriment, Deterministic & stochastic effect of radiation, somatic and genetic effects, dose relationship, effects of antenatal exposure 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 radiosensitivity. Biological effects of non-ionizing radiation like ultrasound, lasers, IR, UV and magnetic fields.
7. 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

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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 & appropriateness of different detectors for different type of radiation measurement.

8. 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, Dose area product in fluoroscopy and angiography systems, AGD in mammography.

9. Radiation protection, Hazard evaluation and control: Philosophy of Radiation protection Radiation protection of self and patient and General Public, Principles of radiation protection, time - distance and shielding, shielding - calculation and radiation survey, Calculation of Work load, weekly calculated dose to radiation worker & General public: Good work practice in Diagnostic Radiology.

10. Planning consideration for radiology, including Use factor, occupancy factors, and different shielding materials. Protection for primary radiation, work load, use factor, occupancy factor, protection from scatter radiation and leakage radiation, X-Ray/ Fluoroseopy/ Mammography/ Intervention/ DSA/ CT room design, structural shielding, protective devices.

11. Regulatory Bodies & regulatory Requirements: International Commission on Radiation Protection (ICRP) / National Regularity body (AERB - Atomic Energy Regulatory Board) - Responsibilities, organization, Safety Standard, Codes and Guides, Responsibilities of licenses, registrants & employers and Enforcement of Regulatory requirements. (ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection).

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12. NABH guidelines, AERB guidelines, PNDDT Act and guidelines

Newer Radiation safety protocols and recent advances in radiation safety. Role of Radiographer in Planning & Radiation Protection: Role of technologist in radiology department - Personnel and area monitoring., Setting up of a new X-Ray unit, staff requirement, AERB specifications for site planning and mandatory guidelines - Planning of X-ray/CT rooms, Inspection of X-Ray installations - Registration of X-Ray equipment installation- Certification -Evaluation of workload versus radiation factors - Occupational exposure, jmd protection Tools/devices.

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*Umesh Deshpande*

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### Dark Room Procedures

- (a) Dark Room-Size and Installation, Ventilation, Electric Wiring, Pass Box, Entrances, Illumination, Dry and Wet Side
- (b) Film Construction, Types of Film, Intensifying Screens, Screen Characteristics, Rare Earth Screen, Fluoroscopic Screen, Luminescence, Safety in Dark Room
- (c) Manual and Automatic Processing
- (d) Fault in Radiography and Remedy
- (e) Green Sensitive Films, Dry vs. Laser Films, Day Light Processing

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## SECOND YEAR

### Paper - I

#### Technique of CT Scan and Mammography

##### Technical Aspect of CT Scan - Includes

A - (1) Basic Computed Tomography - Basic principles of CT, generation of CT, CT instrumentation, image formation in CT, CT image reconstruction, Hounsfield unit, CT image quality, CT image display.

2. 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 swfeaisced protocols - CT angiography - (Aortogram, selective angiogram head, neck and peripheral) image documentation and Filing, maintenance of equipment and accessories.

B - (1) Technical Aspect of Mammography.

(2) Mammography and its clinical application.

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Paper - II

Technique of MRI

A - Technique of MRI Includes

1. Advanced technique & instrumentation of MRI
2. Basic Principle : Spin - precession - relaxation time - pulse cycle - T1 weighted image - T2 weighted image - proton density image.
3. Pulse sequence ; Spin echo pulse sequence - turbo spin echo pulse sequence - Gradient echo sequence - Turbo gradient echo pulse sequence - Inversion recovery sequence - STIR sequence -SPIR sequence - FLAIR sequence - Echo planar imaging - Advanced pulse sequences.
4. MR Instrumentation : Types of magnets - RF transmitter - RF receiver - Gradient coils - shim coils - RF shielding - computers.
5. Image formation; 2D Fourier transformation method - K-space representation - 3D Fourier imaging - MIP.
6. MR contrast media - MR angiography - TOF & PCA - MR Spectroscopy - functional MRI

B - Ultrasonography Technique Includes :

1. 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.
2. Production of ultrasound: Piezoelectricity, Medical ultrasound transducer : Principle, construction and working, characteristics of US beam.
3. Ultrasoxind display modes: A, B, M

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- 4. Real-time ultrasound : Line density and frame rate, Real-time ultrasound transducers : mechanical and electronic arrays, ultrasound artifacts, ultrasound recording devices, and Distance, area 85 volume measurements.
- 5. Techniques for imaging different anatomic areas, ultrasound artifacts, biological effects and safety.
- 6. Doppler Ultrasound - Patient preparation for Doppler, Doppler artifacts, vascular sonography.

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*16.5.19*

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**Paper - III**

**Radionuclide Imaging - Nuclear Medicine**

(A) Principles, Physics of Radioactivity, Types of Radiation, Cyclotron, Radionuclide Generator, Detectors, Collimators, Imaging Device, Radiopharmaceuticals, Important Other Nuclear Medicine Imaging, SPECT, PET Scanner, Clinical Application, Cardiac Imaging, Bone and Liver Scanning, Neuro Psychiatric Application, Epilepsy, CVS, Thallium, Stress Testing, Perfusion Imaging, Gr.LT Imaging, etc.

**(B) Elementary of General Pathology of Health and Disease.**

Degeneration, Repair of wound Inflammation, Tumor - Definition, Classification, Spread.

**(C) Newer Developments in Advanced Imaging Technology**

1. In addition to existing Radiological and Imaging Modalities -Newer Developments in Digital Imaging CT, MRI, US and any other modality.
2. Newer Radiological and Imaging Equipment: including Computed radiography: Digital Radiography, Digital Fluoroscopy, Digital Mammography and DSA - Introduction to Newer Technology innovations, software and its applications.
3. Computed Tomography Introduction to Newer Developments/ Newer Technology innovations, software and its applications.
4. MRI Introduction to Newer Developments/Newer Technology innovations, software and its applications.
5. Advanced Ultrasonography Newer Developments/Newer Technology innovations, software and its applications Elastography, HIFU, ABVS, etc.
6. Fusion Imaging -PET CT & PET-MRI
7. Teleradiology, HIS, RIS, PACS, Imaging Processing and Archiving.

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Administrative - General

1. The purpose of this document is to provide information regarding the administrative procedures for the project. This document is intended for the use of all project staff and is to be read and understood by all project staff. The purpose of this document is to provide information regarding the administrative procedures for the project.

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