Syllabus

B Sc

(Ophthlamic Techniques / Radio Diagnosis)

at the AIIMS

All India Institute of Medical Sciences
Ansari Nagar, New Delhi, 110029

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All India Institute of Medical Sciences

New Delhi - 110 029

Academic Affairs
Concerned Officials

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Dr. Y.K. Joshi	–	Sub-Dean (Acad.)
Dr. Y.K. Gupta	–	Prof. in-Charge (Exam.)
Dr. K.K. Deepak	–	Sub-Dean (Exam.)
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PREAMBLE

The Health Survey and Development Committee, popularly known as the Bhore Committee, in its report published in 1946, recommended very strongly the establishment of a national medical centre at Delhi which will concentrate on training of highly qualified teachers and research workers in order that a steady stream of these could be maintained to meet the needs of the rapidly expanding health activities throughout the country. After the attainment of independence the Union Ministry of Health proceeded to implement this challenging idea and a magnificent grant of one million pounds by the Government of New Zealand through the Colombo Plan helped to translate the idea into reality. An Act of Parliament in 1956 established the All India Institute of Medical Sciences as an autonomous institution of National importance and defined its objectives and functions.

The prime concern of the Institute is to develop patterns of teaching in undergraduate and postgraduate medical education in all the branches so as to demonstrate a high standard of medical education to all medical colleges and other allied institutions in India. This educational experience is imparted in an atmosphere of research.

By virtue of the Act, the Institute grants its own medical degrees and other academic distinctions. The degrees granted by the Institute under the All India Institute of Medical Sciences Act are recognised medical qualifications for the purpose of the Indian Medical Council Act and, notwithstanding anything contained therein, are deemed to be included in the first schedule of that Act, entitling the holders to the same privileges as those attached to the equivalent awards from the recognized Universities of India respectively.

The AIIMS imparts graduate degrees in major specialities of **applied** sciences i.e.

1. B Sc (Ophthalmic Techniques)
2. B Sc (Radio Diagnosis)

The courses are managed by faculty of the concerned departments and further scrutinized by the Academic Section under the supervision of the Dean.

CONTENTS

B Sc (Ophthalmic Techniques)

MAIN OBJECTIVES OF THE COURSE

Basic Medical Sciences

1. To achieve general understanding of the Human Biology (Anatomy, Physiology, and Biochemistry).
2. To achieve good understanding of the basic medical sciences as related to Ophthalmology (Anatomy, Physiology, Optics, Pharmacology and Microbiology).

Clinical

The objective of the clinical work are to enable a student to work under the supervision of an Ophthalmologist so as to render assistance, develop skills and to perform other optometric jobs.

1. Be able to develop skills to carryout Ophthalmic Investigations.
2. Be able to do refraction work including prescription of glasses, contact lenses, low vision aids.
3. Be able to assess disorder of Ocular motility and uniocular and binocular visual functions and knowledge of principles of non-surgical therapy and indications of surgery.
4. To impart knowledge with regard to common eye diseases with a view to acquaint them in their recognition.
5. To impart training to develop skill in manufacturing of spectacle lenses and contact lenses.
6. To impart knowledge regarding organizations of eye banks and preservation of ocular tissues.
7. To impart knowledge regarding importance and the methodology of conducting surveys for early detection of visual defects, prevalence of ocular diseases and organization of community services like eye camps, schools, clinics and community eye care programme.
8. To impart knowledge regarding the programme of blindness, its causes and principles of rehabilitation of the blind.

COURSE STRUCTURE

This course shall be for a period of three academic years and commencing from 1st August. Each year is divided into two semesters. There is no session vacation.

The admission for this course shall be:

1. Candidates who have secured at least 50% of marks or Grade-III in class 12 or equivalent examination in science. Subjects (Physics, Chemistry, Biology & Mathematics)
2. Admission shall be held in July each year.

Academic Time

Monday to Friday -9:00AM to 4:30 PM

Saturday –9:00 AM to 1:00 PM

Sunday -holiday

Academic time is devoted to

1. Theory classes
2. Lecture demonstrations
3. Seminars/Group discussion
4. Practical works in OPD (out patient department), various laboratories, clinics, and ophthalmic investigative labs. and community work.

First Year

Thirty-six theory lectures per month (each one hour) and two seminars in a month (each two hours)

Total theory time per month: 10 hrs/week

Practical postings: 26 hrs/week

Total academic time per month: **36 hrs/week**

Second Year

Thirty six theory lectures per month (each one hour) and two seminars in a month (each two hours)

Total theory time per month: 10 hrs/week

Practical postings: 26 hrs/week

Total academic time per month: **36 hrs/week**

Third Year

Eighteen theory lectures per month (each one and half hour) and two seminars in a month (each two hours)

Total theory time per month: 8 hrs/week, Practical postings: 28 hrs/ week

Total academic time per month: **36 hrs/week**

GENERAL LECTURES FOR ALL STUDENTS (1ST, 2ND & 3RD YEAR)

1. Hospital environment and role of student.
2. The profession & Ethics
3. Communications with the patients.
4. Statistics and its importance.
5. Social welfare of eye patients.
6. Law and The Optometry.

THEORY SUBJECT FOR FIRST YEAR

1. HUMAN ANATOMY & PHYSIOLOGY

1. Introduction of human body, cell and various tissue of the body
2. Embryology and development.
3. Skeletal system of Human body
4. Muscles of the body
5. Circulatory System
6. The Blood
7. The main arteries and veins of the body & Lymphatic system
8. Digestive system
9. The Liver
10. The Gall bladder, Pancreas & Spleen
11. Respiratory system
12. Endocrine Organs
13. Excretory System,
14. Reproductive system
15. Central Nervous System
16. Brain & Cranial Nerves
17. Spinal Cord and peripheral nerves
18. Autonomic nervous system
19. The Food, Vitamins & Protein
20. Organs of taste and smell

2. OCULAR ANATOMY

1. Embryology of the eye in general
2. Orbit and its immediate relations
3. Lids and eye lid glands
4. Conjunctiva. Cornea and Sclera
5. Iris and Cilliary body
6. Lens and Vitreous
7. Retina & Choroid
8. Ocular Muscles
9. Visual pathways
10. Sympathetics and parasympathetics system
11. Vascular supply of eye
12. Lacrimal apparatus
13. Higher visual centres

3. OCULAR PHATHOLOGY

1. HAEMATOLOGY

1.1. Blood Cells and blood collection techniques

1.2. Haemoglobin estimation

1.3. Total leucocyte count

1.4. Differential leucocyte count

1.5. Erythrocyte sedimentation rate

1.6. Pheripheral blood film – staining, significance of a peripheral smear

1.7. Bleeding time, clotting time

2. CLINICAL PATHOLOGY

2.1. Urine collection methods

2.2. Physical Examination of Urine

2.3. Chemical Examination of Urine

2.4. Microscopic Examination of Urine

3. HISTOPATHOLOGY

3.1 Grossing of tissue

3.2 Tissue processing

3.3 Fixation of tissue

3.4 Section cutting

3.5 Staining – Hematoxylin & Cosin and Special Stains

4. OCULAR MICROBIOLOGY

1. Introduction to Microbiology & classification.
2. Gram Positive Bacteria
3. Gram Negative Bacteria
4. Fungi -sephorophytics and pathogenic
5. Virus
6. Aseptic techniques
7. Chlayadia & parasites.

5. OCULAR PHYSIOLOGY

1. General physiology of the eye - An introduction
2. Maintenance of Transparency of the Cornea
3. Maintenance of Transparency of the Lens
4. Visual acuity and form sense
5. Pupillary reflexes
6. Accommodation
7. Convergence
8. Intra Ocular Pressure
9. Night Vision
10. Colour Vision
11. Visual Fields
12. Extrinsic Muscles, Actions and Ocular Movements
13. Higher Visual Centres and righting reflexes
14. Electrophysiological Aspects
15. Conjugate and Disguate -Movements of the eye

6. OCULAR BIOCHEMISTRY

1. Introduction to various biochemical test
2. Tears film and pH

3. General Introduction to metabolic processes affecting the eye
4. Rhodopsin cycle
5. Aqueous and Vitreous humours
6. Metabolism of lens and cornea.

7. PHYSICAL AND PHYSIOLOGICAL OPTICS

1. Elementary basis of light- Interference, diffraction, polarization spectrum, surface tension, viscosity
2. Principles of Refraction.
3. Physical Optics -1, Lens Shapes -Convex, Concave
4. Physical Optics -2, Thin Lens equation, thick lens equation
5. Physical Optics -3, Front and back vertex power
6. Physical Optics -4. Aberrations
7. Physical Optics -5. Spherical, Cylindrical & Toric surfaces, Aspheric surfaces
8. Prisms -definition, uses, nomenclature, apex
9. Determination of focal length & diopteric power of lens
10. Strum's Conoid
11. Neutralization of lenses
12. Focimeter
13. Centre & Axis Marking by focimeter
14. Simple & Toric transposition
15. Prismatic effect & Decentration
16. Aberrations & Tints in spectacle Lenses
17. Spectacle Lens Manufacturing -Sphericals, Toric, Bifocals, Lenticular & Lab Visit
18. Spectacle Frames -History, Nomenclature, Types & parts, sides, joints, frame bridge.
19. Shape of Spectacle Frame -Measurements & Making, Frame & Face Measurements
20. Schematic eye
21. Emmetropia & Ammetropia -Aetiology, Population, Distribution,Growth of eye,
22. Myopia
23. Hypermetropia
24. Astigmatism
25. Aphakia/Pseudo-phakia
26. Presbyopia

27. Keratoconus
28. Post-Op. Refractive errors
29. Refraction of irregular reflex
30. Accommodation & Convergence -1, Far point, near point, range, amplitude of accommodation
31. Accommodation & Convergence -2. Methods of measurements, NPA. AC/A ratio.
32. Retinoscopy -Principle & Methods
33. Objective Refraction
34. Subjective Refraction
35. Cross Cylinder
36. Workshop
37. Manufacturing Spectacle Lens
38. Plastic Lenses -Manufacturing & Characteristic
39. Lens Designs -Ashperic
40. High Index Lenses,
41. Photocromatic Lenses
42. Tinted Lenses
43. Polaroid Lenses
44. Bifocals
45. Measurement for ordering spectacle, IPD, Marking centration.V. D. Calculation.
46. Fitting Bifocals, Multifocals, Prism Lenses
47. Fitting Lenses in Frames
48. Glazing & Edging
49. Final Checking & Adjustments to prescriptions
50. Patient complains, handling correction.
51. Repair of spectacles
52. Special types of spectacles monocells/ptosis hemianopic glasses
53. Test chart standards
54. Phoropter
55. Objective Optometer
56. Projection Charts
57. Refraction room Standards

PRACTICAL SUBJECT FOR FIRST YEAR

1. HUMAN ANATOMY & PHYSIOLOGY

1. Introduction of human body, cell and various tissue of the body
2. Embryology and development.
3. Skeletal system of Human body
4. Muscles of the body
5. Circulatory System
6. The Blood
7. The main arteries and veins of the body & Lymphatic system
8. Digestive system
9. The Liver
10. The Gall bladder, Pancreas & Spleen
11. Respiratory system
12. Endocrine Organs
13. Excretory System,
14. Reproductive system
15. Central Nervous System
16. Brain & Cranial Nerves
17. Spinal Cord and peripheral nerves
18. Autonomic nervous system
19. The Food, Vitamins & Protein
20. Organs of taste and smell

2. OCULAR PATHOLOGY

1. Sampling and Collection of Blood: intro-venous and peripheral
2. Estimation of haemoglobin
3. Peripheral Blood Film Staining
4. Identification of normal white blood cells
5. Erythrocyte sedimentation rate
6. Urine chemical examination – Sugar and Protein
7. Hematoxylin and Cosin Staining

3. OCULAR MICROBIOLOGY

1. Introduction to Microbiology: Culture media, Classification, Morphological, Lab. diagnosis of infection
2. Collection of samples
3. Serology
4. Culture media for bacteria, fungi and viruses
5. Oxidase test
6. Mantoux test
7. Staining procedures: Gram Staining
8. Staining procedures: Romanowsky stains
9. Staining procedures: Ziehl Neelsen's staining

4. ORTHOPTICS

1. Latent squint work-up
2. Synptophore
3. Maddox wing
4. Maddox rods
5. Prism bar
6. Near point of accommodation
7. Near point of convergence
8. Fusion exercises

5. OCULAR BIO-CHEMSTRY

1. Sampling and Collection of Blood
2. Biochemical tests, including blood sugar estimation
3. Ketone bodies in urine
4. Spectrophotometry
5. Serum-cholesterol

6. OPTICS

1. Workshop
2. Manufacturing Spectacle Lens
3. Manufacturing Bifocal Lenses
4. Measurement for ordering spectacle, IPD, Marking centration, V. D. Calculation.

5. Fitting Bifocals, Multifocals, Prism Lenses
6. Fitting Lenses in Frames
7. Glazing & Edging
8. Final Checking, Adjustments to prescriptions
9. Patient complains, handling correction.
10. Repair of spectacles
11. Special types of spectacles monocells/ptosis hemianopic glasses
12. Neutralization of lenses
13. Focimeter
14. Shape of Spectacle Frame -Measurements & Making, Frame & Face Measurements
15. Refraction under the supervision

THEORY SUBJECT FOR SECOND YEAR

1. OCULAR PHARMACY AND PHARMACOLOGY

1. Ocular Pharmacology – An introduction
2. Autonomic nervous system
3. Routes of drug administration
4. Miotics, Mydriatics & Cycloplegics drugs
5. Antibacterial drugs & therapy
6. Antifungal drugs & therapy
7. Anti-Viral drugs & therapy
8. Antibacterial drugs & therapy
9. Anti-inflammatory drugs & therapy
10. Anti-glaucoma drugs & therapy
11. Ophthalmic dyes
12. Local Anaesthetics
13. Ophthalmic preservatives
14. Ocular lubricants
15. Ocular irrigating solutions
16. Ocular antiseptics & disinfectants
17. Anti-cataract agents

18. Contact lens solution
19. Chelating agents
20. Immunosuppressive agents

2. REFRACTION

1. Emmetropia & Ammetropia -Aetiology, Population, Distribution, Growth of eye.
2. Myopia
3. Hypermetropia
4. Astigmatism
5. Aphakia/Pseudo-phakia
6. Presbiopia
7. Keratoconus
8. Post-Op. Refractive errors
9. Refraction of irregular reflex
10. Accommodation & Convergence –1. Far point, near point, ranges. Amplitude of accommodation
11. Accommodation & Convergence – 2. Methods of measurements, NPA. AC/A ratio.
12. Retinoscopy -Principle & Method
13. Objective Refraction
14. Subjective Refraction
15. Cross Cylinder

3. INVESTIGATIVE OPHTHALMOLOGY

ORTHOPTICS

1. Orthoptics-General Concept
2. Ocular muscles and movements
3. AC/ A ratio
4. Measurements of angle of squint
5. Latent squint
6. Maddox rod
7. Maddox wing
8. Synoptophore
9. Manifest concomitant
10. Squint concomitant

11. Paralytic Squint
12. Head posture and its significance
13. Hess Screening and its Interpretations
14. Pleoptics
15. Occlusion -types and uses
16. Nystagmus
17. A. V. Syndromes
18. Testing of ARC
19. Amblyopia
20. Disorders of accommodation
21. Paediatric visual acuity assessment
22. Paediatric Refraction
23. Neural aspects of binocular vision

4. OPHTHALMIC INSTRUMENTS AND APPLIANCES

1. Indirect Ophthalmoscope
2. Direct Ophthalmoscope
3. Slit Lamp: Haag-Streit.
4. Photo-slit lamp
5. Lensometer. Lens gauge
6. Tonometer
7. Fundus Camera
8. External eye photography
9. Auto-refractometer
10. Corneal Examination -1. Placido disc
11. Corneal Examination -2. Keterometer
12. Corneal Examination -3. V KG
13. Corneal Examination -4. Specular Microscopy
14. Corneal Examination -5. Aesthesiometer
15. Exophthalmometer
16. Perimeter – Manual & automated
17. Orthoptics Instruments -Haploscope/Home devices
18. Heidelberg Retino-tomography HRT -II

19. Nerve fiber analyzer
20. Frequency doubling perimeter
21. Non Contact Tonometer
22. Heidelberg Analmascope
23. Pachometers
24. Contrast sensitivity tests
25. Glare acuity tests
26. Colour vision tests
27. Dark adaptometer

PRACTICAL SUBJECT FOR SECOND YEAR

1. OCULAR PHARMACY AND PHARMACOLOGY

1. Quality Control :
    - 1.1. Sterilization
    - 1.2. pH measurement
    - 1.3. Osmolarity
    - 1.4. Spectrophotometry for concentration
2. How to prepare following eye drops:
    - 2.1. Pilo-clonidine eye drops
    - 2.2. Artificial eye drops
    - 2.3. Glycerin eye drops
    - 2.4. Homatropine eye drops
    - 2.5. EDTA eye drops
    - 2.6. Sulphacetamide eye drops
    - 2.7. Dexamethasone eye drops
    - 2.8. Methylecellulose eye drops
    - 2.9. Saline eye drops
    - 2.10. Sodium citrate eye drops
3. MK Media preparation
4. Fluorescein Strip, Rose Bengal Strips preparation

5. Autologous serum eye drops preparation
6. Dilution of drug in different concentration
7. Steroid detection test

2. REFRACTION

1. Refraction and prescription of glasses in OPD

3. INVESTIGATIVE OPHTHALMOLOGY

1. Manifest squint work-up
2. Paralytic squint work-up
3. Pleoptics
4. Orthoptic Exercises

4. OPHTHALMIC INSTRUMENTS AND APPLIANCES

1. Lensometer, Lens gauge
2. Tonometer
3. Placido disc
4. Keterometer
5. VKG
6. Specular Microscopy
7. Exophthalmometer
8. Perimeter
9. Non Contact Tonometer
10. Slit Lamp: Haag-Streit.
11. Photo-slit lamp
12. Fundus Camera
13. Contrast sensitivity tests
14. Glare acuity tests
15. Colour vision tests
16. Dark adaptometer

THEORY SUBJECT FOR THIRD YEAR

1. CLINICAL & ADVANCED ORTHOPTICS

1. Orthoptic-General concept
2. Ocular muscles and movements

3. AC/ A ratio.
4. Measurements of angle of squint
5. Latent squint
6. Maddox rod
7. Maddox wing
8. Synoptophore
9. Manifest concomitant
10. Squint concomitant
11. Paralytic Squint
12. Head posture and its significance
13. Hess Screening and its Interpretations
14. Pleoptics
15. Occlusion -types and uses
16. Nystagmus
17. A. V. Syndromes
18. Testing of ARC
19. Amblyopia
20. Disorders of accommodation
21. Paediatric visual acuity assessment
22. Paediatric Refraction
23. Neural aspects of binocular vision

2. CLINICAL & ADVANCED OPTICS

1. Emmetropia & Ammetropia –Aetiology, Population. Distribution, Growth of eye.
2. Myopia
3. Hypermetropia
4. Astigmatism
5. Aphakia/Pseudo-phakia
6. Presbiopia
7. Keratoconus
8. Post-Op. Refractive errors
9. Refraction of irregular re/ex
10. Accommodation & Convergence -1. Far point, near point, range, amplitude of accommodation
11. Accommodation & Convergence -2. Methods of measurements. NPA. AC I A ratio.

12. Retinoscopy -Principle & Methods
13. Objective Refraction
14. Subjective Refraction
15. Cross Cylinder

3. CONTACT LENS

1. History of Contact Lens
2. Corneal Anatomy and Physiology
3. Corneal Physiology and Contact Lens
4. Preliminary Measurements and Investigations
5. Slit Lamp Biomicroscopy
6. Contact Lens materials
7. Optics of the Contact Lens
8. Glossary of Terms: Contact Lenses
9. Indications and Contra Indications Contact Lens
10. Rigid gas permeable contact lens design
11. Soft Contact lens design & manufacture
12. Kertometery, Placido's disc, Tonography
13. Fitting philosophies
14. Fitting of Spherical SCL and effect of parameter changes
15. Astigmatism correction options
16. Fitting Spherical RGP contact Lenses, Low OK, High OK
17. Effects of RGP contact Lens parameter changes on lens fitting
18. Fitting in Astigmatism (Sph RGP)
19. Follow-up post fitting examination
20. Follow-up Slit Lamp examination
21. Fitting in Keratoconus
22. Fitting in Aphakia, Pseudophakia
23. Cosmetic Contact Lenses
24. Fitting Contact Lens in children
25. Toric Contact Lenses
26. Bifocal Contact Lenses
27. Continuous wear and extended wear lenses

28. Therapeutic Lenses/Bandage lenses
29. Contact lens following ocular surgeries
30. Disposable contact lenses, frequent replacement and Lenses
31. Use of Specular Microscopy and Pachymetry in Contact Lenses
32. Care & maintenance of Contact Lenses
33. Contact Lens modification of finished lenses
34. Instrumentation in contact lens practise
35. Checking finished lenses parameters
36. Recent developments in Contact lenses
37. Review of lenses available in India

4. CLINICAL & ADVACED REFRACTIONS

1. Emmetropia & Ammetropia -Aetiology, Population, Distribution, Growth of eye.
2. Myopia
3. Hypermetropia
4. Astigmatism
5. Aphakia/Pseudo-phakia
6. Presbyopia
7. Keratoconus
8. Post-Op. Refractive errors
9. Refraction of irregular reflex
10. Accommodation & Convergence -1. Far point, near point, range, amplitude of accommodation
11. Accommodation & Convergence -2. Methods of measurements, NPA, AC/ A ratio.
12. Retinoscopy -Principle & Method
13. Objective Refraction
14. Subjective Refraction
15. Cross Cylinder
16. Low- Vision aids: Techniques & microscopes
17. Rehabilitation of blinds

5. EYE BANK

1. Publicity
2. How to donate your eyes
3. Collection of eyes

4. Preservation of eyes
5. Pre-operative Instructions
6. Post-operative Instructions
7. Latest techniques for preservation of donor Cornea

6. COMMUNITY OPHTHALMOLOGY

1. Concepts of community Ophthalmology - I
2. Concepts of community Ophthalmology - II
3. The Epidemiology of Blindness (General Principles) - I
4. The Epidemiology of Blindness (General Principles) - II
5. The Epidemiology of Blindness (Disease specific strategies) - III
6. The Epidemiology of Blindness (Disease specific strategies) - IV
7. Survey Methodological - I
8. Survey Methodological - II
9. Survey Methodological - III
10. Screening procedures in Ophthalmology – I
11. Screening procedures in Ophthalmology – II
12. School eye screening programme
13. Primary eye care
14. Organization of Out reach services
15. Organization of Reach-in-Programme
16. Information, Education, communication
17. Rehabilitation of the visually handicapped
18. National programme for control of Blindness – I
19. National programme for control of Blindness – II
20. Vision 2020 : The Right to sight

7. INVESTIGATIONS IN CLINICAL OPHTHALMOLOGY

1. Principle, Techniques and preparation of the patient
2. ERG
3. EOG

4. Electro-Oculomyo-gram
5. Ultra-sono-graphy
6. Tonography
7. Berman's Locator/Foreign body locator
8. Fluorescein Angiography
9. Ocular Photography -anterior segment
10. Dark Adaptometry : Adaptation & Adaptometry
11. Syringing & Lacrimal function Test
12. Gonioscopy
13. Pachometry
14. Perimetry
15. Laser therapy
16. Contrast Sensitivity
17. Slit Lamp
18. VKG
19. Specular Microscopy
20. Fundus Photography
21. Colour Vision Investigations – Ishhara Charts, E-G Lantern, Negal's anomaloscope, 100 Hue Test
22. A -Scan Biometry
23. Heidelberg Retina-tomography HRT –II
24. Nerve fiber analyzer
25. Frequency doubling perimeter
26. Non Contact Tonometry
27. UBM
28. OCT

8. MANAGEMENT OF O T

1. Introduction to Ocular in general.
2. Asepsis: How to achieve
3. Aanesthetic agents and where indicated

4. 0 T Sterilization procedures
5. Sterilization procedures of 0 T Instruments
6. Maintenance of Instruments and equipments: Ophthalmic Instruments
7. Maintenance of Instruments and equipments: Orthoptics Instruments
8. Maintenance of Instruments and equipments: Surgical Instruments
9. Maintenance of Instruments and equipments: Optometric & Contact Lens Equipment

PRACTICAL SUBJECT FOR THIRD YEAR

1. CLINICAL & ADVANCED ORTHOPTICS

1. Manifest squint work-up
2. Paralytic squint work-up
3. Pleoptics
4. Orthoptic Exercises

2. CLINICAL & ADVACED OPTICS

1. Refraction and prescription of glasses in independent cabin

3. CONTACT LENS

1. Contact Lens fitting
2. Counselling to Contact Lens patient
3. Post-fitting instructions
4. Remedy of post-fitting problems

4. CLINICAL & ADVACED REFRACTIONS

1. Refraction and prescription of glasses

5. EYE BANK

1. How to donate your eyes/Counselling
2. Collection of eyes
3. Preservation of eyes

6. COMMUNITY OPHTHALMOLOGY

1. Eye Screening Programme & Surveys
2. Eye camp (approx. 3) of 10 days each

3. PHC posting

7. INVESTIGATIONS IN CLINICAL OPHTHALMOLOGY

1. Fluorescein Angiography
2. Syringing & Lacrimal function Test
3. Slit Lamp
4. VKG
5. Specular Microscopy
6. NCT
7. Applanation and schiotz tonometry
8. Dark Adaptometry
9. A -Scan Biometry
10. Contrast Sensitivity
11. Perimetry
12. Keratometry
13. Focimetry
14. ERG/EOG/VER

SEMINARS: All students have to attend Seminars

TO BE PRESENTED BY FIRST YEAR

1. Optics

1.1. Frames & Spectacle Lens Materials

1.2. Quality control methods of Spectacle Lens

1.3. Application of focimeter and Genva lens measure in Optical dispensing.

2. Refraction

2.1. Visual acuity methods

2.2. Principles and application of Retinoscopy

2.3. Explanation of various types of refractive error

3. Advanced Refraction

3.1. Comparison between Static and Dynamic Retinoscopy

3.2. Subjective Methods of Refraction

3.3. Objective Methods of Refraction

TO BE PRESENTED BY SECOND YEAR

1. Anterior Segments

1.1. Introduction of eye disorders

1.2. Physiology & Investigations for corneal disorders

1.3. Physiology & Investigations for lenticular disorders

2. Posterior Segments

2.1. Anatomy and physiology of retina & optic nerve

2.2. Principles of direct & indirect Ophthalmoscopy

2.3. Principles of FA & Laser therapy

3. Tonometry

3.1. Principles & comparison of various types of tonometry

3.2. Standardization of various types of tonometers

3.3. Special methods in tonometry

4. Perimetry

4.1. Theoretical Comparison between Static & Kinetic Perimetry

4.2. Static & Kinetic Perimetry -practical view

4.3. Standardization of perimeters and the factors affecting its reliability.

TO BE PRESENTED BY THIRD YEAR

1. Orthoptics

1.1. Diagnosis of latent and manifest squint

1.2. Paralytic squint investigations

1.3. Amblyopic and pleoptics treatment

2. Posterior Segments

2.1. Normal & pathological fundus

2.2. Fundus Camera & application of FA.

2.3. Lasers and its uses in Ophthalmology

3. Cornea and Refractive Surgery

3.1. Clinical investigations of pre-refractive Surgery

3.2. Clinical investigations of post-refractive Surgery

3.3. Clinical analysis of refractive Surgery

4. Advanced Refraction and Contact Lenses

4.1. Low vision aids for poor vision patients

4.2. Materials and manufacturing techniques of contact lenses

4.3. Indications & Contra-indications for Contact Lenses

5. Advanced Contact Lenses

5.1. Fitting philosophies of contact lenses

5.2. Post fitting problems of contact lenses and its remedy

5.3. Toric/Bifocal Contact lenses

6. Perimetry in Ocular disorders

6.1. Visual fields defects in Glaucoma

6.2. Visual fields defects in retinal & neurological disorders

6.3. Latest development in perimetry

APPENDIX – 1

B. Sc. (Hons) Ophthalmic Techniques Phase – I

Paper	Subject	Theory Final	Internal Assessment	Total
Theory				
I	Human Anatomy & Physiology	50	50	100
II	Ocular Anatomy, Pathology & Microbiology	50	50	100
III	Ocular Physiology & Biochemistry including Binocular reflexes & its maintenance	50	50	100
IV	Optics	50	50	100
Practical (Including Viva)				
I	Anatomy & Physiology	50	50	100
II	Ocular Pathology & Microbiology	50	50	100
III	Orthoptics	50	50	100
IV	Lens Grinding & fitting	50	50	100

APPENDIX – 2

B. Sc. (Hons) Ophthalmic Techniques Phase – II

Paper	Subject	Theory Final	Internal Assessment	Total
Theory				
I	Pharmacology & Pharmacy	50	50	100
II	Refraction (including prescription, making & fitting of glasses)	50	50	100
III	Investigative Ophthalmology	50	50	100
IV	Ophthalmic instruments and appliances	50	50	100
Practical (Including Viva)				
I	Pharmacology & Pharmacy	50	50	100
II	Refraction (including prescription, making & fitting of glasses)	50	50	100
III	Special investigation, including Orthoptics	50	50	100
IV	Appliances	50	50	100

APPENDIX – 3

B. Sc. (Hons) Ophthalmic Techniques Phase – III

Paper	Subject	Theory Final	Internal Assessment	Total
Theory				
I	Clinical & advanced Optics & Orthoptics	50	50	100
II	Clinical Refraction and Contact lenses	50	50	100
III	Community Ophthalmology and Eye Bank	50	50	100
IV	Investigations in Clinical Ophthalmology and management of OT	50	50	100
Practical (Including Viva)				
I	Refraction	50	50	100
II	Orthoptics and pleoptics	50	50	100
III	Community work	50	50	100
IV	Investigations in Clinical Ophthalmology and management of OT	50	50	100

APPENDIX – 4

First Year (1st and 2nd semester)

Two batches (Six Months rotation)

Batch A	Batch B	Batch A	Batch B
1-3 months Optometry	1-3 months Orthoptics	Optometry: 1 month each posting for medical record	1 month each for pharmacy
4-6 months continue Optometry	4-6 months continue orthoptics		
2 students for pathology for one month	2 student for microbiology one month each form 4-6 months		

Second Year (3rd and 4th Semester)

OPD	C. L. Lab Clinic & Le.	OT	Investigative procedures including pharmacy	Optometry : Six Student	Orthoptics : Six Student
I	II	III	IV	2 each by rotation for clinical investigation	2 each by rotation for clinical investigation.
II	III	IV	III		
III	IV	I	II		
IV	I	II	I		

Third Year (5th and 6th Semester)

Morning 3 batches			Afternoon 2 batches	
OPD & Casualty	Operation Theatre and Ward	Community including survey	Optometry and prosthetics	Orthoptics & C L Lab.
I	II	III		
II	III	II		
III	I	I		

APPENDIX – 5

B. Sc. (Hons) Ophthalmic Techniques

During the course semester examination in the month of March/April and other day to day assessment will be done and called internal assessment. In the month of July final examination will be done.

Rules of examination

1. The student will not be allowed to appear in the examination unless he/ she attended 80% of the

total lectures, demonstration, practical and posting in the each subject separately.

2. Date of examination and appointment of examiners will be made by the Dean.
3. In the theory examination essay or multiple choice/objective type questions will be included at the discretion of the examiner. 50% of marks will be assigned for internal assessment.
4. The marks of the theory of internal assessment and final examination will be added and together considered theory marks. Similarly, the mark obtained in practical of internal assessment will be added to the practical marks of the final examination.
5. A student will be deemed to have passed in the subjects if he/ she obtains a minimum of 50% marks in that subject in the theory and practical separately.
6. A student will be deemed to have passed in the examination if he /she passed in each subject separately.
7. The students who will absent himself /herself from the examination without prior permission of the Dean, will be deemed to have failed in that examination
8. There will be no internal assessment and compulsory attendance for the student for the examination in which he/she has failed at the time of subsequent examination in that subject.
9. A candidate who will obtain 80% or more marks of the total marks in any subject shall be declared to have obtained distinction in that subject provided he /she passed in all the subjects of the course in all the phases, in the first attempt.
10. There will be two internal examiners.
11. The candidate who shall pass in one or more papers will be given exemption in those subjects. After that he/she will be given two chances at six months interval to pass in all the subjects. If he/she fails to pass in the subjects in these two extra attempts, he /she will be expelled from the course.
12. The first year candidate who fails in more than two subjects will not be promoted to second year.
13. The candidate will be required to pass in the subjects of first year at least six months before the final examination of second year.
14. A second year candidate who fails in more than one subject will not be promoted to third year.
15. For the third year candidate, the examination will be taken by both internal and external examiners. There will be four examiners – two internal and two external.
16. The third year candidate who passes in one or more subjects will be given exemption in that subject. After that he/she will be given three more chances at six months interval to pass in all the subjects. However, if he/she fails to pass in all subjects, in these three extra attempts, he/she will be required to reappear the whole examination.
17. The candidate will be required to pass in all the subjects at least six months before he/she shall be allowed to appear for the final examination of third year.

B Sc (Radio-Diagnosis)

PHASE-I

*First week after joining (1st week of August): orientation programme :

- Introduction to department
  - Rooms
  - Staff
    - Medical
    - Non-Medical
- Hospital set up
  - Location of departments/wards/administrative offices, lecture theatres, etc.
  - supportive services
    - Electricity
    - A/C
    - Generator
    - Library
- Work Ethics – Do's and Don'ts
- Departments where students are posted : Anatomy, Physiology, Biostatistics, Medical Physics, Neuro-radiology, Cardiac –radiology, MRI.

*Besides classes in Anatomy, Physiology, Bio-statistics and Physics - the Radiographic Classes will also begin after the first week.

PHASE-I

PHYSICS

GOAL

Student will have an understanding of important areas in Physics, knowledge of which are essential to appreciate the principles and functioning of equipment and various physical and chemical processes, all of which will be dealt with later in the Phase-II and III of the course.

PHYSICS

Areas covered

1. Units
2. Mechanics
3. Electricity
4. Electronics
5. Megnetism
6. Acoustics
7. Optics
8. Heat
9. Atomic structure and related areas
10. Radioactivity
11. Basics of biological effects of ionizing radiation
12. Basics of radiation protection

CONTENT

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), Radiation exposure, Absorbed dose, Equivalent dose, etc.). Measurements, significant figures/digits in calculation, uncertainty in measurement, Propagation of errors

Radiation Physics and Mathematics

Number system, graphical representation of complex number, co-ordinates system, relation between polar and Cartesian co-ordinate, exponents, logarithms (to base 10 and e), exponential and logarithmic functions, representation of a function, continuous and discrete function. Trignometric ratio, use of sine and cosine rules, Limit and continuity of a function, Derivative of a function, rule of differentiation, partial derivatives of a function, Integration, definite integral, line integral, Area under curve, infinite and

indefinite integrals.

FFT. Rules for Congruent triangles, rules for similar triangles, differential calculus : dy/dx as a rate measurer, Maxima and minima

Note : These topics should be discussed in brief and emphasis should be given on understanding the meaning of the mathematical terms (not the mathematical derivation or proof) and its use/application in diagnostic radiology.

Mechanics

Scalar and vector quantity, speed, velocity and acceleration, Equation of motion under constant/uniform acceleration ($v = u+ at$, $S = ut + ½ at^2$, $v^2 = u^2 + 2aS$), relative velocity, projectile, Newton's law of motion, conservation of linear momentum, Basic forces in nature (Gravitational force, electrostatic force, magnetic force, electromagnetic force, the strong and weak forces), study of forces in equilibrium.

Work and Energy, forms of energy : kinetic and potential energy, conservation of energy, work done by constant forces, work done by variable forces. Elastic and inelastic collisons.

Rotational motion : Angular displacement (in degrees and radians), angular velocity, centripetal acceleration, centripetal force.

Sound

The nature and propagation of sound wave (the characteristics of sound, wave theory), speed of sound in a material medium, intensity of sound, the decibel, Interference of sound waves, beats, diffraction, Doppler's effect, Ultrasonic wave, production of ultrasonic wave (piezo-electric effect) in ultrasonography. Use of principle of Doppler's effect in Diagnostic radiology (e.g. Echo, blood flow measurement).

Heat

Definition of heat, temperature, Heat capacity, specific heat capacity, Heat transfer-conduction, convection, radiation, thermal conductivity, equation for thermal conductivity (k), the value of k of various material of interest in radiology, thermal expansion, Newton's law of cooling, Heat radiation, perfect black body, Stefan law, application in diagnostic radiology (Heat dissipation in both stationary and rotating X-Ray tubes).

Electrostatics

Electric charge (positive and negative charge), Coulomb's law, Electric field, electric potential and potential difference, equipotential lines, the eV (electron volt), Electric potential due to a point charge, Capacitance, dielectric, Capacitor, series and parallel combination of capacitors, energy stored on capacitor, charging and discharging of capacitors, use of capacitors in diagnostic radiology (e.g Mobile X-Ray generators, radiation detectors etc.).

Electricity and Magnetism

DC circuit, Ohm's law, resistivity, series and parallel combination, EMF, Krichoff's law, heating effect of current, Ammeter, voltmeter, Galvanometer. Magnets and magnetic field, force on an electric current in a magnetic field, force on electric charge moving in a magnetic field, magnetic field due to straight wire ; force between two parallel wires, Ampere's law, electromagnet and solenoids.

Electromagnetic Induction (A.C. Circuit)

Induced EMF, Faraday's Law, Lenz's law, EMF induced in a moving conductor, changing magnetic flux produces electric field, Transformer, Inductance, Energy stored in a magnetic field, resonance in A.C circuit.

Light

Index of refraction, Snell's law, total internal reflection, lens law, rectilinear propagation of light, umbra and penumbra effect, use of principle of rectilinear propagation of light in radiology (e.g. magnification, patient positioning device, setting areas for exposure, etc.).

Photometry : Total radiation flux, luminosity of radiant flux, Luminous flux : relative luminosity, luminous efficiency, Illuminance, Inverse square law, Lambert's cosine law.

Electromagnetic waves

Introduction, Maxwell's equation, electromagnetic waves, energy density and intensity, momentum, electromagnetic spectrum and radiation in Atomsphere.

Atomic structure

Atomic and nuclear structure (protons, neutrons, electrons), Atomic number, atomic masses, nuclides and isotopes, early atomic models, the hydrogen spectra, difficulties with Rutherford's model, Bohr's model, limitations of Bohr's model, the wave function of an electron, Quantum mechanics of hydrogen atom, Quantum numbers, Pauli exclusion principle, periodic table of element.

Radioactivity

Structure and property of nucleus, Nuclear forces, Binding energy, Radioactive decay, law of radioactive decay (decay equation, half-life, mean life), excitation, ionization, characteristic X-Ray, charts of radio-nuclides, alpha, beta, positron, gamma emissions, Modes of decay, Auger electrons, electron capture, isomeric transitions, internal conversion, Naturally occurring radio-nuclides.

Semiconductors and Semiconductor devices

Introduction, energy bands in solids, the semiconductor, p-type and n-type semiconductors, density of charge carriers and conductivity, p-n junction, p-n junction diode, p-n junction diode as rectifier (half-wave and full-wave rectifier), junction transistor, Logic gates.

Digital electronics and computers fundamental

Number systems : Binary, octal, decimal and Hexa-decimal number systems, conversion from one number system to another one, Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC).

Computer fundamentals : Central Processing Unit (CPU), Memory RAM (random access memory) and ROM (read only memory), Airthmetic and Logic Unit (ALU), Display devices, Hard copy devices, Input device (key board, mouse etc.).

Radiation Protection

Somatic and genetic effect of ionising radiation ; need for protection, principle of radiation protection,

ALARA, radiation monitoring devices (film badge and TLD), radiation shielding devices available for protecting staff, patient and public and how to use them. (Methods of Radiation Protection of patients, radiation workers and public).

PHASE-I

RADIOGRAPHY

Goal

To introduce students to and familiarise them with the applications of plain non-contrast radiography.

Specific Objectives : At the end of this phase the student should be able to :

1. Correctly position a patient for plain radiography (anatomical areas given in content).
2. Select and perform basic views (projections) for the above, using appropriate radiographic parameters.
3. Differentiate a properly positioned and exposed radiograph from a wrongly positioned and over or underexposed radiograph.
4. Correctly identify anatomical features displayed in radiograph obtained.

RADIOGRAPHY

(BASIC VIEWS)

CONTENT

1. Upper extremity - basic views
2. Lower extremity (including pelvis) - basic views
3. Chest including thoracic age and sternum
4. Spine - Cervical, dorsal, lumbar, lumbo-sacral (including functional views).
5. Skull – including trauma cases
6. Facial bones (nasal bones, zygoma, orbits, maxilla)
7. Mandible, Temporo-Mandibular Joints, Mastoids, petrous temporal bones
8. Abdomen - erect, supine, lateral decubitus
9. Soft tissue radiography : Larynx, pharynx, nasopharynx, thoracic inlet
10. Dental radiography
11. General Paediatric Radiography
12. Foreign body localization
13. High kV technique
14. Macroradiography

Patient care and hospital administration

1. Hospital structure and organization
2. Radiography as a profession - professionalism, projecting professional image, professional and personal qualities (both essential and desirable) of the radiographer.
3. Communication and Relational Skills - development of appropriate communication skills with patients, verbal and non-verbal communication, appearance and behaviour of the radiographer.
4. Moving and lifting patients - hazards of lifting and manoeuvring patients, rules for correct lifting, transfer from chair or trolley to couch and vice-versa, safety of both "Lifter" and "the Lifted" must be emphasised. Highlight on handling of geriatric, paediatric and trauma patients.
5. Communicable diseases (special reference to AIDS), cross infection and prevention, patient hygiene, personal hygiene, departmental hygiene, handling of infectious patients in the department, application of asepsis, inflammation and infection processes.
6. Patient vital signs - temperature, pulse, respiration and blood pressure - normal values and methods of taking and recording them.
7. Medico-legal considerations - radiographers clinical and ethical responsibilities, misconduct and malpractice ; handling female patients, practic in pregnancy.
8. Radiological contrast media - classification, need for radiological contrast media, methods of administration, dosage, reactions to contrast media, role of the imaging department and the radiographer in management of patient with contrast reaction.

PHASE-II
PHYSICS

GOAL

1. To be familiar with principles of radiographic imaging
2. To apply this knowledge to the production of radiograph and the assessment of image quality
3. To understand the construction, operation of imaging and processing equipment, radiation protection and quality control

Objectives : At the end of this phase, student should be able to :

1. Describe the construction and operation of general radiographic and fluoroscopic equipment, mammographic unit and dental radiographic equipment.
2. Control and manipulate parameters associated with exposure and processing to produce a required image of desirable quality.
3. Practise the procedures employed in producing a radiographic image.
4. Describe methods of measuring exposure and doses of radiographic beams.

5. Describe the principles and applications of basic methods of safety in diagnostic radiology.
6. Carry out quality control for automatic film processing, evaluate and act on results.

PHYSICS

AREAS COVERED

1. X-Ray and related equipment
2. X-Ray films and film processing
3. Image characteristics
4. Interaction of ionising radiation with matter
5. Detection of ionising radiation
6. Dosimetry
7. Biological effects of ionising radiation
8. Radiation protection (related to Phase-II topics)
9. Biological effects of non-ionizing radiation
10. Quality assurance (related to Phase-II topics)
11. Presentation and viewing of radiographs
12. Mammography
13. Xeroradiography
14. Dental Radiography

CONTENT

1. Interaction of ionizing radiation with matter
2. Types of interactions of X- and gamma radiation, Photoelectric & Compton, Bremsstrahlung, pair production, annihilation radiation.
3. Exponential attenuation (linear/mass attenuation coefficients), Half Value Thickness (HVT), Tenth Value Thickness (TVT), dependence on energy and atomic number.
4. Radiation intensity and exposure, photon flux and energy flux density.
5. LET, range of energy relationship for alpha, beta particles and X-Rays.

X-Ray production and properties

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.

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.

Common factors affecting thermionic emission, specialized types (metallic, biangular, fluoro, CT) 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.

Heat dissipation methods, tube rating, heat units, operating conditions, maintenance and Q.A procedures.

X-Ray generators and circuits

Filament current and voltage, X-Ray circuits (primary circuit, auto transformer), types of exposure switch and timers, principle of automatic exposure control (AEC) and practical operation, filament circuit, high voltage circuits, half wave, full wave rectification, three phase circuits.

Types of generators, 3 phase, 6 and 12 pulse circuits, falling load generators, capacitors discharge and grid control systems.

Control of scattered radiation and grids/Bucky

Methods of minimizing formation of scatter radiation, effectiveness of grids [types (moving grids), composition and grid ratio) in preventing scattered radiation, use of cones, diaphragm light beam devices and effectiveness of collimation in reducing effects of scatter.

Effects of scatter radiation on radiograph image quality, patient dose and occupational exposure.

Radiation units Dosimetry and Detection of ionizing radiation

Units of radiation, ICRU definition of absorbed dose, KERMA exposure, Quality factor, dose equivalent, relationship between absorbed dose and equivalent dose.

Basic principles of ionization chambers, proportional counters, G.M counters and scintillation detectors, thermoluminiscent dosimeters, film batches.

Biological effects of radiation

Ionization, excitation and free radiacal formation, hydrolysis of water, action of radiation on cell, DNA, RNA, chromosome, tissue and organ radiosensitivity, cytoplasm, cellular membranes, effects of whole body and acute irradiation, dose fractionation, effects of ionizing radiation on each of major organ system including fetus stochastic and non-stochastic effects, mean and lethal dose, direct and indirect effects, multi target and multi hit theory, factors affecting radiosensitivity, RBE, survival curves, LD_{50} and oxygen enhancement ratio.

Biological effects of non-ionizing radiation (ultrasound, sound lasers, IR, UV and magnetic fields).

Radiation protection

Natural and background radiation (cosmic, terrestrial).

Principles of radiation protection, time - distance and shielding, shielding calculation and radiation survey, personnel dosimeters (TLD and film batches), occupational exposure, radiation protection of self and patient, ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection.

X-Ray film and Image processing

Composition of single and double coated radiographic films, structure of emulsion, film characteristics (speed, base + fog, gamma, latitude) ; effect of grain size on film response to exposure, interpretation of characteristics curve.

Latent image formation ; process of film developing (composition of fixer, developer and other processing solution), common errors and faults while processing (densitometry), automatic processing (processing cycle), developer replenishment, silver recovery and economics.

Image intensifiers and cassettes (structure and function) ; types of image intensifiers and relative advantage, loading and unloading of cassettes and their care/maintenance ; effects of kV and mA on variation of emitted radiation intensity, determination of relative speeds, film contrast, film screen contact.

Film storage, handling.

Factors affecting Image Quality

Meaning of radiographic image contrast, density, resolution, sharpness, magnification and distortion of image, noise and blur.

Radiographic illuminators and viewing conditions, visual acuity and resolution.

Quality assurance of the related equipment and its benefits w.r.t visual assessment.

Dark room design and accessories

Site, layout and safe light compatibility.

Mammography and Xerography

Background, diagnosis and screening, equipment, tube, AEC, grids, compression and image receptors, film processing and radiation dose.

Photo conduction and xerography plates, equipment exposure and developing of plates, image quality and advantage, future developments.

Portables and Mobiles

Types of mobile units, mobile image intensifiers, advantages and limitations, radiation protection.

Dental Radiography

Equipment, film types and processing.

PHASE-II

RADIOGRAPHY

GOAL

Student should be able to reliably perform all non-contrast plain Radiography, conventional contrast studies and non-contrast plain radiography in special situations.

OBJECTIVES

1. Correctly position for radiography of a particular anatomical area.
2. Correctly select appropriate projection/projections to demonstrate the area of interest.
3. Use appropriate radiographic parameters to produce a radiograph with satisfactory results.
4. Competently use radiographic/fluoroscopic equipment and associated accessories.
5. Correctly identify anatomical features on the radiographs and identity some major pathological and traumatic conditions.
6. Help in administration of correct contrast dosage.
7. Take all correct steps for radiation protection.

Radiography

(i) **Conventional – non-contrast radiography**

Same topics as in Phase-I but additional views :

Upper extremity – lower extremity (including pelvis) – Chest (including thoracic cage) – spine - skull – facial bones – mandible, TMJ, mastoid etc. - abdomen – soft tissue radiography – dental - paediatric - foreign body localization.

For all : radiographic and technical considerations, equipment requirement, conditions essential for optimal image quality.

(ii) **Conventional contrast radiography**

[A] **Urinary system imaging (IVU, MCU, RGU)**

Revision of anatomy and physiology, clinical indications and contraindications - patient preparation - contrast media used and dosage - physiological process by which urinary tract is outlined - film sequence (projection and timing), normal anatomy on films, additional techniques, radiation protection, care of patient during and after examination.

Pathological conditions of urinary system : kidneys, ureter, urinary bladder, urethra.

[B] **Gastrointestinal tract imaging**

(Barium swallow, Barium meal upper GI, Barium meal follow through, Barium enema, small bowel enema, distal colography, defaecography).

Revision of anatomy and physiology - clinical indications and contraindications - contrast media used : preparation and dosage - patient preparation – preparation of equipment – control of radiographic and fluoroscopic equipment – film sequence – radiographic projections – radiation protection – patient management – after care of patient – radiographer's role in the team.

Pathological conditions of the GI tract.

[C] **Biliary system (PTC, ERCP, T-Tube cholangiography, per-op. cholangiography)**

Revision of anatomy and physiology – clinical indications and contraindications – contrast media – patient preparation – film series - radiation protection – patient care - normal anatomy.

Pathological conditions of biliary system.

[D] **Sialography and sinography**

Anatomy - Clinical indications and contraindications – patient preparation – contrast media and dosage – injection procedure – techniques for radiographic projections - radiographic appearances – radiation protection – patient care.

Pathological conditions.

[E] **Hysterosalpingography (HSG)**

Revision of anatomy and physiology – clinical indications and contraindications – contrast-injection-projections – radiation protection – patient care.

Normal and pathological conditions.

[F] **Procedures which are obsolete or rarely used : An overview**

- Myelography – indications and contraindications – contrast used – patient preparation – injection technique – film sequence – projections – patient care
- Pelvimetry
- Oral cholecystography/intravenous cholangiography
- Dacrocystography
- Arthrography
- Discography

(iii) **Conventional – non-contrast - special situations**

[A] **Paediatric Radiography**

Special needs of patient and radiographer – equipment considerations (use of dedicated equipment and accessories)

Technical considerations - the need to modify "adult" techniques – selection of exposure factors – image quality considerations – radiation protection of the patient - special techniques peculiar to children as follows :

– Anorectal malformation – contrast study

- intersex disorders - contrast study
- esophageal atresia – pre/post op.
- intussusception
- congenital dislocation of hip
- scoliosis
- Leg–length measurements
- assessment of bone age
- non accidental injury
- radiography of babies in incubators

[B] **Geriatric radiography**

Understanding patient profile - possible difficulties during radiography – Technical considerations – need to carry out standardised projections in unconventional position – equipment and accessories – exposure factor considerations in view of variations in skeletal tissue – special care.

[C] **Trauma/Emergency Radiography**

Limb fractures - Fracture of thoracic cage, spine, skull – GIT obstruction – lung collapse – pleural effusion – pneumo-thorax. Selection of suitable X-Ray equipment – patient position - radiographic projections and sequence for each patient – modification of routine positioning, X-Ray tube and film – radiation protection – patient care.

[D] **Operation theatre radiography**

Operative cholangiography – orthopaedic procedures – pre-operative chest.

Strict observation of asepsis – preparation of radiographer and equipment/accessories – careful safe use of mobile and fluoroscopic equipment – radiation protection – patient care – protection of theatre staff – rapid availability of radiographic image.

[E] **Mammography**

Anatomy and Physiology of female breast – knowledge about the nature of X-Ray beam suitable for breast imaging – equipment suitable for generating such X-radiation – image recording devices – accessories for immobilisation and identification, positioning, techniques for various projection ; exposure factors, radiation protection – technique of biopsy procedure – characteristics of benign and malignant lesions – patient care – female attendant.

PHASE-II

Equipments for Radiography and processing techniques

General Aims

To enable students understand the construction, design operation of imaging and processing equipment

including associated radiation protection and quality control.

Objectives

Upon completion of this, students will be able to

(i) Describe the construction and operation of general radiographic equipment

(ii) Practise the procedures employed in producing a radiographic image

(iii) Control and manipulate parameters associated with exposure and processing to produce a required image quality

(iv) Carry out routine procedures associated with maintenance of imaging and processing systems.

COURSE CONTENTS

1. **Main Electric supply and Distribution /Diagnostic X-ray circuits**

   The X-Ray circuit

   The autotransformer

   Full wave rectification two-pulse

   Three phase circuit six pulse

   Advantages of the 3-phase over single phase

   Radiographic advantages of 3 phase X-Ray generators over single phase.

   12 pulse circuit

2. **Exposure timers /AEC**

   The electronic timer

   Automatic exposure control – photo timer/iontomat

   X-Ray tube overload protection circuits.

   Loadix, percentage tube overload indication.

3. **Specilazed X-Ray generators**

   High Frequency

   Shared generators

4. **Cassettes**

   Structure and function

   Types - single, gridded, filmholder.

   Design features and consideration with loading/unloading

   Care and maintenance (cleaning)

5. **Grid**

Purpose and function, effect on radiation exposure, use of grid, structure and materials.

Types : stationary, parallel, focused, cross-hatch Moving grids. Purpose/advantages/disadvantages.

6. **Intensifying screens**

Structure and functions, common phosphors used for determination of relative speeds, types, screen mounting, care and maintenance of film screen contact.

7. **Radiographic Film**

Structure, properties of different parts, handling, film wrappings. Handling of exposed and unexposed films.

Types, applications, advantages/limitations of different types, safe light requirements.

8. **Diagnostic X-ray tubes**

The stationary anode X-Ray tube

The rotating anode X-Ray tube :

The insert/filament/anode rotation/anode/anode speed

X-Ray tube inherent and added filtration

Heavy duty X-Ray tube

The grid controlled X-Ray tube

The super rotalix metal X-Ray tube

Mammography X-Ray tube

Micro focus X-Ray tube

Super rotalix ceramic X-Ray tube

9. **Tube rating & tube supports**

The rating of X-Ray tubes - maximum power

Type of rectification (three phase)

Focal area

Speed of anode rotation

Heat transfer through X-Ray tube

Heat path

Anode, tube housing cooling chart

X-Ray tube supports

Floor stands

Floor to ceiling stands

'C' aim supports

Advantages of ceiling suspend tubes

10. **X-ray tables/bucky & LBD**

Floating top table

Variable height table

The vertical bucky

The versatile bucky

Limitations of the primary beam/the light beam diaphargm.

11. **Equipment for Fluoroscopy**

Fluoroscopic equipment

The serial changer (spot film device)

Image intensifier tubes

Triple field image intensifier

Television cameras

The vidicon camera tube

The plumbicon camera tube

Kinescopy - Roll and cut film cameras

Cine fluorography - mode of operation, cine pulsing

Automatic brightness control

Quality assurance tests for fluoroscopic equipment.

12. **Equipment for mobile radiography**

Portable X-Ray unit

Capacitor discharge unit

Cordless mobiles

Mobile image intensifier, limitations.

13. **Equipment for MMR (Mass Miniature Radiography)**

Design and construction and function

Film loading, care.

14. **Equipment for Dental Radiography**

Intra oral radiography unit

The orthopantomograph unit (OPG)

The cephalostat.

15. **Equipment for Tomography**

Tomography equipment

Basic requirements and controls, attachments

Types of movements and applications

Effect on image of variation in focus object distance,

Object film distance, exposure angle, tube movement pattern.

16. **Equipment for Film Processing**

Functions of various components

Film roller transport - transport time, film feed system,

Importance and relation to temp, fixed and variable time cycles.

Care and maintenance (cleaning routine and methods of cleaning).

17. **Equipment for Skull Radiography**

Types and principles, basic requirements in control and design, types of movements and accessories, application.

18. **Dark Room**

The processing area

Dark room design, construction, illumination, entrance safe lighting - types

Storage, shelving of films

Cleaning and maintenance.

19. **Film Processing**

Principles : Acidity, alkalinity, pH, the processing cycle, development, developer solution.

Fixing, fixer solution, washing, drying replenishment, checking and adjusting

Replenishment rates, manual and automatic processing

Silver recovery

Auto and manual chemicals.

Area covered

1. Main electric supply and distribution
2. Diagnostic X-Ray circuits/Exposure timers/AEC etc.

3. Specialized X-Ray generators - high frequency/shared
4. Cassettes/construction/types/care
5. Grid/construction/types/uses
6. Intensifying screens/construction/type/care/uses
7. Film/construction/type/used in ?
8. Diagnostic X-Ray tubes (past/present/future)
9. Tube rating and tube supports
10. X-Ray tables/bucky/bucky stands
11. Equipment for fluoroscopy and flurography
12. Equipment for mobile radiography
13. Equipment for MMR radiography
14. Equipment for dental radiography (+ Cephalu/panromax)
15. Equipment for Tomography
16. Equipment for film processing (Automatic)
17. Equipment for skull radiography
18. Dark room (the processing area)
19. Film processing

PHASE-III

PHYSICS

GOAL

Student will have exposure to a range of special equipment, have an understanding on quality assurance and radiation protection.

OBJECTIVES

1. Describe the construction and operation of advanced imaging equipment : CT, MRI, Sonography, Angiography.
2. Apply quality control procedures for these equipment.
3. Discuss and apply radiation protection principles and codes of practice.
4. Have an understanding of processing of images in digital form and be familiar with recent advances in imaging.

AREAS COVERED

1. Automatic exposure devices

2. Automatic film handling systems
3. X-Ray room/dark room planning, management and maintenance of X-Ray Department
4. Image recording devices
5. Cine radiography
6. Angiography including DSA, Venography
7. C.T
8. Sonography
9. MRI
10. Digital Radiography
11. Picture Archiving and Communication Systems (PACS)
12. Quality control (for Phase-III topics)
13. Protection (related to Phase-III topics)
14. Fundamentals; concepts and applications of processing of images in digital form using computer based system
15. Newer advancements - updates

PHYSICS

CONTENT

Advanced computerized tomography (CT)

Historical background, various generations of scanners, advancement in CT technology (helical/spiral and multi slice), ultra fast scanners

System components, CT performance parameters, image quality and methods of image reconstruction, radiation dose measurements and technical aspects of Q.A. (quality assurance).

Digital Radiography and PACS

Image acquisition, photostimulable phosphors, digital chest radiography and future developments

Picture characteristics, archiving possibilities; transfer system and designs

Image recording devices, laser imager and multiformatter

Fluoroscopic equipment and image intensifiers

Fluoroscopic screen, tilting tables, over and under couch tubes, safety features, image intensifier tubes. Types of day light film handling system, types of optical coupling and methods of viewing, recording of intensified image, CCTV, cine fluorography

Diagnostic Ultrasound

Basic physics of sound propagation in different media, production of Ultrasound (piezoelectric effect), transducer, half and quarter wave length, transmission of pulse and echo modes, Doppler Ultrasonography, A, B and M scanning modes.

Properties of Ultrasound (propagation in tissue, absorption, scattering, reflection and refraction, acoustic impedence).

Ultrasound image formation and storage/documentation devices.

Magnetic Resonance Imaging

History, advantage over other imaging modalities, equipment terminology, physical principle, NMR signals, pulse sequences, spectroscopy parameters, hardware, site selection and safety.

Image formation and storage devices

Angiography and Cine Radiography

DSA Subtraction process, X-Ray equipment, injection pump and serial imaging devices, cine camera, optical system, X-Ray equipment and film processing

X-Ray room specifications and administrative information

Setting up of a new X-Ray unit, staff requirement, AERB (Atomic Energy Regulatory Board) specifications for site planning and mandatory guidelines

Quality assurance (Q.A), acceptance testing and quality control tests

Meaning of the term and aspects of a QA programme, equipment and staff requirements, benefits of QA procedures in an imaging department.

IMAGING

GOAL

Student will be introduced to the full range of radiographic equipment designed for special procedures.

OBJECTIVES

1. Student should be able to competently handle the special imaging equipment i.e. ultrasound, CT, MRI, angiographic equipment and their related accessories.
2. Demonstrate good understanding of the normal anatomy and common pathological conditions on the images obtained using these special equipment.
3. Should take all precautions in the protection of staff and patient.
4. Should have knowledge of the advantages and limitations of each equipment.

IMAGING

SONOGRAPHY

Review of equipment - summary of applications -

Techniques for :

- Upper and lower abdominal structures
- Thyroid
- Testis
- Breast
- Neonatal Brain
- Vascular structures (including extremity)
- Pregnant abdomen

CT

Head and neck – thorax – abdomen – pelvis - musculo-skeletal system – spine – PNS

Anatomy – clinical indications and contraindications – patient preparation – technique – contrast media types, dose, injection technique; timing, sequence - image display – patient care – function of image processing facilities, CT anatomy and pathology of different organ systems.

Magnetic Resonance Imaging

Head and Neck, Thorax, Abdomen, Musculoskeletal System.

Clinical indications and contraindications, types of common sequences, effects of sequence on imaging, patient preparation, paramagnetic agents and dose, additional techniques and recent advances in MRI : MRS blood flow imaging, diffusion/perfusion scans etc.; strength and limitations of MRI; role of radiographer.

Angiography (including Venography)

Abdominal, visceral, peripheral, cerebral and cardiac [for cerebral and cardiac arteriography – posted in Neuro- and Cardiac-Radiology Deptts., respectively]

Revision of Anatomy and Physiology, clinical indications and contraindications, types of contrast and dosage, patient preparation, equipment, outline of radiological procedure, radiographer's role in the team viz. Control of radiographic and fluoroscopic equipment, including exposure factors for serial programmes, video-recorder, procedures for subtraction, digital techniques, radiation protection, general patient management before -during and after the procedure. Vascular anatomy and pathological conditions.

Interventional Radiology

Practical interventional radiology in the diseases of the Hepatobiliary, GIT, Urology and Vascular System

(non Neuro/Cardiac).

Indications and contraindications, equipment, pitfalls and complications, role of radiographer in the team.

PHASE–III

EQUIPMENTS FOR RADIOGRAPHY

General Aims

To enable the students understand to the full range of radiographic equipment including those designed for special procedures. Quality assurance and radiation protection principles and practise have been extended.

Objectives

After studying this subject students should be able to :

(i) Describe the design, construction, operation and quality control of advanced imaging equipment used for specialised techniques.

(ii) Apply quality control procedures for specialised radiographic equipment.

Course contents (details)

1. **Computed tomography (CT)**

   Historical, digital fundamentals, computer hard wire of software. Scanner types, technologic considerations of sequential/spiral volume zoom – CT (advantages and limitations)

   Basic data acquisition concepts

   CT – detectors technology

   Image reconstruction

   CT computer and image processing system

   Image display, storage, recording system

   CT control console

   Options and accessories for CT systems.

   Tools for use in CT guided Interventional procedures.

   Dosimetry, image quality in CT.

   Future developments.

2. **Ultra Sound Scanning (U/S)**

   Terminology - physical principle. Different types of machines –

   Portable etc.

U/S generators, different modes, doppler U/S. clinical applications.

Image display & recording systems

Transducers (scanning probes)

Types and shapes/choice/care and maintenance

Recording devices/orientation of the image

Focus of the beam/sensitivity and gain

Artifacts/quality control

Acoustic coupling agents - Ingredients/preparation

3. **Digital Radiography Systems**

Image acquisition

Digital Spot Imaging (DSI)

Digital chest radiography

Future developments

4. **Angiography Systems**

Equipment (present and past)

serial imaging devices

subtraction process, (contrast media)

Accessories and choice - catheters, guide wires.

Intervential Angiography:

Accessories and uses

e.g coils/stents

Radiation safety.

5. **Pressure Injectors:**

Types, programming,injection protocols,uses.

6. **Magnetic Resonance Imaging (MRI)**

Terminology :

- Physical principles, NMR signals
- MR system components
- The magnet system
- The reconstruction system

- Host computer, viewing archiving, hard copy
- Magnetic shielding
- RF shielding

7. **Mammography system**

   Background, diagnosis and screening.

   Imaging requirements

   Equipment - tube, compression, grids, AEC

   Image receptor requirements.

   Radiation dose, Image quality

   Interventional - accessories

   Biopsy equipment attachments.

8. **Film archieving systems**

   Image recording devices

   Laser imager/camera-functioning.

   Multiformatter

   Automatic film handling systems

   Picture archieving and communications systems (PACS)

   Systems designs, transfer restrictions.

   Optical Disc. System (ODS)

Course contents

1. CT systems (operation) – care/basic trouble shooting Present/Past/Future
2. U/S system - basic/care

   Transducers - construction types and uses\

   Image display and recording systems

   Interventional - accessories

   + Colour Doppler /portable systems

3. Digital radiography systems

   e.g - DSI

4. Angiography systems - present/past

DSA system - basics

DSA - accessories/choice off Catheters/guidwires Interventional accessories, Coils/stents/chemo-embo – choice

5. Pressure Injectors - types/construction/uses programming
6. MRI equipment - basic/past/present uses accessories coils etc. Interventional accessories
7. Mammography system - construction/types accessories for interventional procedures Biopsy equipment
8. Film archieving systems - MOD/disc/PACS etc.
9. Care, choice and installation of the equipment
10. Quality assurance of special equipments and radiation protection.