Curriculum for Diploma in Medical Technology
of
Radiology & Imaging

The State Medical Faculty of Bangladesh

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Bijoynagar, Dhaka -1000

August 2021

Curriculum for Diploma in Medical Technology of Radiology & Imaging

Compiled by & edited by-

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Supported by-

World Health Organization (WHO), Bangladesh

Preface

With increasing public expectations about the health care services, specially in the emergency & pandemic situation like COVID 19 the quality of care itself is under scrutiny all over the world. Therefore a positive change is needed in the role of Medical Technologists. The role of teachers and students in teaching and learning to bring a positive changes in allied health professionals education also needs to be reviewed and further developed to make it more competency based.

This revised Health Technology (HT) competency based curriculum has been developed and scientifically designed, making it responsive to the needs of the learners and focussed towards the need of consumers and country. The present HT curriculum with its assessment methods is expected to effectively judge competencies acquired with those which are required to cater the health needs of our people. It is gratifying to note that all concerned in the promotion of allied health science in the country have involved themselves in the planning and formulation of this competency based & community oriented need-based curriculum.

Contents like basic computer science, communicative English, Ethics, communication skills, behavioural science, primary health care, environment and sanitation have been given the required emphasis in this document. Though the curriculum is not the sole determinants of the outcome, yet then it is very important as it guides the faculty members in preparing their instruction, tells the students where to go, what to do and what knowledge, skills and attitude they are expected to develop.

In conclusion, I would like to state that, the curriculum planning process should be continuous, dynamic and never-ending. If it is to serve best, the needs of the individual students, educational institutions and the expectations of people community to whom we are ultimately accountable, are required to be evaluated and given due attention.

I congratulate all who were involved in designing and developing the competency based curriculum, particularly the Director, CME, ADGs & Directors of DGME, Secretary, SMFB, members of the working group and the faculty members of Centre for Medical Education (CME). My special thanks to WR, WHO Bangladesh, Team Leader (Health System) & NPO (HRH) WHO Bangladesh for financial & technical support.

Professor Dr A.H. M. Enayet Hussain
Director General
Directorate General of Medical Education (DGME)

Foreword

Curriculum planning and designing is not a static process, rather a continuous process done regularly through a system. This curriculum was developed a few years back in 2008 but it was needed to be updated to make it more technology oriented students centred and competency based.

Initially there were policy level meetings and meeting of the Curriculum Working Group of different disciplines/courses from Institute of Health Technologies (IHT) to prepare a draft curriculum. Subsequently, in order to develop a consensus, decision was taken to hold Review Workshops through active participation of different groups of faculty members. A taskforce group examined the revised curriculum for the different courses of IHT to give it a final shape with the financial & technical support by WR, WHO Bangladesh & NPO (HRH) WHO Bangladesh.

The revised Curriculum for Health Technology (HT**)** is expected to be implemented for the newly admitted students of the next session. The success of this curriculum, which is made more competence based and need-based, depends on its proper implementation with active leadership of the MOH&FW, DGME, SMFB, principals & teachers of IHT with interactive participation of students.

It is expected that this curriculum will serve as present day guideline for the students of IHT and its faculty members. In order to ensure further improvement, this curriculum needs constant review and revision with time to time updating.

My sincere thanks to Prof Dr A.H. M. Enayet Hussain, Director General, DGME, for his guidance & supervision with his team of DGME. My special thanks to Dr. Bardan Jung Rana, WR, WHO Bangladesh, Dr Sangay Wangmo, Team leader (Health System) & Mr Md Nuruzzaman, NPO (HRH), WHO Bangladesh country office for financial & technical support for this activity. I like to thank Professor Dr. Md. Humayun Kabir Talukder, Professor (Curriculum Development & Evaluation), Centre for Medical Education (CME), working co-ordinator, IHT Curriculum Development Committee for his continuous technical assistance and co-ordination to prepare this curriculum. The technical team comprising the faculty members of the Centre for Medical Education (CME) deserve special appreciation.

Lastly, I would like to extend my deep and sincere gratitude to all principals & teachers of different IHTs, subject experts, faculty members and others computer and secretarial support staff of CME who shared their expertise and worked hard to produce this valuable document.

Professor Dr Syeda Shahina Subhan
Director
Centre for Medical Education (CME)

Acknowledgement

This is indeed a pleasant responsibility to bring out this curriculum on Diploma in Health Technology course, which has been developed through a participatory approach by a team of policy teachers of IHTs and medical educationists. It aims to review and update the Health Technology (HT) curriculum.

I would like to express my deep gratitude to Prof Dr A.H. M. Enayet Hussain, Director General, DGME, for his overall supervision in this activity along with ADG (Admin), ADG(Education) & Directors of DGME, under the leadership of whom the plan of reviewing and updating the IHT curriculum has been materialized, and who provided immense support and encouragement to finish the work. My cordial thanks are extended to Dr Sangay Wangmo, Team leader (Health System) & Mr Md Nuruzzaman, NPO (HRH), WHO Bangladesh country office for financial & technical support for this activity.

I am grateful to all the resource persons/teachers from different institutes, subject experts, principals of IHT specially the faculty of Center for Medical Education (CME), who devoted their immense efforts, time and hard work to develop this curriculum. My special thanks to Professor Dr. Md. Humayun Kabir Talukder, Professor (Curriculum Development & Evaluation), Centre for Medical Education (CME), working co-ordinator, IHT curriculum reviewing & updating committee for his continuous efforts without which it would not have been possible to complete this work. My thanks to all other faculty members & staffs of CME, who were involved directly or indirectly in preparation of this curriculum.

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List of Content

Course Overview

Course Aims:

To prepare Medical Technologist (Radiology & Imaging) for the department of Radiology and Imaging with proper knowledge, skill and attitude so that he/she can perform her/his duties to making ideal quality and informative radiological image for the purpose of radiological diagnosis.

Course objectives:

At the end of this course the students will be able to-

- Explain basic concepts of behavioral sciences that are relevant to establishing good interpersonal relationship and empathy with the patients.
- Describe and understand the Anatomcal and Physiological structural components of the human body that may be appeared in the image after completion of radiological procedure responsible for normal body functions.
- Innumerate normal functions of human body and interpret normal functions with a view to differentiate them from abnormal functions.
- Execute theoretical procedure for the operation of 'Radiology and Imaging' equipment in order to activate, applicate, operate and maintain.
- Describe the purpose and basis of radiological procedures and their role in the diagnosis and management of diseases.
- Perform routine and specialized radiological examination by using modern equipment's, maintaining proper quality and standard of medical images.
- Apply and moderate the proper Radiological technique and protocol for the better Radiological Image.
- Prepare record, report and interpret results of the tests using computers and other technology.
- Control the quality of Radiological image by optimizing contrast, density, and resolution and exposure control parameter.
- Select the radiation safety measures for patients, personal and environment.
- Use radiation safety monitoring devices for the personal, departmental and environmental monitoring.
- Explain basic mechanism of diseases, etiology, pathogenesis, morphological changes and co- relate between clinical findings and Radiological findings.
- Identify normal and abnormal Radiological findings of different organ in human body appeared in Radiological image.
- Develop attitude for continuous self-learning and self assessment throughout the whole practicing.

Course Details

A. Course Title: Diploma in Medical Technology (Radiology & Imaging)

B. Course philosophy and rational

Radiology and Imaging technology assure the maximum life savings solutions by producing internal image of human body. Medical Technologist (Radiography) performs different types of examination of Human body, such as General Radiography, Contrast Radiography, CT scan, Mammography, MRI, PET, SPECT and other huge numbers of modalities are used in the Diagnostic Radiology and Imaging Field. Therefore, Technologists have needed enough knowledge and skills on their respective field. Also to work with radiation is very risky so that technologist should have sufficient knowledge about radiation safety and radiation control.
This course finds its rationality to develop adequate number of Medical Technologists (Radiography) in the Radiology and Imaging to cope up with growing demand and expansion of Radiology and Imaging Diagnostic services in different sectors and to meet the desired need of Medical Technologist/ Radiologist/Patients ratio in Bangladesh.

C. Conditions for entrance:

1. Qualifications & prerequisite:
    (i) SSC Science or equivalent with Science with Physics, Chemistry and Biology.
    (ii) Candidate has to secure required grade point in the SSC examinations which will be decided by the concern competent authority.
    (iii) Candidate passed SSC examination in current Year and previous 3rd Year is illegible for admission or as decided by the authority for each year of admission.

D. Examinations for Entrance/Admission Test:

All candidates are to sit for admission tests through prescribed rules and examination method as specified in the advertisement. Selection of the candidates will be done on merit basis as based on marks obtained in the admission test.

Despite the general merit in consideration for selection the reserved quota for different groups of applicants as specified in the advertisement shall be maintained on the merit basis for the respective reserved quota as well. Candidates selected for admission will have to appear before the Medical Boards as organized by the respective Institute of Health/ Medical Technology.

Course structure and duration

Total duration of the course will be 4 years
The course will be of four years' duration. The total period is divided into 4 parts-1st year, 2nd year, 3rd year and 4th year. In each there will be 40 weeks of teaching and learning at the end of which there will be a year final examination. Supplementary examinations will be held 6 months of the year final examination.

Year	Duration
1st Year	12 months
2nd Year	12 months
3rd Year	12 months
4th Year	12 months

NB: All academic activities including yearly faculty examination of each phase must be completed within the specified time of the phase.
NB: Total duration for completion of the four years (4) course will be 10 years after admission in 1st year

E. Distribution of the papers with teaching /learning hour's as per year wise:

1st year

Exams	Papers	Subjects	Lecture (in hours)	Tutorial (in hours)	Institutional Academic Lab based Practical Training/ Demonstration (in hours)	Formative Exam		Summative exam		Total Hours
						Preparatory leave	Exam time	Preparatory leave	Exam time	
Teaching-learning both formative & summative assessment	I	English	66	34	-	7 days	10 days	10 days	15 days	100
	II	Basic Anatomy	70	60	70					200
	III	Basic Physiology	75	60	65					200
	IV	Basic Community Medicine & Behavioral science	150	50	-					200
	V	Basic computer science	25	-	75					100
		Total	**395**	**195**	**210**	**17 days**		**25 days**		**800**
		Grand total	**800 hours**			**42 days**				**800 hours**

2nd year

Exams	Papers	Subjects	Lecture (in hours)	Institutional Academic Lab based Practical Training/ Demonstration (in hours)	Formative Exam		Summative exam		Total Hours
					Preparatory leave	Exam time	Preparatory leave	Exam time	
Teaching-learning both formative & summative assessment	I	Physics	40	30	7 days	10days	10 days	15days	70
	II	Chemistry	80	20					100
	III	Basic Microbiology & Parasitology	80	20					100
	IV	Radiological Anatomy, Physiology and pathology.	100	150					250
	V	Radiological Physics & Equipment	100	200					300
		Total	**370**	**450**	**17 days**		**25 days**		**820**
		Grand total	**820 hours**		**42 days**				**820 hours**

3rd year

Exams	Papers	Subjects	Lecture (in hours)	Institutional Academic Lab based Practical Training/ Demonstration (in hours)	Formative Exam		Summative exam		Total Hours
					Preparatory leave	Exam time	Preparatory leave	Exam time	
Teaching-learning both formative & summative assessment	I	Radiological Procedure	100	150	7 days	10 days	10 days	15 days	250
	II	Radiological photography and Quality assurance	100	150					250
	III	Radiation Biology & Patients care	100	150					250
		Total	**300**	**450**	17 days		25 days		750
		Grand total	**750 hours**		**42 days**				**750 hours**

4th Year

Exams	Papers	Subjects	Lecture (in hours)	Institutional Academic Lab based Practical Training/ Demonstration (in hours)	Special attachment at relevant lab based advance training (in hours)	Formative Exam		Summative exam		Total Hours
						Preparatory leave	Exam time	Preparatory leave	Exam time	
Teaching-learning both formative & summative assessment	I	Advanced Radiology & Imaging procedure	100	100	200	7 days	10 days	10 days	15 days	400
	II	Basic concepts of Radiological findings	100	100	200					400
		Total	**200**	**200**	**400**	17 days		25 days		**800**
		Grand total	**800 hours**			**42 days**				**800 hours**

F. Teaching & learning methods, media and faculty members

The following teaching and learning methods will be followed:

1. Large Group Teaching Lecture aided by –
   - Multimedia
   - Computer
   - Chalk board
   - OHP/ Slide projector
   - Handouts

2. Small Group Teaching-
   - Tutorial/ Demonstration
   - Students interaction

3. Practical session-
   - Use of practical manual Chalk board
   - Performing the task/examination by the student
   - Writing the practical note book
   - Log book

4. Lab Placement-
   - In small groups for performing activities by the student themselves

5. Faculty members-
   - Subject oriented teacher (Professor/ Associate professor/ Assistant professor/Lecturer/Instructor will be illegible to perform lecture/theoretical class.
   - Subject oriented instructors will be illegible to perform practical/demonstration class.

G. Assessment

- Examination will be held on month of January & July of every year.

<u>Assessment Methods:</u>

- There will be in-course/formative (card/ item) and end-course/summative (terminal) assessment for the students in each part (1^{st}, 2^{nd}, 3^{rd} & 4^{th} year) of the course i.e. formative and year final examination.
- There will be year final examination at the end of each academic year and one supplementary examination 6 months after each regular year-final examination.
- Formative assessment will be done through items and cards ending exam.

In the year-final examination marks allocation will be as follows:

- 50% from year-final written examination
- 10% from the formative examinations (Card final examination/Item marks).
- 40% from the oral and practical examinations.
- In written assessment Short Answer Question (SAQ) and Multiple choice question (MCQ)-true/false, in practical along with traditional objective structure practical examination (OSPE) & in oral structure oral examination (SOE) will be utilized

Eligibility for appearing in the year-final examination:

- Certificate from the respective head of institutes regarding students obtaining at least 75% attendance in all aspects (theory, practical, tutorial, residential field practice) during one academic year.
- Obtaining at least 50% marks in the formative examinations.
- No objection Certificate from the respective head of institutes regarding taking part any activities contrary to the discipline of the institute.
- No student shall be allowed to appear in the Year II, Year III and Year IV Final examinations unless the student passes all the subjects of 1st, 2nd and 3rd year Final examinations respectively.

Carry on

- One can be eligible to attend the classes of 2nd year after passing at least 3 subjects among 5 subjects of 1st year.
- One can be eligible to attend the classes of 3rd year after passing at least 3 subjects among 5 subjects of 2nd year.
- One can be eligible to attend the classes of 4th year after passing at least 2 subjects among 3 subjects of 3rd year.

Assessment personnel:

- Subject oriented teacher (Professor/ Associate professor/ Assistant professor/Lecturer will be illegible to be an examiner, moderator and able to evaluate the examination script.
- Subject oriented instructors will be illegible to undertake the practical examinations

Grading

Numerical percentage of Marks	GPA letter Grade	GPA Numerical Grade (Grade points)
85% and above	A^+	4
81% to less than 85%	A	3.75
76% to less than 80%	A^-	3.5
71% to less than 75%	B^+	3.25
66% to less than 70%	B	3.00
61% to less than 65%	B^-	2.75
Only 60%	C	2.50
Less than 60%	F	0

Pass Marks/Grade-C

Written Exam - 60%
Practical - 60%
Oral - 60%

Student shall have to pass written, oral, practical and formative separately in each paper of the examination.

Results will be publish in GPA system and number of the subjects will be reflected in the academic transcript.

H. Examinations & distribution of marks as per each year

1st Year Examination

Paper	Subjects	Written Exam	Oral Exam	Practical Exam	Formative Exam	Total Marks
I	English	75	15	-	10	100
II	Basic Anatomy	100	40	40	20	200
IV	Basic Physiology	100	40	40	20	200
V	Basic Community Medicine & Behavioral Science	100	40	40	20	200
VI	Basic computer science	50	--	40	10	100
	Total	**425**	**135**	**120**	**80**	**800**

2nd Year Examination

Paper	Subjects	Written Exam	Oral Exam	Practical Exam	Formative exam	Total Marks
I	Physics	75	10	15	--	100
II	Chemistry	75	10	15	--	100
III	Basic Microbiology & Parasitology	100	40	40	20	200
IV	Radiological Anatomy, Physiology and Pathology	100	40	40	20	200
V	Radiological Physics & Equipment	100	40	40	20	200
	Total	**450**	**140**	**150**	**60**	**800**

3rd Year Examination

Paper	Subjects	Written Exam	Oral Exam	Practical Exam	Formative exam	Total Marks
I	Radiological Procedure	100	40	40	20	200
II	Radiographic Photography and Quality Assurance	100	40	40	20	200
III	Radiation Biology & Patients care	100	40	40	20	200
	Total	**300**	**120**	**120**	**60**	**600**

4th Year Examination

Paper	Subjects	Written Exam	Oral Exam	Practical Exam	Formative exam	Total Marks
II	Advanced Radiology & Imaging procedure	100	40	40	20	200
II	Basic concepts of Radiological findings	100	40	40	20	200
	Special Lab Attachment					
	Total	**200**	**80**	**80**	**40**	**400**

I. This curriculum is meant for the guidance of four groups for people --

- Students to guide them in what to learn and how to learn
- Teachers to guide them in what to teach and how to teach
- Examiners to guide them in what to evaluated and how to evaluated
- Concerned policy persons to guide how to implement this curriculum with proper--
  - Governance
  - Guidelines
  - Faculty members with updated organogram
  - Institutional academic lab
  - Attached OPD
  - Special lab attachment as per future job
  - Appropriate students friendly academic environment
  - Teachers to be oriented about the implementation of curriculum
  - Log book to be prepared

J. Required faculty members of the concerned subject/discipline are as follows to implement this curriculum --

- Professor……..... 1
- Associate Professor..... 1
- Assistant Professor..... 2
- Lecturer..... 3
- Instructor..... 4
- Technologist..... 5

1st Year
Paper I: Subject - English

Total hours: 100 hour
Lecture: 66 hour
Practical / Tutorial: 34 hours

Total marks-100
Written-75
Oral & practical- 15
Formative 10

Objectives:

At the end of the course the students will be able to: -

- read & write any story in English and attain HSC level English proficiency
- show proficiency in English grammar (article, tense, voice, phrases & idioms)
- write letters in English (private, Official etc).
- translate & retranslate in English
- read and write essays on different topics in English
- develop listening skills in English
- communicate with each other in English
- read and write laboratory reports/findings in English
- follow written and oral instructions in English of the seniors/authorities

List of Competencies

Ability to--

- write Paragraph, Letter, Application & report in English
- show skill in reading, writing ,listening & Conversations in English
- understand & interpret any reports or manuals in English
- read & write any story in English and attain HSC level English proficiency
- write letters in English (private, Official etc.).
- translate & retranslate in English
- read and write essays on different topics in English
- develop listening skills in English
- communicate with each other in English

Course Contents of English (Part -I) ***Marks = 50***

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	**Tutorial**
1.	**Text book: English for Today-Published by N.C.T.B. (Intermediate)** **Unit- Three: Learning English.** A. Learning a language B. Why to learn English C. How to learn English D. Different learners, different ways E. Dealing with grammar F. Integrated skills development G. How to use dictionary **Unit-Six: Our Environment.** 1. The environment and the ecosystem 2. How the environment is polluted. 3. The world is getting warmer. 4. Let's not be cruel to them. 5. Beware of pollution. 6. Forests should stay. 7. How to manage waste. **Unit-Twenty-four: People, People Everywhere** 1. What's the problem? 2. Kalim Majhee's boat. 3. The rootless. 4. Why is there discrimination? 5-7. The Revenge.	16	

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Tutorial
2.	**Grammar:** **Articles :** ▪ Indefinite & definite articles **Tense:** ▪ Present, Past & Future tense **Voice :** ▪ Active voice ▪ Passive voice ▪ Voice change **Speeches:** ▪ Direct speeches ▪ Indirect speeches **Linkers** ▪ In addition ▪ Besides ▪ Moreover ▪ However ▪ Because ▪ Either or , neither nor **Idioms & Phrases :** **Subjects & predicate** **Parts of speech-** ▪ Noun & its classification ▪ Pronoun & its classification ▪ Adjective & its classification ▪ Verb-Adverb **Conjugation** **Preposition** **Punctuation (**capitalization, fragment, end, comma, semi colon, colon, hyphen, underlining**)** **Spelling** **Wrong words** **Translation** (Bengali to English, English to Bengali), short story writing, technical description, comprehension.	22	
	Paragraph writing : **Letter writing:** **Application writing:** **Report writing :**	10	
	Telegrams & E-mail:	2	

Course Contents of English (Part -II) ***Marks = 25+25***

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	**Tutorial**
	Communicative English : ▪ Reading skill ▪ Writing skill ▪ Listening skill ▪ Conversations skill	 4 4 4 4	 8 8 8 10
	Total	66	34

Teaching Methods:

Lecture

Practical/ Tutorial/Communication

Media:
Multi media,
Laptop,
OHP,
White Board/marker
Black board/ chalk
Wall chart
VCD, DVD, CD

Assessment:

Written – SAQ -75 marks
Practice : Reading, Listening & conversation-15 marks
Formative -10 marks

Paper II : Subject - Basic Anatomy

Total hours: 200 hours **Total marks-200**
Lecture: 70 hours **Written-100**
Tutorial : 60 hours **Oral-40**
Practical/Demons: 70 hours **Practical- 40**
Formative- 20

Objectives:
At the end of the course the students will be able to: -

- acquaint with the anatomical terminologies
- demonstrate a comprehensive knowledge base about the major anatomical organ, system and structure of human body
- identify major anatomical organ, system and structure of human body
- identify the specific structures and organs and application of such knowledge in studying their individual disciplines.
- do surface marking of important organ of human body.

List of Competencies:
Ability to--

- demonstrate a comprehensive knowledge base about the major anatomical organ, system and structure of human body
- identify major anatomical organ, system and structure of human body
- identify the specific structures and organs and application of such knowledge in studying their individual disciplines.
- do surface marking of important organ of human body.

Course Contents of Basic Anatomy

Sl. No	Topics/Lessons	Teaching/learning Hours		
		Lecture	Tutorial	Practical/ Demonstration
1.	**Introductory Anatomy :** **a)** Anatomical Terminologies : i) Definition of Anatomy ii) Anterior, Posterior, superior, inferior, medial, lateral & median plane. **b)** i) Systems of Human body ii) Human cell: structure and classification. iii) Cell division: types. Phases of mitosis iv) Tissue: Types of tissues.	10	05	10
2.	**Musculoskeletal system:** ▪ component ▪ Types of bones & joints ▪ short description of important bones	10	10	05
3.	**Cardio-vascular system.** ▪ Location & Basic structure of cardiovascular system ▪ Short description of heart, major arteries, capillaries/veins	10	05	10
4.	**Respiratory system** ▪ Basic structure of respiratory system ▪ Description of larynx, trachea, bronchi, bronchioles and alveoli ▪ Gross Anatomy of lung	06	06	10

Sl. No	Topics/Lessons	Teaching/learning Hours		
		Lecture	Tutorial	Practical/ Demonstration
5.	**Gastro-intestinal and Hepatobiliary system:** ▪ Short description of the different parts of alimentary system: mouth, tongue, esophagus, stomach, small and large intestine, rectum & anal canal ▪ Anatomy of salivary glands, pancreas, liver, gall bladder	10	10	10
6.	**Genito –urinary system:** ▪ Anatomy of urinary system ▪ Male genital system: ▪ Female genital system	10	10	10
7.	**Nervous system and Endocrine system.** ▪ Basic structure of nervous system ▪ Parts of nervous system and short description of brain, spinal cord, cranial nerves, peripheral nerves ▪ Autonomy of nervous system and short description of sense organs-eye, ear, nose, throat, tongue and skin ▪ Important endocrine glands	12	12	10
8.	**Lymphatic System :** ▪ Anatomy of lymph nodes and vessels	02	02	05
	Total	70	60	70

Teaching Methods:

Lecture
Tutorial
Practical/ Demonstration

Media:

Multimedia,
Laptop,
OHP,
White Board/Marker,
Black/board
Skeleton
Wall chart
Microscope

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper III : Subject - Basic Physiology

Total hours: 200 hours
Lecture:75 hours
Tutorial: 60
Practical: 65

Total marks-200
Written-100
Oral -40
Practical- 40
Formative- 20

Objectives:
At the end of the course the students will be able to: -

- Demonstrate a comprehensive knowledge on functional aspects of different important components, organs and systems of human body.

- Apply the practical knowledge of human physiology in studying and performing the allotted tasks in their individual discipline.

List of Competencies

- Ability to demonstrate a comprehensive knowledge on functional aspects of different important components, organs and systems of human body.

- Ability to apply the practical knowledge of human physiology in studying and performing the allotted tasks in their individual discipline.

Course Contents of Basic Physiology

Sl. No	Topics/Lessons	Teaching/learning Hours		
		Lecture	Tutorial	Practical/ Demonstration
1.	**Introductory Physiology:** ▪ Physiological terminologies ▪ Basic structure and organizations of human body ▪ Cell physiology and metabolism/multiplication of living cells ▪ General functions of different systems of the body: Musculoskeletal/Respiratory/ Circulatory/Digestive/Urinary/Nervous/ Endocrine/Immune/ Reproductive	10	04	10
2.	**Musculoskeletal system :** ▪ Physiological components of musculoskeletal system ▪ Functions of important muscles, bones & joints of human body ▪ Movements of joints	10	10	05
3.	**Cardiovascular System:** ▪ Functions of circulatory system ▪ Composition of Blood and their Functions ▪ Conductive system of heart & Cardiac cycle ▪ Physiology of Blood Pressure	10	05	10

Sl. No	Topics/Lessons	Teaching/learning Hours		
		Lecture	Tutorial	Practical/ Demonstration
4	**Respiratory system :** ▪ Functions of respiratory system ▪ Mechanism of breathing	05	05	10
5	**Digestive and hepatobiliary system:** ▪ Definition of digestion, absorption, metabolism ▪ Digestion, absorption & metabolism of carbohydrate, fat & protein ▪ Nutritional deficiency disorders : anemia, iodine deficiency, vitamin deficiencies ▪ Functions of liver, pancreas and gall bladder ▪ Composition & functions of different digestive juices & bile	10	10	10
6	**Genitourinary system:** ▪ Functions of Kidney ▪ Formation, appearance and composition of urine ▪ Functions of reproductive organs of both sexes: uterus/ovary/fallopian tube/vagina/ penis/testes/scrotum/vas deferens/prostate	10	10	10
7	**Nervous system, organs of special sense:** ▪ Functions of motor, sympathetic & parasympathetic nervous system ▪ Functions of cranial nerves ▪ Cerebrospinal fluid formation, composition & function ▪ Functions of special sense organs-eye, ear, nose, tongue and skin ▪ Functions of the endocrine glands & hormones secreted by them: Pituitary / thyroid / parathyroid / adrenal /gonads/pancreas/placenta	12	10	10
8	**Immune System :** ▪ Definition/classification and components of immune system ▪ Cells and tissues of immune system & their functions	05	05	
9	**Lymphatic System :** ▪ Structure & functions of lymph nodes and vessels	03 05	01	
	Total	75	60	65

Teaching Methods: Lecture, Tutorial, Practical/ Demonstration

Media:

Multimedia, Laptop, OHP, White Board/Marker, Black board/chalk, Wall chart, Lab. Reagent & Apparatus, Microscope

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks

Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper IV : Subject – Basic Community Medicine & Behavioural Science

Total hours: 200 hour
Lecture: 150 hour
Practical / Tutorial: 50 hours

Total marks-200
Written-100
Oral-40
Practical- 40
Formative- 20

Objectives

At the end of the course the students will be able to: -

- describe the general aspects of community medicine
- describe the basic concepts of epidemiology
- explain the concept of primary health care
- define organizations of health services and major health program in Bangladesh
- carry on elementary bio-statistics
- describe the concept of Demography and Family Planning
- define Maternal and Child Health (MCH), describe its objectives and explain the importance of ante-natal and post-natal care for mother and children
- define food and nutrition and be aware of nutritional problems in Bangladesh
- acquaint themselves with occupational health hazards and their preventive and protective measures
- describe the principles of health education and their application in the community
- acquaint themselves with environmental pollution and methods of prevention and control of pollution
- explain the basic concept of Essential Service Package (ESP)

List of Competencies:

Ability to --

- describe the general aspects of community medicine
- describe the basic concepts of epidemiology
- explain the concept of primary health care
- define organizations of health services and major health program in Bangladesh
- carry on elementary bio-statistics
- describe the concept of Demography and Family Planning
- define Maternal and Child Health (MCH), describe its objectives and explain the importance of ante-natal and post-natal care for mother and children
- define food and nutrition and be aware of nutritional problems in Bangladesh
- acquaint themselves with occupational health hazards and their preventive and protective measures
- describe the principles of health education and their application in the community
- acquaint themselves with environmental pollution and methods of prevention and control of pollution
- explain the basic concept of Essential Service Package (ESP)

Course Contents of Basic Community Medicine

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	**Practical/ Demonstration**
1.	**Introductory community medicine:** ▪ Definition of Community Medicine ▪ Concept of health : Definition / Dimensions / Spectrum / Determinants / Indicators ▪ Concept of general principles for prevention and control of communicable and Non-communicable diseases ▪ Concept of health promotion: Definition / Interventions	16	10
2.	**Primary health care:** ▪ Definition/Elements/ Principles/Scope	05	02
3.	**Health care services and organization:** ▪ Primary/Secondary/Tertiary Health Care services ▪ WHO/UNDP/UNICEF/CARE/ International Red Crescent / BIRDEM / ICDDR,B	06	02
4.	**Basic Epidemiology:** ▪ Definition /Aims/Methods/Scope ▪ Definition of epidemiological terms eg. Epidemic/Endemic/Pandemic/Sporadic/ Zoonotic disease/ Incubation period/ period of communicability/ Epidemiological Triad/ Infection/ Contamination/ Infestation etc. ▪ Major health programs in Bangladesh ▪ Medical Information system (MIS)	12	06
5.	**Basic Bio-statistics :** ▪ Definition /Scope/Functions/Importance and uses of Biostatistics, Medical statistics, Health statistics, Vital statistics ▪ Definition of vital events ▪ Definition/types/characteristics/functions/importance/sources/collection and presentation of data ▪ Morbidity/Mortality/Fertility statistics	17	04

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
6.	**Demography and family planning**. ▪ Demography: Definition/Focus/Process/Stages/Cycle and how to conduct census ▪ Family Planning: Definition/ Objectives/ Scope/Health aspects/Benefits ▪ Contraceptive methods: Short description /Advantages/Disadvantages/Indications/ Contraindications/ Complications	12	04
7.	**Maternal and Child Health Care (MCH):** ▪ Introduction/Definition/Aims & Objectives / Components of MCH ▪ Maternal health care: Antenatal/Intra natal/Postnatal ▪ Care of the New-born/Under 5 children ▪ Indicators of MCH care: MMR, IMR etc	10	
8.	**Food and nutrition:** ▪ Food: Definition/Functions/Classification ▪ Sources/types/functions/daily requirements and deficiency of protein, fat, carbohydrate, vitamins and minerals ▪ Definition of nutrition /Balanced Diet ▪ Malnutrition: Definition/Forms/Causes and prevention ▪ Common nutritional problems of Bangladesh: low Birth Weight/Protein Energy Malnutrition/ Nutritional Blindness/ Nutritional Anemia/ Lathyrism	15	06
9.	**Occupational Health :** ▪ Occupational health : Definition /Objectives ▪ Occupational Hazards: Introduction /Types ▪ Occupational diseases: Definition/Classification/Prevention and control	08	02
10.	**Health education behavioral science and Ethics:** ▪ Health Education: Definition/Importance / Objectives / Components/ Principles/Methods /Media ▪ Communication Skills: Definition/Key elements /Barriers ▪ Behavioral Science : Introduction & concept ▪ Ethics: Introduction and concept	12	04

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
11.	**Environment and sanitation:** ▪ Definition of environment, pollution, sanitation and environmental sanitation ▪ Water: Safe wholesome water/Source of water/water pollution/Hazards of water pollution /water borne diseases/Hardness of water/ Purification of water ▪ Air : Definition/Composition ▪ Air pollution : Sources, pollutants, indicators, health & other effects, prevention & control ▪ Ventilation: Definition/Standards/ Types/ Criteria of good ventilation / effects of good ventilation ▪ Solid waste: Definition/Types/Sources/Health hazards ▪ Disposal of solid waste: Dumping/Controlled tipping or sanitary land fill/ incineration/ composting/Manure pits/Burial ▪ Excreta or night soil: Public health importance/Health hazards/how disease occurs from it/Sanitation Barrier/ Methods of excreta disposal (Unsewered area/Sewered area)	25	04
12.	**First Aid :** ▪ Definition / Principles of First Aid ▪ First Aid Box-List of contents and their uses ▪ First Aid of : Cuts, bleeding, burn, shock, dog bite, snake bite	12	06
	Total	150	50

Teaching Methods:

Lecture
Tutorial
Practical/ Demonstration

Media:

Multi media, Laptop, OHP, White Board/Marker,
Black board/chalk
Wall chart
Models & Samples

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper V : Subject - Basic Computer Science

Total hours: 100 hour
Lecture: 25 hour
Practical / Tutorial: 75hours

Total marks-100
Written-50
Practical- 40
Formative-10

Objectives:
At the end of the course the students will be able to: -

- acquaint with the modern computer technology
- start**,** Shutdown and restore the windows
- open, close & edit the file
- develop skills in ms word, ms-excel, power point, internet
- create chart, graph , tables etc.
- install different programs & software
- prepare reports of various investigations
- do internet browsing & other applications of internet

List of Competencies
Ability to--

- deal with the modern computer technology
- show skills in ms word, ms-excel, power point
- prepare reports of various investigations
- internet browsing & other applications of internet

Course Contents of Basic Computer Science

Sl No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Tutorial/ Practical
1.	**Detailed Contents :** **Relevant Instruction for Practical :** ▪ Information Technology -its concept and scope ▪ Computers for information storage, information seeking, information processing and information transmission ▪ Elements of computer system - computer hardware and software: data -numeric data, numeric data; contents of program, processing ▪ Computer organization, block diagram of a computer, CPU, memory ▪ Input devices; keyboard, mouse etc; output devices; VDU and Printer, scanner, Plotter ▪ Electrical requirements, inter-connections between units, connectors and cables ▪ Secondary storage; magnetic disks-tracks and sectors, optical disk (CD and DVD Memory), primary and secondary memory: RAM, ROM, PROM etc. ▪ Capacity; device controllers, serial port, parallel port system bus 47 ▪ Exercises on file opening and closing; memory management; device management; device management and input-output (I/O) management with respect of windows ▪ Installation concept and precautions to be observed while installing the system and software ▪ Introduction about Operating systems such as and Windows ▪ Special features, various commands of MS word and MS- Excel, Power -point ▪ About the internet-server types, connectivity (TCOP/IP, shell); applications of internet like: e-mail and browsing ▪ Various Browsers like WWW (World wide web); hyperlinks; HTTP (Hyper Text Transfer Protocol); FTP (File Transfer Protocol) ▪ Basic of Networking -LAN, WAN, Topologies	25	
	▪ Give a PC, name its various components and list their functions ▪ Identification of various parts of a computer and peripherals ▪ Practice in installing a computer system by giving connection and loading the system software and application software ▪ Installation of DOS and simple exercises on TYPE, REN, DEL, CD, MD, COPY, TREE, BACKUP commands ▪ Exercises on entering text and data (Typing Practice) ▪ Installation of Windows 98 or 2000 etc. ▪ Features of windows as an operating system ▪ Start ▪ Shutdown and restore ▪ Creating and operating on the icons ▪ Opening, closing and sizing the windows ▪ Using elementary job commands like-creating, saving, modifying, finding and deleting a file ▪ Creating and operating on a folder ▪ Changing setting like, date, time color (back ground and fore ground) ▪ Using short cuts ▪ Using on line help		

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Tutorial/ Practical
	▪ MS-WORD ▪ File Management Opening, creating and saving a document, locating files, copying contents in some different file (s), protecting files, Giving password protection for a file ▪ Page set up : Setting margins, tab setting, ruler, indenting ▪ Editing a document : Entering text, Cut, copy, paste using tool-bars ▪ Formatting a document : Using different fonts, changing font size and color, changing the appearance through bold/italic/underlines, highlighting a text, changing case, using subscript and superscript using different underline methods ▪ Aligning of text in document, justification of document, Inserting bullets and numbering : ▪ Formatting paragraph, inserting page breaks and column breaks ▪ Use of headers, footers: Inserting footnote, end note, use of comments ▪ Inserting date, time, special symbols, importing graphic images, drawing tolls ▪ Tables and Borders Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting row in a table ▪ Print preview, zoom, page set up, printing options ▪ Using Find, Replace options ▪ Using Tools like: Spell checker, help, use of macros, mail merge, word content and statistics, printing envelops ▪ Using shapes and drawing toolbar ▪ Working with more than one window in MS Word, ▪ How to change the version of the document from one window OS to another ▪ Conversion between different text editors, software and MS word		30

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Tutorial/ Practical
	MS -Excel : ▪ Starting excel, open worksheet, enter, edit, data, formulas to calculate values, format data, create chart, printing chart, save worksheet, switching from another spread sheet ▪ **Menu Commands :** Create, format charts, organize, manage data, solving problem by analyzing data, exchange with other applications. Programming with MS Excel, getting information while working ▪ **Work Books :** Managing workbooks (create, open, close, save) working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations, working with arrays ▪ Editing a worksheet, copying, moving cells, pasting, inserting, deleting cells, rows, columns, find and replace text, numbers of cells, formatting worksheet **:** ▪ **Creating a chart :** Working with chart types, changing data in chart, formatting a chart, use chart to analyze data ▪ **Using a list to organize data, sorting and filtering data in list** ▪ **Retrieve data with MS -Query: Create a pivot table, customizing a pivot table. Statistical analysis of data.** ▪ **Customize MS-Excel:** How to change view of worksheet, outlining a worksheet, customize workspace, using templates to create default workbooks, protecting work ▪ **Exchange data with other application: linking and embedding, embedding objects, linking to other applications, import, export document**		20
	Power Point : ▪ Making Slide following the rules & principles ▪ Slide Projection		10
	Internet and its Applications : ▪ Log -in to internet ▪ Navigation for information seeking on internet ▪ Browsing and down loading of information from internet ▪ Sending and receiving e-mail ▪ Creating a message ▪ Creating and address book ▪ Attaching a file with e-mail message ▪ Receiving a message ▪ Deleting message		15
	Total=	**25**	**75**

Teaching Methods:

Lecture
Practical

Media:

Computer
Multi media
Computer lab.
Internet connection
White Board
Marker

Assessment:

Written – SAQ- 50 marks
Oral and Practical – 40 marks
Formative – 10 marks

2nd Year

Paper I : Subject - Physics

Total hours: 70 hour
Lecture : 40hour
Practical/Tutorial: 30 hours

Total marks -100
Written – 75
Oral -10
Practical - 15

Objectives:
At the end of the course, the students will be able to-

- define Physics and state the importance of Physics in the Health Care System.
- describe the different systems of measurement and weights.
- demonstrate basic knowledge on measurement of density and specific gravity of a substance.
- demonstrate basic knowledge on fundamental aspects of heat and temperature, sound, light, electricity and magnetism.

List of Competencies:
Ability to

- define Physics and state the importance of Physics in the Health Care System.
- describe the different systems of measurement and weights.
- demonstrate basic knowledge on measurement of density and specific gravity of a substance.
- demonstrate basic knowledge on fundamental aspects of heat and temperature, sound, light, electricity and magnetism.

Course Contents of Physics

Sl.No	Topic/Lessons তত্ত্বীয়	Teaching/Learning Hours	
		Lecture	Practical
১।	**বলবিদ্যা ও পদার্থের ধর্ম ঃ** ➢ সরল রেখার গতি, গতির সমীকরণ, নিউটনের গতির সূত্র ত্বরণ ও বল, খাত বল, ভেকটর ও সেলের রাশি। ➢ কৌণিক গতি, কৌণিক বেগ ও ত্বরণ বৃত্তাকার পথে গতি, কেন্দ্রভিগ বল। ➢ কাজ, ক্ষমতা ও শক্তি, শক্তির সংরক্ষণ নীতি। ➢ সরল দোল গতি, সরল দোলক ➢ আর্কিমিডিসের সূত্র ও তার প্রয়োগ আপেক্ষিক গুরুত্ব নির্ণয়।	০৮ ঘন্টা	
২।	**তাপ ঃ** তাপমিতি, তাপের একক, আপেক্ষিক তাপ, তাপীয় ক্ষমতা পানিসমও সুপ্ততাপ এবং ইাহাদের নির্ণয় পদ্ধতিঃ সরলীয় পদ্ধতিতে তাপের পরিবাহিতা নির্ণয়।	৫ ঘন্টা	
৩।	**শব্দ ঃ** ➢ শব্দের উৎপত্তি ও শব্দ সালন, আড় তরঙ্গ ও দীঘল তরঙ্গ শব্দের ব্যভিচার ও বীট। বীটের সাহায্যে কম্পন সংখ্যা নির্ণয়। ➢ শব্দের বেগ নির্ণয়। ➢ টানা তারের আড় কম্পন, সূত্রের প্রমাণ।	৫ ঘন্টা	

৪।	**আলোক ঃ** ➢ গোলীয় পৃষ্ঠে প্রতিফলন। ➢ সমতল ও গোলীয় পৃষ্ঠে প্রতিফলন। সম্পূর্ণ প্রতিফলন, প্রতিসরাংক, প্রিজম প্রতিসারণ। ➢ লেন্সঃ উত্তল ও অবতল লেন্স। লেন্সের শক্তি ও বিবর্ধন লেন্স সংযোজন। চোখের ত্রুটি সমূহ ও প্রতিকার। ➢ আলোক যন্ত্র-মাইক্রোস্কোপ।	৫ ঘন্টা	
৫।	**চুম্বক ঃ** ➢ চুম্বকনের বিভিন্ন পদ্ধতিঃ চুম্বকের মতবাদ, চুম্বকের ক্ষেত্র ও প্রবাল্য। বিপরীত বর্গীয় সূত্র প্রান্তমূখী ও প্রস্থমূখী অবস্থানে চুম্বকের প্রাবল্য। বিক্ষেপী চুম্বকমান যন্ত্র ও ইহার ব্যবহার। ➢ ভুচুম্বকত্ব।	৪ ঘন্টা	
৬।	**তড়িৎ ঃ** ➢ স্থির তরিৎ, চার্জের অস্তিত্ব ও প্রকৃতি নির্ণয়। বৈদ্যুতিক আবেশ, কুলম্বের সূত্র, ধারকত্ব, তড়িৎ বিভব। সমান্তরাল পাত ধারক। ➢ বিদ্যুৎ কোষ, তাদের কেন্দ্রে উৎপন্ন চুম্বকক্ষেত্র। বিদ্যুৎ প্রবাহ ও চার্জের একক। ➢ ওহমের সূত্র, বিভব বৈষম্যের একক। রোধ ও আপেক্ষিক রোধ, রোধের একক, রোধ সংযোজন, এমিটার, ভোল্ট মিটার। ➢ বৈদ্যুতিক পরিমাপ, হুইট স্টোম ব্রিজ, মিটার ব্রিজ, পোস্ট অফিস বক্স ও পাটেন শিও মিটার। ➢ তড়িৎ প্রবাহ ও উত্তাপ, জুলের সূত্র, বৈদ্যুতিক পদ্ধতিতে নির্ণয়। ➢ তড়িৎ প্রবাহে রাসায়নিক ক্রিয়া, তড়িৎ বিশেষণ, সূত্র ও ইহাদের প্রমাণ। ➢ তড়িৎ চুম্বকীয় আবেশ।	১৩ ঘন্টা	
	ব্যবহারিক	৪০	

Sl.No	**Topic/Lessons**	**Teaching/Learning Hours**	
		Lecture	**Practical**
৭।	**১। স্লাইড ক্যালিপার্স, ব্রুজ ও স্পেরোমিটারের ব্যবহার শিক্ষা।**		৩ ঘন্টা
	২। পানি অপেক্ষা হালকা/ভারি তরল ও কঠিন পদার্থের হাইডো-স্টেটিক ব্যালেন্স, নিকলসন হাইড্রেমিটার ও আঃ হাইড্রো বোতলের সাহায্যে আপেক্ষিক গুরুত্ব নির্ণয়।		৩ ঘন্টা
	৩। সরল দোলকের সাহায্যে জি এর মান নির্ণয়।		৩ ঘন্টা
	৪। একটি ক্যালরিমিটারের সাহায্যে পানিসম নির্ণয়।		২ ঘন্টা
	৫। কঠিন ও তরলের আপেক্ষিক তাপ নির্ণয়।		৩ ঘন্টা
	৬। অবতল দর্পনের ফোকাস দুরত্ব নির্ণয়।		২ ঘন্টা
	৭। প্যারালাক্স পদ্ধতিতে উত্তল লেন্স ফোকাস দুরত্ব নির্ণয়।		২ ঘন্টা
	৮। একখানা কাচ ফলকের প্রতিসরাংক নির্ণয়।		৩ ঘন্টা
	৯। ওহমের সূত্রের সত্যতা নির্ণয়।		৩ ঘন্টা
	১০। যে কোন দৈর্ঘের তারে আপেক্ষিক রোধ নির্ণয়।		৩ ঘন্টা
	১১। নাল পদ্ধতিতে দুইখানা দন্ড চুম্বকের চৌম্বক ভ্রামকের তুলনা।		৩ ঘন্টা
	মোট ঃ ৭০ ঘন্টা	৪০	৩০

মান বন্টন ঃ তত্ত্বীয় = ৬০

১। পদার্থের সাধারণ ধর্ম, আলোক ও তড়িৎঃ প্রতিটি শাখা থেকে ৮ নম্বরের দুটি ও ৪ নম্বরের ২টি করে মোট (৬টি + ৬টি)= ১২টি প্রশ্ন আকারে। তন্মধ্যে ৮ নম্বরের ১টি করে ৩ শাখায় ৩টি ও ৪ নম্বরের ১টি করে ৩ শাখার ৩ টি অর্থাৎ মোট ৬টি প্রশ্নের উত্তর দিতে হবে।

8 x 1x 3 = 24
4 x 1x 3 = 12

২। শব্দ ও তাপ ও চুম্বকতত্ত্বঃ প্রতিটি শাখা থেকে ৪ নম্বরের ৪টি করে মোট ১২টি প্রশ্ন থাকবে। সেগুলোর মধ্যে থেকে ২টি করে মোট ৬টি প্রশ্নের উত্তর দিতে হবে।

4 x 2x 3 = 24

দ্রষ্টব্যঃ বলবিদ্যা ও পদার্থের ধর্ম থেকে ও অন্য যে কোন শাখা থেকে ১টি পরীক্ষণ করতে হবে।

ব্যবহারিকঃ ক্লাস রেকর্ড ৯+১ নং ও ২নং পরীক্ষণ ৮ করে = ১৫ মার্কস
মৌখিক ও ফরমেটিভ = ১০, লিখিত = ৭৫ মার্কস
মোট ঃ তত্ত্বীয়+ব্যবহারিক+মৌখিক = ১০০ মার্কস

Paper II: Subject - Chemistry

Total hours: 100 hour
Lecture : 80 hour
Practical/Tutorial: 20 hours

Total marks -100
Written – 75
Oral - 10
Practical - 15

Objectives:
At the end of the course, the students should be able to:

- describe fundamentals in physical chemistry.
- explain common laboratory process.
- identify organic and inorganic chemical compounds.
- describe the different aspects of metals, non-metal and gaseous substances.

List of Competencies:
Ability to--

- describe fundamentals in physical chemistry.
- explain common laboratory process.
- identify organic and inorganic chemical compounds.
- describe the different aspects of metals, non-metal and gaseous substances.

Course contents of Chemistry

Sl.No	Topic/Lessons	Teaching/Learning Hours	
		Lecture	Practical
	গ্রুপ -ক ভৌত রসায়ন		
	১। ভৌত ও রাসায়নিক পরিবর্তন ও এদের মধ্যে পার্থক্য।	১ ঘন্টা	
	২। পদার্থের গঠনঃ অণু ও পরমানু-অণুর সংজ্ঞা, আন্তঃআণবিক দুরত্ব, আন্তঃআণবিক, কঠিন, তরল, গ্যাস, পরমানু, পারমানবিক ও আনবিক ওজন।	৫ ঘন্টা	
	৩। সাধারণ পরীক্ষাগার প্রণালীঃ দ্রবণ, অভিস্রবণ, পরিস্রাবণ ও অতিপৃক্ত দ্রবণ, দ্রাব্যতা, বাষ্পীভবন, পাতন, আংশিক পাতন, উর্ধ্বপাতন, কেলাসন।	৪ ঘন্টা	
	৪। প্রতীক, সংকেতঃ প্রতীক, আনবিক সংকেত, যোজ্যতা, রেডিক্যাল এবং তাদের যোজনী, যোজনী থেকে আনবিক সংকেত নির্ণয়, গাঠনিক সংকেত।		
	৫। রাসায়নিক বিক্রিয়াঃ বিভিন্ন প্রকারের রাসায়কি ক্রিয়া, রাসায়নিক বিক্রিয়া ঘটানোর উপায় সমূহ।	৪ ঘন্টা	
	৬। অল্ল, ক্ষারক ও লবন।		
	৭। গ্যাসের ধর্ম-বয়েলের সূত্র, চার্লসের সূত্র।	৪ ঘন্টা	
	৮। মৌলের রাসায়নিক তুল্যাংক বা যোজন ভার।	২ ঘন্টা	
	৯। পরমানুর গঠন এবং যোজ্যতার ইলেকট্রনীয় মতবাদ।	২ ঘন্টা	
	বিভিন্ন রাসায়নিক বন্ধন।	২ ঘন্টা	
	১০। ক) এভোগ্যাড্রে সূত্র খ) ভরক্রিয়া সূত্র।	৪ ঘন্টা	
	১১। রাসায়নিক সংযোগ বিধিঃ	২ ঘন্টা	
	ক) ভরের নিত্যতা সূত্র। খ) নির্দিষ্ট অনুপাত সূত্র।	৫ ঘন্টা	
	গ) গুনানুপাত বিধি। ঘ) বিপরীত অনুপাত সূত্র।		
	ঙ) গ্যাস আয়তন সূত্র।		
	গ্রুপ -খ অধাতু ঃ		

Sl.No	Topic/Lessons	Teaching/Learning Hours	
		Lecture	Practical
	১। নিম্নোক্ত পদার্থ গুলোর উৎস, প্রস্তুতি, ধর্ম এবং ব্যবহারঃ	৭ ঘন্টা	
	ক) অক্সিজেন, ওজোন, পানি ও হাইড্রোজেন পার অক্সাইড।		
	খ) হোলাজেন সমূহ ঃ ক্লোরিন, রোমিন, আয়োডিন ও হাইড্রো ক্লোরিক এসিড।		
	গ) নাইট্রোজেন, হাইড্রোজেন সালফাইট, সালফার ডাইঅক্সাইড।		
	ঘ) সালফার, হাইড্রোজেন সালফাইট, সালফার ডাইঅক্সাইড, সালফিউরিক এসিড।		
	ঙ) ফসফরাস চ) জারন-বিজারনঃ জারক ও বিজারক পদার্থ		
	২। ধাতুঃ নিম্নোক্ত পদার্থ গুলোর উৎস, প্রস্তুতি, ধর্ম এবং ব্যবহারঃ		
	ক) সোডিয়াম-সোডিয়াম হাইড্রোঅক্সাইড, সোডিয়াম কার্বনেট, সোডিয়াম ক্লোরাইড।	৬ ঘন্টা	
	খ) ক্যালসিয়াম-ক্যালসিয়াম কার্বনেট, ক্যালসিয়াম ফ্লোরাইড, ক্যালসিয়াম সালফেট, বি-চিং পাউডার।	১ ঘন্টা	
	৩। কপার -কপার অক্সাইড, কপার সালফেট, কপার ফ্লোরাইড	১ ঘন্টা	
	৪। জিংক - জিংক অক্সাইড, জিংক ফ্লোরাইড, জিংক সালফেট।		
	৫। এলুমিনিয়াম - এলুমিনিয়াম ফ্লোরাইড, এলুনিয়াম সালফেট।	১ ঘন্টা	
	৬। আয়রন - আয়রন সালফেট।	১ ঘন্টা	
	৭। লেড - লেড অক্সাইড।	১ ঘন্টা	
	৮। সিলভার - সিলভার নাইট্রেট।	১ ঘন্টা	
	গ্রুপ - গ জৈব রসায়ন		
	১। জৈব রসায়নের সংজ্ঞা, জৈব ও অজৈব যৌগের মধ্যে পার্থক্য জৈব যৌগের গঠন, শ্রেণী বিভাগ, কার্যকরী বা ক্রিয়াশীল মূলক।	৪ ঘন্টা	
	২। জৈব যৌগের নিষ্কাশন ও বিশুদ্ধকরণ	১ ঘন্টা	
	৩। সম্পৃক্ত ও অসম্পৃক্ত হাইড্রোকার্বনঃ প্রস্তুত প্রণালী, ধর্ম এবং ব্যবহার -মিথেন, ইথেন, ইথিলিন, এসিটাইলিন।	২ ঘন্টা	
	৪। এলকোহল হ্যালোজেন জাতকঃ মিথাইল ফ্লোরাইড, ক্লোরোফর্ম এর প্রস্তুতি, ধর্ম ও ব্যবহার।	৪ ঘন্টা	
	৫। এলকোহলঃ শ্রেণী বিভাগ, মিথাইল এলকোহল, ইথানল এলকোহল ও গিসারিনের প্রস্তুতি, ধর্ম ও ব্যবহার।	২ ঘন্টা	
	৬। ডাই-ইথাইল ইথারঃ প্রস্তুতি, ধর্ম ও ব্যবহার।	১ ঘন্টা	
	৭। এলডিহাইড ও কিটোল সমূহঃ নিম্নলিখিত যৌগসমূহের প্রস্তুতি, ধর্ম ও ব্যবহার, ফরমালড্রিহাইড, এসিটালডিহাইড ও এসিটোন।	৩ ঘন্টা	
	৮। কার্বলিক এসিডঃ এসেটিক এসিড ও সাইট্রেক এসিসেডর প্রস্তুতি, ধর্ম ও ব্যবহার।	৩ ঘন্টা	
	৯। এলকোহল এ্যামাইনঃ এ্যামাইনের শ্রেণী বিভাগ, মিথাইল এ্যামাইন ও ইথাইল এ্যামাইনের প্রস্তুতি, ধর্ম ও ব্যবহার।	২ ঘন্টা	
	১০। এ্যারোমেটিক যৌগঃ নিম্নলিখিত যৌগসমূহের প্রস্তুতি, ধর্ম ও ব্যবহার। বেনজিন, টলুইন, ফ্লোরোবেজিন নাইট্রোবেজিন, অ্যানিলিন, কার্বলিক এসিড, বেনজালডিহাইড, বেনজোয়িক এসিড ও স্যালিসাইলিক এসিড।	৪ ঘন্টা	
	ব্যবহারিক ঃ		
	১। অম্ল ও ক্ষারের মাত্রা নির্ণয়।		২০ ঘন্টা
	২। হাইড্রোজেন ও অক্সিজেনের প্রস্তুতি।		
	৩। সহজ জৈব ও অজৈব যৌগের আঙ্গিক বিশেষণ।		
	মোট ঃ ১০০ ঘন্টা	৮০ ঘন্টা	২০ ঘন্টা

মান বন্টন ঃ লিখিত পরীক্ষা=৭৫ মার্কস, ব্যবহারিক = ১৫মার্কস, মৌখিক/ফরমেটিভ =১০ মার্কস

গ্রুপ - ক- ২০ নম্বর

গ্রুপ - খ - ২০ নম্বর

গ্রুপ - গ - ২০ নম্বর

গ্রুপ -ক থেকে ৩টি, গ্রুপ -খ থেকে ৩টি এবং গ্রুপ -গ থেকে ৩টি মোট ৯টি প্রশ্ন থাকবে। তন্মধ্যে প্রত্যোক গ্রুপ থেকে অন্ততঃপক্ষে ২ টি করে মোট ৬টি প্রশ্নের উত্তর দিতে হবে।

Paper III: Subject - Basic Microbiology & Parasitology

Total hours: 100-hour
Lecture: 80 hour
Practical: 20 hours

Total marks-200
Written-100
Oral-40
Practical- 40
Formative- 20

Learning objectives:

At the end of the course the students will be able to –

- Define and classify microorganisms, define and explain microbiological terminologies.
- Identify, use and maintain microbiological articles, equipment, apparatus including microscope and mention parts when applicable.
- Clean, wash, decontaminate, disinfect & sterilization microbiological articles, instruments, glass wares etc.
- Define, classify, and mention morphology of bacteria, virus, fungus, parasite and helminth.
- Name medically important bacteria, virus, fungus, parasite, helminth and diseases caused by them.
- Explain anatomy bacteria and bacterial spores: pathogenicity of medically important bacteria, growth & multiplication of bacteria.
- Identify, staining and culture medically important bacteria.
- Mention knowledge about PPE
- Demonstrate basic knowledge of immunity.

List of Competencies:

1. demonstrate basic knowledge on common microbiological and parasitological issues.
2. perform identification of different microorganisms particularly bacteria & fungus of medical importance ensuring laboratory safety using microbiological, reagents, equipment and apparatus.
3. provide best services to the stakeholders using the knowledge and skills.

Course Contents of Basic Microbiology & Parasitology

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture / Tutorial on Theories	**Practical/ Demonstration/Field visit**
1.	**Introduction to microorganisms:** ▪ Definition and classification of microorganisms ▪ Microbiological terminology ▪ Characteristics of Eukaryotic prokaryotic & sub cellular groups of microorganisms ▪ Microbiological articles, equipment's apparatus ▪ Microscope: Different parts of microscope, & maintenance of microscope	08	03
2.	**Destruction of microorganism:** ▪ Cleaning, Washing, decontamination disinfection & procedures ▪ Sterilization of different laboratory articles, instruments, glass wares etc.	07	03
3.	**Bacteria:** ▪ Anatomy of Bacteria, chemical composition of different structures of bacteria ▪ Bacterial Spore: Definition & function spores, Spores bearing bacteria of medical importance ▪ Bacterial toxin: Definition & types of bacterial toxin, characteristics of endotoxin & exotoxin, Toxin producing organism of medical importance, use of bacterial toxins in diseases prevention ▪ Biology of bacteria: Growth & multiplication of bacteria, bacteria growth curve, bacteria growth requirements. Definition & classification of culture media ▪ Classifying bacteria in terms of morphology, staining, spore, flagella, capsule & Pathogenicity. ▪ Staining bacteria: Gram's staining, AFB staining, Albert staining	15	04
	Virus: ▪ General characters of virus ▪ Morphology & classification of virus ▪ List of viruses of medical importance & diseases produced by them	10	01

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture / Tutorial on Theories	Practical/ Demonstration /Field visit
	Fungus: ▪ General character, Morphology and classification of fungus ▪ List of fungus list medical important and the diseases produced by them	10	02
	Parasite: ▪ Definition /Classification of parasite	03	01
	Helminth: ▪ General characteristics of helminths ▪ Classification /Morphology of helminths	08	02
	Protozoa: ▪ General characteristics of protozoa ▪ Definition /Classification of protozoa	10	02
	PPE: ***Personal protective equipment*** (***PPE***) for different healthcare activities	04	01
	Immunity: **Basic Concept of immunity and immunization Schedule.**	05	01
	Total	**80**	**20**

Teaching Methods:

- Lecture
- Tutorial
- Practical/ Demonstration
- Field visit

Media:

- Multimedia and Laptop
- OHP and transparencies
- White Board and markers
- Blackboards and chalk
- Online and computer based teaching learning materials
- Laboratory: (Microscope, Autoclave, Hot Air Oven, Incubator, Haemocytometer, Haemoglobin meter, Analytical balance, Centrifuge machine, Rotator, Refrigerator, Photometer, Electrolyte analyzer, Electrophoresis apparatus, ELISA reader, PCR machine, Cell counter etc.)
- Hospital/ Health complex

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper IV: Subject - Radiological Anatomy, Physiology and Pathology

Total hours: 250 hours
Lecture : 100 hours
Practical : 150 hours

Total marks : 200
Written : 100
Oral : 40
Practical : 40
Formative : 20

Objectives:

At the end of the course the students will be able to-

- define and explain radiological important human anatomical, physiological and pathological terminologies, issues, classifications and conditions.
- perform surface marking of radiological important human anatomical organs and areas.
- classify, name and give short descriptions of radiological important human cells, tissues, bones, joints and muscles, human organs and organ systems; explain their radiological important functions and functional elements; mention the causes of radiological important diseases.
- mention radiological appearance of the relevant human bones, joints and muscles, organs and organ systems and compare their radiological appearance by using contrast and without contrast medium both in normal and disease conditions.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitude on structural, functional and radiological aspects of different parts, tissues, organs and systems of human body in normal and disease conditions relevant with the course.
- apply these knowledge, skills and attitude in studying and performing the allotted tasks as a radiologist.

Course Contents of Radiological Anatomy

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	• **Anatomical Terms**-Human body planes: Median plane, coronal plane, saggital plane, Para median plane, anterior, posterior, superficial, ventral, cranial, caudal, proximal, Distal, medial, supine, lateral, prone, oblique, Horizontal, transverse, adduction, abduction, rotation, circumfusion, flexion, extension and Anatomical position.	5	8

Course Contents of Radiological Anatomy

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
2.	▪ **Surface Anatomy**: Surface markings of PNS, Mastoid, Larynx, Nasopharynx, Orbit, Trachea, Esophagus, Lung, Mediastinum, Heart, Diaphragm, Aorta, thorax, ribs, spine, stomach, duodenum, large and small intestine, gall bladder, liver, pancreas, spleen, kidney, supra-renal gland, adrenal gland, uterus, ureter, UB, Urethra, prostate, ovary, testis, fallopian tube etc.	6	10
3.	▪ **Skeletal and Locomotor system**: Bone- Definition, short description of the bones of superior and inferior extremity, thorax, skull, vertebra and face and their Radiological appearance in the image.	4	6
4.	• **Joints-** -Definition, classification with example, movements, functions, short description of the joints of superior and inferior extremity, thorax, skull, vertebra, facial bones and their Radiological appearance in the image.	4	6
5.	▪ **Muscular system**: Definition, Classification, and function of muscle, name of the important muscles of the different parts of the body and their connection, tendon and ligament and their Radiological appearance in the image.	3	5
6.	• **Alimentary system**: Definition, Name of the different parts and short description of different parts of HBS and GIT and their Radiological appearance in the image with contrast and without contrast medium.	4	6
7.	• **Respiratory system-** Definition, Name of the different parts and short description of different parts of Respiratory system and their Radiological appearance in the image with contrast and without contrast medium	4	7
8.	▪ **Cardiovascular system-** Definition, Name of the different parts and short description of different parts of the Cardio vascular system and their Radiological appearance in the image with contrast and without contrast medium.	5	8
9.	▪ **Lymphatic system-** Definition, Name of the different parts and short description of different parts of the lymphatic system and their Radiological appearance in the image with contrast and without contrast medium.	3	5
10.	▪ **Urinary system** -- Definition, Name of the different parts and short description of different parts of the urinary system and their Radiological appearance in the image with contrast and without contrast medium.	4	9
11.	• **Reproductive system**-- Definition, Name of the different parts and short description of different parts of the male and female reproductive system and their Radiological appearance in the image with contrast and without contrast medium.	4	9

Course Contents of Radiological Anatomy

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
12.	• **Endocrine system-** Definition, Name of the different Endocrine glands and short description of different endocrine glands of the human body and their Radiological appearance in the image with contrast and without contrast medium.	3	5
13	▪ **Nervous system** - Definition, Name of the different parts and short description of different parts of the nervous system. Short description of neuron, synapse, reflex, brain, spinal cord, spinal cannel, CSF and their Radiological appearance in the image with contrast and without contrast medium.	3	5
14.	▪ **Organs of special senses**- Definition, Name of the different organ of special sense and short description of the organs of special senses and their Radiological appearance in the image with contrast and without contrast medium	3	5

Course Contents of Radiological physiology

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Bones and joints**- Definition, composition, and function of different types bones and joints.	3	4
2.	▪ **Gastrointestinal tract & Hepatobiliary system**- Definition of digestion, absorption, metabolism, function of liver, pancreas, gallbladder, stomach, intestine, composition, function and normal range of gastric juice and their Radiological appearance, functions and activities of those organs in the image by using contrast and without contrast medium.	5	6
3.	▪ **Uro-genital System** –Name and functions of the male and female reproductive organs. Name and functions of the different parts of the urinary system. Mechanism and formation of urine, composition of urine, Normal range of electrolyte and creatinine and their Radiological appearance, functions and activities of those organs in the image by using contrast and without contrast medium	4	5

Course Contents of Radiological physiology

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
4.	▪ **Respiratory System-** Definition of Respiration and function of respiration, Mechanism of respiration and their Radiological appearance, functions and activities of those organs observed in the image by using contrast and without contrast medium	4	5
5.	▪ **Cardiovascular System**-Definition, Hemodynamics, composition and function of blood. Origin of blood cell, normal range of lipid profile, pulmonary and systemic circulation, function of heart blood vessels, blood pressure and pulse and their Radiological appearance, functions and activities of those organs observed in the image by using contrast and without contrast medium.	5	5
6.	▪ **Endocrinology**: Definition and name of the different endocrine glands, definition of hormone and name of the hormones secreted by the endocrine glands and their Radiological appearance, functions and activities of those organs observed in the image by using contrast and without contrast medium.	3	3
7.	▪ **Neurology**: Definition and function of nervous system function of different parts of nervous system and nerves, composition, secretion, circulation and function of CSF and their Radiological appearance, functions and activities of those organs observed in the image by using contrast and without contrast medium.	5	6

Course Contents of Radiological Pathology

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Introduction of Pathology**- normal cell morphology, definition of pathology, pathos, pathogen, pathogenicity, causes of pathology, types and character of pathology. Cell division and multiplication	3	3
2.	▪ **Causes of disease**- congenital anomalies, traumatic (chemical, physical & radiation), metabolic and deficient, infection (acute and chronic) neoplastic, collagen.	3	5
3.	▪ **Cell repairmen**- regeneration, Fibrosis, Bone repair, physiological and local factors influencing repair	2	2
4.	▪ **Neoplasia**- Benign and malignant, and its effects and appeared in the image.	3	3
5.	▪ **Blood disease & condition**- anemia, leukemia and association with Radiological image.	2	3

6.	▪ Radiological appearance of different pathology, different tumor, anomalies in the image by using contrast and without contrast medium.	3	6

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with Human skeleton, model and specimens of different human organs, image, diagram and chart

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper-V: Subject - Radiological Physics & Equipment

Total hours : 300 hours
Lecture : 100 hours
Practical : 200 hours

Total marks : 200
Written : 100
Oral : 40
Practical : 40
Formative : 20

Objectives:

At the end of the course the students will be able to-

- define, explain and classify the terminologies, issues, laws and conditions of matter, energy, light, sound, electrostatics, electrodynamics, magnetism, electromagnetism, high voltage current, electric generator, X-rays, radiation and radio activity relevant with the course.
- perform the practical aspects of the above issues, laws and conditions relevant with the course.
- explain the relevant principles of works, parts, functions and appropriate use of the voltage stabilizer, IPS, UPS, rectifier, X- Ray, ultrasonography, mammography, dental X-ray, fluoroscopy, digital radiography, CT scanning, MRI, isotope imaging, nuclear imaging and angiogram.
- identify, operate and maintain perfectly the above machineries including their parts, accessories and equipment.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitudes on relevant mater, energy and related equipment.
- apply these knowledge, skills and attitudes in studying and performing the allotted tasks as a radiologist.

Course Contents of Radiological physics

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture / Tutorial	Practical/ Demonstration
1.	▪ **The physical concepts of Matter and Energy-** Matter, Energy, Subdivision of matter, Atomic structure, atomic number, mass number, molecular weight and ionization, The electrical nature of matter, energy, types of energy and Laws of conservation of energy	5	10
2.	**Electrostatics-**Definition, Method of electrification, Laws of Electro static's and electroscope	3	5
3.	▪ **Electrodynamics** –Introduction, electric current, electric conductor, nature of electric current, sources of electric current, Ohms law, potential difference, ampere, resistance, different types of electric circuit, types of electric current-AC current & DC current,	6	10
4.	▪ **Magnetism-**Definition, classification of magnetic and non magnetic materials, types of magnet, Magnetic field and magnetic induction, Nature of magnet, Laws of magnetism, magnetic force, magnetic energy, Magnetic permeability, function of magnet and uses of magnet.	4	9
5.	▪ **Electromagnetism-**Definition, Electromagnetic phenomena, Electromagnet, Electromagnetic induction, self induction, Electromagnetism and useful of electromagnet in radiology.	3	5
6.	▪ **Production and control of high voltage regulation of current-**Transformer, principle and construction of transformer, Regulation of high voltage, types of transformer, control of filament current and tube current, control of high frequency and voltage, rectifier and methods of rectifying current.IPS & UPS and their principles, construction and uses.	5	10
7.	▪ **Electric Generator and motors-**Types of electric generators and motors, principles of electric generators and motors, components and function of electric generator and motors.	3	5
8.	▪ **Introduction and production of X-rays-** Definition of X-Ray. Discover of X-Ray, nature of X-Ray, sources & phenomena of X-Ray, condition necessary for the production of X-Ray, types of X-ray, Hard and soft X-Rays, properties of X-Ray.	6	17
9.	▪ **Physical characteristics of X-Ray**-X-ray exposure, quality and quantity of X-rays, controlling of X-Ray exposure, factors affecting the quality and quantity of X-ray production.	3	8

Course Contents of Radiological physics

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture / Tutorial	Practical/ Demonstration
10.	▪ **Radiation and Radio activity** –Introduction, types of radiation, ionizing radiation, sources of radiation, types of radiation, detection of ionizing radiation, unstable atoms, radio- active series, radium, radio-isotopes and their uses in diagnostic and therapeutic field, radium series & radio-active decay, half life, whole life, average life.	5	7
11.	▪ **Light-** Definition, types of light, properties and characteristics of light, colors of light, laws of reflection of light, intensity of light, illumination of light, luminescence and fluorescence, measure of light intensity, frequency of light, usefulness of light in radiology & imaging.	3	5
12.	▪ **Sound-** Definition of sound and ultrasound, intensity and transmission of ultrasound, reflection of sound, wave of sound, types of sound, frequency of sound, , characteristics of ultrasound, useful range of ultrasound and their uses in medical science, pulse and echo, advantage and disadvantage of ultrasound	4	6

Course Contents of Radiological Equipment

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Electric devices-** Construction, function and working principles of voltage stabilizer, IPS, UPS and rectifier	2	4
2.	▪ **X- Ray accessories**- Lead number, hanger, buckeye stand, cassette, screen, etc. definition, construction and function. **General X–Ray equipments-**Generation of X-Ray, X-Ray tube and its construction, types of X-Ray tube. Types of different X-Ray machine. Grid - its type, construction and function. Collimator – construction of collimator and function of collimator. Filter- construction and function of filter. X-Ray control panel and its components. Rectification of X-Ray.	5	10
3.	▪ **Mammography equipments**-components and construction, working principles and function of mammography machine	2	4
4.	▪ **Ultrasound Equipments**- components and construction of ultrasound machine, working principles of ultrasound machine, function of different components	3	11
5.	▪ **Dental X-ray equipments and Portable X-Ray equipments**- construction, properties, principles and function of dental and portable X-ray machine	2	4

Course Contents of Radiological Equipment

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
6.	▪ **Fluoroscopy equipments**-Types of fluoroscopy screen, construction and function of fluoroscopic screen	2	4
7.	▪ **Digital Radiography Equipments**- construction, working principles and function of digital radiography machine	2	4
8.	• **CT scanning equipments**- Introduction of CT scan machine, construction and components of CT scan machine and CT gantry, types of CT scan machine, generation of CT scanner, different between manual and computed tomography machine, detector – types of detector and function of detector, construction and mechanism of CR console,	5	15
9.	▪ **MRI equipments-**Introduction, typical structure of MRI unit, construction of MRI machine, types of MRI machine, components of MRI machine, principles of MRI, different between NMRI and MRI, nuclear spin and its type, alignments of magnetic dipoles, nuclear procession, MRI signals, different coils of MRI machine, conversion principles of RF signals to MRI, noise of MRI and hazard of MRI	5	15
10.	▪ **Isotope Imaging Equipment's**-Construction, components, working principles and function of isotope imager.	3	4
11.	▪ **Nuclear imaging Equipments**- Construction, components, working principles and function of nuclear imager -PET and SPECT.	3	4
12.	▪ **Angiogram Equipments**- Construction, components, working principles and function of angiogram equipments and DSA.	3	5
13.	▪ **Organization of X-Ray Unit**- planning and designing construction of X-Ray Unit, Building essential and radiation protection of X-Ray unit, equipments setup and positioning	3	4
14.	▪ **Image & information management system:** PACS, System- components. construction and function of PACS system	3	4
15	• **Medical Electronics**- components. construction and function of various types of medical electronics	3	4
16.	**Maintenance of Equipments:** Organize periodical (quarterly, half yearly and yearly) maintenance of Radiological equipments and calibration test by the vendor.	4	7

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with necessary machineries, equipment and chemicals like different type of X- Ray, Imaging equipment and accessories

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

3rd Year
Paper I: Subject - Radiological Procedure

Total hours: 250 hours
Lecture : 100 hours
Practical: 150 hours

Total marks : 200
Written : 100
Oral & Practical : 40+40
Formative : 20

Objectives:
At the end of the course the students will be able to-

- define and explain the issues of patient preparation, positioning, exposure factor, indication, contra indication, precaution, usefulness and steps of procedures of the radiological studies of different human tissues, organs, body systems including forensic radiology and foreign body in human tissues.
- define and explain the different relevant issues of pharmacology and administration of contrast media in radiological study of different human tissues, organs, body systems including sterography and photofluorography.
- communicate, council the patients and attendants for proving necessary information, getting consent and ensuring their safety for different radiological procedures.
- perform the radiological procedures for studying of different human tissues, organs, body systems including forensic radiographic procedure and radiography of foreign body in human tissues using with and without contrast media.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitudes on different procedures in dealing with patients and attendants during radiological studies of human tissues, organs and systems in normal and disease conditions.
- apply these knowledge, skills and attitudes in studying and performing the allotted tasks as a radiologist.

Course Contents of General Radiological procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ Basic terminology of General Radiography	3	3
2.	▪ Radiographic procedure of respiratory system- pharynx, larynx, chest, heart, trachea, diaphragm, mediastinum and pleura	5	7

Course Contents of General Radiological procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
3.	▪ Radiographic procedure of upper extremities – shoulder joint, scapula, clavicle, arm, elbow joint, fore arm, wrist, hand and finger	5	10
4.	▪ Radiographic procedure of lower extremities – hip joint, thigh, knee joint, leg, ankle joint, foot and toes.	5	10
5.	▪ Radiographic procedure of head and neck- skull, sinuses, mastoid, base of the skull, orbit, auditory cannel, nasal bone, TM joint, facial bone, maxilla, mandible, and soft tissue neck.	6	12
6.	▪ Radiographic procedure of vertebral column- cervical vertebra, atlas and axis, thoracic vertebra, thoracic case, lumber vertebra, sacrum, coccyx and SI joints	6	12
7.	▪ Radiographic procedure of Abdomen and pelvis – plain abdominal organs and peritoneum, pelvic bone, pelvic organs. urinary system- kidney, ureter, urinary bladder, urethra, control of HBS, pelvimitry- CPD and lower abdomen.	8	15
8.	▪ Radiographic procedure of Oral and dental radiography maxillary region- accessories required for dental radiography, upper palate, lower palate, oral phenogram (OPG), maxilla and mandible, single teeth, multiple teeth dental film and phenoromic radiography	8	12
9.	▪ Radiographic procedure of bony age determination and forensic radiology	4	4
10.	▪ **Foreign body radiography**-Types of foreign body and exposure factor for visualization of for different foreign bodies	3	3

Course Contents of Contrast Radiological procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture / Tutorial	Practical/ Demonstration
1.	▪ **Pharmacology of Contrast media**-Definition, composition of contrast media, types of contrast media, absorption of contrast media, indication, and contra indication and precaution of contrast media.	4	5
2.	▪ **Administration of Contrast study**- Rules of contrast study, patients history and record keeping, counseling, preparation, disease controlling, emergency management and protocol upgrading	3	5

Course Contents of Contrast Radiological procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
3.	▪ **Contrast study of GI Tract**-patient preparation, positioning, exposure factor, indication, contra indication and precaution of Barium- swallow of larynx, pharynx and oesophagus, gestrographin swallow of oesophagus, Barium- meal of stomach and duodenum, Barium enema of large intestine and Barium follow through, sinography, fistulography and loopography.	6	11
4.	▪ **Contrast study if HBS**- patient preparation, positioning, exposure factor, indication, contra indication and precaution of OCG, IVC, TTC, PTC	4	6
5.	▪ **Contrast study of urinary system**- patient preparation, positioning, exposure factor, indication, contra indication and precaution of KUB, IVU, IVC, IVP, Retrograde utrethrography (RGU), Micturating urethrography (MCU)	5	7
6.	▪ **Contrast study of male Reproductive organ**- patient preparation, positioning, exposure factor, indication, contra indication and precaution to see seminal vesicle and vas difference and genitography.	4	4
7.	▪ **Contrast study of female Reproductive organ**- patient preparation, positioning, exposure factor, indication, contra indication and precaution of Histerosalfingography	4	4
8.	▪ **Contrast study of optic cannel** – patient preparation, positioning, exposure factor, indication, contra indication and precaution optic cannel and optic nerve.	2	2
9.	▪ **Contrast study of salivary gland and parotid gland and sinuses**- patient preparation, positioning, exposure factor, indication, contra indication and precaution Sinogram and silogram.	3	5
10.	▪ **Contrast study of Bronchus and trachea** - patient preparation, positioning, exposure factor, indication, contra indication and precaution of Bronchogram.	3	3
11.	▪ **Contrast study of Spinal cannel** – patient preparation, positioning, exposure factor, indication, contra indication and precaution of Mylogram- cervical, thoracic and lumber region.	3	5
12.	▪ **Contrast study of spleen and pancreas**- patient preparation, positioning, exposure factor, indication, contra indication and precaution splenoportography and pancreatography and ERCP.	3	3

Course Contents of Contrast Radiological procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
13.	▪ **Sterography and photoflourography**- patient preparation, positioning, exposure factor, indication, contra indication and precaution and usefulness.	2	2

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration
- Field placement

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with necessary machineries, equipment and chemicals like General Radiography machine, Digital Radiography machine, Dental X- Ray machine and portable radiography machine, Fluoroscopic machine, pressure injector for the administration of contrast study, and contrast dispenser etc.
- Clinical word

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper II: Subject - Radiological Photography and Quality assurance

Total hours: 250 hours
Lecture : 100 hours
Practical: 150 hours

Total marks : 200
Written: 100
Oral & Practical : 80
Formative: 20

Objectives:
At the end of the course the students will be able to-

- define relevant terms, explain the common issues, mention their use, describe the principles and procedures of : photography and radiographic photography, radiographic film, photographic film, CR film, film holders, cassette, radiographic screen, IP, CR screen, organization of dark room, radiographic chemistry and film processing systems, auto-processor, computed film processing developing systems, computed radiography, photofluorography.
- define relevant terms, explain the common issues, and describe the procedures of: ensuring reprographic qualities, solutions of dark room problems, storage and preservation of film and chemicals, presentation of film and patients' information to radiologists.
- prepare and use photography and radiographic photography, radiographic film and photographic film, CR film, film holders, cassette, radiographic screen, IP, CR screen.
- organize dark room, manage radiographic chemistry and film processing systems, operate auto-processor, computed film processing, computed radiography, photofluorography.
- ensure radiographic qualities, solve dark room problems, store and preserve film and chemicals, present of film and patients information to radiologists.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitude on relevant aspect of photography in radiology and it quality assurance.
- apply these knowledge, skills and attitudes during performing the allotted tasks as a radiologist.

Course Contents of Radiological Photography

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Radiographic photography and its aspects-** Define photography and radiographic photography, aspects of radiographic photography objectives of radiographic photography, importance of radiographic photography.	5	10
2.	▪ **Radiographic film, photographic film, CR film, film holders and cassette**- Types of film, different between radiographic film and photographic film, screen film and non screen film, practical suggestion of handling unexposed and exposed film, types of cassette, construction of general radiographic cassette and CR cassette.	10	12
3.	▪ **Radiographic screen and IP, CR screen-** construction of radiographic screen and IP, CR screen function of screen, difference between radiographic screen and IP CR screen, image capturing system by IP, function of PSP.	7	10
4.	▪ **Dark room organization**- Building essential of dark room, lighting system and light controlling system of dark room, equipments, film loading box and accessories setup of dark room, ventilation and water supply system of dark room, save light and its properties, illumination of dark room, temperature and humidity of dark room.	6	12
5.	▪ **Radiographic chemistry and film processing system**- Film blackening phenomena system and process, principles of latent image and its characteristics, and process of transformation to visible image, different steps film processing, composition and function of developer, fixer and replenisher, time-temperature factors of film processing chemicals, indication, contra indication and precaution of processing chemicals, washing, rinsing and drying system of film.	12	16
6.	▪ **Auto-processor and its working principles** – construction, working principles, maintenance and chemical changing system of auto processor.	5	10
7.	▪ **Computed image film processing developing system and computed radiography (CR)-** working principles of CR, Image developing system by CR, Image contrast, density, resolution enhancing system by CR, automatic and manual blackening processing and manipulation system in CR system, film loading and magazine setup system in CR.	13	16
8.	▪ **Photofluorography –** working principles of photofluorography	2	4

Course Contents of Quality assurance program

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Radiographic quality-** contrast- subject contrast and film contrast, density and sharpness, definition, FOV maintaining, motion sharpness, FFD and OFD controlling for better resolution. Blurring control. Optimization of exposure factors- KV, MA and time.	8	12
2.	▪ **Darkroom problem-** Artifacts- types of artifacts, causes of artifacts, removing and avoiding procedure of artifacts, streaking of film, causes of film streaking and avoiding procedure, distortion of film, causes of film distortion, avoiding procedure of film distortion, causes of film fogging, various types of fog, avoiding procedure of film fogging. Mark and defects, avoiding procedure and importance of mark and defects.	10	16
3.	▪ **Devices for improving radiographic quality**- Grid, properties of grid, function of grid, quality enhancement by using grid, filtration, shielding, and collimating.	8	12
4.	▪ **Storage and Preservation of Film and chemicals**- Un exposed Film storage system and exposed image, chemicals preservation and storage system, humidity and temperature,	7	10
5.	▪ **Presentation-** presentation of ideal film to radiologist, proper name, number, information and disease history of patients and others particulars, film analysis – QA and QC.	7	10

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration
- Field placement

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with necessary machineries, equipment and chemicals like Auto processor, CR system, view box, and film processing chemicals etc.
- Clinical word

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper III: Subject - Radiation Biology & Patients Care

Total hours : 400 hours
Lecture : 100 hours
Practical : 150 hours
Special Lab Attachment: 150

Total marks : 200
Written : 100
Oral & Practical : 80
Formative : 20

Objectives:

A. At the end of the course the students will be able to-

- define relevant terms and explain relevant issues of: Cellular components; Controlled and uncontrolled cell proliferations; Effects of ionizing radiation, radiation absorption limits, doses of radiation, protective measures of radiation; NSRC Acts and rules of Bangladesh; Radiation protection surveys in Bangladesh; Radiation measuring devices; Radiation hygiene.
- prevent harmful effects of ionizing radiation, take care to limit the radiation absorption and doses of radiation, use radiation protective measures, and ensure radiation hygiene.

B. At the end of the course the students will be able to-

1. Define relevant terms and explain relevant issues of : Organization of Radiological department; Patients management protocol; Transportation, handling and care of different kind of sick patients; Collection and maintenance of patients' devices, Personal and patients' hygiene, Sterilization and disinfection; Inflammation and infection; Patient preparation for different radiography and imaging; Administration of different kind of drugs, contrast media, oxygen and IV injection in radiography; First aid and resuscitation; Taking patient's history, record keeping and archiving; Patients' privacy confidentiality, Legal, ethical, moral issues and cultural values; Nursing of patients during radiography; Fire controlling related to radiography.
2. Organize of radiology department; Manage patients protocol; Transport, handle and take care of different kind of sick patients; Collect and maintain of patients' devices, Ensue personal and patients' hygiene, Perform sterilization and disinfection; Prepare patients for different radiography and imaging; Administer different kind of drugs, contrast media, oxygen and IV injection during radiography; Provide first aid and resuscitation; Take patient's history, keep their records and perform archiving; Maintain patients' privacy confidentiality, legal, ethical, moral issues and cultural values; Provide nursing to the patients during radiography; Ensure fire control related to radiography.

List of Competencies:

- Demonstrate basic knowledge, essential skills and positive attitude on relevant issues of radiation related biology and patient care in radiological procedures.
- Apply these knowledge, skills and attitudes during performing the allotted tasks as a radiologist.

Course Contents of Radiation Biology

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Cellular biology** – DNA, RNA, Gens, chromosomes, germ cell, gonads, zygote and normal cell morphology, mitotic cellular division, mitotic cellular division, proliferation of cell, uncontrolled proliferation of cell, causes of uncontrolled proliferation of cell, radiation sensitivity of cell, free radical and factors affecting the free radical.	7	10
2.	▪ **Biological effects of ionizing radiation-** Deterministic effect, stochastic effect, acute effect, late effect, somatic effect, genetic effect, dose and effect relationship, mechanism of tissue damage.	8	10
3.	▪ **Radiation absorption limits, doses of radiation and protective measures of radiation**-Back ground radiation, dose equivalent limits, occupation limits, General public limits, patients limits, pregnant women's limits, ALARA concept for the protection of radiation in diagnostic radiology, Personal protection, patient protection, environmental protection, general principles of radiation protection in fluoroscopic radiography and organizing the radiology & imaging department as per NSRC guideline.	10	10
4.	▪ **Radiation measuring devices and dosimeter-** Half life, whole life and average life, HPD &MPD,RAD, REM, Millicevert, Gray, Roentgen and relation among different units, Dosimeter, TLD and film badge.	8	10
5.	▪ **Radiation hygiene-** Personal hygiene, patient'hygiene, and attendant's hygiene.	3	7
6.	▪ **NSRC Acts and rules of Bangladesh**- NSRC Act and NSRC rules of Bangladesh and its effectiveness for the control of radiation in the diagnostic radiology of Bangladesh	7	8
7.	▪ **Radiation protection surveys in Bangladesh-** Present status of radiation control in the diagnostic field and future plan, Activities of AECB and IAEA for the radiation safety, Role and illegibility of RCO in the radio-diagnostic department. Regulatory requirements to set up a diagnostic radiology department in Bangladesh.	9	17

A) Course Contents of Patient's care

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Organization**-Departmental organization, planning and technical procedure, health care organizations, health care delivery and management system in Bangladesh.	5	8
2.	▪ **Patient's management protocol**- Methods and maintain of patients management protocol	2	4
3.	▪ **Transportation of patient**- Transportation rules and procedure of medical and surgical emergency patient in radiology department. Technique of lifting patients to wheelchair and trolley.	3	6
4.	▪ **Instrumentation-** Name, storage, care, usefulness, maintenance and record keeping collection. of accessories, devices, electronics and equipments in the department.	3	6
5.	▪ **General Hygiene** – Define hygiene, different perspectives of hygiene, Methods and maintain of Personal hygiene and patients hygiene	3	6
6.	▪ **Sterilization and disinfection-** Definition, types of sterilization, Methods of sterilization and advantages of sterilization	2	7
7.	▪ **Inflammation and infection**- Definition, causing agents, routes, types, prevention and control of infection, using principles and methods of PPE.	2	7
8.	▪ **Patient preparation** – preparation for general radiography, preparation for contrast radiography and preparation for Radiological imaging.	3	8
9.	▪ **Catheterization, intubations and suction**- Technique, principles, procedure, care, management after procedure and handling the patient during Radiological procedure.	4	6
10.	▪ **Tracheotomy Colostomy and Ileostomy and suction**- Management, Technique, procedure and care during Radiological procedure.	3	6
11.	▪ **Drug, and contrast media and oxygen administration**- Name of the drugs used in radiography, side effect, adverse reaction, management methods, principles and procedure of using pressure injector for IV infusion.	3	3
12.	▪ **First aid and resuscitation procedure**- Definition, methods, aims and objectives of first aid , first aid during/after Radiological procedure..	2	2
13.	▪ **Care and management of patient**- Care and management of the unconscious, shocked, anaesthetized, fractured, hemorrhagic patient, cardiac resuscitation and respiratory arrest management.	3	5
14.	▪ Health informatics- Patient's history, document, record keeping and archiving.	2	2
15.	▪ Patient's privacy, and secrecy confidentiality, legal, ethical, moral issues and cultural values	2	2

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
16.	▪ **Nursing procedure of imaging patients**- Nursing procedure, technique, care and rules	3	3
17.	▪ **Fire controlling procedure**- Operation protocol, rules and procedure of fire rescue operations, fighting tools and extinguishers distinguisher.	3	3

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration
- Field placement

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with necessary machineries and equipment like Dosimeter, TLD, Infusion dispenser, Oxygen cylinder, Emergency drugs, Sterilizer, catheter, sucker machine etc.
- Clinical word

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

4th Year
Paper I: Subject - Advanced Radiology & Imaging Procedure

Total hours: 400 hours
Lecture: 100 hours
Practical: 100 hours
Special Lab Attachment: 200

Total marks: 200
Written : 100
Oral : 40
Practical : 40
Formative: 20

Objectives:

At the end of the course the students will be able to:

- define, classify and explain relevant terminologies, issues and procedures of radiological imaging, digital radiography, mammography, computed tomography, magnetic resonance imaging, angiogram, isotope imaging and ultrasonography.
- perform relevant procedures and patient dealing perfectly during radiological imaging, digital radiography, mammography, computed tomography, magnetic resonance imaging, angiogram, isotope imaging and ultrasonography.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitude on relevant advanced radiological issues and radiological imaging procedures.
- apply these knowledge, skills and attitudes during performing the allotted tasks as a radiologist.

Course Contents of Advanced Radiology & Imaging Procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Clinical aspects of Radiological Imaging**- Definition of Radiological Imaging, Usefulness of Radiological Image, advantage and disadvantage of Radiological Image, precaution of Imaging, objectives and target achievements of Imaging.	5	8
2.	▪ **Digital Radiography and its procedure**- procedure and technique of digital radiography, Image enhancement system by digital machine, differentiation of hard tissue and soft tissue radiography, Image collection and storage system of Digital radiography machine	10	13
3.	▪ **Mammography and its procedure**- preparation, indication, contra indication, positioning, exposure factors and technique protocol of mammography.	8	15

Course Contents of Advanced Radiology & Imaging Procedure

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
4.	▪ **Computed Tomography of different organ and its procedure**-patients information and history taking, counseling, preparation, indication, contra indication, positioning, exposure factors operation protocol and technique for CT scan of brain and pituitary, mastoid, pharynx, larynx, sinuses, chest, HRCT, HBS, abdomen and peritoneum, KUB, female reproductive system, pelvis, upper and lower extremity, bones and joints and vertebral column spine and neural system and angiography.	20	30
5.	▪ **Magnetic Resonance Imaging of different organ and its procedure** – patients information and history taking, counseling, preparation, indication, contra indication, positioning, operation protocol and sequence selection for MRI of brain, pituitary and tractography, mastoid, pharynx, larynx, sinuses, chest, HBS, abdomen and peritoneum, KUB, female reproductive system, pelvis, upper and lower extremity, bones, joints and vertebral column spine and neural system. MR angiography, MRCP, MRA, MRV and MRS.	25	35
6.	▪ **Angiogram of Cardio vascular system and its procedure**- preparation, indication, contra indication, positioning, exposure factors operation protocol and technique of DSA. for CT coronary angiogram, of venography, aortography, limphangiography, carotid angiography, peripheral angiography.	10	20
7.	▪ **Isotope Imaging procedure** -preparation, indication, contra indication, positioning, operation protocol and technique for isotope imaging, PET and SPECT of different organs of human body.	8	15
8.	▪ **Ultra-Sonography**-Basic components of Ultrasonography machine, pulse & echo technique- A mode, B-mode and M-mode, B scan- real time scanning techniques, electrode acoustic contact jelly and contrast medium for USG. Transducers- volume scanning, sector scanning, linear scanning, linear, phased array electronic multi element transducers, special transducers, basic principles of Doppler techniques.	14	14

Teaching Methods:

- Lecture
- Tutorial
- Practical / Demonstration
- Field training for 18 weeks

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies
- Manuals / text books / hand-outs
- Online and computer based teaching learning materials
- Laboratory with necessary machineries and equipment like Digital Radiography machine, CT scan machine, MRI machine, Mammography machine, Ultra-sonography machine, Isotope imager, Broad band Internet and cooling system etc.
- Clinical word

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Paper II: Subject - Basic Concepts of Radiological Findings

Total hours: 400 hours
Lecture: 100 hours
Practical: 100 hours
Special Lab Attachment: 200

Total marks: 200
Written : 100
Oral : 40
Practical : 40
Formative: 20

Objectives:

At the end of the course the students will be able to:

- define, classify and explain relevant terminologies and issues of : Radiological appearances and causes of abnormal findings in different diseases; Diseases of sinus, soft tissue, chest, pleura and heart; Metastasis of lung; Bone diseases, fractures, dislocation, congenital anomalies, bone development, bone deformation; Cancer and Radiological important health problems of esophagus; Intestinal obstruction, perforation, common diseases and anomalies of GI tract; Obstetric radiology.
- identify Radiological appearances abnormal findings in different diseases; Perform Radiological procedures for diagnosis of diseases of sinus, soft tissue, chest, pleura and heart; Perform Radiological procedures for diagnosis of metastasis of lung, bone diseases, fractures, dislocation, congenital bone anomalies, bone development, bone deformation, cancer and Radiological important health problems of esophagus, intestinal obstruction, perforation, common diseases and anomalies of GI tract, female reproductive organs' diseases.

List of Competencies:

- demonstrate basic knowledge, essential skills and positive attitude on different issues of advance radiology and imaging procedure.
- apply these knowledge, skills and attitudes during performing the allotted tasks as a radiologist.

Course Contents of Basic concepts of Radiological findings

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
1.	▪ **Principles of Radiological abnormal findings in an image**-Idea about Radiological appearances of different diseases and findings.	3	3
2.	▪ **Common causes of abnormal findings and disease**- common causes of different diseases of Radiological importance.	3	13
3.	▪ **Terminology of Radiological diagnosis**	3	3
4.	• **Diseases of sinus and soft tissue:** diseases of sinuses, soft tissue in upper respiratory tract, ear and throat and their Radiological findings**.**	6	10

Sl. No	Topics/Lessons	Teaching/learning Hours	
		Lecture	Practical/ Demonstration
5.	▪ **Diseases of chest, pleura** and heart– common diseases of chest and pleura, definition, types, causes and Radiological findings of pleural effusion, pneumonia and tuberculosis. Normal and abnormal size and shape of heart and Radiological measurement.	10	15
6.	▪ **Secondary metastasis of lung-** definition, causes, and significant primary malignant tumors may causes, routes of spreading and Radiological findings of secondary metastasis of lung.	6	13
7.	▪ **Bony diseases, fractures, congenital anomalies and bony development of skeletal system-** development of human bone, diseases of bone, fracture, definition, causes, classification and Radiological findings of bony diseases, anomalies and fractures.	12	18
8.	▪ **Bony deformation & dislocation:** different bones and joints in human skeletal system and different types of dislocation and deformation of joints	8	14
9.	▪ **Diseases of Cancer esophagus** – common diseases of esophagus, definition, causes and Radiological findings of different common diseases of Cancer esophagus	6	13
10.	▪ **Intestinal Obstruction, perforation, common diseases and anomalies of GI tract–** name the common diseases of intestine, definition, causes and Radiological findings of intestinal obstruction, perforation and common intestinal diseases and anomalies.	10	14
11.	▪ **Obstetric radiology**- different problems, diseases and anomalies of female reproductive system, Definition, causes, and Radiological findings of obstetric radiology.	8	14

Teaching Methods:

- Lecture, Tutorial, Practical / Demonstration, Field training for 18 weeks

Teaching Learning Media:

- Blackboards and chalk / White Board and markers / Multimedia and laptop /OHP and transparencies, Manuals / text books / hand-outs, Online and computer based teaching learning materials, Laboratory with necessary machineries and equipment like View box, X-Ray, CT, MRI, Dental and Mammogram Film etc.
- Clinical word

Assessment:

Written – SAQ= 80 marks, MCQ=20 marks
Practical or OSPE 40 marks, Oral/SOE-40 marks, Formative-20 marks

Outline of Institutional Academic Laboratory

Basic Institutional Lab Practice: Student will be attached with relevant institution laboratory with a structured program of clinical experience to attain the applied knowledge and skills for radiographic examinations taught in radiology & imaging. Upon completion of the clinical program, the student should be able to perform correctly all general radiographic procedure expected of a beginning practitioner. Each student will work with qualified professional technologist/instructor and will perform to assist with radiological examinations under supervisions for contrast examinations. Regarding that the respective intuitions should have the following instruments, apparatus and accessories;

1. At least 500mA general radiography system
2. Computed Radiography (CR) system/Digital Device (FPD)
3. USG system
4. Dental Radiography system and OPG
5. Mammography machine
6. Darkroom facilities and required accessories and chemicals
7. Enough number of lead apron and gonad shield
8. Sufficient spaces as per admitted students.

Outline of Special Laboratory Attachment

Special Field Attachment: Students will be placed to attached with medical college hospital/medical university hospital / specialized hospital / general hospital /national referral laboratory/ combined military hospital or any types of specialized hospitals for 36 weeks' period with a structured program of clinical experience to attain the applied knowledge and skills for special radiological examinations by using modern radiological equipment's. Regarding that the special filed side should have the following equipment's, apparatus and facilities:

1. Advanced radiological equipment's: CT, MRI, DSA, PET, SPECT etc.
2. Special radiological equipment's: Mammography, OPG, and Fluoroscopy system along with digital subtraction angiographic technology, ultrasonography machine etc.
3. General Radiography equipment's: General Radiographic equipment's, dental X-Ray machine, CR, DR etc.
4. Relevant accessories, emergency drugs, chemical, films, cassette, pressure injector, sucker machine etc.

Job description of Diploma Medical Technologist (Radiology & imaging)

General Job of Medical Technologist (Radiology & imaging)

The MTR (Medical Technologist Radiology) is the expert in integrating different areas of key importance in the imaging departments. The areas include patient care, use of technology, optimization of dose, clinical responsibility, organization, quality assurance and education and training. The role of the MTR in each of these areas is outlined as follows:

Patient Care

The MTR(Medical Technologist Radiology) has both a direct and a supervisory role with regard to the welfare of the patient in his or her care. This is a prime responsibility of the MTR. The welfare of the patient will depend upon:

- Recognizing by the MTR of all relevant physical and psychological factors which may affect the patient, together with an understanding of the patient's social, cultural, ethical and confidential needs and a reporting of these when necessary.
- The MTR making appropriate arrangements for the patient's as well as technologists himself by ensuring general safety, infection control and radiation safety.
- The MTR ensuring that all required information is present and correct, and that correct examination identification procedures as advised by the physician are carried out through.
- The patient giving receiving informed consent from the patient for to the required the procedure going to be performed.
- The MTR fulfilling the requirement to use all appropriate facilities, measures and methods to prevent cross-infection.
- The MTR ensuring properly proper identity and history identified of patient has been before starting procedure.
- The MTR collecting all resent performed reports, documents and images if available. No previously performed imaging procedure has already provided the information requested.
- Obtaining all relevant clinical history has been obtained from the patient prior to the Radiological examination, and that an appropriate examination has been requested or if not, that referred by referral to an appropriate member of the medical staff occurs.
- Ensuring emergency management, drugs, accessories that may be required during or after performed Radiological investigations.
- Handling cardiac arrested, ventilated, shocked, anesthetized, oxygenated, surgical, CCU, ICU, plastered, burned, intubation and catheterized patient gently.
- Ensuring fire fighting devices and operating fire extinguisher as well as other facilities and methods effectively.
- Ensuring good Radiological investigations results it the patients is on any concurrent treatment or investigation.

Performing Radiological Procedure & Patient Positioning

It is the vital role responsibility of the MRT to position the patient, setup film and select the direction of the X-ray beam in such a way that the final image will be quality optimum. The following aspects must be considered during patients positioning:

- Patients' comfort.
- Immobilization
- Departmental sustainable, perfect and standard views, protocols and necessary modifications.
- Patient's safety, privacy, confidentiality, culture and ethical values.
- Personal safety, privacy and ethical values.
- Radiation protection for all present.

Exposure Factors

It is the responsibility of the MTR to select suitable combination of exposure factors and image recording materials to produce the correct radiographic contrast, densities and image detail sharpness, considering allowing for the patients' age, sex, body weight and thickness condition. The following aspects must be considered:

- The penetrating capacity power of the produced X-ray beam.
- Selection of optimum exposure factors- (kV, mA, mAs) grid frequency and FFD.
- Correct usage of any automatic exposure device or MA-Time-FFD distance combinations.
- The FOV focus size selection selected, observing anode heating capacity and the tube rating chart.
- The use of all possible appropriate and functional equipments to control limit primary and secondary radiation.
- The image receiving recording systems selected, and the selection of required processing methods.

Optimization Of Dose

MTRs are in a key position regarding radiation protection of the patient, himself and environment and will be by their "skill and care determine, within wide limits, the amount of radiation administered". The MTR must therefore:

- Be able to interpret and apply all relevant laws, rules, regulations and recommendations relating to the application of ionizing radiation to patients, staffs and attendants.
- Be able to measure and understand Maximum Permissible Dose (MPD), Radiation Absorbed Dose (RAD), Tissue Weighting Factor (TWF), Background Radiation Dose (BRD) and Threshold and Non-Threshold Dose.
- Understand both the somatic and the genetic hazards, deterministic and stochastic effects, early and delayed effects which are consequent upon the medical and research uses of ionizing radiations, and to be able to explain these in appropriate terms to inquiries.
- Have collaborative by their attitude, authority and maintenance of current knowledge help in the control and of use of radiation for medical purposes.
- The MTR should be prepared to act as 'Radiation Control Protection Officer'.

Image Receiving & Processing Recording

It is the responsibility of the MTR to maintain and control all the steps involved in the processing, production and storage of a permanent and/or visible image. He would should be able to evaluate judge subsequently whether the image is of sufficient standard for a report to be given. The MTR is responsible for the following aspects:

- The processing equipment's, films and chemicals are in good order and safe to use
- Optimum image quality and standard for the interpretation is optimum for its purpose.
- Identification is correct, complete and permanent (this is a medico-legal requirement).
- Manipulation should be minimized during image processing by using CR
- Documentation is completed before the image is presented to the appropriate member of the medical staff.

Equipment Maintainance & Calibration

The MTR must be able to use and care for equipment in such a way that:

- There is minimum possible hazard to patient, staff or to any other person.
- There is no unnecessary irradiation of the patient, staff or any other person.
- Any error in the final radiographic image is not due to incorrect use of equipment.
- The equipment is used safely and correctly.
- Monthly, quarterly, half yearly and yearly calibration should be maintained by the vendor and the performance of the equipment is constantly monitored.
- The maximum utilization and life time of the equipment's must be ensured.

Digital Imaging, Conventional, Intervetional & Modern Imaging Modalities

The MTR is responsible for:

- Applying a detailed knowledge of cross-sectional anatomy in order to be able to correlate the position of the patient with the required three-dimensional information.
- Selecting programs, protocols, projections, signal sequences and parameters to use modern imaging modalities- CT, MRI, PET, SPECT, DSA, OPG, BMD, and MAMMOGRAPGY etc.
- Selecting Giving advice as to the likely quality of the image using the parameters selected, and e.g. using window width, window level, FOV, pixel size, boxel size of compensating filters, selection of exposure factors, or pulse sequences, use of RF coils, surface coils, body coils as well as use of accessory equipment etc to control quality of image..
- Receiving Recording, adapting and reconstructing data to obtain optimum image quality.
- Using contrast medium for the enhancement of any pathology of suspected body organ.
- Managing and care the patient during or after introducing the contrast medium.
- The storage and retrieval of information.
- Assessing the resultant images for suitability for interpretation and diagnosis.

Job In Examinations Requiring A Multidisciplinary Approach

It is the responsibility of the MTR to cooperate with the radiologist or trained clinician with procedures such as:

- Fluoroscopy and image intensification.
- Complex Radiological examination such as angiography and treatment procedures.
- Radiographic examinations carried out externally to the main department such as the operating room or cardiac laboratory and portable X-ray by using C-Arm or portable X-ray machine.
- Other imaging modalities.

The MTR's responsibilities in these contexts situations may include the coordination of the examination, in addition to the following:

- Preparation and use of equipment.
- Patient care and positioning.
- Personal care, protection and safety assurance.
- The selection of exposure factors.
- Optimization of dose.
- Documentation or archiving of the procedure patients history, and images and reports recording.

Clinical Responsibility

The MTR, s prime expertise and responsibility is to take care of patient before/during/after imaging procedure, prepare the patient for imaging, to undertake the whole range of techniques in diagnostic imaging and to subsequently assess the quality of his own work. The MTR must be professionally accountable for his behavior, actions, make judgments as to his professional limitations and maintain confidentiality of patients as well as their information. The MTR working in the clinical situation must be involved with the clinical education of the radiology & imaging student.

Organization/Management

Depending upon the level in the organization to which an MTR is appointed, he/she has the responsibility for proper and efficient organization of his work, use of resources and the application of departmental policies for the area for which he is responsible.

Quality Assurance

All areas of the MTR's responsibility require quality assurance procedures. In all specializations, he/she must be a full member of the team that develops, maintains and monitors the quality standards of the department. If no program is in place, then the MTR has the responsibility to initiate one, and to ensure its implementation.

Job in the Training Institute (IHT)

At the teaching Institutes the Medical Technologist (Radiology & Imaging) personnel are positioned at three levels:

a. Lecturer
b. Instructor
c. Medical Technologist

a. ***Lecturers*****:**

- They shall perform tutorial, demonstration, and lecture classes.
- Facilitate practical demonstration and work of the students in the laboratory as a 'facilitator' of practical 'teaching group'
- They will perform large group teaching and supervise the junior colleagues.

b. ***Instructors*****:**

- They will perform tutorial and demonstration classes relevant to practical items.
- Ensure and guide the students to prepare practical note books.
- Demonstrate elaborately procedures, methods and examinations of the practical works in the laboratory and follow students' performance in the practical classes.
- Supervise practical classes as a 'Team leader'.

c. ***Technologists*****:**

- They shall run the procedures and examinations in all practical classes.
- Run practical demonstration and works for the students.
- Perform small group demonstration relevant to practical.
- Prepare chemicals and reagents and maintain instruments, apparatus, glasswares and other laboratory material and logistics.
- Responsible for laboratory set up and organisation including maintenance of registers, records and stock ledger under guidance of the supervisors.
- Responsible for the security and safety of the laboratory especially in respect to chemicals and reagents, infection, fire, electric hazards and disposal of wastes.

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11. Diploma Curriculum of “Nanyang Poly-technique Institute, Singapore”

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