REVA UNIVERSITY
Bengaluru, India

(School of Allied Health Sciences)
B.Sc. Medical Radiology & Diagnostic Imaging
HANDBOOK
2021

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
Phone No: +91-080-46966966, Fax: 080-28478539
www.reva.edu.in

Chancellor's Message

"Education is the most powerful weapon which you can useto change the world."- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. Thedifference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is Power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge populationof young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA Universityhas been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System(CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nutured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible toall and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. Dhanamjaya M
Vice-Chancellor, REVA University

MESSAGE FROM THE DIRECTOR

Medical Radiology and Diagnostic Imaging is Allied Health Sciences program assimilates in itself a number of disciplines and as such hasgrown rapidly. B Sc in MR & DI offered by REVA University aims to provide the required skills and knowledge necessary to pursue a successful career in MR & DI. This program imparts need based, practical education in contemporary world to develop global competence among students. It strives to prepare students to become leaders in the field of Health Sciences in general and MR & DI in particular by encouraging them to inculcate scientific thinking coupled with creative and innovative ideas.

The program provides hands- on training and practical skills in the field of Health Sciences like Radiation Physics &Instrumentation, Interventional Radiology & Nuclear Medicine, Radiation Protection and Safety in Radiology, Clinical Biochemistry, CT and USG imaging and Clinical MRI & Physics of MRI aligning to current demand in the Medical field.

As far as employment is concerned MR & DI has become one of the fast-growing sectors. Employment record shows that MR & DI has a great scope in future. Radiologists can find careers with Hospitals, and allied health care.

The curriculum caters to and has relevance to local, regional, national, global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

This handbook provides you outline of regulations for bachelor's degree, scheme of instruction, and detailed syllabus. I am sure the students choosing BSc Medical Radiology and Diagnostic Imaging at REVA University will enjoythe curriculum, teaching and learning environment, the vast infrastructure and the experienced teacher's involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students a pleasant stay at REVA and grand success in theircareer.

Dr. Jayashree S
Director
School of Allied Health Sciences

Preface

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

Indian economy is experiencing an upward growth right from the beginning of 21st century necessitating well qualified science graduates to work as scientists, teachers, algorithm developers, computer programmers, professionals and often administrators. At present morethan 400 million youth are below 18 years of age and government is committed to increase the GER to 30% by 2020, further necessitating more number of teachers and professors to work in schools and colleges. Research has also been given equal importance. Pivate sector and Corporates are also looking for smart science graduaes in a big way. The B.Sc .Medical Radiology and Diagnostic Imaging degree program of REVA University is designedto prepare biotechnologist, biochemists, genetists, scientists, teachers, professionals & administrators who are motivated, enthuastics& creative thinkers to meet the challenges of growing economy aswell as to fulfill the growing aspirations of the youth.

The program has been developed with an emphasis on knowledge assimilation, application, national and international job market and its social relevance. The outcoce-based curriculum designed and followed imbibes required theoretical concepts and practical skills in the domain. By undergoing this program, you will develop critical, analytical thinking and problem solving abilities for a smooth transition from academic to real-life work environment. The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society.

This handy document containing brief information about B.Sc. Medical Radiology and Diagnostic Imaging program, scheme of instruction and detailed course content will serve as a guiding path to you to move forward in a right direction.

I am sure you will enjoythe curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive toprovide all needed comfort andcongenial environment for your studies. I wish you and allstudents' pleasant stay in REVA and grand success in your career.

Dr. Jayashree S

- Professor & Head, School of Allied Health Sciences

CONTENTS

Sl.No.	Particulars	Page No.
1	Message from the Honorable Chancellor	2
2	Message from the Vice- Chancellor	3-4
3	Director's Message	5
4	Preface	6
5	Rukmini Educational Charitable Trust	8
6	About REVA University	9-13
7	About School of Allied Health Sciences - Vision - Mission - Values - Advisory Board Members	14-16
8	**B. Sc Medical Radiology and Diagnostic Imaging** Program Overview - Program Educational Objectives - Program Outcomes - Program Specific Outcomes - Mapping programme outcomes with Programme Educational Objectives - Mapping of Course Outcomes with programme Outcomes	17-43
9	Regulations Governing School of Allied Health Sciences Programmes	
10	**B. Sc Medical Radiology and Diagnsotic Imaging** ➢ Scheme of Instructions ➢ Detailed Syllabus - Course Overview - Course Objective - Course Outcomes - Course Contents (Unit-1,2,3,4) - Skill development activity, if any - Text books - Reference books	44
11	Career Development and Placement	103-105
12	List of Faculty Members	105

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust(RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conductingacademic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions,the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 7thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students toopt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced

qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industried, business firms and other insitutions seeking their help in imparting quality education through practice, internship andalso assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary- multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the coreareas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless CensorNetworks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio- fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable EnergySources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers. The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other

unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University ofAlabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher-scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitatestudents to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsvile, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works onplanning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India,Dr. Balaram, Former Director I.I.Sc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers, and such others who have contributed richly for the development

of the society and progress of the country. One of such awards instituted by REVA University is **'Lifetime Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Lifetime Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges.

During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark intheir respective spheres of activities. During this occasion, the students who have achieved top ranks and wonmedals and prizes in academic, cultural and sports activities are also recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honored with many more such honors and recognitions.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards

Misson

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT SCHOOL OF ALLIED HEALTH SCIENCES

The School of Applied Sciences offers graduate programs in Medical Laboratory Technology, Medical Radiology and Diagnostic Imaging, also Nutrition and Dietetics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The school presently offers BSc Medical Radiology and Diagnostic Imaging, BSc Medical Laboratory Technology, BSc Nutrition and Dietetics and Diploma in Medial Laboratory Technology

The School of Allied Health Sciences is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as models of innovative problems solving in the university environment to enrich their academic and professional careers.

Vision

To nurture intellect, creativity, character and professionalism among students and impart contemporary knowledge in various specialities of allied health sciences improving best practises in clinical imaging and diagnosis sciences to treat diseases that are socially relevant and transform society and individually student become global paramedical citizen

Mission

1. Committed to provide students with well-equipped advanced laboratory and research facilities.
2. To provide highest quality learning environment, teaching methods, programme specific curriculum, and the changing patterns of skills that is demanded by modernhealth care.
3. To impart knowledge and skill-based training to create cadre of globally competent Biochemistry and Allied Health Care professionals.
4. To provide an opportunity to expose students to intellectual environment and a specialized body of knowledge

5. To develop their proficiency in laboratory techniques in collaboration with leading Heath sectors and Industries.
6. To improve the quality of life and society by teaching moral values and enhancing leadership qualities.

Values

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Teamwork

"The constant questioning of our valuesand achievements is a challenge without which neither science nor society can remain healthy" **— Aage Niels Bohr**

Advisory Board

S	Name of the Member	Designation
1	**Dr. Jayashree S** Prof. and HOD School of Biochemistry, REVA University jayashrees@reva.edu.in 8610123372	Chairperson
2	**Dr. Lakshmikanth GN** Radiologist, St.Martha's Hospital Bangalore. 9535151288	External Member
3	**Dr. Gale Kathleen Edward** HOD Laboratory Service and Consultant Pathologist ELBIT Medical Diagnostics Pvt. Ltd galekathleen@gmail.com 9901994545	External Member
4	**Dr. Sujatha K** Associate Professor of Anatomy, P.E.S. Institute of Medical Sciences and Research, Kuppam, Chittoor district, Andhra Pradesh sujathambbs@gmail.com 9916287074	External Member
5	**Dr. Satish Kumar Murari** School of Biochemistry, REVA University satishkumar.m@reva.edu.in 9686088514	Internal Member
6	**Dr. D V Sunitha** Associate Professor and Coordinator School of AppliedSciences – Physics REVA University sunitha.dv@reva.edu.in 7760884884	Internal Member
7	**Dr. Hareesh K** Assistant School of Applied Sciences – Physics REVA University hareesh.k@reva.edu.in 9986996834	Internal Member

B. Sc Medical Radiology and Diagnostic Imaging

Programme Overview

B.Sc. in Medical Radiology and Diagnostic Imaging is a three year degree program designed to impart profound Medical imaging knowledge through quality teaching and training programs to cater the community health needs thereby facilitating the development of socially responsible radio-technologist and entrepreneurs. The course of study for B.Sc. in Medical Radiology and Diagnostic Imaging shall extend over a period of six semesters (Three academic years). The course curriculum designed on the basis of Government of India's newly approved National Commission for Allied and Healthcare Professions Bill, 2021which includes in-depth study of Radiographic and Image Processing Techniques, Conventional Radiological Equipment, Modern Radiological & Imaging Equipment, Contrast & Special Radiography procedures etc.

Programme Educational Objectives (PEOs)

- To develop knowledge and skilled professionals to perform medical radiological and diagnostic imaging using various clinical tools at multi-centric facilities in India and abroad.
- To pursue successful industrial, academic and research careers in specialized fields of radiological and imaging technology.
- To edify students with necessary skills to perform various diagnostic procedures in the domain of medical radiological and diagnostic imaging following ethical principles.
- To Educate students about various modalities in Radiology.
- To train students in aspects of medical ethics and Radiation safety in the daily practice.
- To inculcate a problem solving mindset of the students through clinical exposure of real world problems.
- To equip students with good laboratory practices pertaining to radiology and imaging procedures with due safety of the personnel involved.

The Programme Educational Objectives are to prepare the students:

- State the importance of the Medical Radiology and Diagnostic Imaging plays important role in the diagnosis and treatment of the patient. Perform proficiently routine laboratory procedures and some specialized procedures.
- Add new procedures and duties to his/her repertoire with ease using the basic knowledge acquired in the clinical program and will demonstrate the ability to read and understand a procedure manual in order to perform testing.

- Judge the validity of Radiology and Diagnostic Imaging results, confirm abnormal results, and integrate and relate data generated by various departments while making decisions regarding possible discrepancies in routine tests.
- Utilize quality control methods and standards in maintaining accuracy and precision. Perform some basic preventative maintenance of equipment and instruments.
- Evaluate new methods and procedures with minimal assistance by applying knowledge of principles, procedures, and techniques.
- Recognize a problem and identify the cause; apply the problem-solving approach to situations including making decisions concerning the results of quality control and quality assurance measures.
- Communicate ideas and data and exhibit professional conduct through interpersonal skills with patients, laboratory personnel, other healthcare professionals, and the public. Recognize the need to be responsible for his/her work and to respond to constructive criticism in a positive manner.
- Exhibit compassion and respect for the patient and allied health care personnel. Recognize the importance of information concerning the patient and realize that it should not be discussed indiscriminately.
- Attend continuing educational programs to establish and maintain continuing education as a function of growth and maintenance of professional competence. Follow established safety procedures in the performance of his/her Radiology and Diagnostic Imaging duties in order to maintain a safe working environment for himself/herself and other laboratory employees.
- Apply principles of current Radiology and Diagnostic Imaging information systems. Write simple procedures for collecting, processing and analyzing patient and other substances following established guidelines.

Programme Educational Objectives (PEOs)

The programme educational objectives of the B.Sc Medical Radiology and Diagnostic Imaging course is to prepare graduates to

PEO-1	Demonstrate problem solving skills in performing routine Medical Radiology and Diagnostic Imaging procedures by communicating effectively with the patient or either leading a team or as a team member in a clinical facility
PEO-2	Express oral and written interpersonal skills as part of the health care teams requirements to understand, learn and advance their careers through clinical care developments and seeking higher learning.
PEO-3	Understand the professional, ethical and social responsibilities through lifelong

	learning skills
PEO-4	Acquire higher degree of work in academics and research.

Programme Outcomes (POs)

PO1. Science Knowledge: Apply the knowledge of radiological sciences and imaging techniques for the solutions to the problems in various diagnostic domains particularly for health care industries for efficient diagnosis of the diseased.

PO2. Problem analysis: Identify formulate and analyze problems related to various medical imaging domains of clinically relevant procedure of radio diagnostic of the patients

PO3. Conduct investigations of relevant problems: Comprehend, analyze, model and solve complex problems in the areas of Medical Radiology and Diagnostic Imaging

PO4. Modern tool usage: Utilize modern tools and modalities in the arena of medical imaging technology for better outcomes.

PO5: Environment and sustainability: Understand and appreciate the role of radio diagnostic in the development of healthy society

PO6: Individual and team work: Recognize the need to expertise in the areas of medical radiology and diagnostic imaging by self up gradation through life long learning.

PO7.Communication: Communicate with clarity and coherence, both written and verbally.

PO8. Ethics: Exibit professional responsibility in conducting standardized radiological and imaging diagnostic procedure within the realm of ethical guidelines

PO9. Project management and finance: Encourage collaborative learning and analyze the impact of radio diagnostic practices in a global, economic, environmental, and societal context

P1O. Life long learning: Use latest computer techniques and tools to carry out scientific investigations and develop new Medical Radiology and Diagnostic Imaging solutions and solve problems related to society.

Programme Specific Outcomes (PSOs)

After successful completion of the programme, the graduates shall be able to

PSO1. Demonstrate the knowledge of medical radiology and diagnostic imaging

PSO2. Apply the concepts in the design, development and implementation of application oriented medical radiology and diagnostic imaging solutions.

PSO3. Comprehend the fundamentals of radiology/imaging skills and undertake advanced level of knowledge to analyse and create techniques to solve real life problems.

REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Science Graduate Degree Programs, 2020

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1. These Regulations shall be called the **"REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Under Graduate Degree Programs- 2020".**

1.2. These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:

The following programs and all Graduate Degree programs to be instituted and introduced in REVA University in coming years shall follow these regulations.

B.Sc in:

Nutrition and Dietetics

Medical Radiolgy and Diagnostic Imaging

Medical Laboratory Technology

3. Definitions:

Course: Every course offered will have three components associated with the teaching-learning process of the course, namely:

- L= Lecture (ii) T= Tutorial (iii) P=Practice; where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / selfstudy/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

4. Courses of study and Credits

4.1. The study of various subjects in B.Sc., degree program are grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

4.1.1. In terms of credits, every **one hour session of L amounts to 1 credit per Semester.**
In terms of credits, every **one hour session of L amounts to 1 credit per Semester** and a minimum of **two hour session of T or P amounts to 1 credit per Semester** over a period of one Semester of 16 weeks for teaching-learning process.

4.1.2. The total duration of a semester is 20 weeks inclusive of semester-end examination.

4.1.3. **A course shall have either or all the four components.** That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

4.1.4. The concerned BoS will assign Credit Pattern for every course based on the requirement. However, generally, courses can be assigned with 1-4 Credits depending on the size of the course.

4.1.5. Different **Courses of Study** are labelled and defined as follows:

Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Foundation Course (ii) Hard Core Course, and (iiI) Soft Core Course.

a. Foundation Course (FC)

b. Foundation Courses are four courses including language study which are mandatory in nature prescribed by the University and should be completed successfully as part of Graduate Degree Program irrespective of the branch of study.

c. Hard Core Course (HC):

The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

d. Soft Core Course (SC):

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

e. Open Elective Course:

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an O**pen Elective Course.**

f. Clinical Postings /Internship/:

Clinical Postings /Internship is a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problem. An internship carrying **EIGHT** credits and Clinical postings with 2 to 4 credits on each semester. **Clinical Postings /Internship may be a hard core or a Soft Core as decided by the BoS / concerned.**

5. Eligibility for Admission:

Pass in PUC/10+2 examination with life science/Biology as compulsory subjects with minimum 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together of any Board recognized by the respective State Government /Central Government/Union Territories or 2 years DMLT(10+2) or any other qualification recognized asequivalent thereto.

6. Scheme, Duration and Medium of Instructions:

6.1 The Three Year degree program is of 6 semesters (3 years) duration. A candidate can avail a maximum of 12 semesters (6 years) as per double duration norm, in one stretch to complete the ThreeYear Degree, including blank semesters, if any. Whenever a candidate opts fo blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

7.1. A candidate has to earn 120 credits for successful completion of Three Year Degree B.Sc Medical Radiology and Diagnostic Imaging with a distribution of credits as given in Table - 1 below:

Table-1: **Credits and Credit Distribution for ThreeYear degree programs**

Course Type	**Credits for Three Year Degree(6 semesters)**
Hard Core Course	116
Core Courses (languages)	2
Skill EnhancementCourses	2
Total	**120**

7.2. The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, and field work, self-study elective, as **Foundation Course (FC), Hard Core (HC) or Open Elective (OE)**.

7.3. Every course including project work, practical work, Clinical Postings, self-study elective should be entitled as Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE) by the BoS concerned.

7.4. The concerned BOS shall specify the desired Program Objectives, Program Educational Objectives, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

7.5. A candidate can enrol for a maximum of 19-20 credits and a minimum of 20-21 credits per Semester. However, he / she may not successfully earn a maximum of 20 credits per semester. This maximum of 20 credits does not include the credits of courses carried forward by a candidate.

7.6. Only such full-time candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully 120 credits in 6 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

8. Add-on Proficiency Certification / Diploma:

8.1 Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 2 extra credits either in the same discipline /subject or in different discipline / subject in excess to 144 credits for the Three Year Graduate degree programs.

8.2 Add on Proficiency Diploma:

To acquire Add on Proficiency Diploma, a candidate can opt to complete a minimum of 2 extra credits either in the same discipline /subject or in different discipline / subject in excess to 120 credits for the Three Year Graduate degree programs.

The Add on Proficiency Certification / Diploma so issued to the candidate contains thecourses studied and grades earned.

9. Assessment and Evaluation

a) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight is for Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This is applicable for theory, laboratory, workshop, studio and any such courses

b) Out of 50% weight earmarked for Internal Assessment (IA)- 15% for test-1, 15% for test-2 and 20% for Assignments and this is applicable for theory based courses

c) The tests and assignments are conducted as per the semester academic calendar provided by the University.

The details as given in the table

Component	**Description**	**Conduction**	**Weight Percentage**
C1	**Test-1: IA1**	**6th week from the starting date of semester**	**15**
	Test-2: IA2	**12th week from the starting date of semester**	**15**
C2	**1 Assignment 1**	**7th week**	**10**
	2 Assignment 2	**13th week**	**10**
C3	**SEE including practical & Clinical Postings Report**	**between 17th Week-20th Week**	**50**
Results to be Announced			**By the end of 21st Week**

Note: IA or CIA includes C1 and C2

Each test must be conducted for a duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for a duration of 3 hours and the question paper must be set for a maximum of 100 marks.

d) Students are required to complete courses like technical skills, placement related courses, Open electives and any such value addition or specialized courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not

be considered for SGPA calculations. The Online/MOOCs courses will not have continuous internal assessment component

Such of those students who would like to discontinue with the open elective course that they have already registered for earning required credits can do so, however, they need to complete the required credits by choosing an alternative open elective course.

Setting question paper and evaluation of answer scripts.

i. For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question papers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor

ii. The Chairman of BoE shall get the question papers set by internal and external examiners.

iii. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.

iv. There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.

v. The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.

vi. If a course is fully of (L=0):T:(P=0) type or a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by theBoS concerned.

10. Evaluation of Practical's and Minor Project / Major Project / Dissertation /Clinical Postings

10.3.1. A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.3.2. In case a course is fully of P type (L=0:T=0:P=4), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) Continuous Internal assessment (CIA) = 50 marks

b) Semester end practical examination (SEE) = 50 marks

The 25 marks for continuous assessment shall further be allocated as under (IA or CIA):

i	Conduction of regular practical throughout the semester	20 marks
ii	Maintenance of lab records /industry reports	15 marks
iii	Laboratory test and viva	15 marks
	Total	50 marks

The 50 marks meant for Semester End Examination, shall be allocated as under:

i	Conduction of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	50 marks

10.3.3. The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

10.3.4. In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

10.3.5. The duration for semester-end practical examination shall be decided by the concerned School Board.

10.4. Evaluation of Internship/Clinical Postings:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

1	Internship/Clinical Postings	Should be done a semester before the project semester	Weightage: 0%
2	Internship/Clinical Postings	7th week from the start date of project semester	Weightage: 25%
3	Internship/Clinical Postings	14th Week from the start date of project semester	Weightage: 25%
4	Internship/Clinical Postings	17th -20th Week of project Semester	Weightage: 30% for Dissertation Weightage : 20% for Final Viva Voce

11. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1,C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

12. Eligibility to Appear Semester End Examination (SEE)

12.1. Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2. Requirements to Pass a Course

Students are required to score a total minimum of 40% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 25% (12) marks in final examination.

13. Requirements to Pass the Semester

To pass the semester, a candidate has to secure minimum of 40% marks in each subject / course of the study prescribed in that semester.

13.1 Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters of first year shall move to third semester of second and final year of the study. However, he / she shall have toclear all courses of all semesters within the double duration, i. e., within six years of admission of the first semester failing which the student has to re-register to the entire program.

13.2. Provision to Withdraw Course:

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is Soft Core Course or Open Elective Course.
A DROPPED course is automatically considered as a course withdrawn.

13.3. Re-Registration and Re-Admission:

a) In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination (C3) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

14. Attendance Requirement:

14.1 All students must attend every lecture, tutorial and practical classes, clinical postings.

14.2 In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

a) Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C4) examination and such student shall seek re-admission as provided in 7.8.4.

b) Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of

the Registrar & Registrar (Evaluation).

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid-semester (C1,C2) examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special test for such candidate(s) well in advance before the C3 examination of that respective semester. Under no circumstances C1,C2 test shall be held after C3 examination.

16. Grade Card and Grade Point

16.1. Provisional Grade Card: The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

16.2. Final Grade Card: Upon successful completion of B.Sc., Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

16.3. The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90 >100	10	v*10	O
80 > 90	9	v*9	A+
70 > 80	8	v*8	A
60 > 70	7	v*7	B+
55 > 60	6	v*6	B
50 > 55	5.5	V*5.5	C +
40 > 50	5	v*5	P
0-40	0	v*0	F
ABSENT			AB

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail

Here, P is the percentage of marks (P=[C1+C2+C3]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

16.3.1. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e:

SGPA (Si) = ∑(Ci x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4X9=36
Course 2	4	A	8	4X8=32
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, **SGPA = 188 ÷ 24 = 7.83**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	P	5	3X5=15

Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			199

Thus**, SGPA = 199 ÷ 24 = 8.29**

Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for Two year Post Graduate degree program is calculated taking into account all the courses undergone by a student over all the semesters of a program i. e.,

$CGPA = \sum(Ci \times Si) / \sum Ci$

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration: No.1

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92

2	24	7.71	24 x 7.71 = 185.04
3	24	8.68	24 x 8.68 = 208.32
4	24	9.20	24 x 9.20 = 220.80
Cumulative	96		778.08

Thus, CGPA = 24x6.83+24x7.13+24x8.68+24x9.20 = 8.11

16.3.2. CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10=81.0

16.3.3. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows

CGPA	**Grade (Numerical Index)**	**Letter Grade**	**Performance**	**FGP**
	G			**Qualitative Index**
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C	Average	
> 4 CGPA <5	5	P	Pass	Satisfactory

Overall percentage=10*CGPA

17. Challenge Valuation

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for SEE.

The answer scripts for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

b. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Mapping of PEOS with Respect to Pos

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
PE01	√	√	√	√	√	√	√	√	√	√
PE02	√	√	√	√	√	√	√	√	√	√
PE03	√	√	√	√	√	√	√	√	√	√
PE04	√	√	√	√	√	√	√	√	√	√

Attainment of CO (Course Outcome)

CO Attainment	**Value**
0.4 - 0.6	1
0.6 – 0.75	2
> 0.75	3

Mapping of Course Outcomes with programme Outcomes

Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21AHE102	CO	3	2	3	3	3	2	2	2			2	1	1
	CO	2	3	1	3	1	3	2	2			1	1	1
	CO	1	2	2	3	1	3	3	3			2	1	2
	CO	3	3	2	3	1	3	2	3			1		2

Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0101	CO	2	3	3	3	1	2	2	3			2	1	2
	CO	3	2	3	3	1	2	2	3			2	2	1
	CO	2	2	3	2	1	3	3				1	1	2
	CO											2	1	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0102	CO	2	3	2	3	1	3	1	1			1	2	2
	CO	2	3	3	3	1	1	2	3			2	2	2
	CO	3	3	3	2	1	1	2	1			1	2	1
	CO	3	2	1	3	1	3	2				1	1	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0103	CO	3	1	3	3	2	1	3	2			1	1	1
	CO	3	3	2	3	1	1	2	3			1	2	2
	CO	2	3	2	3	2	1	2	3			2	1	1
	CO	1	3	2	3	2	3	2	3			2	2	1
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P

	COs													
B21HB0104	CO	3	3	1	2	1	1	2				1	1	1
	CO	2	2	1			1					1	1	2
	CO	3	2	1	2		1	1				2	2	2
	CO	3	3	2	3		1	1				2	1	1
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0105	CO	2	2	3	3	1	2	3	1			1	1	2
	CO	3	2	2	3	3	2	2	2			2		1
	CO	2	3	3	3	3	2	3	3			2		2
	CO	1	3	3	3	2	2	3	3			1		2
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0106	CO	2	2	3	3	1	2	3	1			1	1	2
	CO	3	2	2	3	3	2	2	2			2		1
	CO	2	3	3	3	3	2	3	3			2	1	2
	CO	1	3	3	3	2	3	3	3			1		2
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
	CO	2			1	1				2		3	2	3

B21HB0107	CO	1	2	2	3		1			2	1	2	3	1
	CO	1	1		2					1			2	1
	CO	2	1	1	2	1				1	2	1	2	2
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0201	CO		1			1		2	2				1	
	CO		1			1		2	2				1	
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0202	CO	3	1	1	3	1	2	2	1			2	1	1
	CO	3	3	1	3	1	2	2	1			1	1	2
	CO	3	1	1	3	1	2	3	1			1	1	1
	CO	3	1	1	3	1	2	2	1			2	2	1
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0203	CO	3	2	1	3	1	1	2	2			2	2	1
	CO	3	2	2	3	1	1	2	2			1	2	2

	CO	3	3	3	2	2	2	3	3			1	2	2
	CO	2	3	3	3	3	2	2	3			2	2	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0204	CO	2			1	1				2		3	2	3
	CO	1	2	2	3	1				2	1	2	3	1
	CO	1	1		2					1			2	1
	CO	2	1	1	2	1				1	2	1	2	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0205	CO	3	3	3	2	3	2	3	2		2	2	2	3
	CO	3	3	3	2	3	2	3	2		2	2	2	3
	CO	3	3	3	2	3	2	3	2		2	2	2	3
	CO	3	3	3	2	3	2	3	2		2	2	2	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0206	CO	1	1			1	1	3	3				1	3
	CO	1	3	1	2	1		3	3				1	2
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P

	COs													
	CO	1	1	3			1		1			1	1	1
B21HB0207	CO	3	3	3	2		2	1	1		1	1	2	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
	CO	1		2	2	1	1			1	2		1	
B21HB301	CO	2	2	3	2	1	2				2	1	2	1
	CO	2	3	3	2	1	3	1	2	1	1	1	3	3
	CO	3	3	3	3	2	3	1	2	1	3	2	3	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
	CO	3	3	3	2	3	2	3	2	1	2	2	3	3
B21HB0302	CO	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO	3	3	3	2	3	2	3	2	1	2	2	3	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P

B21HB0303	CO	1	2		3	1	1	3	3				2	3
	CO	1	2		3	1	1	3	3				2	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0304	CO	1	1						1			2	1	2
	CO	2		2	1				1			1	1	1
	CO	2	1	1	2		1	1	2	1	2	1	2	2
	CO	3	3	2	3	3	3	1	3	1	2	1	2	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0305	CO	3	3	3	3	2		2	3		2		1	2
	CO	2	2	2	2			2	3	3			2	3
	CO	2	3	3	2				2	2		1	3	2
	CO		2					1	3	3			2	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0306	CO	1		2	2				1			1		2
	CO	2	1	1	2	2			1	1	2	1	2	3

	CO	3	3	3	3	1			1	2	1	1	3	2
	CO	3	3	3	2	1	2	1	2	2	3	1	3	3
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HS0401	CO	3	3	2	1	1	1	2	3			1	2	2
	CO	2	3	3	2	1	1	2	2			1	1	2
	CO	3	2	3	1	1	2	3	2			1	1	1
	CO	2	3	2	1	1	1	2	2			2		1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0401	CO	2	1	1	2	1						2	3	1
	CO	2	2	1	3	1	2	3	2		1	2	3	1
	CO	2	1	1	3			2	1			1	2	1
	CO	2	1	1	3			2	1			1	2	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0402	CO	1	2	1			1	3	2					3
	CO		1	1	2				2			1		
	CO	2	2	3	1			2	3	1	2		2	3

	CO		3	3	2		1	2	3		1	1	2	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0403	CO	1	1	1	1	3	2	1	1					2
	CO	2	2	1	1	1	2		2			1		2
	CO	3	2	2	3		3		2	1	2	2	2	3
	CO	2	3	3	2	2	1		2	1			3	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0404	CO	1	2	2	3			1	2	1	1		1	2
	CO	2	2	1	1	1	2		2			1		2
	CO	3	2	2	3		1		2	1	2	2	2	3
	CO	2	3	3	2	2	1		2	1			3	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0405	CO		3	2	3	1	3	3	3			1	3	3
	CO	3	3	2	2		1	3	3	1	1		1	2
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P

	CO	2	3	3	3	1	1	3	3			1	3	3
B21HB0406	CO	2	3	3	3	1	1	3	3			1	3	3
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0501	CO	2	1	2	2	1	2	1			3	2	3	2
	CO	3	3	3	3	2	1			2	3	2	3	2
	CO	1	3	2	2	1	1	1	2	1	3	1	3	3
	CO	2	2	1	3	1	1	1	2	2	2	2	3	3
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0502	CO	3	3	3	3	1	2	2	3		3	3	3	3
	CO	2	3	3	1	1	1	3	3			1	1	1
	CO	2	1	1	2	1	1	1	3			1	2	2
	CO	3	3	3	3	3	2	2	3	2	3	2	3	3
Course Code	PO	P	P	P	P	P	P	P	P	P	P	P	P	P
	COs													
B21HB0503	CO	1	2		1	2	1	3	3				1	3
	CO	1	3		1	1	1	3	3				1	3

Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0504	CO	1	3	3	2		1	1	1			1	1	2
	CO	1	3	3	2		1	1	1			2	2	1
	CO	1	3	3	2		1	1	1			2	1	2
	CO	1	3	3	2		1	1	1			2	2	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0505	CO		1	1			2							2
	CO		1	1			2							2
	CO	1	2	1			1	2	1		1		1	
	CO	1	1	2	1		1			1	1			
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0506	CO		2	1	1		1	3	3				3	3
	CO	2	3	2	1	2	1	3	3				3	3
	CO		1		1		1	1	3			1	2	
	CO	2	1	2	3	2	2	3	2		1		2	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P

B21HB0507	CO		1	1		1	1	3	3					
	CO		1	3	1	1		3	3				1	1
Course Code	PO COs	P	P	P	P	P	P	P	P	P	P	P	P	P
B21HB0601	CO	3	2	1	3	2	1				2	1	3	3
	CO	3	2	1	3	2	1				2	1	3	3

Mapping of PEOS with Respect to Pos

	P	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO4	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

B. Sc Medical Radiology and Diagnostic Imaging
Scheme of Instruction and Detailed Syllabus
(Effective from the Academic Year 2021-24)

HC = Hard Course; SEC= Skill Enhancement Course; CC = Core Course

Scheme of Instruction **Duration: 6 Semesters (3 Years)**

Sl. No	Course Code	Title of the Course	HC/ /CC	Credit Pattern				
				L	T	P	Total	Hours
FIRST SEMESTER								
1	B21AHE102	Communicative English	FC	2	0	0	2	3
2	B21HB0101	Anatomy	HC	2	1	0	3	4
3	B21HB0102	Physiology	CC	2	1	0	3	4
4	B21HB0103	Biochemistry	CC	2	1	0	3	4
5	B21HB0104	Health Care System	SC	2	1	0	3	4
		Practical						
6	B21HB0105	Anatomy Laboratory	HC	0	0	2	2	3
7	B21HB0106	Physiology Laboratory	HC	0	0	2	2	3
8	B21HB0107	Biochemistry Laboratory	HC	0	0	2	2	3
Total Credits				**10**	**4**	**6**	**20**	**28**
SECOND SEMESTER								
1	B21HB0201	Pharmacology	HC	2	0	0	2	4
2	B21HB0202	Microbiology	HC	2	1	0	3	3
3	B21HB0203	Pathology	CC	2	1	0	3	4
4	B21HB0204	Radiation Physics &Instrumentation	HC	3	1	0	4	4
5	B21HB0205	Positioning and Techniques I	HC	3	1	0	4	4
		Practical						
7	B21HB0206	Clinical Postings - Radiographic image processing.	HC	0	0	2	2	4
8	B21HB0207	Radiation Physics & Physics of Diagnostic Radiology.	HC	0	0	2	2	4
		Total Credits		**12**	**4**	**4**	**20**	**27**

THIRD SEMESTER								
1	B21HB0301	Physics & Instrumentation of CT	HC	3	1	0	4	4
2	B21HB0302	Positioning II	HC	2	1	0	3	4
3	B21HB0303	Special Procedures	HC	2	1	0	3	4
4	B21HB0304	Physics & Instrumentation of USG	HC	3	1	0	4	4
		Practical						
5	B21HB0305	Radiographic Positioning and Special Procedures	HC	0	0	3	3	3
6	B21HB0306	CT and USG instrumentation and Physics	HC	0	0	2	2	3
		Total Credits		**10**	**4**	**5**	**19**	**22**
FOURTH SEMESTER								
1	B21HS0401	Environmental Science and Health	SC	2	0	0	2	3
2	B21HB0401	Interventional Radiology &Nuclear Medicine	HC	3	1	0	4	4
3	B21HB0402	Imaging Protocol in USG and CT	HC	2	0	1	3	4
4	B21HB0403	Radiation Protection and Safety	HC	3	1	0	4	4
		Practical						
5	B21HB0404	Radiation Protection and Safety	HC	0	0	2	2	3
6	B21HB0405	CT and USG imaging	HC	0	0	3	3	3
7	B21HB0406	Interventional and Nuclear Medicine	HC	0	0	2	2	3
		Total Credits		**10**	**1**	**9**	**20**	**24**

1	B21HB0501	MRI Physics and Instrumentation	HC	3	1	0	4	4
2	B21HB0502	Sequences and Clinical	HC	2	0	1	3	4
3	B21HB0503	Patient Care	HC	2	1	0	3	4
4	B21HB0504	Medical Sociology, Law & Ethics	CC	2	0	0	2	4
5	B21HB0505	Biostatistics and Research	HC	2	0	0	2	3
6	B21HB0N01	SWAYAM/MOOC	SEC	2	0	0	2	2
		Practical						
7	B21HB0506	MRI Instrumentation	HC	0	0	2	2	3
8	B21HB0507	Patient Care	HC	0	0	2	2	3
		Total Credits		**13**	**2**	**5**	**20**	**27**

SIXTH SEMESTER

	B21HB0601	Advancements in Medical Imaging	HC	1		**1**	**2**	
	B21HB0602	Internship and Research	CC			**19**	**19**	
		Total Credits					**2 1**	

INTERNSHIP	Radiographic Positioning- CR and DR	3	
	Special Procedures/Fluoroscopy	3	
	Computed Tomography	3	
	Ultrasonography	3	
	Interventional Radiography	2	
	Nuclear Medicine	2	
	Magnetic Resonance Imaging	3	

Semester-wise Summary of Credit Distribution

Semester	L	T	P	Total	Total Hours
I	10	4	6	**20**	28
II	12	4	4	**20**	27
III	10	4	5	**19**	22
IV	10	1	9	**20**	24
V	13	2	5	**20**	27
VI	1	-	20	**21**	28
Total Credits	**56**	**23**	**33**	**120**	**156**

B. Sc (Medical Radiology & Diagnostic Imaging)
Detailed Syllabus

FIRST SEMESTER

Course Code	Communicative English	Course Type	L	T	P	C	H
B21AHE102		AEC	2	0	0	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21AHE102	CO1	3	2	3	3	3	2	2	2			2	1	1
	CO2	2	3	1	3	1	3	2	2			1	1	1
	CO3	1	2	2	3	1	3	3	3			2	1	2
	CO4	3	3	2	3	1	3	2	3			1		2

Course Description:

This 2-credit course focuses on improving the spoken and written communication of the learners. The course develops personal, inter-personal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.

Prerequisites:

The student must have knowledge of intermediate English Grammar and LSRW skills.

Pedagogy:

Direct method, ICT, Collaborative learning, Flipped Classroom.

Course Objectives:

1. To enhance functional communication skills.
2. To develop functional use of language in professional contexts.
3. To utilize oral presentations in multiple contexts.
4. To apply effective written skills in formal communication.

Course Outcomes:

After the completion of the course, students will be able to:

1. Identify pressing issues relating to society, environment and media.
2. Develop a process-oriented approach to writing.
3. Apply the grammatical skills developed during the course aptly.
4. Demonstrate a good command over language usage and refined interpersonal skills.

Course Content:

Unit-I: Functional English **7 Hrs**

Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs
Writing Skills: Paragraph Writing
Activities: Conversations; Leaving Phone Messages
Literature: Chief Seattle – The End of Leaving and Beginning of Survival

Unit-II: Interpersonal Skills **6 Hrs**

Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs
Writing Skills: Official Letters
Activities: Making Apologies; Invitations & Making Arrangements
Literature: Ruskin Bond – Tiger in the Tunnel

Unit-III- Multitasking Skills **7 Hrs**

Remedial Grammar: Present Perfect; For, Since & How Long; -ed & -ing adjectives; Prefix & Opposites of Adjectives
Writing Skills: Note Making
Activities: Agreeing & Disagreeing with Opinions
Literature: Jesse Owens - My Greatest Olympic Prize

Unit-IV: Communication Skills **6 Hrs**

Remedial Grammar: Collocations; Prepositions
Writing Skills: Precise Writing
Activities: Offers, Suggestions & Requests
Literature: Avijit Pathak – Onscreen Magic

Reference Books:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

Course Code	Anatomy	Course Type	L	T	P	C	CH
B21HB0101		HC	2	1	0	3	4

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PSO1	PSO2	PSO3
B21HB0101	CO1	2	3	3	3	1	2	2	3			2	1	2
	CO2	3	2	3	3	1	2	2	3			2	2	1
	CO3	2	2	3	2	1	3	3				1	1	2
	CO4											2	1	1

Course Objectives:

. 1. To understand the organization of human body

2. To obtain knowledge regarding the structural compositions in various organ systems

3. To undrstand the structure and functions of nervous system

4. To interpret the importance of lymphatic system

Course Outcomes:

CO1. Ready to explain the organization of components in the Human Body
CO2. Able to understand the structural compositions in various organ systems
CO3. To get knowledge about the structure and functions of nervous system
CO4. Able to analyse the blood components and lymphatic system

Course Content:

Anatomy

UNIT I: Systems of support and movement

Skeletal system- Cartilage: Type and basic histological feature; Bones: definition, classification based on location, name and number of bones with general feature of important bones, function of bone, histological feature of a compact bone. Joints – Definition and types with example, Axis and movements. Shoulder, elbow, hip, knee joints – type, bones and ligaments involved, possible

movements. Bones of the upper limb, Bones of the lower limb, Bones of the thorax, Bones of the Abdomen and pelvis, Skull and face bones.

Muscular system - Types of muscle with basic histological features, Parts of skeletal muscle. Definition of origin and insertion; Origin, insertion, nerve supply, action of sternocleidomastoid, pectoralis major, deltoid, gluteus maximums and diaphragm.

UNIT II: Controls systems of the body

Nervous system- Subdivisions of the nervous system. Spinal cord-location, extent, external features, and blood supply. Brain-subdivision, location, external features of Medulla oblongata, Pons, Midbrain, Cerebellum, and Cerebrum, Thalamus and Hypothalamus, Location and subdivision of ventricles of brain. Circle of Willis.

Cranial nerves-name, number, attachment, area of distribution. Spinal nerves-typical spinal nerve. Name and location of plexuses. Location and distribution of brachial and lumbosacral plexus. Autonomic nervous system-sympathetic and parasympathetic nervous system. Location of pre-ganglionic and post-ganglionic neurons.

Sense organs - Location and features of nose, tongue, eye, ear, and skin.

Endocrine system - Names of the endocrine glands. Location and features of pituitary, thyroid, parathyroid, suprarenal, pancreas, ovaries and testis. Names of hormones produced by each gland. Microscopic features of thyroid and pancreas.

UNIT III: Maintenance of the human body

Cardiovascular system - Types and general features of blood vessels. Structure and types of arteries and veins. Shape, size, location, covering, external and internal features of Heart.Conducting system of heart.

Blood supply of the heart. Name, location, branches and main distribution of principal arteries and veins

Lymphatic system - General features of Lymph node and lymphatic vessels. Name, location, external features, microscopic feature of tonsil and spleen.

Respiratory system - Name the organs of respiration. Location and features of Nasal cavity, pharynx, larynx, trachea, lung & pleura. Mention the microscopic feature of lung.

Digestive system - Name the parts of the alimentary canal and accessory organs. Location & features of oesophagus, stomach, small and large intestine. Location and feature of tongue, salivaryglands, pancreas, liver and gall bladder. Microscopic feature of liver.

Urinary system - Names of urinary organs. Location and features of kidney, ureter, urinary bladder & urethra. Microscopic feature of kidney.

Reproductive system - Names of male and female organs of reproduction. Location and features of testis, epididymis, vas deferens, prostate gland and spermatic cord. Location & features of uterus, uterine tube, ovary and breast.

UNIT IV: Anatomical regions and general radiological anatomy.

Simple ideas about scalp, triangles of neck, axilla, cubital fossa, carpal tunnel, mediastinum, umbilicus, inguinal canal, femoral triangle; Subsartorial canal popliteal fossa.X ray plain, X ray contrast, newer imaging techniques a brief overview and correlation in anatomy.

Reference Books

1. Human Anatomy by Inderbir Singh
2. Ross & Wilson Anatomy & Physiology in Health & Illness by Waugh (A)
3. Text Book of Human histology by Inderbir Singh
4. Theory and Practice of Histological Techniques by Bancroft (JD)
5. Human Genetics by Gangane (SD)
6. Ross & Wilson,(2014),Anatomy & Physiology in health & illness,11th edition, Elsevier Publications
7. Chaurasia B D, (2016), Human Anatomy, 7th edition, CBS publishers
8. Gerard J. Tortora and Bryan H.Derrickson,(Principles of Anatomy and Physiology,14th edition,Wiley Publications.

Course Code	**Physiology**	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21HB0102		**CC**	**2**	**1**	**0**	**3**	**4**

Course Code	POS/COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO 10	PSO1	PSO2	PSO3
	CO1	2	3	2	3	1	3	1	1			1	2	2
	CO2	2	3	3	3	1	1	2	3			2	2	2
	CO3	3	3	3	2	1	1	2	1			1	2	1
B21HB0102	CO4	3	2	1	3	1	3	2	3			1	1	2

Course Objectives:

1. To know about blood cell, blood component, lymphatic system and related lab technique

2. To learn about cardiovascular system, cardiac cycle, blood pressure & heart rate and ECG

3. To known about nerve cell & nervous system, nerve impulse, EEG and about the sense organ

4. To understand the gastrointestinal physiology, digestion of lipid, carbohydrate and protein and related disease.

Course Outcomes:

CO1. Achieve knowledge about blood cell, blood component, lymphatic system and related lab technique

CO2. Able to understand cardiovascular system, cardiac cycle, blood pressure & heart rate and ECG measurement

CO3. Able to understand nerve cell & nervous system, nerve impulse, EEG and about the sense organ Prerequisites: Course Objectives: Course Outcomes:64

CO4. Ready to understand the gastrointestinal physiology, digestion of lipid, carbohydrate and protein and related disease.

Course Content:

Unit - 1. General Physiology: Cell: morphology, Structure and function of cell organelles Structure of cell membrane Transport across cell membrane Intercellular communication Homeostasis.

Blood: Introduction-composition & function of blood W.B.C., R.B.C., Platelets formation & functions, Immunity Plasma: composition, formation & functions, Plasma Proteins: -types & functions Blood Groups- types , significance, determination Hemoglobin Haemostasis Lymph- composition, formation, circulation &functions.

Cardiovascular system: Conducting system-components, impulse conduction Heart valves Cardiac cycle- definition, phases of cardiac cycle Cardiac output- definition, normal value, determinants. Stroke volume and its regulation Heart rate and its regulation: Arterial pulse, Blood pressure-definition, normal values, factors affecting blood pressure Shock-definition, classification, causes and features Basic idea of ECG Cardiovascular changes during exercise.

Unit - 2. **Respiratory System:** Mechanics of respiration Lung volumes and capacities Pulmonary circulation, transport of respiratory gases Factors affecting respiration Regulation of respiration- neural regulation, voluntary control and chemical regulation Hypoxia, Hypercapnoea, Hypocapnoea Artificial respiration Disorders of respiration- dyspnoea, orthopnoea, hyperpnoea, hyperventilation, apnoea, tachypnoea Respiratory changes during exercise.

Nerve Muscle Physiology: Muscles- classification, structure, properties, Excitation contraction coupling Motor unit, EMG, factors affecting muscle tension, Muscle tone, fatigue, exercise Nerve –structure and function of neurons, classification, properties Resting membrane potential & Action potential their ionic basis All or None phenomenon Neuromuscular transmission Ionic basis of nerve conduction Concept of nerve injury & Wallerian degeneration Synapses Electrical events in postsynaptic neurons Inhibition & facilitation at synapses Chemical transmission of synaptic activity Principal neurotransmitters.

Unit- 3. Nervous system: Introduction, central and peripheral nervous system, functions ofnervous system Reflexes- monosynaptic, polysynaptic, superficial, deep &withdrawal reflexSense organ, receptors, electrical & chemical events in receptors Sensory pathways for touch, temperature, pain, proprioception & others Control of tone & posture: Integration at spinal, brainstem, cerebellar, basal ganglion levels, along with their functions Motor mechanism: motor

cortex, motor pathway: the descending tracts-pyramidal & extra pyramidal tracts-origin, course, termination & functions. Upper motor neuron and lower motor neuron paralysis. Spinal cord lesions- complete transection & hemi section of the spinal cord Autonomic nervous system :features and actions of parasympathetic & sympathetic nervous system Hypothalamus Higher functions of nervous system Special senses- eye, ear, nose, mouth Water excretion, concentration of urine-regulation of Na+ , Cl-, K+ excretion Physiology of urinary bladder.

Unit- 4: Renal System: Physiology of kidney and urine formation Glomerular filtration rate, clearance, Tubular functions.

Digestive System: Digestion & absorption of nutrients, Gastrointestinal secretions & their regulation Functions of Liver & Stomach. Endocrinology Physiology of the endocrine glands – Pituitary, Pineal Body, Thyroid, Parathyroid, Adrenal, Gonads, Thymus, Pancreas. Hormones secreted by these glands, their classifications and functions.

Male & female reproductive system Male - Functions of testes, pubertal changes in males, testosterone - action & regulations of secretion. Female - Functions of ovaries and uterus, pubertal changes, menstrual cycle, estrogens and progestron - action and regulation.

Reference Books :

1. Ross & Wilson,(2014),Anatomy & Physiology in health & illness,11th edition, Elsevier Publications
2. Sujit Chaudhury,(2011),Concise Medical Physiology,6th edition, NCBA
3. Sembulingam k,(2012),Essentials of Medical Physiology,6th edition, Jaypee Publications
4. Guyton and Hall,(2011) Textbook of Medical Physiology,12th Edition,Saunder/Elsevier

a. Gerard J. Tortora and Bryan H.Derrickson,(Principles of Anatomy and Physiology, 14th edition, Wiley publications

5. Textbook of Medical Physiology by G.K. Pal.
6. Review of Medical Physiology by Ganong.
7. Samson Wrights Applied Physiology.
8. Text book of Medical physiology by A.B. Das Mahapatra.

Course Code		Course Type	L	T	P	C	CH
B21HB0103	Biochemistry	CC	2	1	0	3	4

Course Code	POS/ COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0103	CO1	3	1	3	3	2	1	3	2			1	1	1
	CO2	3	3	2	3	1	1	2	3			1	2	2
	CO3	2	3	2	3	2	1	2	3			2	1	1
	CO4	1	3	2	3	2	3	2	3			2	2	1

Course Objectives:

1. To understand the knowledge of medical laboratory, apparatus handling and maintenance
2. To understand about the basic instruments used in the laboratory, preparation of reagents and
buffers with units and measurements
3. To know about the collection and processing of biological samples

Course Outcomes:

CO1. Apply knowledge on safety rules and ethics in the practice of medical laboratory.
CO2. Acquire knowledge to explain the principles and the operation mode of the most used analytical equipments used in biochemistry lab.
CO3. Apply knowledge on reagents and buffer preparations and their applications.
CO4. Ascertain the collection and processing of biological specimen.

Course Content:

Unit – 1 : Carbohydrate Chemistry - Classification (Definition/ examples for each class) Monosaccharides (classification depending upon number of carbon atoms and functional group with examples) Disaccharides (Sucrose/ lactose/ maltose and their composition) Polysaccharides : a) Homopolysaccharides (Structure of starch and glycogen) b) Heteropolysaccharides (Functions)

Lipid Chemistry Definition of lipids, Functions of lipids in the body Classification of lipids (subclasses with examples) Definition and Classification of fatty acids Essential fatty acids Phospholipids and their importance; Digestion and Absorption - General characteristics of digestion and absorption, • Digestion and absorption of carbohydrates, proteins and lipids.

Unit – 2 - Amino-acid and Protein Chemistry General structure of D and L amino acids, Amino acids; Definition and Classification of amino acids with examples. Peptides; definition & Biologically important peptides, Classification of Proteins based on composition, functions and shape (with examples), Functions of amino acids and Proteins.

Nucleotide and Nucleic acid Chemistry Nucleosides & Nucleotides, Nucleic acid Definition & types, Composition & functions of DNA & RNA ,Structure of DNA (Watson and Crick model), Structure of tRNA, & functions of tRNA, rRNA, mRNA Difference between DNA and RNA ;
Enzymes - Definition & Classification of Enzymes with example Definitions of Active site, Cofactor (Coenzyme, Activator), Proenzyme; Definition and examples (Pepsin & trypsin)

Unit – 3 Carbohydrate Metabolism- Glycolysis ; Aerobic, Anaerobic, Definition , Site and subcellular site , Steps with all the enzymes and coenzymes at each step , mention the regulatory enzymes , Energetics, Citric acid cycle; Pyruvate dehydrogenase complex (reaction and coenzymes) , Site and subcellular site , Reactions with all the enzymes and coenzymes ,Regulatory enzymes , Energetics Significance of HMP Shunt pathway. Hyperglycemic and hypoglycemic hormones Blood Glucose Regulation. Diabetes mellitus (definition, classification, signs and symptoms) Glycogen metabolism and gluconeogenesis.

Lipid Metabolism- Introduction to lipid metabolism, Lipolysis Beta oxidation of fatty acids ; Definition ,Site and subcellular site , Activation of palmitic acid , Transport of activated palmitic acid into mitochondria , Reactions , Energetics. Name the different ketone bodies . Note on ketosis.

Amino acid and Protein Metabolism- Introduction, transamination, deamination, Fate of ammonia, transport of ammonia, Urea cycle ;

Unit – 4 Radioactive Isotopes: Definition, clinical applications, biological effects of radiations.

Acids, bases & buffers: Definitions of acid, base, pH and pKa, Buffers- Definition, Henderson Hassel Balch equation, • Principal buffer systems in the ECF ICF and urine • Bicarbonate and phosphate buffer systems (pKa value, normal ratio of base/acid in the plasma) • Acidosis & Alkalosis.

Clinical biochemistry: Definition, Normal serum levels and condition where they are altered, Glucose, Protein, urea, uric acid, and creatinine. Bilirubin, cholesterol • Serum Electrolytes

Fundamental Chemistry: Valency, Molecular weight & Equivalent weight of elements and compounds. Normality, Molarity, Molality.

Preparation of Reagents & Solutions: Definition, use, classification where appropriate, preparation and storage, Stock and working solutions, Molar and Normal solutions of compounds and acids. (NaCl, NaOH, HCl, H_2SO_4,H_3PO_4, CH_3COOH etc.,). Preparation of percent solutions – w/w, v/v w/v (solids, liquids and acids), Conversion of a percent solution into a molar solution, Saturated and supersaturated solutions, Standard solutions. Technique for preparation of standard solutions and Storage. E.g: glucose, albumin etc. Dilutions- Diluting Normal, Molar and percent solutions. Preparing working standard from stock standard. Part dilutions: Specimen dilutions. Serial dilutions. Reagent dilution. Dilution factors.

Reference Books:

1. D M Vasudevan, (2011),Text book of Medical Biochemistry,6th edition Jaypee Publishers
2. M N Chatterjea & Rana Shinde,(2012),Text book of Medical Biochemistry,8th edition, Jayppe Publications
3. Singh & Sahni,(2008),Introductory Practical Biochemistry,2nd edition, Alpha Science
4. Lehninger,(2013),Principles of Biochemistry,6th edition, W H Freeman
5. U Satyanarayan,(2008), Essentials of Biochemistry,2nd edition, Standard Publishers
6. Medical laboratory Procedure Manual (T-M) by K.L. Mukerjee 1987, Vol.I, II & III Tata McGraw Hill Publication.
7. Text book of Medical Biochemistry by Ramakrishna
8. Text Book of Clinical chemistry by Norbert Teitz 4. Principles and Techniques of Practical Biochemistry by Wilson and Walker.
9. Clinical Chemistry - Principle and techniques by Rj Henry, Harper & Row Publishers.
10. Schaum's Outline of Biochemistry.Philip W. Kuchel, Ph.D, Simon Easterbrook-Smith, Vanessa Gysbers, J. Mitchell Guss
11. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology
12. Pearson's Biochemistry.Christopher K. Mathews, Kensal E. van Holde,Dean R. Appling,Spencer J. Anthony-Cahill
13. Biochemistry. Donald Voet, Judith G. Voet

Course Code	Health Care System	Course Type	L	T	P	C	CH
B21HB0104		HC	2	1	0	3	4

Course Code	POS/COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0104	CO1	3	3	1	2	1	1	2				1	1	1
	CO2	2	2	1			1					1	1	2
	CO3	3	2	1	2		1	1				2	2	2
	CO4	3	3	2	3		1	1				2	1	1

Course Objectives:

1. The objectives of this course are to help the students understand the knowledge of basic concepts, principles of health care system and its practical applications in the organization.

Course Outcomes:

CO1: Understand the concepts of health care and Explain how local health policy is made
CO2: Explain the history and organization of the health care system Identify and critique the difference between health care in India and certain other countries.
CO3: Explain and understand health policy and various national health programs
CO4: Acquire the fundamentals of health economics ,health insurance and health care finance

Course Content:

UNIT I: Concept of Health Care and Health Policy Health in Medical Care, Indigenous systems of Health Care & their relevance, Framework for Health Policy Development.

UNIT II: Health Organisation Historical development of Health Care System in the third world & India, Organization & Structure of Health Administration in India, Type of Health Organization including International Organizations, Private & Voluntary Health care provider, Distribution of Health Care Services, Health Care System in Public Sector Organization, Health systems of Various Countries.

UNIT III: Health Policy and National Health Programme National Health Policy, Drug Policy, National Health Programs (Malaria, T.B., Blindness, AIDS etc.), Evaluation of Health Programs (Developing indicators for evaluation), Medical Education & Health Manpower Development.

UNIT IV: Health Economics – Fundamentals of Economics Scope & Coverage, Demand for Health Services, Health as an Investment, Population, health of Economic Development. Economics of Health – Population based health services, Economics of Communicable and Non Communicable diseases ; Methods & Techniques of Economic Evaluation of Health Program Cost Benefit & Cost Effective Methods. • Household & Health Health Expenditure & Outcome.

Reference Books: Rovner, Julie. (2000). Health Care Policy and Politics A-Z. Washington, DC,

1. AHA Guide to the Health Care Field. (2007) Chicago: Health Forum.
2. Slee, Debora N. (2008) Slee's Health Care Terms. 5th ed.Sudbury, MA: Jones and Bartlett Publishers
3. Timmreck, Thomas C. (1997). Health services cyclopedic dictionary : a compendium of health-care and public health terminology. 3rd ed. Sudbury, MA : Jones and Bartlett Publishers.
4. Control of Communicable Diseases in Man: Benenson A S
5. Manson's Tropical Diseses:Cook G, Zumla A
6. Hunters Tropical Medicine and emerging infectious diseases: Strickland GT
7. Training modules of various national & international institutes and national health programme.

Course Code	Anatomy Lab	Course Type	L	T	P	C	CH
B21HB0105		CL	0	0	2	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0105	CO1	2	2	3	3	1	2	3	1			1	1	2
	CO2	3	2	2	3	3	2	2	2			2		1
	CO3	2	3	3	3	3	2	3	3			2		2
	CO4	1	3	3	3	2	2	3	3			1		2

Course Objectives:

1. To demonstrate about heart, vessel, atery and vein
2. To see microscopic image of artery and vein in heart
3. To know about histology of lymph node, spleen, tonsil & thymus
4. To learn radiograph, angiogram, demonstration about reflection and parts of urinary system
5. To know about histology of kidney, ureter, urinary bladder

6. To learn about histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tubes, ovary
7. To know about radiographs of abdomen-IVP, retrograde cystogram and pelvis – hysterosalpingogram

Course Outcomes:

CO1. To get knowledge of heart, vessel, atery and vein and achieve visual knowledge of artery and vein in heart
CO2. Ready to explain about lymph node, spleen, tonsil & thymus
CO3. Able to explain radiograph, angiogram, demonstration about reflection and parts of urinary system and able to discuss about histology of kidney, ureter, urinary bladder
CO4. Able to discuss about histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tubes, ovary and handle radiographs of abdomen-IVP, retrograde cystogram and pelvis – hysterosalpingogram.

Course Content:

1. Demonstrations of dissected specimens
2. Demonstration of Bones of the upper limb& lower limb.
3. Demonstration of Bones of the thorax.
4. Demonstration of Bones of the Abdomen and pelvis.
5. Demonstration of Skull and face bones.
6. Study of bones, muscles, joints, nerve supply of the limbs and arteries of limbs..
7. Points of palpation of nerves and arteries
8. X rays plain , X rays contrast ,newer imaging technique's CT,MRI.Identification of a fracture.
9. Demonstration of dissected parts (upper extremity, lower extremity, thoracic & abdominal viscera, face and brain).
10. Clinico anatomical correlation in common diseases-eggoiter,swelling in the abdomen,locating the site of lumbar puncture,femoralartery,vein.

Reference Books: 1. Manipal manual for AHS by Dr. Sampath Madhyastha, (Second Edition) Published by CBS Publishers.
2. Handbook of anatomy for nurses by Dr. P. Saraswathi.
3. Text book of anatomy BD-CHAURASIA-LATEST EDITION.
4. Theory and Practice of histological techniques by Bancroft(jd).

Course Code	Physiology Laboratory	Course Type	L	T	P	C	C
B21HB0106		**CL**	0	0	2	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0106	CO1	2	2	3	3	1	2	3	1			1	1	2
	CO2	3	2	2	3	3	2	2	2			2		1
	CO3	2	3	3	3	3	2	3	3			2	1	2
	CO4	1	3	3	3	2	2	3	3			1		2

Course Objectives:

. 1. To measure clotting time, bleeding time and blood pressure

2. To auscultate heart sound, artificial respiration process and determination of vital capacity

3. To use haemoglobinometry, counting blood cell and determination of blood group

4. To learn differential WBC counting and Leishman's staining

5. To know about ESR and packed cell volume determination

Course Outcomes:

CO1. Able to check clotting time, bleeding time and blood pressure
CO2. Able to diagnose ausculate heart sound, artificial respiration process and determination of vital capacity
CO3. Able to handle the haemoglobinometry, counting blood cell and detrmination of blood group
CO4. Ready to do differential WBC counting, Leishman's staining, ESR determination and packed cell volume calculation.

Course Content:

. 1. Determination of Clotting Time, Bleeding Time
2. Blood pressure Recording
3. White Blood Cell count, Red Blood Cell count, Calculation of Blood indices
4. Determination of Blood Groups
5. Collection of blood, Urine, Gastric juice,
6. Separation of serum/ plasma and Deproteinization of blood sample

Course Code	Biochemistry Laboratory	Course Type	L	T	P	C	C
B21HB0107		**CL**	0	0	2	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0107	CO1	2			1	1				2		3	2	3
	CO2	1	2	2	3		1			2	1	2	3	1
	CO3	1	1		2					1			2	1
	CO4	2	1	1	2	1				1	2	1	2	2

Course Content

1. Preparation of different percentage solutions and Molar and Normal solutions

2. Accuracy, precision and quality control – Demonstration and preparation of twomethods using histogram, F-test and Barr test.

3. Demonstration of Colorimeter, Spectrophotometer, and pH meter

4. Determination of Copper, Zinc and selenium in human plasma and urine samples.

5. Determination of human serum lactate dehydrogenase isoenzymes.

6. Estimation of blood sugar in serum/plasma.

7. Quantitative assay for estimation of ketone bodies in diabetic urine

8. Estimation of Serum Cholesterol and triglycerides.

SECOND SEMESTER

Course Code	Pharmacology	Course Type	L	T	P	C	CH
B21HB0201		**HC**	**2**	**0**	**0**	**2**	**4**

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0201	**CO1**		1			1		2	2				1	
	CO2		1			1		2	2				1	

Course description: The module is intended to provide the student insights into pharmacotherapeutic interventions and their interactions with patient recovery process.

Course Objectives :
At the end of the course, the student should be able to know:

- The various pharmacological agents, route of administration, effects and uses
- The pharmacotherapeutic interventions and their interactions with patient recovery process

Course Outcomes:

CO1. Ascertain the knowledge about various drugs and their administration

CO2. Acquire the knowledge about drugs predominantly used in Radiology Department

Course Content:

UNIT -I:

Introduction: Definitions of pharmacology and drugs, Definitions of Pharmacokinetics, pharmacodynamics, pharmacotherapeutics, clinical pharmacology and toxicology**,** Drug sources with examples – Animal, plant, mineral and synthetic Drug nomenclature – Chemical, generic, official and trade name**,** Routes of drug administration, Pharmacokinetics, Pharmacodynamics, Drug toxicity and safety

Autonomic nervous system including skeletal muscle: Introduction to ANS , Cholinergic drugs, Anticholinergic drugs, Neuromuscular blocking drugs, Adrenergic drugs, Adrenergic receptor antagonists:

UNIT 2:

Central nervous system: General anesthetics (GA), Local anesthetics (LA) Sedative & hypnotics, Opioids, NSAIDs, Drug treatment of rheumatoid arthritis (RA), Drug treatment of gout, Psychopharmacology, Parkinson Antiepileptic drugs

Cardiovascular system: Drugs used in congestive heart failure (CHF), Antihypertensives, Antianginal drugs, Hypolipidemic, Diuretics:

GIT: Peptic ulcer**,** Antiemetics, Laxatives and antidiarrheals

Blood: Hematinic, Anticoagulants, Antiplatelet drugs, Fibrinolytics and antifibrinolytics

Corticosteroids, Antidiabetic drugs, Antiviral drugs, Antifungal agents, Antimalarial drugs

TEXT BOOK / REFERENCE BOOKS:

1. K.D. Tripathi, Essentials of Medical Pharmacology, 6th edition, Jaypee brothers medical publishers (P) Ltd

Course Code	Microbiology	Course Type	L	T	P	C	CH
B21HB0202		HC	2	1	0	3	4

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0202	CO1	3	1	1	3	1	2	2	1			2	1	1
	CO2	3	3	1	3	1	2	2	1			1	1	2
	CO3	3	1	1	3	1	2	3	1			1	1	1
	CO4	3	1	1	3	1	2	2	1			2	2	1

Course Objectives:

1. To learn the fundamental aspects of microbiology including taxonomy and classification
2. To understand about different kinds of microscopes used in the microbiology laboratory
3. To learn about gram staining for the identification of bacteria
4. To learn about disinfection methods used to control contamination of microorganisms

Course Outcomes:

CO1. Ascertain about the fundamental aspects of microbiology including taxonomy and classification.
CO2. Acquire the knowledge of microscopes used in the microbiology laboratory.
CO3. Ascertain the knowledge of gram staining method used in microbiology.

CO4. Acquire the knowledge of about disinfection methods used to control contamination of microorganisms.

Course Contents:

Unit 1: Morphology - Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria. 2. Growth and nutrition - Nutrition, growth and multiplications of bacteria, use of culture media in diagnostic bacteriology. 3. Sterilization and Disinfection - Principles and use of equipment of sterilization namely Hot Air oven, Autoclave and serum inspirator. Pasteurization, Anti septic and disinfectants. Antimicrobial sensitivity test

Unit 2: Disease caused and laboratory diagnosis of medically important bacteria (Staphylococcus, coagulase negative Staphylococcus, MRSA, Streptococcus pyogenes, Pneumococcus, gonococcus, E.coli, diarrhoeagenic E.coli, Salmonella, Vibrio cholerae, Halophilic vibrios, Shigella, Mycobacterium tuberculosis, Mycobacterium leprae, Atypical Mycobacteria, Treponema pallidum, leptospira) (no need of classification, antigenic structure, virulence mechanism)

Unit 3 : Systematic Bacteriology - Morphology, cultivation, diseases caused ,laboratory diagnosis including specimen collection of the following bacteria(the classification, antigenic structure and pathogenicity are not to be taught) Staphyloccci, Streptococci, Pneumococci, Gonococci, Meningococci, C diphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, Esch coli, Klebsiella, Proteus,vibrio cholerae, Pseudomonas & Spirochetes ; Parasitology - Morphology, life cycle, laboratory diagnosis of following parasites E. histolytica, Plasmodium, Tape worms, Intestinal nematode

Unit 4 : Microorganisms usually encountered in radiology department and route of disease transmission; Transmission based precautions .; decontamination of medical equipment specific to the radiology department.; protocol in the event of a needlestick injury or other infectious agent exposure - Management of bloodborne pathogen exposure as per OccupationalHealth and Safety Administration. Components of standard precautions – Contact, droplet, airborne, transportation, safe handling of specimen, decontamination of reusable items & surface as per CDC Spaulding classification; Sterilant and Disinfectants; Morphology & Physiology of Bacteria, Staphylococcus, Streptococcus, Mycobacterium tuberculosis, Spirochetes, CornybacteriumDiptheria

Reference Books

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. RobertyCruckshank – Medical Microbiology – The Practice of Medical Mircrobiology 70
3. Medical Microbiology by R. Cruick shank et al , vol.I ELBS
4.Rabbins & Cotran, Pathologic Basis & Diseases

5. Harsh Mohan, Pathologic Basis & Diseases
6.Todd & Sanford, Clinical Diagnosis by Laboratory Method
7. Ramanik Sood, Laboratory Technology Methods and Interpretation
8. Anand Narayan and Panikar, Textbook of Microbiology
9.. Baweja, Medical Microbiology
10. Arora, Medical Lab Technology

Course Code	Pathology	Course Type	L	T	P	C	CH
B21HB0203		CC	2	1	0	3	4

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0203	CO1	3	2	1	3	1	1	2	2			2	2	1
	CO2	3	2	2	3	1	1	2	2			1	2	2
	CO3	3	3	3	2	2	2	3	3			1	2	2
	CO4	2	3	3	3	3	2	2	3			2	2	1

Course Objectives:

1. To discuss about the history, basic concept of pathology, safety and basic histotechnology
2. To reveal blood composition blood cell & plasma, coagulation factors and blood cell formation
3. To discuss about RBC, hemoglobin's, oxygen dissociation curve and study of blood group
4. To explain about sectioning, staining of tissue and various types of stain

Course Outcomes:

CO1. To aware about the history and basic concept of pathology, safety and basic histotechnology.
CO2. To know about blood cell & plasma composition, coagulation factors and stage of blood cell formation.
CO3. To know about RBC, normal and abnormal hemoglobin's, oxygen transport and bloodgroup system.
CO4. To learn about sectioning, staining of tissue and aware about various types of stain

Course Contents:

Unit -I : General Pathology I: Cellular Pathology, Cell: basic structure and function, cell organelles, cell cycle, Tissue Renewal Regeneration and Repair, Adaptations Of Cellular Growth And Differentiation, CausesOf Cell Injury, Mechanisms Of Cell Injury, Necrosis, Apoptosis, Acute Inflammation Chronic Inflammation, Healing By Repair, Scar formation And

Fibrosis, Cutaneous Edema, Hemostasis and Thrombosis, Infarction, Shock

UNIT-II: Introduction to Clinical Pathology - Collection, Transport, Preservation, and Processing of various clinical specimens ; Urine Examination – Collection and Preservation of urine ; Physical, chemical, Microscopic Examination of body fluids. Examination of cerebro spinal fluid (CSF) ; Sputum and feces. Basics of hematology with type of anticoagulants. Blood Bank.

UNIT-III: General Pathology II: Diseases of the Immune System, Innate Immunity, Adaptive Immunity, Components Of The Immune System, Hypersensitivity Reactions, Acquired Immunodeficiency Syndrome (AIDS), Neoplasia – Definition and Nomenclature, Characteristics Of Benign And Malignant Neoplasms, Laboratory Diagnosis Of Cancer, Tumors

UNIT-IV: Systemic Pathology I: Blood Vessels of the Heart, Red Blood Cell and Bleeding Disorders, Diseases Of White Blood Cells Arteriosclerosis, Atherosclerosis, Hypertensive Vascular Disease, Ischemic Heart Disease, Valvular Heart Disease, Infective Endocarditis, Cardiomyopathies, Leukopenia, Anemias, Polycythemia, Bleeding Disorders, Definitions And Classifications of Lymphoid Neoplasms and Myeloid Neoplasms, Splenomegaly.

Reference Books:

1. Textbook of Pathology, 6th Edition, 2013 by Harsh Mohan
2. A Short Textbook of Pathology by Sajal Md Tahminur Rahman, Charu Hosne Ara Tahmin, Sajani Tabassum Tahmin, Sarnali Tanjila Tahmin (2013)Edition
3. Text book of Medical Laboratory Technology
4. Robbins and Cotran pathologic basis of disease (2009)

Course Code		Course Type	L	T	P	C	CH
B21HB0204	**Radiation Physics**	**HC**	**3**	**1**	**-**	**4**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0204	CO1	2			1	1				2		3	2	3
	CO2	1	2	2	3		1			2	1	2	3	1
	CO3	1	1		2					1			2	1
	CO4	2	1	1	2	1				1	2	1	2	2

Course Objectives:

1. To gain a clear picture of the physical principles which are the basis of all diagnostic methods in radiology.
2. To understand the basic knowledge in Radiation Physics
3. To understand the types of radiation and quality quantity of Xray and its application inradiology
4. To understand the Electric system, Components and Control in X-Ray Circuit

Course outcomes

CO1. To get Knowledge about the Radiation Physics and Production & interaction of X-rays
CO2. To get the knowledge of instrumentation and parts of the x-ray tube and machine
CO3. To learn about generators and circuits in the modern and conventional x-ray machineElectric system, Components and Control in X-Ray Circuit
CO4. To know about the fluoroscopy, Image intensifier, film screen technique, Cassettes and film components and various other xray machines in practices

Course Contents:

Unit – 1: Radiation Physics, Introduction to nuclear physics, Electromagnetic Radiation, Review of x-rays (Properties), Production of x-ray, Properties of x-ray radiations, Production of X-rays, Interaction of X-rays with matter

Unit – 2, Xray tubes and Modern X-rays tubes, Gas filled x-ray tube and rotating anode, Anodeheel effect, Grid controlled x-ray tubes Filtration, Filters, Types of Filters, Effect of filter in

patient and on the quality of the spectrum Beam Restrictors, Physical requirements of the beam defining devices Grids, Grid Cutoff, Evaluation of Grid Performance, Air gap technique

Unit 3 : Electric system, Components and Control in X-Ray Circuit Electric supply & Distribution; diagnostic X-Ray circuits X-Ray Tube, Transformers, types of transformers, losses. Specialized X-ray Generators & Transformers. Basic X-Ray circuits transformers laws and types used in X-Ray machine. The rectification of high tension, control of kilovoltage, filament circuit and tube current, Quality Assurance and Quality control of the Xray machine

Unit 4: Fluoroscopy, Image Intensifier, Photographic Principles- (Image characteristics, Photographic effect, Film screen system, Sensitometry, Characteristic curve), Cassettes, Single anddouble emulsion cassettes, Mammography Machine, Portable mobile units, OPG x-ray tubes and construction, Principles of CR and DR

Reference Books:

1. Christensen's Physics Of Diagnostic Radiology Thomas Curry, James E Dowdey , Robert C Murry
2. Physics for Diagnostic Radiology, Philip Palin Dendy, Brian Heaton
3. Basic of Radiological Physics K.Thalayan
4. Fundamental Of X-Ray And Radiation Physics- Joseph Selmam
5. Essential Physics Of Medical Imaging Jerrold T Bushberg, J Antony Seibert, Edvin M Leidholdt
6. Concise Radiology for Undergraduates Bhushan N. Lakhkar Chandrakant M.Shetty
7. The Essential Physics of Medical Imaging- Jerold T Bushberg

Course Code	Positioning and Techniques I	Course Type	L	T	P	C	CH
B21HB0205		HC	3	1	0	4	4

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0205	CO1	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO2	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO3	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO4	3	3	3	2	3	2	3	2	1	2	2	3	3

Course Description:

The curriculum provides the radiographic practice within the clinical environment to the student, The student should be made familiar with radiographic appearance both of the normal subject and of common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique, which may be necessary for various disabilities or types of subject. Technical skill and patient care areemphasized

Course Objectives:

At the end of the course, the student should be able to understand the following:

- Knowledge about the radiographic positioning and related anatomy
- Technical factors used while taking x rays
- Patient care given during the positioning
- Patient care for pediatrics, geriatrics, and during bedside radiography

Course Outcomes:

CO1. Acquire the knowledge of radiographic positioning and related anatomy.
CO2. Ascertain the technical factors like Kvp and mAs For specific anatomy
CO3. Acquire the knowledge of radiation protection
CO4. Acquire knowledge on the patient care

Course Contents:

Unit 1: Anatomical Terminology, Positioning terminology, Projection terminology, Radiographic, Image Quality (Noise, Density, Contrast, Sharpness, Resolution), Exposure Factors, Digital Imaging

Unit 2: Routine and Special Positioning of Shoulder gridle, Shoulder (Trauma), Humerus, Forearm, Elbow, Wrist, Hand, Thumb, Fingers.

Unit 3: Routine and Special Positioning of Pelvis gridle, Hip, Femur, Knee, Leg, Ankle, Foot, calcaneus

Unit 4: Routine and Special Positioning of Chest, Abdomen, KUB

Text Book References:

1. Clarks Positioning In Radiography R. A. Swallow, E Naylor
2. Merrill's Atlas Of Radiographic Positioning &Radiological Procedure Philip W Ballinger &Ergene D Frank

Course Code	Clinical Radiography-Positioning	Course Type	L	T	P	C	CH
B21HB0206		HC	0	0	2	2	4

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0206	CO1	1	1			1	1	3	3				1	3
	CO2	1	3	1	2	1		3	3				1	2

Course Objective:

1. To learn the fundamental aspects of practice on the patient
2. To study upper limb, lower limb and pelvic girdle

Course Outcomes:

CO1. Ascertain about the fundamental aspects of practice on the patient
CO2. Acquire the knowledge of upper limb, lower limb and pelvic girdle

Course Content

UNIT 1: Practice on the patient • Age, subject types and sex, anatomical landmarks-postural variations-erect and horizontal technique-respiratory movement and diaphragm level-regional densities-preparations and immobilization of patient-pathological conditions-injuries, fracturesand dislocations congenital, localized views-periodic examinations-use of dry bones-positioning terminology identification systems. • The position of the patient, the relative position of the tube to the patient and to all the exposure factors.
UNIT 2: Upper limb & lower limb • Techniques for hand-fingers-thumb-wrist joint-forearm-elbow joint-humerus-shoulder joint and sterno-clavicular joint. • Techniques for foot-calcaneum-ankle joint-leg-knee joint-patella-and femur (lower two thirds). • Techniques for pelvic-iliac fossa-ischium and sacro iliac joint. Techniques involving all the imaging techniques in pelvis

Reference Books:

1. Clarks Positioning In Radiography R. A. Swallow, E Naylor
2. Merrills Atlas Of Radiographic Positioning &Radiological Procedure Philip W Ballinger & Ergene D Frank
3. Radiographic Imaging – Derrick
4. Physics and photography principles of Medical Radiography – Seeman and Herman.
5. First Aid – Haugher and Gardner

Course Code	Physics of Diagnostic Imaging and Instruemntation	Course Type	L	T	P	C	CH
B21HB0207		HC			2	2	4

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0207	CO1	1	1	3			1		1			1	1	1
	CO2	3	3	3	2		2	1	1		1	1	2	1

Course Objective:

To learn the fundamental aspects of x-ray production and Instrumentation of Xray and fluoroscopy. To learn the knowledge about quality and quantity of Xray for better x-ray image. (Image Quality)and Image Characteristics.

Course Outcomes:

CO1. Ascertain about the fundamental aspects of production and instrumentation o Xray and Fluoroscopy machine

CO2. Acquire the knowledge of x-ray imaging factors that govern the image Quality and artifacts

Course Content:

Unit-1: Properties and Production of X-rays, interaction of Xray with target and Matter Attenuation, and the instrumentation of general Xray, OPG and mammography instrumentation.

Unit-2: Quality and Quantity of Xray and the factors that influence a good x-ray image with reduced patient dose. Components and instrumentation of conventional and modern x-ray tube.

Reference Books:

1. Christensen's Physics Of Diagnostic Radiology Thomas Curry, James E Dowdey , Robert C Murry
2. Physics for Diagnostic Radiology, Philip Palin Dendy, Brian Heaton
3. Basic of Radiological Physics K.Thalayan
4. Fundamental Of X-Ray And Radiation Physics- Joseph Selmam
5. Essential Physics Of Medical Imaging Jerrold T Bushberg, J Antony Seibert, Edvin M Leidholdt
6. Concise Radiology for Undergraduates Bhushan N. Lakhkar Chandrakant M.Shetty

THIRD SEMESTER

Course Code	Physics and Instrumentation of CT	Course Type	L	T	P	C	CH
B21HB0301		HC	3	1	0	4	4

Course Code	POs/COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0301	CO1	1		2	2	1	1			1	2		1	
	CO2	2	2	3	2	1	2				2	1	2	1
	CO3	2	3	3	2	1	3	1	2	1	1	1	3	3
	CO4	3	3	3	3	2	3	1	2	1	3	2	3	3

Course Description:

The curriculum will provide a understanding of basic principles, Construction and the application of Computed Tomography imaging for use in hospitals and the biomedical research environment.

Course Objectives:

Completion of this module a student should be able to

- Understand the basic physical principles of modern X-ray computed tomography
- Describe the chain of physical and technical processes contributing to the successful formation, acquisition, processing and display of CT.
- Recognize the fundamental trade-off between X-ray image quality and radiation dose to the patient X-ray CT imaging
- Appreciate the complimentary roles of CT play in medical diagnosis

Course Outcome:
CO1: Understand the basic principle and technology of CT
CO2: Know the CT generations and the components of the CT instruments
CO3: Acquire the knowledge about the factors that affect the image quality including artifact
CO4: Understand the Quality Assurance and Quality control programs

Course Content:
Course Content:
UNIT I: Introduction of CT, Basic Principle of CT, Generations of CT
UNIT II: Instrumentation, Image Reconstruction,
UNIT III: Data Acquisition, Image Display, Image Quality
UNIT IV: CT Artifacts, Radiation Dosimetry, QA of CT

Introduction of CT- Basic Principle, History of CT evolution, CT Number/Hounsfield Units, Evolution of Terms.

Generations of CT: First to Seven generation of CT with their design model, Advantages, Disadvantages and Clinical application.

Instrumentation: Gantry, X-ray Tube, Slip Ring, Collimators, Filters, Cooling Systems Detectors- Ionization Chamber & Solid State Crystal Detectors

Image Reconstruction: Raw Data and Image Data, Basics of Image Reconstruction, Various Algorithms involving Reconstruction- Back Projection, Iterative reconstruction and Analytical methods.

Data Acquisition : SDCT, MDCT, Pitch

Image Display: Pixel, Voxel, Matrix, Display Monitors, Window Setting – Gray Scale, Window Width, Window level

Image Quality: Factors affecting CT image quality- Noise, Patient Exposure, Resolution- Spatial, Contrast & Temporal.

CT Artifacts: Definition and Various types of Artifacts in routine Clinical Practice- Its appearance and Rectification.

Quality Assurance: Various QA methods in CT- Resolution QA, Slice thickness, Gantry Light,Noise, Linearity, Dose

Radiation Dosimetry: Radiation Units**,** CT Dose Metrics, Factors affecting dose in CT.

Text Book References:

1. CT Imaging Technologist- Lois E Romans
2. CT Seeram -Dr Seeram Euclid
3. Computed Tomography- Principles, Design, Artifacts and Recent Advances – Jiang Hsieh
4. The Essential Physics of Medical Imaging- Jerrold T Bushberg

Course Code	Radiographic Positioning and Techniques II	Course Type	L	T	P	C	CH
B21HB0302		HC	2	1	0	3	4

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0302	CO1	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO2	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO3	3	3	3	2	3	2	3	2	1	2	2	3	3
	CO4	3	3	3	2	3	2	3	2	1	2	2	3	3

Course Description:

The curriculum provides the radiographic practice within the clinical environment to the student, The student should be made familiar with radiographic appearance both of the normal subject and of common abnormal conditions where elementary knowledge of the pathology involved will ensure the application of the appropriate radiographic technique, which may be necessary for various disabilities or types of subjects. Technical skill and patient care are emphasized

Course Objectives:

At the end of the course, the student should be able to understand the following:

- Knowledge about the radiographic positioning and related anatomy
- Technical factors used while taking x rays
- Patient care given during the positioning
- Patient care for pediatrics, geriatrics, and during bedside radiography

Course Outcomes:

CO1. Acquire the knowledge of radiographic positioning and related anatomy.

CO2. Ascertain the technical factors like Kvp and mAs for specific anatomy

CO3: Acquire the knowledge on the various positioning techniques

CO4. Acquire the knowledge of radiation protection and Patient care

Course Contents:

Unit 1: Spine: Cervical, Thoracic, Lumbar and SI joints

Unit 2: Skull Facial and Sinus, Trauma/ Emergency Radiography

Unit 3: Pediatric, geriatric, Ward and Theatre Radiography,

Unit 4: Mammography, Dental, Skeletal Survey

Text Book References:

Clarks Positioning in Radiography R. A. Swallow, E Naylor

Merrill's Atlas of Radiographic Positioning &Radiological Procedure Philip W Ballinger & Ergene D Frank

Course Code	Special Procedures	Course Type	L	T	P	C	CH
B21HB0303		HC	2	1	0	3	4

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0303	CO1	1	2		3	1	1	3	3				2	3
	CO2	1	2		3	1	1	3	3				2	3

Objectives:

At the end of the course, the student should be able to comprehend the following Procedures:

Barium Studies, Dacrocystography, Sialography, FTR, HSG, Myelogram, Myelogram, MCU, IVU and Contrast media

CO1. Ascertain the knowledge of Contrast radiography Radiological contrast media
CO2. Acquire the knowledge of various radiographical procedures

Course Content:

Unit 1: Contrast media, Intravenous Urogram (IVU/IVP), Retrograde pyeloureterography**,** Micturating Cystourethrogram (MCU),
Unit 2: Ascending Cystourethrogram (ASU), Dacrocystography,Myelogram,
Unit 3: Contrast Media in GIT, Barium Swallow, Barium Meal, BMFT,
Unit 4 Enterocylsis, BariumEnema, Sialography, FTR, HSG

Text Book References:

1. Merrills Atlas Of Radiographic Positioning &Radiological Procedure -Philip W Ballinger & Ergene D Frank
2. Radiological Procedures- Dr. Bhushan N Lakhar

Course Code	Physcis and Instrumentation of USG	Course Type	L	T	P	C	CH
B21HB0304		HC	3	1	0	4	4

Course Code	POs/ COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0304	CO1	1	1						1			2	1	2
	CO2	2		2	1				1			1	1	1
	CO3	2	1	1	2		1	1	2	1	2	1	2	2
	CO4	3	3	2	3	3	3	1	3	1	2	1	2	2

Course Description:
The curriculum will provide a sound understanding of basic principles and the application of Ultrasound imaging for use in hospitals and the biomedical research environment.

Course Objectives:

To provide an appreciation and understanding of the basic principles of USG and its main clinical applications. Completion of this module a student should be able to

- Understand the basic physical principles of modern USG
- Describe the chain of physical and technical processes contributing to the successful formation, acquisition, processing and display of USG images.
- Recognize the fundamental trade-off between image quality
- Appreciate the complimentary roles play in medical diagnosis.

Course Outcome:

CO1: Understand the basic principle and technology of USG
CO2: Know the components of the instrumentation
CO3: Acquire the knowledge about the factors that affect the image quality including artifacts
CO4: Acquire the knowledge about different modes of Ultrasound including Doppler

Course Content:
UNIT I: Introduction, Transducers, Instrumentation,
UNIT II: Interaction of USG with matter, Display modes,
UNIT III: Doppler Instrumentation, Doppler n Diagnostic Radiology, Real Time Imaging
UNIT IV: Image Quality, Artifacts, Bioeffects

Introduction: Definition of Ultrasound and Overview & Characteristics about the Diagnostic Ultrasound, of Ultrasound.

Transducer: Construction of Transducer, Piezoelectric Crystal, Effect & Its Characteristics Types of Transducers.

Instrumentation: Beam Former, Signal Procesor, Image Processor, Display Controls of USG Consoles/Keys, Coupling gel.

Interaction Between USG and Matter: Types of USG interactions- Reflection, Absorption & Refraction in detail- Factors affecting it and Diagnostic Aspects of it.

Image Display: Modes of Display: A mode, B mode, M Mode, TM Mode ad Gray scale imaging.

Doppler: Doppler Principle & Effect, Doppler – Continuous Wave doppler, Pulsed Doppler, Power Doppler, Color Doppler.

Real Time USG: Real Time Imaging, Types of Transducers in real time Imaging.

Image Quality – Resolution – Axial and lateral Resolution- Factors affecting and ways to improve the resolution in diagnostic imaging.

Artifacts: Definition, Various Artifacts involved in Diagnostic USG along with the appearance and its remedies, diagnostically useful USG artifacts.

Bioeffects: Biological effects of Diagnostic Ultrasound, MI and TI

Text Book References:

1. Christensen's Physics of Diagnostic Radiology- Thomascurry, James E Dowdey, Robert C Murry
2. Diagnostic US Principle and Instruments- Dr. Frederick w kremkaus
3. Principle and Practice of Ultrasound – Sathish K Bhargava
   Essentials of Ultrasound Physics- Book by James A. Zagzebski

Course Code	Radiographic Positioningand Special Procedures	Course Type	L	T	P	C	CH
B21HB0305		HC			3	3	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0305	CO1	3	3	3	3	2		2	3		2		1	2
	CO2	2	2	2	2		2	3	3				2	3
	CO3	2	3	3	2			2	2			1	3	2
	CO4		2				1	3	3				2	3

Course Objectives:

At the end of the course, the student should be able to understand the following:

- Knowledge about the radiographic positioning and related anatomy
- Technical factors used while taking x rays
- Patient care given during the positioning
- Patient care for pediatrics, geriatrics, and during bedside radiography

Course Outcomes:

CO1. Acquire the knowledge of radiographic positioning and related anatomy.
CO2. Ascertain the technical factors like Kvp and mAs for specific anatomy
CO3. Acquire the knowledge of radiation protection and Patient care
CO4: Knowledge about various Special Procedures like IVU, MCU, HSG, FTR, Barium Studies, Myelogram, Dacrocystography, Sialography

Course Content:

Unit-1: Various Positioning techniques along with their Technical Factors prepare radiographic positioning landmarks; appropriate radiographic methods to minimize the need for repeat exposures;
Unit-2: Knowledge about special Procedures including indication, contraindications, patient preparation and positioning technique along with various views.
Unit 3: Knowledge about radiation protection accordingly to various positioning techniques and Procedures.
Unit 4: After care of the individual techniques and Procedure

Reference Books:

1. 1.Clark, Radiographic Positioning and Special Procedure
2. Chapman, Radiological Procedure
3. Merrill's Atlas of Radiographic Positioning &Radiological Procedure -Philip W BallingerEugene D Frank
4. Radiological Procedures- Dr. Bhushan N

Course Code	CT And USG Physics and Instrumentation	Course Type	L	T	P	C	CH
B21HB0306		HC			2	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0306	CO1	1		2	2				1			1		2
	CO2	2	1	1	2	2			1	1	2	1	2	3
	CO3	3	3	3	3	1			1	2	1	1	3	2
	CO4	3	3	3	2	1	2	1	2	2	3	1	3	3

1. To learn the instrumentation and working principle of CT and USG
2. To study the various imaging techniques of CT and modes of USG
3. To know the factors affecting the images quality of CT and USG imaging
4. To acquire the knowledge about the artifacts in CT and USG

Course Outcome:

CO1. Acquire the knowledge about the instrumentation and working principle of CT and USG
CO2. Acquire the knowledge of different modes of USG and Generations of CT
CO3. Ascertain the knowledge of Doppler and Single and Multislice CT
CO4. Acquire the knowledge of image quality along with the artifacts in CT and USG

Course Content:

Unit - 1 Basic Principle of CT, Instrumentation of CT, Generations of CT, Working Principle of USG, Instrumentation of USG
Unit - 2. Different modes of USG and the Generations of CT
Unit - 3. Influence of pitch and rotation time in Single slice and Multislice CT and various modes of USG – Doppler studies and its principle
Unit -4: Artifacts in USG and CT

Reference Books:

1. Christensen's Physics of Diagnostic Radiology- Thomascurry, James E Dowdey, Robert C Murry
2. Diagnostic US Principle and Instruments- Dr. Frederick w kremkausPrinciple and Practice of
3. Ultrasound – Sathish K Bhargava Essentials of Ultrasound Physics- Book by James A. Zagzebski
4. CT Imaging Technologist- Lois E RomansCT Seeram -Dr Seeram Euclid

FOURTH SEMESTER

Course Code	Environmental Sciences & Health	Course Type	L	T	P	C	CH
B21HS0401		**CC**	**2**	**0**	**0**	**2**	**3**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HS0401	CO1	3	3	2	1	1	1	2	3			1	2	2
	CO2	2	3	3	2	1	1	2	2			1	1	2
	CO3	3	2	3	1	1	2	3	2			1	1	1
	CO4	2	3	2	1	1	1	2	2			2		1

Course Objectives:

1. Discuss Foster clear awareness and concern about economic, social, political and ecological interdependence in urban and rural area
2. Influence the new patterns of behaviors of individuals, groups and society as a whole towards the environment
3. List the knowledge values, attitudes, commitment and skills needed to protect and improve the environment
4. Elaborate the evaluation of the environmental measures and education programs.

Course Outcomes:

.1. Adapt the environmental conditions and protect it
2. Estimate the role of individual, government and NGO in environmental protection.
3. Interpret the new renewable energy resources with high efficiency through active research.
4. Analyze the ecological imbalances and protect it.

Course Content:

Unit I: Introduction to Environment and Health Sources, health hazards and control of environmental pollution Water The concept of safe and wholesome water. The requirements of sanitary sources of water. Understanding the methods of purification of water on small scale and large scale.

Unit II : Various biological standards, including WHO guidelines for third world countries. Concept and methods for assessing quality of water. Domestic refuse, sullage, human excreta and sewage their effects on environment and health, methods and issues related to their disposal. Awareness of standards of housing and the effect of poor housing on health. Role of arthropods in the causation of diseases, mode of transmission of arthropods borne diseases, methods of control

Unit III: Environmental Management Policies and Practices Municipal solid waste management: Definition, sources, characterization collection and transportation and disposal methods. Solid waste management system in urban and rural areas. Municipal Solid waste rules. Policies and practices with respect to Environmental Protection Act, Forest Conservation Act, Wild life protection Act, Water and Air Act, Industrial, Biomedical and E waste disposal rules

Unit IV: Environmental Epidemiology - Toxicology and Disease; Exposure Science, Risk Assessment:
Health in the workplace and hospitals; Environmental health professions

Reference Books:

1. CURRENT Occupational and Environmental Medicine 5/e by Joseph LaDou; Robert Harrison
2. Ecosystems and Human Health by Richard B. Philp
3. Environmental Epidemiology by Ray M. Merrill
4. Environmental Health and Hazard Risk Assessment by Louis Theodore; R. Ryan Dupont
5. Environmental Health Ethics by David B. Resnik

Course Code	Interventional & Nuclear Medicine	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21HB0401		**HC**	**3**	**1**	**0**	**4**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0401	CO1	2	1	1	2	1						2	3	1
	CO2	2	2	1	3	1	2	3	2		1	2	3	1
	CO3	2	1	1	3			2	1			1	2	1
	CO4	2	1	1	3			2	1			1	2	1

Course Objectives:

1. To understand the basics of matter, atomic models, fluorescence and Radioactivity and concept of Interventional Radiology, DSA techniques
2. To learn the basics of Angiography and RP based procedures
3. To learn the instrumentation of nuclear medicine equipment and knowledge about different types of catheters, embolic agents and contrast used in angiography procedure.
4. To learn the different procedures performed in Interventional and Nuclear Medicine

Course Outcomes:

After completing the course, the student should be able to

CO1: Explain the basics of matter, atomic models, fluorescence and Radioactivity and concept of Interventional Radiology

CO2: Illustrate the instrumentation of nuclear medicine equipment and Interventional Equipment

CO3: Explain all forms of diagnostic procedures in Interventional Radiology, and Procedures in Nuclear Medicine

CO4: Understand the concept of patient care and radiation protection

Course Contents:

Unit-1: Nuclear Medicine -Introduction & History, Basic atomic & nuclear physics
Basics: Elementary introduction to structure of matter- elements compounds and mixtures-molecules and atoms-Atomic & Nuclear structures-Atomic models-Periodic table-simple ideas of quantum mechanics- Mass energy equivalence, Fluorescence- Phosphorescence-luminescence-electromagnetic spectrum. Radioactivity & Interaction of Radiation: Radioactivity-Discovery-Natural & Artificial Radioactivity Isotopes and nuclides-binding forcesbetween nuclear particles **Interventional Radiology** - a) Definition b) Indication c) Clinical Application d) Name of different type of procedure; Anaesthesia in diagnostic radiology - 1 Facilities regarding general Anesthesia in the X-ray Department. 2 Anesthetic Problems associated with specific technique-a) Vascular Studies b) Carotid Angiography c) Venography d)T and NMR

Unit-2: Nuclear Medicine Interaction of radiation with matter: alpha & beta particles, gamma radiation-mechanisms of radioactive decay-half life –Interaction of electrons, X-ray & r-rays with matter- Radiation intensity & exposure- radiation dose- Radiation quality- law of exponential attenuation- half value layer- linear attenuation coefficient, Scattering- photo elective effect-Compton-scattering-pair production-particle interactions, Types of reactions; induced radioactivity; fission and fusion (energy considerations); cross section; energetics of reactions **Interventional Radiology** Radiography: Basic angiography and DSA: - a. History , technique, patient care, **Catheters** b. Percutaneous catheterization, catheterization sites, Asepsis,
c. Guidewire, catheters, pressure injectors, accessories, d. Use of digital subtraction- single plane and bi-plane; All forms of diagnostic procedures including angiography, angioplasty, bilary examination, renal evaluation and drainage procedure ; Central Nervous System: a.Myelography b. Cerebral studies c. Ventriculography ; Arthrography: Shoulder, Hip, Knee

Unit-3: Nuclear Medicine Introduction to radiopharmaceutical, Nuclear Medicine Instrumentation/ equipments-2: Focused collimators- iso-response curve, focal length, depth of focus, effect of size and number of holes on response, septa thickness, resolution and sensitivity, line source response and MTF, Whole body counters – profile scanning and clinical applications **Interventional Radiology** Angiography: a. Carotid Angiography (4 Vessel angiography) b. Thoracic and Arch Aortography c. Selective studies: Renal, SMA, Coeliac axis d. Vertebral angiography e. Femoral arteriography f. Angiocardiography

Unit-4: Nuclear Medicine-Gamma Camera, PET, SPECT Nuclear Medicine Instrumentation/ equipments-1: Gamma ray spectrometer/cameras, Probe systems ,Nuclear gamma probe system, - radioisotope generators-SPECT-CT & PETCT with clinical applications, Rectilinear scanner. Nuclear Scintiscan procedures: SPECT-CT & PET-CT studies, protocols, Basics of common clinical Nuclear Medicine procedures/techniques– comparison with different structural imaging studies advantages and limitations. **Interventional Radiology** Venography: a. Peripheral venography b. Cerebral venography c. Inferior and superior venocavography d. Relevant visceral phlebography 6. Cardiac catheterization procedures: PTCA, BMV, CAG, Pacemaker, Electrophysiology; interventional angiography in hepatobiliary, GIT, urology and vascular system- coils/stents etc- indications and contraindications - role of radiographer-radiation safety.

Reference Book:

Physics in Nuclear Medicine – Simon Cherry, James Sorenson & Michael Phelps.

1. Basic Medical Radiation physics: Stanton
2. Physics and Radiobiology of Nuclear Medicine -Gopal B Saha
3. Fundamentals of Nuclear Pharmacy- Gopal B Saha
4. Physics of Nuclear Medicine, - James A. Sorenson & Michael
5. Principles of Nuclear Medicine – Henry N. Wagner, W.B. Saunders company, London
6. Principles and practice of Nuclear Medicine, Paul J. Early, D. Bruce Sodes. C.V. Mosby company Princeton
7. Handbook of Interventional Radiologic Procedures by Janette D. Durham; Krishna Kandarpa; Lindsay Machan.
8. Interventional Radiology by Hector Ferral; Jonathan M. Lorenz; Jonathan Lorenz
9. Interventional Radiology: a Survival Guide by David Kessel; Iain Robertson
10. Intraoperative and Interventional Echocardiography by Donald Oxorn; Catherine M. Otto
11. Magnetic Resonance Angiography by James C. Carr (Editor); Timothy J. Carroll (Editor)
12. The Practice of Interventional Radiology by Karim Valji
13. Teaching Atlas of Interventional Radiology by Saadoon Kadir
14. Vascular Interventional Radiology by Mark G. Cowling

Course Code	Imaging Protocol In CT and USG	Course Type	L	T	P	C	CH
B21HB0402		**HC**	**2**	**0**	**1**	**3**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0402	CO1	1	2	1			1	3	2					3
	CO2		1	1	2				2			1		
	CO3	2	2	3	1			2	3	1	2		2	3
	CO4		3	3	2		1	2	3		1	1	2	2

Course Objectives:

1. To understand the patient preparation and techniques for CT and USG Scans.
2. To gain knowledge on imaging techniques and methods and protocols of routine CT and USG studies
3. To learn the radiation safety in CT and Bioeffects and safety in USG
4. To learn Angiography in CT and Doppler protocol in USG

Course Outcomes:

After completing the course, the student should be able to

CO1: Acquire the knowledge about the routine protocols for CT and USG imaging of Brain, Spine, Abdomen, KUB, MSK

CO2: Contrast Media in CT and USG

CO3: Acquire the knowledge about the Angiography protocol in CT and Dopplers protocol in USG, CT and USG guided procedures- FNAC and Biopsy

CO4: Understand the knowledge about Radiation Protection in CT and Bioeffects of USG

Course Content:

Unit1: Basic Diagnostic Aspect- Role of tech, Patient management, Patient Preparation in CT and USG for Routine and Special Procedures an Techniques

Unit2: Contrast Media in CT and USG - Types, Uses and administration and Contraindication, Routine CT and USG Studies protocols and techniques- CT- Brain,

Abdomen, Thorax, MSK (Shoulder, Elbow, Wrist, Knee, Foot, Ankle, Pelvis)
USG-Abdomen, KUB, Breast, Prostate, Neonatal Skull,

Unit 3: CT and USG Guided Procedure- Protocol Biopsy and FNAC, Patient Preparation, Doppler Studies (Carotid, Renal, Portal Vein Doppler, Prostate Doppler)and Angiography (Carotid, Cerebral, Aortogram, Abdominal Angiography, Peripheral & pulmonary) and Venography

Unit 4: Safety Consideration – Tech Safety, Patient safety, Universal Precaution, Knowledge of communicable and non- communicable disease

Reference Books:

1. Principle and Practice of Ultrasound – Sathish K Bhargava
2. Essentials of Ultrasound Physics- Book by James A. Zagzebski
3. CT Imaging Technologist- Lois E Romans

Course Code	Radiation Safety and Protection	Course Type	L	T	P	C	CH
B21HB0403		**HC**	**3**	**0**	**1**	**4**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0403	CO1	1	1	1	1	3	2	1	1					2
	CO2	2	2	1	1	1	2		2			1		2
	CO3	3	2	2	3		3		2	1	2	2	2	3
	CO4	2	3	3	2	2	1		2	1			3	2

Course Description

In this module various aspects of sources of radiation and its risk and benefits is explained in detail whichincludes the biological effects of radiation on the humans and the environment as well.

Objectives

At the end of the course, the student should be able to comprehend the following:

1. Sources of radiation.
2. Biological effects of radiation.
3. Quality and quantity of radiation and its application in radiology
4. Rules and Regulation and guidelines of Radiation Protection.

Course Outcomes:

After completing the course, the student should be able to

CO1: Understand the concept of radiation and its biological effects on Humans
CO2: Acquire the knowledge about the dose limits of radiation worker and the general public
CO3: Acquire the knowledge on the construction of the radiology department with the aspects of safety aspects
CO4: Ascertain the knowledge about the various regulatory bodies in India and Global/ International

Course Contents

Unit1: Introduction To Radiation Protection, History for Radiation accidents, Basic radiation units and quantities.

Unit2: Biological aspects of Radiological protection- Direct, Indirect effect, hydrolysis of water, Stochastic and deterministic effects Radiation Protection Bodies & Regulations

Unit 3: Technical Protective Consideration During Radiography-Evaluation of hazards**,** Effective communication**,** Immobilization**,** Beam limiting devices**,** Beam centering devices**,** Filtration**,** Exposure technical factors**,** Protection in Fluoroscopy**,** Protection in mammography, Protection in mobile radiography**,** Protection in CT scan, Protection in Angiography

Unit 4: Radiation measuring instruments, Dose Limits for Radiation exposure in General Public, Radiation worker, Protective Consideration During Radiography and structural construction.

Reference Books:

Radiation Protection in Medical Radiography- E. Russel Ritenour
ICRP, NCRP, AERB -Manual

VIVA

Course Code	Radiation Protection and Safety	Course Type	L	T	P	C	CH
B21HB404		HC			2	2	3

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB404	CO1	1	2	2	3			1	2	1	1		1	2
	CO2	2	2	1	1	1	2		2			1		2
	CO3	3	2	2	3		1		2	1	2	2	2	3
	CO4	2	3	3	2	2	1		2	1			3	2

Course Outcome:

By the end of this clinical practice the students should be able to

1. Acquire the knowledge about the radiation doses and radiation measuring devices
2. Understand the concepts of constructure importance in aspects of radiation protection
3. Ascertain the knowledge about reducing the radiation dose to the patient and oneself
4. Acquire the knowledge about the radiation dose to various population of people

Course Contents:

Unit 1: Radiation protection in radiological procedures, interventional and Therapeutic Procedures.

Unit 2: The regulatory board approved construction of the modalities along with the safety aspects taken into consideration

Unit 3: Radiation protective measures like lead and other materials its atomic number and vaying thickness

Unit 4: Radiation dose to age specific organs and group of people including infant, children, adult, pregnant women, radiation worker etc.

National Council on Radiation Protection and Measurements (1988). Quality Assurance for Diagnostic Imaging Equipment (NCRP Report #99). Bethesda, Maryland.

1. NCRP #102. Medical X-ray, Electron Beam and Gamma Ray Protection for Energies up to 50 MeV (Equipment Performance Design and Use).
2. NCRP #100. Exposure of the U.S. Population from Diagnostic Medical Radiation.
3. NCRP #91. Recommendations on Limits for Exposure to Ionizing Radiation.
4. American Institute of Physics. American Association of Physics in Medicine (AAPM) Report #14. Performance Specifications and Acceptance Testing For X-ray Generators and Automatic Exposure Control Devices. (1985), New York, New York.
5. AAPM Report #25. Protocols for Radiation Safety Surveys of Diagnostic Radiological Equipment.
6. American College of Medical Physics. ACMP Report #1. Radiation Control and QA Surveys: Diagnostic Radiology
7. Atomic energy act, 1962.
8. Atomic energy (radiation protection) rules, 2004.
9. Aerb safety code no. aerb/rf-med/sc-3 (rev. 2), radiation safety in manufacture, supply and useof medical diagnostic x-ray equipment

Course Code	CT and USG Imaging	Course Type	L	T	P	C	CH
B21HB405		HC			3	3	4

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0405	CO1		3	2	3	1	3	3	3			1	3	3
	CO2	3	3	2	2		1	3	3	1	1		1	2

Course Objectives:

1. To understand the patient preparation and techniques for CT and USG Scans.
2. To gain knowledge on imaging techniques and methods and protocols of routine CT and USG studies
3. To learn Angiography in CT and Doppler protocol in USG
4. To understand the bioeffects and radiation effects to minimize its effects on human body

Course Outcomes:

After completing the course, the student should be able to

CO1: Acquire the knowledge about the routine protocols for CT and USG imaging (Brain, Spine, Abdomen, KUB, MSK) Angiography protocol in CT and Dopplers protocol in USG, CT and USG guided procedures- FNAC and Biopsy

CO2: Acquire the knowledge about radiation protection in CT and factors to reduce the bioeffects

Course Contents

Unit1:

CT Protocols:

Head- Routine, Sinus, Temporal bones, Orbits, Vascular
Neck – Soft tissue, Vascular and Solid organs and Vascular
Spine- Lumbar, Cervical, Thoracic, Spinal Trauma
Abdoemn- Routine Abdoemn, KUB, Vascular
MSK- Upper extremity, Pelvic Gridle, Lower Extremity, Hips
Chest- Routine Chest, HRCT, Vascular chest , Chest truama, Airway, Heart,
Pelvis- Routine Pelvis, Bladder, Pelvic Truama, vascular
Angiography- Cerebral and Carotid, Cardiac, Pulmonary, Abdominal , Aortogram Renal,Upper Limb, Lower limb

Unit 2:

USG Techniques and Protocols:

Routine- Abdomen, KUB, Neonatal Scans, Antenatal and GynecologyScans, Breast, Scrotum, Neck-Thyroid,Eye,MSK

Doppler- Carortid, Renal, Scrotom, Lower Limb, Upper limb for varicose Veins

Course Code	Interventional and Nuclear Medicine	Course Type	L	T	P	C	CH
B21HB406		HC	-	-	2	2	4

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0406	CO1	2	3	3	3	1	1	3	3			1	3	3
	CO2	2	3	3	3	1	1	3	3			1	3	3

Course Objectives:

1. To understand the concept of Interventional Radiology and Nuclear Medicine
2. To learn the patient Preparation methods for Procedures in Interventional nad Nuclear
3. To gain knowledge about the various procedures

Course Outcomes:

After completing the course, the student should be able to

CO1: Understand the patient preparation for various procedures in Interventional andNuclear medicine along with the techniques

CO2: Acquire the Knowledge on the RP, Catheters, Embolization agents and the patient care forappropriate procedures

Course Contents

Unit1: Interventional: Various Angiographic and Venographic Procedures, PTC,PTBD, ERCPCatheters, Uterine Artery Embolization, Catheters, Embolic agents, Pressure injectors

Unit 2:Nuclear Medicine: Radiopharmaceuticals: In vivo technique Static and dynamic studies, Thyroid imaging, Imaging of bone, Respiratory system, Urinary system, G.I. system, Cardiovascular system, Iodine131 uptake studies, Iodine 131 therapy for thyrotoxicosis and thyroid ablation

Reference Books:

1. Physics in Nuclear Medicine – Simon Cherry, James Sorenson & Michael Phelps.
2. Basic Medical Radiation physics: Stanton
3. Physics and Radiobiology of Nuclear Medicine -Gopal B Saha
4. Fundamentals of Nuclear Pharmacy- Gopal B Saha
5. Physics of Nuclear Medicine, - James A. Sorenson & Michael
6. Principles of Nuclear Medicine – Henry N. Wagner, W.B. Saunders company, London
7. Principles and practice of Nuclear Medicine, Paul J. Early, D. Bruce Sodes. C.V. Mosby company Princeton
8. Handbook of Interventional Radiologic Procedures by Janette D. Durham; Krishna Kandarpa; Lindsay Machan.
9. Interventional Radiology by Hector Ferral; Jonathan M. Lorenz; Jonathan Lorenz
10. Interventional Radiology: a Survival Guide by David Kessel; Iain Robertson
11. Intraoperative and Interventional Echocardiography by Donald Oxorn; Catherine M. Otto
12. Magnetic Resonance Angiography by James C. Carr (Editor); Timothy J. Carroll (Editor)
13. The Practice of Interventional Radiology by Karim Valji
14. Teaching Atlas of Interventional Radiology by Saadoon Kadir
15. Vascular Interventional Radiology by Mark G. Cowling

FIFTH SEMESTER

Course Code	MRI Physics and Instrumentation	Course Type	L	T	P	C	CH
B21HB0501		**HC**	**3**	**1**	**0**	**4**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0501	CO1	2	1	2	2	1	2	1			3	2	3	2
	CO2	3	3	3	3	2	1			2	3	2	3	2
	CO3	1	3	2	2	1	1	1	2	1	3	1	3	3
	CO4	2	2	1	3	1	1	1	2	2	2	2	3	3

Course Description:

Magnetic Resonance Imaging is a core subject for the student of Medical Imaging. In this module various aspect about the physics of the magnetic resonance imaging is explained in detail

Objectives:

At the end of the course, the student should be able to comprehend the following:

1. Basic principle of MRI
2. Pulse Sequences and parameters
3. Image Quality
4. Various advanced MRI techniques like SWI, DWI, Perfusion, Interventional

Course Outcome:

CO1: Understand the principle of MRI and the parameters associated with the imaging

CO2: Acquire the knowledge of various pulse sequences and its function

CO3: Ascertain the knowledge of doppler instrumentation

CO4: Acquire the knowledge of doppler

Course Content:

Unit 1: Basic principle, - Atomic Physics, Hydrogen as magnet and its atomic structure, T1 and T2 relaxations, TR, TE, Image Contrast – T1 and T2 times, T1 Recovery, T2* decay, T1 recovery T2 Decay **Encoding and image formation** – K space and its filling techniques Data collection and image formation,
Instrumentation and Equipment of MRI-Magnets, Coils, Rf coils, Gradient coils and bore magnet

Unit 2: **Parameters and trade- offs** : Factors governing good images quality regarding god Spatial, Contrast and temporal resolution**, Pulse sequences**: Spin Echo – Conventional Spin, Turbo Spin Echo, Inversion Recovery, Fast inversion recovery, STIR< FLAIR sequences and Gradient Echo pulse Sequences- Conventional Gradient echo, Coherent gradient, Incoherent, Balanced gradient echo, fast gradient echo sequences, Single shot free precession sequences

parallel imaging, EPI

Unit 3: Flow phenomena Flow phenomena, Mechanism, Time of Flight, Entry Slice Phenomenon, Intra voxel dephasing, and Flow phenomenon compensation**,**
Artifacts: Phase mipmapping, Moiré, Aliasing, Out of Phase, Indian Ink, Zipper, Shading artifact,Magic angle, Ghost artifact Artifact rectification techniques and methods

Unit 4: Advances MRI Techniques Vascular and cardiac imaging, Advanced imaging techniques- DWI, SWI, Perfusion, Spectroscopy and Parallel imaging

Reference Books:

1. MRI in Practice Catherine Westbrook
2. MRI Made Easy -Govind B Chauhan
3. Picture to Proton- Donald W McRobbie, Elizabeth A Moore, Martin J Graves and Martin R Prince

Course Code	Clinical Imaging and Sequences MRI	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21HB0502		**HC**	**2**		**1**	**3**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0502	CO1	3	3	3	3	1	2	2	3		3	3	3	3
	CO2	2	3	3	1	1	1	3	3			1	1	1
	CO3	2	1	1	2	1	1	1	3			1	2	2
	CO4	3	3	3	3	3	2	2	3	2	3	2	3	3

Course Description:

Magnetic Resonance Imaging is a core subject for the student of Medical Imaging. In this module various aspect about the physics of the magnetic resonance imaging and MRI protocol isexplained in detail.

Course Objectives:

At the end of the course, the student should be able to comprehend the following:

1. Sequences for Routine Studies including brain, Spine and MSK
2. MR safety and Contrast Media
3. Understand the image characteristics and differentiate the sequences visually and artifacts associated including advanced techniques such as SWI, DWI, Perfusion, Interventional etc
4. Patient care in aspect of before, during and after a MRI study

Course Content:

Unit 1: MRI Imaging protocol: Sequences involved in Imaging of Routine Brain, Neck**,** Heart, Abdomen, Pelvis, Extremities, Spine

Unit 2: MR safety Introduction, MRI Environment, Safety from main magnetic field, Safety from varying magnetic field (gradient), Safety from Radio frequency field, Projectiles, Medical emergencies, Implants and prostheses, Claustrophobia, Quenching, Safety education, Patient monitoring, Monitors and devices in MRI, MRI personnel, Safety tip, Site planning

Unit 3: Contrast agents in MRI: Introduction, Uses and administration, Review of weighting, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Relativity, Gadolinium safety, Feridex safety, Current applications of contrast agents

Unit 4: Advanced techniques like Cardiac MRI, Sleep Study, Spectroscopy, SWI, DWI.

Reference Books:

1. Handbook of MRI Technique -Catherine Westbrook
2. MRI Made Easy -Govind B Chauhan
3. Picture to Proton- Donald W McRobbie, Elizabeth A Moore, Martin J Graves and Martin R Prince

Course Code	Patient Care	Course Type	L	T	P	C	CH
B21HB0503		HC	2	1	0	3	3

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0503	CO1	1	2		1	2	1	3	3				1	3
	CO2	1	3		1	1	1	3	3				1	3

Course Objectives:

Objectives

At the end of the course, the student should be able to understand the following:

- Knowledge about handling patients of different age groups as well as different situations.
- Handling patients in emergency cases.
- Basic and advanced life support.

Course Outcomes:

After completing the course, the student should be able to

CO1: Acquire the knowledge of the Patient rights and the responsibilities of Technologist in the day-to-day practice and in emergency situations
CO2: Acquire the skill of performing BLS, ALS and emergency medications in radiology and its administration

Course Contents:
Unit 1: Services and roles in the imaging department, Professional roles and behavior, Patient rights and legal considerations, Professional attitudes and communications, medical information and record keeping
Fire safety and other common hazards

Unit 2:

BLS and ALS, Infection Control, Safety, transfer, and positioning, Patient Care and Assessment, Medications and their Administration, Dealing with acute situations

Reference Books:

Patient Care in Radiography Ruth Ann Ehrlich-Ellen Double, McCloskey Joan A. Daly

Course Code	Medical Sociology, Law and Ethics	**Course Type**	**L**	**T**	**P**	**C**	**CH**
B21HB0504		**CC**	**2**	**0**	**0**	**2**	**4**

Course Code	POS/COs	PO1	P02	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0504	CO1	1	3	3	2		1	1	1			1	1	2
	CO2	1	3	3	2		1	1	1			2	2	1
	CO3	1	3	3	2		1	1	1			2	1	2
	CO4	1	3	3	2		1	1	1			2	2	1

Course Objectives:

1. To gain knowledge on medical sociology

2. To understand the concept of Indian health care industry and the culture of alternative medicine
3. To gain an understanding on the clinical and ethical responsibilities of radiographers
4. To learn the documentation of Medico-legal aspects

Course Outcomes:

After completing the course, the student should be able to

CO1: Understand the concept of medical sociology
CO2: Explain the roles of different Healthcare providers
CO3: Analyze the clinical and ethical responsibilities of radiographers
CO4: Document the different aspects of Medico-legal considerations

Course Content:

UNIT 1: Introduction to medical sociology, theories, methodological considerations, Social inequalities in health as class, gender, race & nativity; Illness experience, patient-provider interactions, Work, family & health; Neighborhood and social support;

UNIT 2: Indian health care industry; Healthcare providers - Physician, Nurses, Physician Assistants and Pharmacists and allied health care workers. Alternative medicine and culture; Deviance - Social control & Medicalization; Social movement and health; Health policy and reforms.

UNIT 3: Medico-legal considerations - radiographers clinical and ethical responsibilities-misconduct and malpractice; Pre-Conception and Pre-Natal Sex Determination (PC-PNDT) Act as well as the Consumer Protection Act (CPA). National Commission for Allied & Health Professionals Bill 2020 ;

UNIT 4: Medico-Legal Aspects - Breach of professional Conduct, Negligence and responsibility for negligence, Procedure to record the event of an accident Importance of records ; AERB safety guide for persons in radiation facilities and their approval / licensing processor as per Atomic energy *Act*, 1962 and major amendments. Newer Radiation safety protocols and recent advances in radiation safety including AERB guidelines.

Reference Books: 1. Medical Ethics: A Reference Guide for Guaranteeing Principle

Care and Quality by Eldo E. Frezza.

1. Medical Ethics, Fourth Edition by Kevin D. O'Rourke Georgetown University Press
2. Handbook for Health Care Ethics Committees, Third Edition by Linda Farber Post **and** Jeffrey Bluestein Johns Hopkins University Press
3. Medical Ethics: A Clinical Textbook and Reference for Health Care Professionals edited by Natalie Abrams and Michael Buckner.

Course Code	Biostatistics and Research	Course Type	L	T	P	C	CH
B21HB0505		**HC**	**2**	**0**	**0**	**3**	**4**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0505	CO1		1	1			2							2
	CO2		1	1			2							2
	CO3	1	2	1			1	2	1		1		1	
	CO4	1	1	2	1		1			1	1			

Objectives*:*

To provide the students an understanding about the basic procedures of research and statistical methods applied to analyze the results obtained.

This may help the candidates to carry out project works.

Course Outcomes:

After completing the course, the student should be able to

CO1: Understand the types data and representation of those data for research
CO2: Explain the various research methods
CO3: Analyze the data to conduct the
researchCO4: Carry out various research
projects

Course Contents

Unit 1:

Introduction to Biostatistics: Definition of Biostatistics**,** Characteristics of statistical data**,** Role of statistics in health sciences **Variables:** Qualitative & Quantitative**,** Continuous & Discrete**,** Nominal & Ordinal, **Scales of Measurement:** Nominal, Ordinal, Interval, Ratio **Tabular presentation of data:** Types of class intervals: Inclusive, Exclusive & Open ended, Frequency, Relative and Cumulative frequency, Frequency Table, **Graphical presentation of data:** Histogram**,** Frequency Polygon**,** Frequency Curve
Diagrammatic presentation of data: Bar diagram: Simple, Clustered and Stacked, Pie diagram

Unit 2:

Measures of Location (Definition, computation, merits, demerits & application): Mean**,** Median**,** Mode**, Partition values (Definition, computation & application:** Quartile, Percentile

Measures of Variation (Definition, computation, merits, demerits & application): Range, Inter-quartile range, Variance, Standard deviation, Coefficient of variation

Sampling: Population & Sample**,** Reasons for sampling**,** Errors in sampling**,** Non probability & probability sampling (comparison)

Unit 3:

Probability Sampling (Method, Merits & Demerits): Simple random, Stratified, Systematic, Cluster

Non Probability Sampling (Methods, Merits & Demerits) Normal Distribution: Concept, Normal curve and its properties, Reference Range, Exercises **Skewness and Kurtosis:** Concept, Types

Correlation: Concept**,** Scatter diagrams**,** Pearson's and Spearman's correlation coefficient (No computation), Properties of correlation coefficient**,** Assumptions & Interpretation
Regression: Dependent and Independent variables**,** Simple Linear Regression equation, Interpretation of intercept and slope (No computation), Assumptions of simple linear regression, Prediction

Unit 4 :

Demography: Definition, Sources of demographic data: census, surveys and registration of vital events **Vital Statistics:** Ratio, Proportion and Rate **Morbidity rate:** Prevalence, Incidence **Mortality rates, Fertility rates:** Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate, Gross Reproduction Rate, Net Reproduction Rate, **Research:** Definition, Categories, Steps involved in research process**,** Construction of research protocol, **Epidemiology:** Definition, Uses *Descriptive Epidemiology Designs*: Case Reports, Case Series, Cross Sectional studies**,** *Ecological descriptive studies*

Text Books:

1. Lwanga SK, Tye CY, Ayeni O. Teaching health statistics: lesson and seminar outlines. World Health Organization, Marketing and Dissemination, 1211 Geneva 27, Switzerland; 1999.
2. Health research methodology: a guide for training in research methods. World Health Organization; 2001.
3. Bonita R, Beaglehole R, Kjellström T. Basic epidemiology. World Health Organization; 2006.
4. Campbell MJ, Swinscow TD. Statistics at square one. John Wiley & Sons; 2011.

Course Code	SWAYAM/MOOC	Course Type	L	T	P	C	CH
B21HB0N01		SEC	2	0	0	2	2

Course Code	MRI Lab Instumentaion and Clinical	Course Type	L	T	P	C	CH
B21HB0506		**HC**	**0**	**0**	**2**	**2**	**3**

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0506	CO1		2	1	1		1	3	3				3	3
	CO2	2	3	2	1	2	1	3	3				3	3
	CO3		1		1		1	1	3			1	2	
	CO4	2	1	2	3	2	2	3	2		1		2	1

Course Objectives:

By the end of this course the students will be able to exposed clinically the aspects of patient care,MR contrast media and the sequences used on the daily practice in diagnostic MRI**.**

Course Outcomes:

After completing the course, the student should be able to

CO1: Acquire the knowledge on routine sequences for Brain, Spine, MSK, Abdomen etc.CO2: Understand the Safety aspects of MRI and MR contrast Media.
CO3: Adjust image contrasts and parameters to obtain good quality image
CO4: Acquire knowledge on Pulse sequences along with techniques such as Spectroscopy, DWI,SWI, Parallel Imaging

Course Content:

Unit 1: MRI Imaging protocol: Sequences involved in Imaging of Routine Brain, Neck**,** Heart, Abdomen, Pelvis, Extremities, Spine along with the Physics

Unit 2: MR safety: Parameters and the tradeoff to improve the image quality**,** Introduction, MRI Environment, Safety from main magnetic field, Safety from varying magnetic field (gradient), Safety from Radio frequency field, Projectiles, Medical emergencies, Implants and prostheses, Claustrophobia, Quenching, Safety education, Patient monitoring, Monitors and devices in MRI, MRI personnel, Safety tip, Site planning

Unit 3: Contrast agents in MRI: Introduction, Uses and administration, Review of weighting, Mechanism of action, Dipole-dipole interactions, Magnetic susceptibility, Relaxivity, Gadolinium safety, Farday safety, Current applications of contrast agents

Unit 4: Advanced techniques like Cardiac MRI, Sleep Study, Spectroscopy, SWI, DWI.

Reference Books:

Handbook of MRI technique – Catherine Westbrook

Course Code	Patient Care	Course Type	L	T	P	C	CH
B21HB0507		HC	0	0	2	2	3

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0507	CO1		1	1		1	1	3	3					
	CO2		1	3	1	1		3	3				1	1

Objectives

At the end of the course, the student should be able to understand the following:

- Knowledge about handling patients of different age groups as well as different situations.
- Handling patients in emergency cases.
- Basic and advanced life support.

Course Outcomes:

After completing the course, the student should be able to

CO1: Acquire the knowledge of the Patient rights and the responsibilities of Technologist in the day-to-day practice and in emergency situations

CO2: Acquire the skill of performing BLS, ALS and emergency medications in radiology and its administration

Course Contents:

Unit 1: Services and roles in the imaging department, Professional roles and behavior, Patient rights and legal considerations, Professional attitudes and communications, medical information and record keeping, Fire safety and other common hazards

Unit 2:

BLS and ALS, Infection Control, Safety, transfer, and positioning, Patient Care and Assessment, Medications and their Administration, Dealing with acute situations

Reference Books:

Patient Care in Radiography Ruth Ann Ehrlich-Ellen Double, McCloskey Joan

SIXTH SEMESTER

Course Code	Advancements in Radiology Diagnostic Imaging	Course Type	L	T	P	C	CH
B21HB0601		HC	2	0	1	2	20

Course Code	PO/ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
B21HB0601	CO1	3	2	1	3	2	1				2	1	3	3
	CO2	3	2	1	3	2	1				2	1	3	3

Course Objectives:

1. To train graduating student to be successful, well-qualified Radiologists
2. To acquire knowledge about the basic and advanced techniques, protocol and methods to acquire images in clinical practice

Course Outcomes:

CO 1: Student will acquire skill in the correct evaluation of radiographical image from the point of used quality and technique. Knowledge about the advancements in clinical practice
CO 2: Student's will acquire skills in guiding the patient before, during and after radiography.

Course Content:

Unit 1: Advancements in Physics and instrumentation of Xray, Advancements in CT and USG, Advancements In CR and DR

Unit 2: Advancements of MRI Physics and Instrumentation, Advancements in fluoroscopy/ Image intensifier

Course Code	Internship and Research	Course Type	L	T	P	C	CH
B21RT602		HC	0	0	1	1	20

Course Objectives:

1. To train graduating student to be successful, well-qualified Radiotechnologist.
2. To study required skill in communicating with patients and getting their help in taking radiography procedures, CT, USG and MRI scan, and other radiology and therapeutic procedures.
3. To practice skills in taking the right and appropriate radiography with appropriate computer setting and according to the physician's request and patient's status
4. To be able to obtain skill in radiation protection and patient care.

Course Outcomes:

CO 1: Student will aquire skill in the correct evaluation of radiography from the point of instrumentation and techniques of Xray, CT, USG, MRI, Special procedures, Interventional, Nuclear Medicine

CO 2: Student's will aquire skills in guiding the patient before and after the diagnostic and therapeautic procedures.

CO3: Student will acquire knowledge on the techniques, factors that can be manipulated to get better quality images

CO4: Student will learn about the radiation protection and ways to reduce the radiation to the patient, and themselves

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1.Willingness to learn
2.Self motivation
3.Team work
4.Communication skills and application of these skills to real scenarios
5.Requirement of gathering, design and analysis, development and testing skills
6.Analytical and Technical skills
7. Computer skills

8. Internet searching skills

9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objectiveof the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helpsin developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Biotechnology, Biochemistry, Genetics isnot only the knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Applied sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill DevelopmentCentre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill

development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

LIST OF FACULTY MEMBER

Sl No	Name of the Teacher	Designation	Contact No.	E-mail
1	Dr. Jayashree S	Professor & Head	8610123372	Jayashree.s@reva.edu.in
2	Dr. V Damodara Reddy	Associate Professor	9502639348	damodara.reddyv@reva.edu.in
3	Dr. Karthi N	Assistant Professor	9686088514	karthi.n@reva.edu.in
4	Dr. Satish Kumar M	Assistant Professor	7483072566	sikandar.mulla@reva.edu.in
5	Mrs. Pooja Karkera	Assistant Professor	9741224361	poojar.karkera@reva.edu.in
6	Dr. Gale Kathleen Edward	Visiting faculty	9901994545	galekathleen@gmail.com
7	Dr. Sujatha K	Visiting faculty	9916287074	sujathambbs@gmail.com
8	Dr. D V Sunitha	Associate Professor and Coordinator School of Applied Sciences	7760884884	sunitha.dv@reva.edu.in
9	Dr. Hareesh K	Assistant Professor	9986996834	hareesh.k@reva.edu.in