REGULATIONS AND CURRICULUM GOVERNING

B.Sc. RADIOTHERAPY TECHNOLOGY PROGRAM

Implemented in Academic Year 2022-23

Revised in 2023

Amended up to 2025

Name of the constituent Unit: Yenepoya School of Allied Health Sciences

RABBI ZIDNI 'ILMA

YENEPOYA

(DEEMED TO BE UNIVERSITY)

Deralakatte, Mangalore, Karnataka

YENEPOYA
(DEEMED TO BE UNIVERSITY)

NOTIFICATION FROM THE UNIVERSITY

Sl. No.	ACM with date	BOM/BOS with date	Decisions/Approvals
1.	13.12.2019	48th BOM/16.07.2025	Regulation & Syllabus of B.Sc. Radiotherapy Technology course is approved.

YENEPOYA
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1. Preamble

Health care sector has become one of the largest employment generation sectors in India and abroad. Rapidly changing and expanding horizon of the health care sector demands formal training programs in all its allied areas. Advanced complex instrumentation & equipment require technologists not only to operate but also to care & maintain these instruments and equipment. These technologists should possess a strong scientific foundation to be able to perform these tasks at a much higher level than the traditionally trained technicians of the past used to perform. The students who are trained in the technological aspects of medical care with a good scientific foundation will be in a position to competently execute the radiotherapy plan and assist the Radiation Oncologist, Medical Physicist. Hence to prepare the students to meet the demands of the healthcare sector and in accordance with Ministry of Human Resource Development (HRD), Govt. of India education system introduced National higher education quality framework (NHEQF), the program is designed in a way the curriculum is student centric having flexible choice based credit system with value based holistic multidisciplinary approach.

B.Sc. Radiotherapy Technology (RTT) is an undergraduate program in the field of health care offered by Yenepoya Deemed to be University.

BSc (RTT) is an allied health speciality utilising radioactive materials to diagnose and treat malignant disease with minimum radiation hazards and quality patient care.
The field involves patient care, execution of all routine radio therapeutic procedures as per prescription and direction of Radiation Oncologist. Operation of the radiotherapy equipment used in treatment of cancer patient independently and maintain the equipment under the guidance of Medical Physicist.

As far as the curriculum is concerned, the Radiotherapy Technologist must have an educational background in a wide variety of subjects. Basic and Advanced science courses, Computer science, Psychology, Communication are highly recommended.

Specialised nuclear / radiation courses form a solid base and promote good radiation safety practices. Overall, the curriculum provides a challenging and highly rewarding educational experience.

The objective of the program is to develop a pool of trained Radiotherapy Technologists. Radiotherapy Technologists are currently in great demand Nationwide. Numerous career opportunities are available in virtually every area of the Country in a variety of workplace settings.

2. Definition

2.1. Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

2.2. Semester System/ Choice Based Credit System: The Semester system accelerates the teaching- Learning process. The Credit based Semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The Choice- Based Credit system provides a cafeteria type approach in which the students can take courses of their choice, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning

An academic year shall consist of two semesters;

Odd Semester 1st, 3rd, 5th& 7th	September/October to February/March
Even semester 2nd, 4th, 6th& 8th	March/April to August/September

2.3. Course: Usually referred to, as “papers” is a component of a programme. The courses shall define learning objectives and learning outcomes. A course shall comprise

lectures/ tutorials/ laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of these. The courses can be of the following types ie, Core, Ability Enhancement, Skill enhancement, Value added courses, Multidisciplinary Elective and Internship.

2.4. Credits: Credit defines the quantum of contents/syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus, normally in each of the courses, credits will be assigned on the basis of the number of lectures/tutorial laboratory work and other forms of learning required, to complete the course contents in a 15-20week schedule: One credit =1 hour of lecture per week/ two hours of Laboratory or practical/three hours of clinical rotation, field work/posting. All courses need not carry the same credits.

	Lecture- L	**Tutorial- T**	**Practical – P**	**Clinical Training/Rotation**
1 Credit	1 Hour	1 Hour	2 Hours	3-5 Hours

Credit Hours for different types of Courses:

Each course may have only a lecture component or a lecture and tutorial component or a lecture and practicum component or a lecture, tutorial, and practicum component, or only practicum component. For example, a three-credit lecture course in a semester means three one-hour lectures per week with each one-hour lecture counted as one credit. In a semester of 15 weeks duration, a three-credit lecture course is equivalent to 45 hours of teaching.

One credit for tutorial work means one hour of engagement per week. In a semester of 15 weeks duration, a one-credit tutorial in a course is equivalent to 15 hours of engagement.

A one-credit course in practicum or lab work, community engagement and services, and fieldwork in a semester mean two-hour engagement per week. In a semester of 15 weeks duration, a one-credit practicum in a course is equivalent to 30 hours of engagement.

A one-credit of Seminar or Internship or Studio activities or Field practice/projects or Community engagement and service means two-hour engagements per week. Accordingly, in a semester of 15 weeks duration, one credit in these courses is equivalent to 30 hours of engagement.

A course can have a combination of lecture credits, tutorial credits, and practicum credits. For example, a 4–credit course with three credits assigned for lectures and one credit for practicum shall have three 1-hour lectures per week and one 2-hour duration field-based learning/project or lab work, or workshop activities . In a semester of 15 weeks duration, a 4-credit course is equivalent to 45 hours of lectures and 30 hours of practicum. Similarly, a 4 –credit course with 3- credits assigned for lectures and one credit for tutorial shall have three 1-hour lectures per week and one 1-hour tutorial per week. In a semester of 15 weeks duration, a four-credit course is equivalent to 45 hours of lectures and 15 hours of tutorials.

Experiential learning credit is equal to 3-hour duration per week. For example, 1 credit for experiential learning will mean 45 hours of learning. The credits assigned to the course is indicated as L:T:P format. For example, for a 4credit course format could be: 4:0:0 or 1:2:1 or 3:1:0 or 0:0:4etc.

2.5. Programme: An educational programme leading to award of a degree, diploma or certificate. The following types of courses/activities constitute the programmes of study. Each of them will require a specific number of hours of teaching/guidance and laboratory/studio/workshop activities, field-based learning/projects, internships, and community engagement and service

a. Lecture courses: Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.

b. Tutorial courses: Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work/vocation, or professional practice.

c. Practicum or Laboratory work: A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice.

d. Seminar: A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.

e. Internship: A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

f. Studio activities: Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative

activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic focused experiential work.

f. **Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.

g. **Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

h. **Experiential learning activities:** Field project work / Day out learning activities etc are considered as experiential activities.

2.6. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

2.7. Credit Point: It is the product of grade point and number of credits for a course.

2.8. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters: O,A+, A, B+, B, P, F,AB.

2.9. Cumulative Grade Point Average (CGPA): It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

2.10. Semester Grade Point Average (SGPA): It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a

student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

2.11. Transcript or Grade Card or Certificate: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester.

2.12. Academic Bank Account: means an individual account with the Academic Bank of Credits opened and operated by a student, to which all academic credits earned by the Student from course(s) of study are deposited, recognized, maintained, accumulated, transferred, validated or redeemed for the purposes of the award of degree/diploma/certificates etc. by an awarding institution.

2.13. Academic Bank of Credits: means the provision for innovative and interchangeable curricular structures to enable creative combinations of Courses or Programmes in Disciplines of study leading to Degree or Diploma or Post Graduate Diploma or Certificate of Study offering multiple entry and multiple exit facilities, while removing rigid curricular boundaries and creating new possibilities of life-long learning;

2.14. Credit-accumulation: means the facility created by Academic Bank of Credits in the Academic Bank Account opened by students in order to transfer and consolidate the credits earned by them by undergoing Courses;

2.15. Credit-redemption: means the process of commuting the accrued credits in the Academic Bank Account of the students maintained in ABC for the purpose of fulfilling the credits requirements for the award of Degrees or Diplomas or Certificates or Course work for Ph.D. programme etc., by the registered degree-awarding Higher Educational Institutions;

2.16. Credit-transfer: Means the mechanism by which the Registered Higher Educational Institutions are able to receive or provide prescribed credits to individual Academic Bank Accounts in adherence to the University Grants Commission credit norms for the 'course/s' undertaken by students enrolled in any Registered Higher Education Institution within India.

2.17. Curricular components of the B.Sc. Respiratory Therapy

Programme:

Courses in the programme may be of the following types:

a. Core Course
b. Skill Enhancement Courses (SEC)
c. Ability Enhancement Courses (AEC)
d. Value Added Courses (VAC)
e. Multidisciplinary Elective (ME)
f. Internship

a. Core Course (CC): A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. This is the course which is the major disciple/subject having main focus and degree will be awarded in this discipline. This core course provides opportunity for our student to pursue in depth study of a particular subject or discipline hence, it is compulsorily studied by a student as a core requirement to complete the program of study in a said discipline. Every Core course shall be restricted to a minimum of 4 credits.

b. Skill Enhancement Course (SEC): SEC courses are aimed at imparting practical skills, hands- on training, competencies etc to enhance the skill-based knowledge and thus the employability of the students.

c. Ability Enhancement Courses (AEC): These are the courses which aim to provide the students the competency in a modern Indian language (MIL) and in the English language with special emphasis on language and the communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic skills, that helps students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity. The courses will also emphasize the development and enhancement of skills such a communication, and the ability to participate/ conduct discussion and debate.

d. Value Added Courses (VAC): These are the courses relating to understanding India, environmental science/ education, Health and Wellness etc..

i. Constitution of India: The course aims at enabling the students at acquire and demonstrate the knowledge and understanding of contemporary India with its historical perspective, the basic framework of the goals and policies of National development, and

the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties.

ii. **Environmental Studies:** The course aims to equip the students with the ability to apply the acquired knowledge, skills, attitudes, and values require to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wild life conservation, and sustainable development and living.

iii. **Human Rights & Gender equity:** TheCourse emphasis understanding social justice issues and roles of human rights in promoting equitable society including international, national perspective, contemporary issues with this holistic coverage and relevance to today's world.

iv. **Medical Ethics:** The course deals with ethics involving fundamental and moral issues related to decision making while performing professional practice. It guides the students in systematic and rational way of working through dilemmas and to determine the best course of action in their field of practice.

e. **Multidisciplinary Electives (ME):** These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students are not allowed to choose or repeat courses already undergone at the higher secondary level (Twelfth class). The courses relating to any of the broad discipline given below will come under this category.

i. **Natural and Physical Sciences:** Students can choose basic courses from disciplines such as natural science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental sciences, etc.

ii. **Mathematics, Statistics and computer applications:** Courses under this category will facilitate the students to use and apply tools and techniques in their major

and minor disciplines. The course may include training in programming software like python among others and application software like STATA, SPSS, TALLY, etc. Basic courses under this category will be helpful; for science and social science in data analysis and the application of quantitative tools.

iii. **Library, Information, and Media Sciences:** Courses from this category will help the students to understand the recent developments in information and media science (journalism, Mass Media, and Communication)

iv. **Commerce and Management:** Courses include business management, accountancy, financial institutions, Fintech, etc.,

v. **Humanities and Social Sciences:** The courses relating to Social sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political science, Psychology, Social work, Sociology, etc. will enable students to understand the individuals and their social behavior, society and nation. Students be introduced to survey methodology and available large – scale databases for India. The courses under humanities include for example, Archeology, History, Comparative Literature, Arts and Creative Expressions, Creative writing and literature, language(s), philosophy etc., and interdisciplinary courses relating to humanities. The list of courses that can include interdisciplinary subjects such as cognitive science, environmental science, gender studies, global environment and health, international relations, political economy and development, sustainable development, Women's and gender studies, etc. will be useful to understand society.

The Multidisciplinary elective offered by Yenepoya (Deemed to be) University includes:

i. **First Aid and Basic Life Support (BLS):** ThisCourse deals with training the students to be a first responder when there are medical or traumatic emergencies.

ii. **Yoga:** The coursedevelop a comprehensive understanding of yoga, including its history, various schools, practices, and their application in daily life, while also recognizing its potential for personal well-being, professional growth, and promoting positive health.

iii. **Vermitechnology:** This category of course will help students to gain skills in using worms to convert decomposing food waste into nutrient-rich fertilizer in simple, inexpensive and energy efficient way.

iv. **Positive Psychology:** The course will enable students to enrich themselves to thrive on the belief that people want to lead meaningful and fulfilling lives, cultivate what is best within them, and enhance their experiences of love, work, and play.

v. **National Service Scheme (NSS):** Students can choose NSS to understand the basic concept of NSS, to identify the needs and problems of the community in which they work and to gain skills in mobilizing community participation.

vi. **Lifestyle Management:** This course will help students to learn to achieve health goals through lifestyle and behavior adjustments by creating healthy habits as well as stress management.

vii. **Youth Red Cross:** The course deals withproviding knowledge on Youth Red Cross volunteer ship and identifying the role of youth in humanitarian service. It also enables youth to promote national and international understanding by using international link of the movement.

viii. **Jeevan Kaushal:** University grant commission identified 4 modules on life skills (Jeevan Kaushal), the skills that required through our life. Jeevan Kaushal courses such as Communication skills, Professional Skills, Leadership and Management skills and Universal Human Values which will help students in developing personal competencies that helps to deal with challenges of life effectively thereby realizing his/her infinite potential as a human being.

ix. **Self – learning course:** In accordance with the UGC (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2021, New Delhi, dated 25th March 2021, and reference No.F.1-100/2016 (MOOCs/e-content), students are encouraged to augment their learning experience by opting for Massive Open Online

Courses (MOOCs), Study Webs of Active Learning for Young Aspiring Minds (SWAYAM), and Coursera courses as part of the multidisciplinary elective.

Yenepoya (Deemed to be University) will adhere to UGC regulations governing MOOCs/SWAYAM/Coursera courses, incorporating amendments as communicated by UGC over time. To facilitate the seamless completion of chosen courses, the department will appoint a designated course coordinator. The coordinator will guide and support students throughout the duration of the selected online courses.

The evaluation process will adhere to predefined norms and parameters, which will be communicated in the course overview at the time of offering.

In COURSERSA, the assessment are multifaceted and include quizzes or tests at the conclusion of each module, assignments or projects demonstrating the practical application of concepts, active participation in discussion forums, and peer-reviewed assessments. The culmination of each course involves final quizzes or capstone projects tailored to the course's content. Upon successful completion, students receive an online certificate, Yenepoya (Deemed to be University) will integrate the acquired credits into the student's official marks sheet.

In SWAYAM, Assessment will include formative continuous online assessments and end-of-course proctored exams, all of which are mandatory for successful completion by the student. Yenepoya (Deemed to be University) will integrate the marks or grade achieved by the student, conveyed by the Host Institution through the PI of the SWAYAM course, into the student's official marks sheet. These marks contribute to the final award of the degree conferred by the University.

f. Internship

The internship time period provides the candidate the opportunity to develop confidence and increased skill in simulation and treatment delivery. Candidate will demonstrate competence in basic and intermediate procedures and will observe the advanced and specialized treatment procedures. The candidate will complete the clinical training by practicing all the skills learned in classroom and clinical

instruction. The candidate is expected to work for minimum 8 hours per day and this may be more depending on the need and the healthcare setting.

3. Eligibility for admission:

To be eligible for admission in B. Sc Radiotherapy Technology, a candidate should have passed two-years Pre University examination/ Pre Degree examination/ two years after ten years of schooling or its equivalent as recognized by the Yenepoya (Deemed to be) University with Physics, Chemistry and Biology as principal courses of study.

Candidate needs to secure minimum 50% in aggregate in Physics, Chemistry and Mathematics/Biology or above marks in the qualifying examination to be eligible for admission. For SC/ST/OBC candidates minimum marks required in the qualifying exam is a 45 % mark in Physics, Chemistry and Mathematics/Biology.

Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.

a. English, Physics, Chemistry, Botany, Zoology

b. English, Physics, Chemistry, Biology and any other language

Selection of eligible candidates: Selection to the course shall be based on the basis of merit obtained in the qualifying examination.

4. Duration of the Programme:

The duration of the programme shall extend over 8 semesters (three academic years with one year internship) each semester comprising minimum of 15 weeks with the minimum of 90 actual working days of instruction in each semester. The successful completion of the Undergraduate program, along with internship as applicable will lead to Bachelor's degree in Radiotherapy Technology (B.Sc Radiotherapy Technology).

5. Maximum Period for Completion of Programme:

A candidate shall complete six semesters (Three Years) programme within Six years from the date of admission. Hence, the maximum period for completion of the programme is seven years.

6. Aim of the Program

Aim of the program is to develop a pool of trained Radiotherapy Technologists (RT) with comprehensive training in the technological aspects of medical care with a good scientific foundation and they will be in a position to competently participate in Radiation Oncology team and execute the treatment by operating the radiation equipment as per the safety code.

7. Outcome of the Program

- **Program Outcome (PO):** Upon successful completion of the undergraduate course, students will have developed a broad knowledge in the area of patient simulation, operation of the radiotherapy equipment and execution of the radiotherapy treatment.

PO 1. Treat patients on Linear accelerators, Cobalt 60, X-ray and other radiation therapy equipment independently as prescribed by radiation oncologists under the supervision of experienced Radiotherapy Technologists

PO 2. Assist Radiation Oncologists and Medical Physicists with the preparation of radiation treatment plan

PO 3. Perform Treatment Simulation in Simulator and image acquisition on CT scanner

PO 4. Prepare Moulds for patient immobilization for the purpose of Radiotherapy.

PO 5. Monitor the patient's physical and psychological well-being during the entire course of treatment.

PO 6. Work as a team to provide quality service.

PO 7. Train and supervise RTT student.

PO 8. Following safety procedures to protect staff and patients from unnecessary radiation exposure

- **Program Structure**

	Broad category of course	Hours / Credits	Course

			(Title)
1.	**Discipline-Specific Courses**		
a)	Theory	**I Semester**	
		60 Hours / 4 Credits	Anatomy
		60 Hours / 4 Credits	Physiology
		60 Hours / 4 Credits	Biochemistry
		45 Hours / 3 Credits	Basic Physics
		II Semester	
		60 Hours / 4 Credits	General Pathology
		60 Hours / 4 Credits	Radiation Physics
		60 Hours / 4 Credits	Radiation Quantities and Detection
		III Semester	
		60 Hours / 4 Credits	Basic Radiographic Imaging
		60 Hours / 4 Credits	Radiobiology
		60 Hours / 4 Credits	Radiotherapy Equipments
		60 Hours / 4 Credits	Basic Radiographic Imaging
		IV Semester	
		60 Hours / 4 Credits	Patient Immobilization & Mould room techniques
		60 Hours / 4 Credits	Modern Radiography Imaging and Applications
		60 Hours / 4 Credits	Basic Oncology
		V Semester	
		60 Hours / 4 Credits	Physics of Radiotherapy and Brachytherapy
		60 Hours / 4 Credits	Management of Various Malignancies
		60 Hours / 4 Credits	Patient Care in Radiotherapy
		VI Semester	
		60 Hours / 4 Credits	Recent Advances in Radiotherapy
		60 Hours / 4 Credits	Radiation Protection and Safety
		60 Hours / 4 Credits	Quality Assurance
b)	Practical (SEC)*	-	-
c)	Clinical (SEC)*	**III Semester**	
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy I

		120 Hours / 4 Credits	Clinical Practice - Radiotherapy II
		IV Semester	
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy III
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy IV
		V Semester	
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy V
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy VI
		VI Semester	
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy VII
		120 Hours / 4 Credits	Clinical Practice - Radiotherapy VIII
d)	Simulation-based (SEC)*	-	-
2.	**Curriculum Enrichment Courses**		
a)	Field Visit	-	-
b)	Community Posting	-	-
c)	Industry / Clinical Internship	**VII Semester**	
		40 Hours/week / 18 Credits	Internship I
		VIII Semester	
		40 Hours/week / 18 Credits	Internship II
d)	Research Project	-	-
3.	**Electives**		
a)	Discipline-Specific Electives	-	-
b)	Interdisciplinary Courses	45 Hours / 3 Credits per year	Coursera/Swayam/NSS/Red cross
c)	Ability Enhancement Courses	**I Semester**	
		45 Hours / 3 Credits	English and Communication I
	• Soft skills	30 Hours / 2 Credits	Kannada

	development • Language and communication skill development • Analytical skill development • Personality and professional development • Employability skill development	**II Semester**	
		45 Hours / 3 Credits	English and Communication – Part II
		30 Hours / 2 Credits	Kannada
d)	Value Added Courses	**I Semester**	
		30 Hours / 2 Credits	Constitution of India
		III Semester	
		30 Hours / 2 Credits	Human Rights & Gender Equity
		IV Semester	
		30 Hours / 2 Credits	Environmental Studies
		V Semester	
		30 Hours / 2 Credits	Medical Ethics
	Total	**6,230 Hours / 171 Credits**	

8.Attendance:

- Each course (theory, practical, clinical etc.) shall be treated as an independent unit for the purpose of attendance. Candidates having minimum 80% attendance in each of the Courses can only qualify to appear for the Semester End Examination. The Candidates with less than 80% of attendance shall be required to repeat that Course by attending the semester.

- There shall be no provision for condonation of shortage of attendance.

- The HOD/Programme Coordinator through the Dean of Faculties shall announce the names of the candidates who will not be eligible to take the Semester End-Examinations (SEE) in the various courses and send a copy of the same to the Controller of Examinations (COE) Office. Registrations of such candidates for those courses shall be treated as cancelled.

9. Syllabus/Course contents

Teaching - Learning method	**Courses**
Experiential learning	Introduction to Radiotherapy Therapy Equipment CT Simulator
Integrated/Inter-disciplinary learning	Image acquisition Equipment quality assurance Setting up phantom for dose quantification
Participatory learning	Mould Preparation Patient preparation for radiotherapy Patient setup for imaging and treatment
Problem-solving methodologies	Patient setup for imaging and verification the position
Self-directed learning	Tele therapy machine operation
Patient-centric learning	Patient position with appropriate immobilization devices Acquiring 4D or Gated image and treatment Notify the radiation induced acute reaction
Evidence-based learning	On board Imaging, Block preparation, mouth bite preparation
The Humanities	Human Rights & Gender Equity

Project-based learning	On line and Off line verification, RT chart QA
Role-play	Introduction to Radiotherapy technologist work flow Patient setup and treatment Record maintained
Team-work	Introduction to Radiation Oncology team Role of the every professional in the team Sequence of the work flow
Reflective writing	Introduction to Radio therapy
Any other (Simulation-Based Learning)	Ensuring the Radiation Safety in the work place Understanding various emergencies situation includes radiation emergency in radiation oncology dept.

10. Scheme of Examination

- Evaluation of a course shall be done based on continuous internal assessment (CIA) mode followed by Semester End University Examination (SEE) for each core, SEC, AEC & VAC. The evaluation of Multidisciplinary elective offered by Yenepoya (Deemed to be) University shall be done based on formative assessment.
- The components of CIA (Continuous Internal Assessment) may include sessional tests, Seminar, Assignment/ Social involvement and other activities as determined by the respective speciality.
- There shall be examinations at the end of each semester ordinarily during February/March for odd semesters and during August/September for even semesters.

- The SEE duration shall be 60 minutes for 25 marks paper and 120 minutes for 50 marks paper.

- The various Formative assessment method include Assignments, reports, quizzes…

Examination/Assessment	Core/SEC/AEC(English)	AEC(Hindi & Kannada) /VAC
Continuous Internal Assessment	50 Marks	25 Marks
Semester End Examination	50 Marks	25 Marks
Total	100 Marks	50 marks

10.1. Examination structure:

The Examination structure shall vary depending on the course, however, broadly divided as follows:

10.2. Multidisciplinary Elective:

Multidisciplinary elective will be assessed through continuous and comprehensive assessment throughout the Semester (50 Marks)

i. Evaluation and Certification of online courses:

Evaluation will be based on predefined norms and parameters and announced in the overview of the Course at the time of offering the course. Formative continuous online assessments and end of course proctored exams shall be completed by the student.

The certificate obtained shall be submitted to the college office which will be communicated to the office of the Controller of Examinations of Yenepoya (Deemed to be University).

The Yenepoya (Deemed to be) University will give the equivalent credit weightage to the students for the credits earned through online learning courses through MOOCS/Coursera as per the credit plan of the program.

ii. Credit Mobility of Online Courses:

The Yenepoya (Deemed to be University) will give the equivalent credit weightage to the students for the credits earned through online learning courses as per the credit plan of the

program.

In case a student fails to complete the online course he/ she may be allowed to complete the course requirements by registering for another online course in subsequent semester or opt for a course offered at this Yenepoya (Deemed to be University).

The elective course offered by the Yenepoya (Deemed to be University) shall be restricted to a maximum of 3 credits.
A candidate shall compulsorily complete total 9 Credits of Multidisciplinary courses.

These courses shall be selected either from the Generic Electives offered by the Yenepoya (Deemed to be) university or from the SWAYAM/Coursera courses. A Candidate shall have freedom to choose the courses of once own choice and learn at their own pace but, require to complete minimum 3 credits before second semester, 6 credits before fourth semester and 9 credits before sixth semester end examination.

A candidate who is desirous to add more credits shall be permitted to do so during the academic duration. Extra credits earned by a candidate shall be included in the marks card on submission of course completion certificate. However, it shall not be considered for awarding the Grade in the UG programme.

10.3. Parameters for Continuous Internal Assessment (CIA)

Internal Assessment Components	**Core / SEC**	**AEC (English, Kannada) / VAC**
Internal Assessment tests	20	10
Assignment	10	05
Continuous and comprehensive assessment	20	10
Total Marks	**50**	**25**

Assessment Methods:

1	Quiz	6	Role Play
2	Group Discussion	7	Peer to Peer Assessment

3	Open Book Exam	8	Mind Mapping
4	Think-Pair-Share	9	Minute paper
5	Presentations	10	Case Study

10.4 Question Paper Pattern for Core course (Internal Assessment & Semester End Examination)

	MAXIMUM MARKS = 50				**Duration**
Type of question	**Number of questions**	**To be Answered**	**Marks for each question**	**Total**	120 minutes
LONG ESSAY TYPE	02	01	10	10	
SHORT ESSAY TYPE	07	05	04	20	
SHORT ANSWERS	12	10	02	20	
			Total	**50**	

MAXIMUM MARKS = 50					**Duration**
PART A					
Type of question	**Number of questions**	**To be Answered**	**Marks for each question**	**Total**	120 Minutes
LONG ESSAY TYPE	02	01	10	10	
SHORT ESSAY TYPE	02	01	05	05	
SHORT ANSWERS	06	05	02	10	
PART B					

LONG ESSAY TYPE	02	01	10	10	
SHORT ESSAY TYPE	02	01	05	05	
SHORT ANSWERS	06	05	02	10	
			Total	**50**	

10.4. Question Paper Pattern for Ability Enhancement Compulsory (AEC) Course

	MAXIMUM MARKS = 25				**Duration**
Type of question	**Number of questions**	**To be Answered**	**Marks for each question**	**Total**	
ESSAY	05	03	05	15	60 minutes
SHORT ANSWERS	07	05	02	10	
			Total	**25**	

10.5. Question Paper Pattern for Value Added (VAC) Course

	SUBJECTS HAVING MAXIMUM MARKS = 25				**Duration**
Type of question	**Number of questions**	**To be Answered**	**Marks for each question**	**Total**	
ESSAY	05	03	05	15	60 minutes
SHORT ANSWERS	07	05	02	10	
			Total	**25**	

10.6. Practical examination (SEC)

SI.NO	Components	Marks
1	Spotters	10
2	Case scenario/Stations	20
3	Viva Voce	20
	Total Marks	50

Particulars of Practical, Viva-Voce

Practical examination will be aimed at examination of clinical skills and competence of the candidates for undertaking independent work as a specialist.

Viva- Voce examination shall aim at assessing depth of knowledge, logical reasoning, confidence &oral communication skills.

OSCE/OSPE- shall have minimum of 4 stations

11. Eligibility to appear for University Examination

Each course (theory, practical, clinical etc.) shall be treated as an independent unit for the purpose of attendance. Candidates having minimum 80% attendance in each of the Courses can only qualify to appear for the Semester End Examination. The Candidates with less than 80% of attendance shall be required to repeat that Course by attending the semester.

There shall be no provision for condonation of shortage of attendance.

Evaluation of a course shall be done based on continuous internal assessment (CIA) mode followed by Semester End University Examination (SEE) for each core, SEC, AEC & VAC. The evaluation of Multidisciplinary elective offered by Yenepoya (Deemed to be) University shall be done based on formative assessment.

The components of CIA (Continuous Internal Assessment) may include sessional tests, Seminar, Assignment/ Social involvement and other activities as determined by the respective speciality.

The marks for CIA shall be 50% and SEE shall be 50%.

The minimum marks for CIA shall be 40% and SEE shall be 40% for a pass, but the minimum marks for pass per course shall be 50% CIA and SEE added together.

The HOD/Programme Coordinator through the Dean of Faculties shall announce the names of the candidates who will not be eligible to take the Semester End- Examinations (SEE) in the various courses and send a copy of the same to the Controller of Examinations (COE) Office. Registrations of such candidates for those courses shall be treated as cancelled.

12. Criteria for Passing

The marks for CIA shall be 50% and SEE shall be 50%.

The minimum marks for CIA shall be 40% and SEE shall be 40% for a pass, but the minimum marks for pass per course shall be 50% CIA and SEE added together.

A candidate shall be declared to have passed the UG programme if he/she secures at least CGPA of 5.0 (Course Alpha-Sign Grade P) in the aggregate of both Internal Continuous Assessment and Semester End Examination.

The results of the candidates who have passed the sixth semester examination but not passed the lower semester examinations shall be declared as NCL (Not Completed Lower semester examinations). Such candidates shall be eligible for the degree only after completion of all the lower semester examinations.

13.Grading and Classification

a. The results of successful candidates at the end of each semester shall be declared in terms of Grade Point Average (GPA) and Alpha-Sign Grade. The results at the end of the sixth semester shall be classified on the

basis of the Cumulative Grade Point Average (CGPA) obtained in all the six semesters and the corresponding overall alpha sign grade

Classification of Successful candidates:

The results of successful candidates at the end of each semester shall be declared in terms of Grade Point Average (GPA) and Alpha-Sign Grade. The results at the end of the sixth semester shall be classified on the basis of the Cumulative Grade Point Average (CGPA) obtained in all the six semesters and the corresponding overall alpha sign grade.

b. Letter Grades and Grade Points:

i. The Deemed to be University would be following the absolute grading system, where the marks are compounded to grades based on pre-determined class intervals.

ii. The UGC recommended 10-point grading system with the following letter grades are given below:

Letter Grade	Marks	Grade Point
O (Outstanding)	90-100	10
A+ (Excellent)	80-89	9
A (Very Good)	70-79	8
B+ (Good)	60-69	7
B(Above Average)	55-59	6
P (Pass)	50-55	5
F (Fail)/ RA (Reappear)	Below 50	0
Ab (Absent)		0

*The Marks with 0.5 shall be rounded up to the next whole number.

iii. A student obtaining Grade RA/ Ab shall be considered failed and will be required to reappear in the end semester examination.

c. The Semester Grade Point Average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester.

For example, if a student takes five (Theory/Practical) in a semester with credits C1, C2, C3, C4 and C5 and the student's grade points in these courses are G1, G2, G3, G4 and G5, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4G4 + C5G5}{C1 + C2 + C3 + C4 + C5}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a student has a F or ABS grade in program 4, the SGPA shall then be computed as:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4 * ZERO + C5G5}{C1 + C2 + C3 + C4 + C5}$$

D.Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the VI semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all VI semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the program(s) is/are passed by obtaining a pass grade on subsequent examination(s)

the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$\text{CGPA} = \frac{C1S1+C2S2+C3S3+C4S4+C5S5+C6S6}{C1+C2+C3+C4+C5+C6}$$

where C1, C2, C3,…. is the total number of credits for semester I,II,III,…. and S1, S2, S3….is the SGPA of semester I,II,III,…..

Calculation of GPA & CGPA: An example (1st semester)

Program Code	Course	Credits (a)	Grade Obtained	Credit Value (b)	Grade Points (axb)
	Course 1	4	B	8	32
	Course 2	4	B	8	32
	Course 3	4	O	10	40
	Course 4	2	C	7	14
	Course 5	2	A	9	18
	Total	16	-	-	136

1st Semester GPA = Total Grade Points / Total Credits = 136 / 16 = 8.5 2nd Semester GPA = 7 with respect to 18 Credits

Then 1st Year CGPA = (8.5 x 16) + (7 x 18) / 16 + 18 = 7.7

14. Journals

- Iinternational journal of cancer therapy and oncology
- Iinternational journal radiation oncology biology physics

15. Any other Information (Progression Criteria, Re-entry after break of the study, Evaluation of Answer Scripts, Internship)

15.1. Progression Criteria

- The students are allowed to carry over any number of courses till sixth semester. But student is eligible to appear for the End semester exam of sixth semester if he/she has cleared all the Courses both Core, AEC, SEC & VAC of first, second, third & fourth semesters. If student has any pending course of first to fourth semesters, he/she is not eligible to appear for the end semester exam of the sixth semester. However, Fifth semester courses are allowed to club with sixth semester end examination. But, all the Core, AEC, SEC & VAC of first to fourth semester should be completed to be eligible for sixth semester End Semester Examination.

- Candidate should clear all Courses (Core, AEC, SEC, VAC & ME) of all the semester, to be eligible to start the one year of mandatory internship.

- A fail in any one Course will mean the candidate has to reappear for the exam in that Course only.

- A candidate who passes the semester examinations in parts is eligible for only CGPA and letter grade but not for award/medal from the University.

15.2. Re-Entry after Break of the study:

Candidates admitted to a program abstaining for more than 3 months must seek readmission

into the appropriate semester. The candidate shall follow the syllabus in vogue (currently approved/is being followed) for the program.

All re-admissions of candidates are subject to the approval of the University.

15.3. Evaluation of Answer Scripts

a. Each theory examination shall have single evaluation. There shall be provision for re-evaluation on a payment of a fee. An external examiner shall value the paper, if the difference is more than 15% of previous marks the answer script shall be sent for third evaluation. In such an event, the average of the best two out of the three scores will be taken as the final score.

b. Practical examination shall be jointly conducted and evaluated by one internal examiner and one external examiner.

15.4. Internship

A candidate has to mandatorily complete 1 year (2 semesters) of internship. The total credit per semester is 20 and for two semesters it is 40.

- **Eligibility:** A candidate should have passed in all the courses (Core, AEC, VAC and
- Multidisciplinary Electives) amounting to 131 number of credits before entering in to internship.
- **Internship guidelines:** Each semester of Internship shall be minimum of 20 credits. The credits are calculated based on 1 credit = 3 to 5 hours of practical training. There shall be an exit exam at the end of the each semester at the college level.
- **Components of Exit Exam**

Sl.No.	Components	Marks
1	Spotters	30
2	Case scenario/Stations	30
3	Viva Voice	40
Total Marks		100

Particulars of Practical, Viva-Voce

- Practical examination will be aimed at examination of clinical skills and competence of the candidates for undertaking independent work as an Optometrist.
- Viva- Voce examination shall aim at assessing, i.e., depth of knowledge, logical reasoning, confidence &oral communication skills.
- OSCE/OSPE- shall have minimum of 3 stations.

SEMESTER I

ANATOMY

Course: Core
Credits: 04 **Number of hours: 60**

- **Course Outcomes:**

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

CO1: To identify and locate each of the body systems to apply anatomical knowledge to perform minor technical procedural skills.

CO2: To know the normal disposition of the structures in the body while clinically examining a patient and while conducting clinical procedures.

CO3: To know the anatomical basis of disease and injury

CO4: To discuss the interrelationship of systems in maintaining homeostasis.

CO5: To describe the structure of each body system

- **COURSE CONTENT:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	2hrs	Introduction: Human body as a whole 1.1 Definition of anatomy and its divisions 1.2Terms of location, positions, and planes 1.3 Cell and its organelles. 1.4Epithelium: definition, classification, describe with examples, function. 1.5 Glands: classification, describe serous & mucous glands with examples. 1.6 Basic tissues: classification with examples 1.7Demonstration: Histology of types of epithelium. Histology of serous, mucous & mixed salivary gland.	√			Lecture, Demonstration, Assignment	10%

Unit II	12hrs	Locomotion and support 2.1Bone: classification, names of bone cells, parts of long bone, microscopy of compact bone, names of all bones, vertebral column, inter-vertebral disc, fontanelles of fetal skull. 2.2 Joints: classification of joints with examples, synovial joint (in detail for radiology). 2.3Muscular system: classification of muscular tissue & histology, names of muscles of the body. 2.4 Demonstration: Bones & joints. Histology of compact bone (TS & LS). Demonstration of all muscles of the body. Histology of skeletal, smooth &cardiac muscle (TS & LS). Histology of the 3 types of cartilage. Demo of all bones showing parts, radiographs of normal.	√			Lecture, Demonstration	15%
Unit III	8hrs	Cardiovascular system 3.1Heart: size, location, chambers, exterior & interior, blood supply of heart 3.2 Systemic &pulmonary circulation, branches of aorta, common carotid artery, subclavian artery, axillary artery, brachial artery, superficial palmar arch, femoral artery, internal iliac artery, peripheral pulse, inferior vena cava, portal vein, Porto-systemic anastomosis, great saphenous vein, Dural venous sinuses. 3.3 Lymphatic system: cisterna chyli& thoracic duct, histology of lymphatic tissues, names of regional lymphatics, axillary and inguinal lymph nodes in brief. 3.4Demonstration of heart and vessels in the body. Histology of large artery, medium sized artery & vein, large vein. Histology of lymph node, spleen, tonsil & thymus. Normal chest radiograph showing heart shadows.	√			Lecture, Demonstration	10%
Unit IV	8hrs	Gastro-intestinal system 4.1 Parts of GIT, oral cavity, lip, tongue, dentition, pharynx, oesophagus, stomach, small and large intestine,liver,gall bladder, pancreas. 4.2 Tonsil, salivary glands extrahepatic biliary apparatus,Waldeyer's ring 4.3Demonstration of parts of gastro intestinal system. Normal radiographs of gastro intestinal system. Histology of gastro intestinal system.	√			Lecture, Demonstration	10%

Unit V	4hrs	Respiratory system 5.1 Parts of RS, nose, nasal cavity, larynx, trachea, lungs, broncho-pulmonary segments, histology of trachea, lung and pleura, names of paranasal air sinuses. 5.2 Demonstration of parts of respiratory System Normal radiographs of chest. - Histology of lung and trachea.	√			Lecture, Demonstration	10%
Unit VI	1hrs	Embryology 6.1Spermatogenesis & oogenesis. Ovulation, fertilization. Fetal circulation. Placenta, Demonstration of models.		√		Lecture, Demonstration	5%
Unit VII	2 hrs	**Urinary system** : Kidney, ureter, 7.1.urinary bladder, male and female urethra. Histology of kidney, ureter and urinary bladder 7.2.Demonstration of parts of urinary system. Histology of kidney, ureter, urinary bladder. Radiographs of abdomen-IVP, retrograde cystogram.	√			Lecture, Demonstration	5%
Unit VIII	2 hrs	**Reproductive system:** 8.1Parts of male reproductive system, testis, vas deferens, epididymis, prostate (gross & histology). Parts of female reproductive system, uterus, fallopian tubes, ovary (gross & histology). Mammary gland: gross 8.2.Demonstration of section of male and female pelvis with organs in situ. Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tube, ovary. Radiographs of pelvis, hysterosalpingogram.	√			Lecture, Demonstration	10%
Unit IX	2 hrs	**Endocrine glands:** 9.1.Endocrine glands:pituitary gland, thyroid gland, parathyroid gland, suprarenal glad (Gross & Histology). 9.2.Demonstration of the glands. Histology of pituitary, thyroid, parathyroid, suprarenal glands.	√			Lecture, Demonstration	5%
Unit	12	**Nervous system:** **10.1.**Neuron,	√			Lecture,	10%

X	hrs	classification of nervous system, cerebrum, cerebellum, midbrain, pons, medulla oblongata, spinal cord with spinal nerve (gross & histology), meninges, ventricles & cerebrospinal fluid, names of basal nuclei, blood supply of brain, cranial nerves. Sympathetic trunk& names of parasympathetic ganglia 10.2.Histology of peripheral nerve & optic nerve. Demonstration of all plexuses and nerves in the body. Demonstration of all parts of brain. Histology of cerebrum, cerebellum, spinal cord.				Demonstration	
Unit XI	3 hrs	**Sensory organs:** 11.1.Skin: histology, appendages of skin. Eye: parts of eye & lacrimal apparatus. Extra-ocular muscles & nerve supply. Parts of ear: external, middle and inner ear and contents. 11.2.Histology of thin and thick skin. Demonstration and histology of eyeball. Histology of cornea & retina.		√		Lecture, Demonstration	5%
Unit XII	3 hrs	**Embryology:** 12.1.Spermatogenesis & oogenesis. Ovulation, fertilization. Fetal circulation. Placenta, Demonstration of models.		√		Lecture, Demonstration	5%

- **Recommended books:**

1. Priya Ranganath, Leelavathy N,Basics in Human Anatomy for BSc Paramedical Courses,Revised and updated edition, The Health
2. Chaurasia BD. Human anatomy. CBS Publisher; 2004.
3. Vishram Singh, Textbook of Anatomy, Revised and updated edition, Elsevier
4. Waugh A, Grant A. , Ross &Wilson Anatomy and physiology in health and illness E-book. Elsevier Health Sciences; 2014 Jun 25.
5. Inderbir S. Textbook of human histology with color atlas. New Delhi: Jaypee BrothersMedical Publishers. 2006.

PHYSIOLOGY

Course: Core
Credits: 04 **Number of hours: 60**

- **Course Outcomes:**

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

CO1: To demonstrate the understanding of physiological structure of Renal system, endocrine system, Nervous system and special senses.

CO2: To broadly identify the clinical abnormalities of organs and its clinical physiological implications

- **COURSE CONTENT:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	2hrs	**General Physiology** 1.1 Introduction to physiology 1.2 Homeostasis: Definition, Positive feedback, negative feedback. PH 1.3 Body Fluid Compartments	√			Lecture	5%
Unit II	7hrs	**Blood** 2.1 Introduction: composition and function of blood. 2.2 Blood Cells: types, Normal Count 2.3 Red blood cells: function. Erythropoiesis: Definition, Stages, Factors affecting 2.4 Hemoglobin: Function, concentration Physiological variation of RBC Count and Hb 2.5 White blood cells: different types, functions, normal count, differential count 2.6 Platelets: origin, normal count, functions. 2.7 Haemostasis: definition, steps, clotting factors, mechanism of clotting, disorders of clotting 2.8 Blood groups: ABO system, Rh system: Rh factor, Rh incompatibility. 2.9 Blood grouping & typing, cross matching.	√			Lecture Chart Preparation	15%

		2.10 Blood transfusion: indication, universal donor and recipient concept. Selection criteria of a blood donor, transfusion reactions. 2.11 Anaemias: definition, Symptoms and signs (brief). 2.12 Blood indices: colour index, MCH, MCV, MCHC (def and Normal Values). 2.13 ESR and PCV: normal values, definition, determination (methods). 2.14Plasma proteins: types and concentration, functions of albumin, globulin, fibrinogen, prothrombin. 2.15 Blood volume: normal value, determination of blood volume					
Unit III	5hrs	**Muscle Nerve physiology** 3.1.1Introduction, Classification and structure of muscle, sarcomere 3.2Neuromuscular junction, Transmission across neuromuscular junction. 3.3 Excitation contraction coupling. Mechanism of muscle contraction, rigor mortis.		√		Lecture	5%
Unit IV	8hrs	**Cardiovascular system** 4.1 Heart: physiological anatomy, nerve supply. 4.2Properties of cardiac muscle PH 4.3Cardiac cycle: definition, systole, diastole, phases, JVP(brief) 4.4Cardiac output, stroke volume, EDV (only definitions). 4.5 Heart sounds, normal heart sounds, mechanism and features, areas of auscultation. 4.6 Blood pressure: definition, normal value, clinical measurement of blood pressure, hypotension, hypertension 4.7Heart rate: Physiological variations, regulation (brief), radial pulse 4.8Electrocardiogram (ECG): Definition, Normal ECG, Causes		√		Lecture	10%

		of ECG waves, Uses of ECG. 4.9Cardiac shock: Definition, Types (brief), Triple response.					
Unit V	6hrs	**Respiratory system** 5.1Introduction: Functions of respiratory system, physiological anatomy of respiratory system, respiratory tract 5.2Respiratory organs: lungs, alveoli, respiratory membrane 5.3Mechanism of breathing: Inspiration and Expiration, muscles involved, Mechanism. 5.4Surfactant: Composition, Function, 5.5Transport of oxygen: forms of transport, Oxygen Hemoglobin Curve. 5.6Lung volumes and capacities: Spirogram, Definitions and normal Volumes. 5.7Regulation of respiration: Nervous and chemical regulation, respiratory centre, Herring Breur reflexes. 5.8Hypoxia: Def, Classification, Description (in brief). 5.9 Cyanosis, Asphyxia, Dyspnea, Dysbarism, Artificial Respiration, Apnoea.(Definition Only)	√			Lecture Chart Preparation	10%
Unit VI	5hrs	**Digestive System** : 6.1.Introduction Physiological anatomy of gastro intestinal tract (All Structures in brief), functions of digestive system. Functions of Saliva Deglutition: definition, stages 6.2.Stomach: functions Gastric secretion: composition, function, Phases of secretion	√			Lecture Chart Preparation	10%

		6.3.Pancreas: Functions (exocrine), pancreatic juice: composition and regulation. Secretin and CCK-PZ 6.4.Liver: Functions, Bile secretion, composition, function of bile; Bilirubin metabolism, types of bilirubin, Vandenberg reaction, Jaundice: types, significance. Gall bladder: Functions. 6.5.Small intestine: functions, digestion and absorption, movements. (brief) Large intestine: functions, defecation reflex					
Unit VII	5hrs	**Renal System** : 7.1.Introduction: Functions of kidneys, composition of urine, nephron, cortical and juxtamedullary nephrons (comparison), Juxta Glomerular 7.2.Apparatus: structure and function. Vasa recta Mechanism of urine formationGFR: Definition, Normal Values, factors effecting GFR, Measurement (Creatine, Inulin Clearance). Tubular reabsorption, TMG, Tubular secretion (brief). 7.3.Mechanism of urine concentration: Counter-current mechanisms, Role of ADHDiuresis, Diuretics. Micturition, innervations of bladder, cystometrogram	√			Lecture Chart Preparation	10%

Unit VIII	1hr	**Skin and Body temperature**: 8.1.Structure and function of Skin Sweat Glands 8.2.Body Temperature: physiological variation. Regulatory mechanisms: 8.3.Mechanisms Activated by Heat/Cold Role of hypothalamus, and fever. Body temperature measurement, hypothermia	√			Lecture	10%
Unit IX	5hrs	**Endocrine System: 9.1.** Introduction: Definition, classification of endocrine glands & their hormones. 9.2.Hypothalamic- pituitary Axis Pituitary hormones: anterior and posterior pituitary hormones, Functions of Growth hormone, 9.3.Thyroid gland: Thyroid Hormones: physiological function, regulation of secretion, disorders: hypo and hyper secretion of hormone. Physiological anatomy of Thyroid 9.4.Adrenal cortex: functions of Cortisol and Aldosterone Adrenal medulla: functions of Adrenaline and Noradrenaline. 9.5.Physiological anatomy of Adrenal Pancreas (Endocrine): Hormones of pancreas. Insulin: functions, regulation of blood glucose level, Diabetes mellitus Abnormalities of pancreatic hormones (brief) Regulation	√			Lecture Chart Preparation	8%

		of Calcium Metabolism: Hormones involved, actions of PTH, Calcitonin, Vit D3Tetany					
Unit X	4hrs	**Reproductive system:** **10.1.**Introduction, Function of reproductive system, Changes during puberty. 10.2. Sex Differentiation Male reproductive system: functions of testes Spermatogenesis: 10.3.Definition, site, stages, factors influencing, Endocrine functions of testes Sperm, semen. Androgens: testosterone functions. 10.4.Female reproductive system, Menstrual cycle: Definition, changes, ovulation Functions of progesterone and estrogen 10.5.Hormonal Regulation Physiological changes during pregnancy, Lactation (brief), milk ejection reflex	√			Lecture	5%
Unit XI	8hrs	**Nervous system:** **11.1.**Introduction: Parts of CNS and PNS, Functions of nervous system **11.**2.Neuron: definition, structure Nerve Fiber: classification, conduction of impulses continuous and saltatory. Neuroglia Synapse: Definition, structure, types, properties (brief). 11.3.Receptors: definition, classification, properties (brief). Reflex: Definition, Reflex Arc, Examples.	√			Lecture	7%

		Babinski's sign. Tone, Posture (definition), Spinal cord nerve tracts: Diagram and Functions: Lateral Spino Thalamic Tract, Dorsal Column, Pyramidal Tract.UMN and LMN lesion, Hemiplegia, Stroke (brief) Functions of: Cerebral cortex, Cerebellum, 11.4.Hypothalamus, Basal Ganglia EEG, Parkinsonism Cerebro Spinal Fluid (CSF): site of formation, circulation (brief), functions. Lumbar puncture. 11.5.Autonomic Nervous System: Sympathetic and parasympathetic distribution and functions (brief).					
Unit XII	4hrs	**Special senses:** 12.1.Vision: Functions of different parts (brief) Optic Pathway, Dark Adaptation, Color vision. Structure of eye, Structure of retina. 12.2.Hearing: Function of Middle Ear, Functions of inner ear, mechanism of hearing (brief). 12.3.Chemical Senses: Taste: types, receptor, Smell: physiology, receptors.	√			Lecture	5%

- **Recommended Books**

1. Guyton (Arthur): Text Book of Physiology. Latest Ed. Prism publishers.
2. Ganong William F: Review of Medical Physiology. Latest Ed. Tata McGraw Hill
3. Chatterjee CC: Human Physiology Latest Ed. Vol-1, Medical Allied Agency.Choudhary Sujith K: Concise Medical Physiology Latest Ed. New CentralBook.

BIOCHEMISTRY

Course: Core **Course Code: AH01CC3**

Credits: 4 **No of Hours: 60 Hours**

- **Course Outcomes:**

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

CO1: Have knowledge and understanding of procedures of specimen collection, reagent preparation of specimens, performing biochemical tests, interpreting results, and managing biomedical waste effectively.

CO2: Understand the basic procedures in specimen collection, reagent preparation, and testing in a clinical laboratory

CO3: Demonstrate the knowledge of properties of biomolecules and their function.

CO4: Have knowledge of the importance of nutrition in health and diseases.

- **Course Content:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	2 hrs	**Introduction to Biochemistry and Clinical Laboratory**	√			Lecture	10%
Unit II	4 hrs	**Specimen collection :** Pre-analytical variables. Collection of blood. Collection of CSF & other fluids. Urine collection. Use of preservatives. Anticoagulants.		√		Lecture	5%
Unit III	2 hrs	**Safety measurements, Conventional and SI units**	√			Lecture	5%

Unit IV	2 hrs	**Dilutions :** Diluting solutions: e.g. preparation of 0.1 N NaCl from 1 N NaCl& from 2NNaCl etc., preparing working standard from stock standard, body fluid dilutions, reagent dilution techniques, calculating the dilution of a solution, body fluid reagent etc., saturated and supersaturated solutions		√		Lecture	5%
Unit V	4 hrs	**Carbohydrate chemistry :** Classification, Isomerism, General reactions of carbohydrates		√		Lecture	5%
Unit VI	4hrs	**Lipids** : Chemistry of fatty acids, triglycerides, cholesterol, phospholipids, lipoproteins, Classification and functions.		√		Lecture	5%
Unit VII	4 hrs	**Protein chemistry, structure**		√		Lecture	5%
Unit VIII	2 hrs	**Plasma Proteins :** Concentration, biochemical changes in disease, interpretation		√		Lecture	5%
Unit IX	6 hrs	**Enzymes :** Definition, classification, coenzymes, cofactors, factors effecting enzyme activity, inhibitors, units of measurements, isoenzymes, biological interpretation		√		Lecture Chart Preparation	5%
Unit X	6 hrs	**Vitamins :** Definition, classification, sources, functions, deficiency disorders	√			Lecture Chart Preparation	10%
Unit XI	6 hrs	**Minerals :** Na, K, Ca, P, Fe, Cu, selenium- sources, daily requirements, availability and properties	√			Lecture Chart Preparation	10%

Unit XII	3 hrs	**Nutrition:** Calorific value, nitrogen balance, respiratory quotient, basal metabolic rate, dietary fibers, nutritional importance of lipids, carbohydrates and proteins, vitamins. nutrition, nutritional support with special emphasis on parental nutrition	√			Lecture Chart Preparation	10%
Unit XIII	2 hrs	**Quality control:** Accuracy, precision. Specificity, sensitivity, limits of error allowable in laboratory, percentage error. Normal values and Interpretations.	√			Lecture	5%
Unit XIV	11 hrs	**Special Investigations** : Serum electrophoresis, immune globulins, drugs: digitoxin, theophylline's, regulation of acid base status, Henderson Hassel Bach equations, buffers of the fluid, pH regulation, disturbance in acid base balance, anion gap, metabolic acidosis, metabolic alkalosis, respiratory acidosis, respiratory alkalosis, basic principles and estimation of blood gases and pH, basic principles and estimation of electrolytes, water balance, sodium regulation, bicarbonate buffers,	√			Lecture	10%
Unit XV	2 hrs	**Bio Medical waste management**	√			Lecture Chart Preparation	5%

- **Recommended Books**

1) Vasudevan DM, Sreekumari S, Vaidyanathan K. Textbook of Biochemistry for medical students. Jaypee Brothers Medical Publishers; 2019 Sep 30.
2) Satyanarayana U and U Chakrapani. 2013. Biochemistry (version 4th ed). 4th ed. New Delhi: Elsevier Health Sciences APAC.

YENEPOYA
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BASIC PHYSICS

Course: Core

Credits: 4 **No of Hours: 60 Hours**

Course Outcome:

CO1: Explicate the structure and composition of an atom and its physics.

CO2: Discuss the fundamentals of electricity, electronics and magnetism.

CO3: Discuss the types,properties and uses of materials based on electrical conductivity

CO4: Explain electromagnetic radiation, xray generators, its types and properties with suitable examples.

Course Content:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	4hrs	**Fundamentals of electricity:** **1.1** Electric charges & units of electric charge **1.2** Coulombs law **1.3** Electric induction **1.4** Resistance **1.5** Conductors **1.6** Insulators & Semi-conductors **1.7** Electric current **1.8** Ohm's, EMF & Kirchhoff's law **1.9** Alternating current **1.10** Charge and discharge of a capacitor through a resistance and inductance.	√			Lecture	15
Unit II	8hrs	**Electromagnetic induction:** **2.1**Maxwell's equation **2.2** Electromagnetic induction **2.3** Electromagnetic waves and their properties **2.4** Electromagnetic Spectrum **2.5** Spectrum of white light **2.6** Spectra- continuous, line & band spectra, absorption spectra **2.7** Luminescence **2.8** Energy density and intensity	√			Lecture	15

		2.9 Quality of Electromagnetic radiation **2.10** Radiation in atmosphere					
Unit III	8hrs	**X-ray generators:** **3.1** Transormers and its types **3.2** Laws of transformers **3.3** Transformer losses **3.4** Filament circuit **3.5** High voltage circuit Rectification **3.6** Types of Transformers **3.7** Fuses, switches and exposure timers **3.8** Interlocking circuits/ Thyristors **3.9** Circuit Breakers, Meters **3.10** Earthing, insulation **3.11** High tension cable Construction and design.	√			Lecture	20
Unit IV	8hrs	**Fundamentals of magnetism:** **4.1** Introduction **4.2** The Bar magnet **4.3** Magnetism **4.4** Gauss's law **4.5** Magnetic Force **4.6** Magnetization and magnetic intensity **4.7** Solenoid and Toroid **4.8** Magnetic properties of materials **4.9**Permanent magnets, Electromagnets **4.10** Earth's magnetism	√			Lecture	15
Unit V	8 Hrs	**Sound** 5.1. The nature and propagation of sound wave, Transverse and longitudinal waves 5.2. Interference of sound waves Beats, Decibel, Speed of sound in material medium. 5.3. Intensity of sound, Superimposition of the wave 5.4. Doppler effect principle	√			Lecture	15
Unit VI	9 Hrs	**Atomic physics** The structure of the Atom,	√			Lecture	20

		Nucleus, Atomic Number(Z), Mass Number(A), Ionization & Excitation Alpha particles cattering Atomic models Atomic spectra Atomic masses and composition of nucleus Mass energy and nuclear binding energy Nuclear force and energy Radioactivity Nuclear reactor					

Recommended Books:

- Modern Physics by B.L Theraja
- Modern Physics, Er.Kiruthiga Sivaprasath & R Murugeshan S.Ch and Publishing

YENEPOYA
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ENGLISH AND COMMUNICATION _ PART – I

ENGLISH PROFICIENCY: A PATH TO EFFECTIVE COMMUNICATION

Course: AEC

Credits: 3 **No of Hours: 45 Hours**

- **Course Outcomes:**

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

CO1: Acquire the LSRW (Listening, Speaking, Reading, and Writing) skills. Through Cambridge Interchange Fifth Edition, students will develop real world communication skills- enhancing fluency in speaking, listening, reading and writing – wile mastering grammar, expanding vocabulary and improving pronunciation with supportive digital tools.

CO2: Learn to appreciate Literature.

CO3: Be aware of social responsibilities.
CO4 :Enhance the analytical skill

- **COURSE CONTENT:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Weightage	Types Of Questions

Unit I	10hrs	**UNIT 1: CAMBRIDGE: INTERCHANGE FIFTH EDITION** 1.1 Good Memories 1.2 Life in the City 1.3 Making Changes 1.4 Have you ever tried it? 1.5 Hit the Road. 1.6 Sure. I will do it. 1.7 What do you use this for? 1.8 Time to Celebrate.	√			23%	SA
Unit II	8hrs	**UNIT- II: PHONETICS** 2.1 Brief Introduction 2.2 Classification of Vowels, Diphthongs and Consonants 2.3 Pronouncing the words phonemically and transcribing them into Phonetics 2.4 IPA	√			18%	SA
Unit III	11hrs	**UNIT – III: Grammar and Written Communication** 3.1 Parts of Speech 3.2 Verb Tenses 3.3 Articles 3.4 Capitalization and Punctuation	√			24%	SA

		3.5 E-mail Drafts 3.6 Formal Letters 3.7 Essay Writing					
Unit IV	4hrs	**UNIT – IV : Prose** 4.1 SteevJobs : Commencement Address 4.2 Mother Teresa's Award Winning Speech	√			9%	LE, SE
Unit V	6hrs	**UNIT – V: Poetry** 5.1 The Road Not Taken : Robert Frost 5.2 The Man with the Wooden Leg : Catherine Mansfield 5.3 Our Casuarina Tree : Toru Dutt	√			13%	LE, SE
Unit VI	6hrs	**UNIT – VI : Short Stories** 6.1 Gift of the Magi : O' Henry 6.2 Kabulivala :Raindranath Tagore 6.3 The Blue Umbrella : Ruskin Bond		√		13%	LE, SE

- **LE**- Long Essay**, SE**- Short Essay**, SA**- Short Answer

- **Recommended Books:**

1. Cambridge: Interchange Fifth Edition
2. Contemporary English Grammar Structures & Composition by David Green

3. English Grammar and Composition: Wren & Martin
4.English Grammar in Use by Raymond Murphy

Constitution of India

Course: Core

Credits: 02 **Number of hours: 30 hours**

Course Objectives

- State and explain the constitution of India and its Constituent Assembly
- Explain fundamental rights and duties of citizen
- Identify union, state and federalism of India
- Knowledge of electoral process in India.
- State the basic concepts of Human Rights and its functions and authorities in society.

Syllabus:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	5hrs	**Indian Constitution** 1.1.Meaning and Importance of Constitution 1.2.The Constituent Assembly 1.3.The Preamble 1.4. Salient Features of Constitution	√			Lecture/ Activity	15%

Unit 2	3hrs	**Fundamental Rights and Directive Principles** 2.1.Meaning and Differences between Fundamental Rights and Directive Principles 2.2.Fundamental Rights 2.3.Rights Information Act Meaning, importance of RTI 2005	√				15%
Unit 3	4hrs	**Union Government** 3.1.President of India- Election, Powers and Position 3.2.Prime Minister and council of Ministers 3.3.Parliament– LokSabha, RajyaSabha- Organisations and Powers	√				10%
Unit 4	4hrs	**State Government** 4.1.The Governor 4.2.Chief Minister and Council of Ministers 4.3.State Legislature Vidhana Sabha, Vidhana Parishad – organization and Powers	√				10%
Unit 5	2hrs	**Federalism In India** 5.1.Meaning Federal and Unitary Features		√			5%
Unit 6	2htrs	**The Judiciary** 6.1.The supreme Court – Organization, Jurisdiction and Role 6.2.The High Court – Organization Jurisdiction and Role	√				10%

Unit 7	2hrs	**Electoral Process In India** 7.1.Election Commission– Organization, Functions		√			10%
Unit 8	2 hrs	**Local Governments** 8.1.Rural and Urban – Organization, Powers and Functions		√			7%
Unit 9	3 hrs	**Human Rights** 9.1.Human rights – Meaning 9.2.Universal Declaration of Human Rights 9.3.Remedies against Violation of Human Rights in India	√				10%
Unit 10	3 hrs	**Special constitutional provisions** 10.1.Special Rights created in the constitution for: Dalits, Backwards, women and Children and the Religious and Linguistic Minorities. 10.2.Constitution and Sustainable Development in India. 10.3.Minority Commission in India		√			8%

Course Outcome:

- This course is to keep the students abreast with the knowledge of the Constitution of India.
- To make the students understand the importance of human rights as citizens of India.

Recommended Books

- Basu, D.D , Constitution of India, New Delhi Himalaya Publication ; 2001
- Dinesh Shelton, David P Stuart, International Human Rights in Nutshell. Thomas Burgenthel, West Nutshell Publisher; London; 2005.

- ParvathyAppaiah, Constitution of India, Mangalore DivyaDeepa Publication; 2005
- ParvathyAppaiah, Human Rights. DivyaDeepa Publication Mangalore; 2016
- RajRam. M, Constitution of India Himalaya Publication, New Delhi; 1999

SEMESTER II

GENERAL PATHOLOGY

Course: Core **Number of Hours: 60**

Credits: 4

Course Objectives:

- To be able to define the medical terms, define and classify disease and understand the concepts of the disease.
- Able to describe the causes and mechanism of common diseases that occur during the routine work and also changes seen in different individuals and various organs and fluids.
- Able to enumerate the laboratory tests eg: urine, blood, body fluids and its application on various diseases.

Syllabus:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	8hrs	Introduction	√			Lecture/ Activity	10%

Unit 2	12hrs	**Cellular Responses to Stress and Injury** 2.1.Types of cellular responses to injury 2.2.Cellular adaptations 2.3.In brief cell injury and types of cell injury, intracellular accumulation 2.4.Necrosis and apoptosis (brief) 2.5.Pathologic calcification, hyaline change, pigments	√			Lecture/ Activity	10%

Unit 3	12hrs	**Acute Inflammation** 3.1.Definition, cardinal signs and sequence of events in acute inflammation 3.2.List chemical mediators of inflammation, outcomes of acute inflammation, morphological types/patterns of acute inflammation and briefly systemic effects of inflammation 3.3.In brief cutaneous wound healing (primary and secondary) Factors that influence wound healing, complications of wound healing 3.4.Types of chronic inflammation, Granulomatous diseases, briefly about tuberculosis, leprosy and syphilis	√			Lecture	20%
Unit 4	6hrs	**Hemodynamic Disorders, Thromboembolism and Shock** 4.1.Edema and thrombosis 4.2.Embolism, infarction and shock (in brief)		≻		Lecture	10%

Unit 5	8hrs	**Diseases of the Immune System** 5.1.Introduction to immune system 5.2.Hypersensitivity reactions (brief) 5.3.Autoimmune diseases and systemic lupus erythematosus (in brief) 5.4.Acquired immunodeficiency syndrome	√				15%
Unit 6	8htrs	**Neoplasia** 6.1.Nomenclature of neoplasms and characteristics of benign and malignant neoplasms 6.2.Metastasis and spread of tumors 6.3.Etiology of cancer (carcinogenic agents) 6.4.Laboratory diagnosis of cancer, staging grading and prognosis	√			Lecture	15%
Unit 7	2hrs	**Genetic Disorders** 7.1.Introduction of genetic disease and classification of genetic disorders	√			Lecture	10%

Unit 8	4 hrs	**Nutritional Disorders** 8.1.Common vitamin deficiencies - Fat-soluble vitamins 8.2.Water-soluble vitamins—vitamin B complex	√			Lecture	10%

Course Outcome:

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

- Understand how body reacts to cellular responses and injuries.
- Have a basic knowledge about various laboratory tests and its application on various disorders.
- Define the medical terms, define and classify disease and understand the concepts of the disease.

Recommended Books

- Nayak R, Rai S, Gupta A. Essentials in hematology and clinical pathology. New Delhi: Jaypee Brothers Medical Publishers; 2012.
- Mohan H. Textbook of pathology. 8th ed. New Delhi, India: Jaypee Brothers Medical; 2018

RADIATION PHYSICS

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

• To explain about atomic structure, electromagnetic radiation and radioactivity; its types and properties with suitable examples.

• To explain and discuss briefly about the production of X-rays and interactions between them.

Syllabus:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	12hrs	**Atomic structure** 1.1.Constituents of atoms, Nucleus, Atomic number (Z), Mass number (A),atomic mass unit, mass defect and binding energy 1.2.Isotopes, isobars and isotones, Ionization & Excitation, And the Periodic Table.	√			Lecture/ Activity	20%

Unit 2	12hrs	**Radioactivity** 2.1.Natural and artificial radioactivity, Activity, Specific activity, Modes of radioactive disintegration. 2.2.Exponential decay, Half Life and mean life, Properties of alpha, beta and gamma rays. Basic interactions between x-rays and matter.	√			Lecture/ Activity	20%
Unit 3	16hrs	**Interaction of Radiation with Matter** 3.1.Photoelectric effect, Compton Effect, Pair production, Ionization of matter, Energy absorbed from X-rays, X-rays Scattering, X-ray's transmission through the medium. 3.2.Linear and mass attenuation coefficient, LET, HVT and TVT, Inverse square law. Relative importance of different types of interactions in body, fat, soft tissue, bone and contrast medium.	√			Lecture/ Activity	30%

Unit 4	20hrs	**Production of X-rays** 4.1.X-ray production, x-ray tube-properties of x-rays, Characteristic and continuous spectra, Various types of sources used in Radiotherapy and their properties, Soft and Hard X-rays. 4.2.Distribution of X-rays in space. Importance of Focal spot. Line focus principle and shape of the anode surface, Anode heal effect. Filters- inherent filters, added filters, heavy metal filters. Basics of X-ray circuits, KV circuit, MA circuit. 4.3.Transmission of X-rays through body tissues: Relative amount of scattered radiation in an X-ray beam during its passage through a patient. Quality and intensity of x-rays, Factors affecting quality and intensity.	√			Lecture/ Activity	30%

Course outcome

At the end of the course students must have gained the knowledge of

• Atomic structure, Radioactivity, Half life and mean life of an isotope

• Various interaction of radiation with matter

- Production of the X-rays and the involvement of various component in the X-rays production

Recommended Books

- The Physics of Radiation Therapy "by Faiz M Khan & John P Gibbons , 5th Edition
- The Modern Technology of Radiation Oncology" by Jacob van Dyk
- Technical Basis of Radiation therapy" by Seymour HLevitt, James A Purdy, 5th Editon
- Modern Physics by B.L Theraja

RADIATION QUANTITIES AND DETECTION

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objective:

- To discuss the important radiation quantities and units
- To make the student to understand about the Principle of radiation detection and their uses
- To brief about different radiation measuring and monitoring instruments.

Syllabus:

Unit	Hrs	Content	Must Know	Good to K	Desirable to Know	Teaching Learning Method	Weightage
Unit I	18hrs	**Radiation quantities and units** 1.1.Quantitiestodescribearadiationbeam,particlefluxandfluence,energy flux and fluency, linear and mass absorption coefficient, stopping power and LET. 1.2. Activity, Curie, Becquerel, Exposure and its measurements, Roentgen, Radiation absorbed Dose, Gray,kerma,kermarateconstant,Relativebiologicaleffectiveness(RBE),radiationweighting factors, equivalent dose, tissue weighting factors, effective dose	√			Lecture/ Activity	25%

Unit 2	18hrs	**Principles of radiation detection** 2.1.General Principle and working of Gas-filleddetectors-ionchambers,proportional counters and Geiger Muller counters. General principle and working of Scintillation detectors, liquid scintillator. General principle and working of Semiconductor detectors. 2.2.Thimblechamber, Secondary Dosimeter, parallelplatechamber, Well-typeionchamber. Principles of Thermo luminescence dosimeters and its application in radiotherapy and radio diagnosis.	√			Lecture/ Activity	25%
Unit 3	12hrs	**Personnel monitors** 3.1.Personnel monitoring device, TLD badge, TLD reader, OSLD, Film badge, pocketdosimeters. Advantages and disadvantages of various monitors.	√			Lecture/ Activity	25%

Unit 4	12hrs	**Measuring Instruments** 4.1.Different types of radiation measuring devices for radiation protection. Gamma zone monitors, survey meters, contamination monitors, neutron monitor. 4.2. Advantages and disadvantages of various instruments, appropriateness of different types of detectors for different types of radiation measurement.	√			Lecture/ Activity	25%

Course outcome

At the end of the course student understand

- The important radiation quantities and units
- The Principle of radiation detection and their usage
- The different radiation measuring, monitoring instruments and how to use them.

Recommended Books

- "The Physics of Radiation Therapy" by Faiz M Khan & John PGibbons,5th Edition
- Radiation detection and measurement–GF Knoll
- Technical Basis of Radiation therapy" by Seymour HLevitt, James A Purdy, 5th Edition.

KANNADA

Course: AECC

Credits: 02 **Number of hours: 30**

Course Objectives

- Enable students to learn alphabet, words and simple sentences in Kannada.
- Enable students to enhance speaking and writing communicative skills in Kannada and learn technical words related to medical science

Syllabus:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	6hrs	1.1. Kannada Letters (vowels, Consonant)	√			Lecture/ Activity	25%
Unit 2	12hrs	**2.1.**Words, Phrases, formation of sentences, Letter Writing, Essay Writing. Treatment related Kannada words (from English to Kannada)		√		Lecture/ Activity	25%

Unit 3	12hrs	3.1.Possible communication in kannada between Patients and Doctors. 3.2.Advising sentences to the possible questions of patients. 3.3. Some important sentences which enable to communicate with doctors and colleagues.		≻		Lecture/ Activity	50%

Course Outcome

- Allied health science students will be able to attend health issues of native Kannada speaking patients more effectively.
- They can also act as a bridge between doctors and patients.

Recommended Books

- Kannada Vyakarana – (8th ,9th and 10th Karnataka government text books)
- HSK, Vyavarahika Kannada

ENGLISH AND COMMUNICATION _ PART – II

ENGLISH PROFICIENCY: A PATH TO EFFECTIVE COMMUNICATION

Course: AEC

Semester : 1I

Credits: 3 **No of Hours: 45 Hours**

➢ **Course Outcomes:**

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

CO1: Acquire the LSRW (Listening, Speaking, Reading, and Writing) skills. Through

Cambridge Interchange Fifth Edition, students will develop real world communication skills- enhancing fluency in speaking, listening, reading and writing – wile mastering grammar, expanding vocabulary and improving pronunciation with supportive digital tools.

CO2: Learn to appreciate Literature.

CO3: Be aware of social responsibilities.

CO4: Enhance the analytical skill

- **COURSE CONTENT:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Weightage	Types Of Questions
Unit I	13hrs	**UNIT – I: CAMBRIDGE INTERCHANGES FIFTH EDITION** 1.1 Only Time Will Tell 1.2 I Like Working with People 1.3 It's Really Worth Seeing 1.4 It's a Long Story 1.5 That's Entertainment 1.6 Now I Get it 1.7 I wouldn't have done that 1.8 Making Excuses	√			29%	SA

Unit II	3hrs	**UNIT – II: Phonetics – IPA Transcription**	√			7%	SA
Unit III	13hrs	**UNIT – III: Grammar and Written Communication** 3.1 Reported Speech 3.2 Modals 3.3 Clauses 3.4 Gerunds 3.5 Active and Passive Voice 3.6 Synonyms and Antonyms 3.7 News Report Writing 3.8 Speech Writing 3.9 Dialogue Writing	√			29%	SA
Unit IV	4hrs	**UNIT – IV: PROSE** 4.1 Chicago Address by Swami Vivekananda 4.2 I have a Dream : Martin Luther King	√			9%	LE, SE
Unit V	6hrs	**UNIT – V: Poetry** 5.1 Still I Rise : Maya Angelou 5.2 BTheRaven : Edgar Allen	√			13%	

		Poe 5.3 Break, Break, Break : Alfred Lord Tennyson					LE, SE
Unit VI	6hrs	**UNIT – VI : Short Stories** 6.1 The Luncheon : William Somerset Maugham 6.2 The Power of Prayer : APJ Abdul Kalam 6.3 The Necklace : Guy De Maupassant		√		13%	LE, SE

- **LE-** Long Essay**, SE-** Short Essay**, SA-** Short Answer

- **Recommended Books:**

3. Cambridge: Interchange Fifth Edition
4. Contemporary English Grammar Structures & Composition by David Green
5. English Grammar and Composition: Wren & Martin
6. English Grammar in Use by Raymond Murphy

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THIRD SEMESTER

BASIC RADIOGRAPHIC IMAGING

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To explain the working and principles of diagnostic X-ray and the clinical usage
- To brief about the X-ray film processing and its images.
- To discuss about the different types of radiographs

Syllabus:

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	6hrs	**Photographic Principles** 1.1.Radiographic film – construction and types, Photographic effect and latent image formation. 1.2.Film density and log relative exposure, Characteristic curve its formation and features, Film faults and Artifacts	√			Lecture/ Activity	15%

Unit 2	6hrs	**Intensifying Screens** 2.1.Luminescence-fluorescence and phosphorescence, Construction and types of Intensifying Screens, Resolving power of Intensifying Screens. 2.2.Speed of intensifying screen, Screen film contact tests, Advantages and limitations of Intensifying Screens.					
Unit 3	6hrs	**X-ray Cassette:** 3.1.Construction of X-ray cassettes, Types of cassettes, Mounting Intensifying Screens on cassettes, Care and maintenance of cassettes					

Unit 4	6hrs	**Dark Room–Planning & Construction** 4.1.Planning for a small & large Hospital, Location of Dark Room Construction of Dark Room, Ventilation, Wall Protection, Entrance to Dark Room-Single Door, Double Door, Labyrinth and rotating					
Unit 5	6hrs	**Dark Room Accessories** 5.1.Dry bench, Hopper, Drawer, Cupboard. Loading and unloading cassettes Hangers, types of hangers and storage of hangers, Wet bench. 5.2.Cleanliness, control of dust, dark rooms inks, Hatches, Drier, Safe Lights-types and uses, factors affecting safelight performance, safe light Tests, Viewing room, Film dispensing					

Unit 6	6hrs	**Film Processing** 6.1.Photochemistry, Developer, Rinsing, Fixer, Washing and drying, Preparation of processing solutions, Manual processing apparatus, Effect of temperature in processing, Rapid processing					
Unit 7	6hrs	**Automatic processor** 7.1.Principle of working and features, thermal regulation and replenishment system, Care and maintenance of automatic processor, Advantages and limitations of automatic processor.					

Unit 8	6htrs	**Computerized and Digital Radiography** 8.1.Day Light Film handling, Computerized Radiography-Principles, Processing, Equipment's, Advantages, disadvantages, Digital Radiography, Principles, Processing, Equipment's, Advantages and Disadvantages					
Unit 9	4hrs	**Radiographic Image:** 9.1.The emergent beam related to densities on film contrast – objective and subjective, Radiation contrast, film contrast and Radiographic contrast, Density, Sharpness, Unsharpness					

Unit 10	4hrs	**Resolution** 10.1.Factors affecting resolution, choice of Kilo voltage and Milli amperage. Choice of Short Focus and Broad Focus. 10.2.Selection of Focus to Film Distance and Object to Film Distance selection of cassettes, Avoiding scatter radiation, magnification, distortion, penumbra					
Unit 11	2hrs	**Reproduction of Radiographs** 11.1.Copying Radiographs, Magnification and Magnification Radiography					
Unit 12	2hrs	**Imaging Communication** 12.1.Hospital Information System, Radiology Information System, PACS, DICOM					

Course outcome

At the end of the course students must demonstrate an understanding of

- Intensifying screen, X-ray cassette

- Film processing, Computerized and Digital Radiography
- Imaging communication

Recommended Books

- Christensen's Physics of Diagnostic Radiology by James E. Dowdey, Robert C. Murry, and Thomas S. Curry, Lippincott Williams & Wilkins,1990
- Medical Imaging Physics by William R. Hendee, E. Russell Ritenour,Fourthedition,Wiley,2016
- Fundamental Physics of Radiology" by W.J.Meredith and J.B. Massey,3rd Edition

RADIOBIOLOGY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To learn the biological basis of radiotherapy
- To brief the biological effects of ionizing radiation on cells and tissues.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage

Unit I	8hrs	**Introduction to Radiobiology** 1.1.Cell structures, Types of cells and tissue- stages of interaction of ionizing radiation with cells, the physics and chemistry of radiation absorption, Cell cycles, molecular mechanisms of DNA and Chromosome Damage and Repair,	√			Lecture/ Activity	15%

Unit 2	18hrs	**Cell survival curves and models** 2.1.Cell survival curves, Generation of cell survival curves, Dose response relationships for normal tissues, Oxygen effect, Linear Energy Transfer and Relative Biological Effectiveness, time dose fractionation in radiotherapy. 2.2.TCP and NTCP models. The Linear Quadratic (LQ) model Radiation dose modifiers. Radio-protectors and radio-sensitizers, Concept of Dose Reduction Factor, mechanism of action					

Unit 3	15hrs	**Biological effects of radiation** 3.1.Effect of ionizing radiation on Cell, Chromosomal aberration, biological dosimetry, Somatic effects and hereditary effects, stochastic and deterministic effects, Acute exposure and Chronic exposure, LD 50 / 60. 3.2.Radiation chemistry direct and indirect effects, free radicals, oxygen effect and free radicals -LET and RBE theory.					
Unit 4	12hrs	**Acute Radiation Syndrome** 4.1.Early Lethal Effects, Radiation Syndrome, The Cerebro-vascular Syndrome, The Gastro intestinal Syndrome, The Hematopoietic Syndrome, concept of Lethal Dose (LD50)					

Unit 5	7hrs	**Effects of Radiation** 5.1.Effects of radiation on the Embryo and Effects of radiation on various stages of fetal development, Observations from survivors of atomic bomb. Occupational exposures and pregnant women					

Course outcome

At the end of the course students understand

- The principle of Radiobiology in Radiotherapy
- Repair and re oxygenation mechanism of cells
- Early effects and late effects

Recommended Books

- Radiobiology for the Radiologist by Eric j Hall & Amato G Glaccia, 8th Edition
- Technical Basis of Radiation therapy by Seymour HL evitt, James A Purdy, 5th Edition'
- Introduction to radiation biology by UmaDevi and B.S. Satish Rao

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RADIO THERAPY EQUIPMENTS

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To brief the historical developments of therapy equipments
- To discuss the working principles of various teletherapy and brachytherapy machines along with their major components.
- To explain various dosimetry equipments those are used in teletherapy and brachytherapy facilities.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	6hrs	**History of Radiotherapy** 1.1.Historical Development of Radiotherapy equipment; Grenz ray therapy-Superficial, Kilo voltage, Ortho voltage Machines	√			Lecture/ Activity	15%

Unit 2	22hrs	**Tele therapy equipment:** 2.1.Linear accelerator- Components of dual energy linear accelerator Van de Graaff generator, cyclotron, Microtron, klystron, Magnetron. 2.2.Isotope machines: Cesium137 teletherapy Units, Cobalt60 teletherapy units, production and details of the source, source housing and shutter mechanisms beam collimation and penumbra, electron contamination in Medical linear accelerators 2.3.Machine properties- Beam directing, modifying and defining devices and other accessories. Radiotherapy simulator, CT Simulator and its applications.					

Unit 3	18hrs	**Brachytherapy treatment unit** 3.1.Remote after loading treatment units –High dose-rate(HDR), Low dose-rate(LDR), Pulsed dose-rate(PDR) treatment units – Design features. 3.2.Radiation sources and its properties -Cs-137 LDRsource,Ir-192HDRsource,Co-60 HDR source, and various types of applicators.					
Unit 4	14hrs	**Dosimetry Equipment** 4.1.Various types of phantoms including the water-phantoms, RFA. Various types of dosimeters including in-vivo dosimeters EPID and other on-board imaging systems - Record and Verify Systems.					

Course outcome

At the end of the course students understand

- The developments of therapy equipments at various stages
- Apply the acquired knowledge of working principles of various teletherapy and brachytherapy machines in routine clinical practice.
- Use the gained knowledge for radiation measurement and survey in Radiotherapy facilities.

Recommended Books

- The Physics of Radiation Therapy by Faiz M Khan & John P Gibbons, 5th Edition
- Radiation detection and measurement–GF Knoll
- Radiation Therapy Physics, William Hendee, Mosby
- The Modern Technology of Radiation Oncology by Jacob vanDyk

CLINICAL PRACTICE– RADIOTHERAPY - I

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- To demonstrate various functions of teletherapy machines
- To demonstrate the components' usage
- To experiment the function of emergency buttons in radiotherapy facilities

Syllabus

- Telecobalt machine
- Usage of T-rod
- Medical Linear Accelerator
- Usage of the various Emergency buttons
- Emergency hand pendent
- Cooling systems
- Portal Imaging
- Beam Modifying Devices
- Various Functional status of the machine (safety aspect)
- CT Simulator
- Various scales and verification of the patient orientation

Course Outcomes:

At the end of the course students can

- demonstrate various functions of teletherapy machines
- demonstrate the components' usage
- experiment the function of emergency buttons in radiotherapy facilities

CLINICAL PRACTICE – RADIOTHERAPY - II

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objective:

- To understand the principle of radiation measurement using various Dosimetry instruments.

Syllabus

- Various Phantoms (TPR20/10, 30X30X30 water Phantom, Slab Phantom)
- RFA (Radiation Field Analyzer)
- Types of Chambers
- Usage of thermometer and Barometer
- Various films for machine
- Types of QA
- Various Survey instruments

Course Outcomes:

At the end of the course students can

- demonstrate the phantom setting
- demonstrate the film usage for QA
- Understand the usage of survey meter in Radiotherapy facilities

HUMAN RIGHTS AND GENDER EQUITY

Course: AECC **Number of Hours: 30 Hours**

Credits: 02

Course Objectives:

- To make the student understand the human rights as citizens of India.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	5hrs	**HumanRights** 1.1.Human Rights- Meaning 1.2.Universal declaration of Human rights	√			Lecture/ Activity	15%
Unit 2	5hrs	**Human Rights Advocacy** 2.1.Global Advocacy of human rights amnesty international and other organizations 2.2.Peoples union for Civil Liberty(PUCL) 2.3.Human Rights Commission in India 2.4.Minority Commission in India 2.5.Remedies against Violation of Human rights in India					

Unit 3	5hrs	**Gender Equity** 3.1.Key Concepts- Gender and sex- Masculinity and Feminity, Partriarchy- Matriarchy, Gender roles and attributes, Gender division or labour, Gender Bias, Gender Stereotypes, Need for Gender Sensitization.					
Unit 4	5hrs	**Woman Status in India** 4.1.Important indicators- Six Ratio, Education, Health, Nutrition, Material and Infant Mortality, Work Participation rate, Political Participation.					
Unit 5	5hrs	**Contemporary Women's Issues** 5.1.Discrimination against Girl child 5.2.Violence against women 5.3.Problems of health and nutrition 5.4.Women's education gender bias in education 5.5.Trafficking in Women					

Unit 6	5 hrs	**State Initiatives on Gender Issues** 6.1.Constitutional Rights of Women 6.2.Laws Pertaining to Women 6.3.The National Commission for Women					

Course Outcome:

- Basic Knowledge of Human Rights and its function and authorities in society and industry women's status, issues and gender equity.

Recommended Books:

1. Parvathy Appaiah, Human Rights, Gender Equity and Environmental Studies, Shivam Books publishers, 2012.
2. Parvathy Appaiah, Human Rights, Gender Equity and Environmental Studies, Jai Bharath Prakashan publishers, 2016.
3. Parvathy Appaiah, Human Rights, Gender Equity and Environmental Studies, Jai Bharath Prakashan publishers, 2018-19.

FOURTH SEMESTER

PATIENT IMMOBILIZATION AND MOULD ROOM TECHNIQUES

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To explain about various immobilization systems and their necessity
- To acquire the application knowledge of various immobilizations devices for various treatment sites.

- To demonstrate the image acquisition and verification for planning and treatment

Syllabus

Unit	Hrs	Content	Must Know	Good to	Desirable to	Teaching Learning Method	Weightage

Unit I	8hrs	**Positioning aids and Immobilization Devices** 1.1.Positioning aids and Immobilization Devices, Breast boards, Lung boards, Belly boards, Head and-neck fixation devices, Vacuum packs, Stereotactic systems Patient positioning, knowledge of fixation techniques. 1.2.Internal organ motion control, Bite blocks, Gating systems, Active breathing control, Diaphragm compression, Prostate immobilization, tracking systems. Laser/ positioning systems marking systems, Isocentre determination, Reference points, Treatment couch	√			Lecture/ Activity	15%

Unit 2	15hrs	**Image acquisition** 2.1.Image acquisition for planning (and/or verification), Modalities for image acquisition for planning Simulation- Conventional Simulation, CTSimulation, VirtualSimulation. 2.2Knowledgeofsimulationtechniquesfora broad range of indications and use of contrast media Contour takingtechniquesandreferencemarking,UseofCTandMRimagesDatarecordingandtransferMouldsforBrachytherapy					
Unit 3	12hrs	**Imaging protocols:** 3.1.Development and implementation, Non-action levels(NAL),On-line/off-line corrections, Matching/co-registration procedures, Geometric uncertainties,					

Unit 4	15hrs	**Beam shaping devices:** 4.1.Compensator-Electron cut out-Shielding Blocks- Customized – Field Shaping (block, compensators etc.) and their preparation; Styrofoam Cutter. 4.2.Bolus material and their preparation. Safety issues, Shielding, Materials used for shielding, Individual shielding, Management of pollution and hazards.					

Course Outcomes

At the end of the course students can

- Understand about immobilization systems and their necessity
- Apply the knowledge to use various immobilizations devices for various treatment sites.
- Demonstrate the image acquisition and verification for planning

Recommended books

- The Physics of Radiation Therapy by Faiz MKhan & John P Gibbons, 5th Edition
- Radiation Therapy Physics, William Hendee, Mosby
- The Modern Technology of Radiation Oncology by Jacob vanDyk

YENEPOYA
(DEEMED TO BE UNIVERSITY)

MODERN RADIOGRAPHY IMAGING AND APPLICATIONS

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To be able to discuss the various diagnostic equipment's
- To be able to understand the basic principle, working and advantages of different imaging modalities used in radiotherapy
- To be able to explain the role of nuclear medicine in radiotherapy

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to	Teaching Learning Method	Weightage
Unit I	12hrs	**Computed Tomography** 1.1.Physics of CT, types of CT scanners, CT Generations Spiral and multi slice CT, CT Imaging Systems-Image reconstruction and Processing, filtered back projection, Image acquisition, Scanned Projection radiographs, Axial CT, Helical CT, MDCT, Cardiac CT, CT Fluoroscopy, artefacts in CT,	√			Lecture/ Activity	15%
Unit 2	10hrs	**Magnetic Resonance Imaging (MRI)** 2.1.Basic Physics of MRI, MRI systems, design considerations. Relaxation Time, Contrast Agents, Screening techniques Gradient echo imaging, spin echo imaging, Multi-slice imaging, 3Dimaging, Artifacts in MRI.					

Unit 3	8hrs	**Ultrasound** 3.1.Physics of Ultrasound, Production of ultrasound waves, interaction of ultrasound waves, Ultrasound systems, Doppler Effect, Scanning principles, Continuous wave Doppler, Pulsed wave Doppler, Electronic focusing and beam steering, three-and four-dimensional imaging,					
Unit 4	10hrs	**Fluoroscopy** 4.1.Direct fluoroscopy, fluoroscopy image, Image intensifier, Image characteristics in fluoroscopy, automatic brightness control, Viewing and recording the fluoroscopic image-closed circuit television, Videocon, plumb icon camera, charged coupled device, cathode ray tube					

Unit 5	8hrs	**Dental Radiography** 5.1.Dental Radiography units, self-rectified tubes, grid control tubes, dental equipment's, cones & filters and Mammography and Digital mammography.					
Unit 6	12hrs	**Nuclear medicine** 6.1.Physics of Nuclear Medicine, Isotopes used in Nuclear Medicine Production and Properties, Biological and Effective half-lives, Radio pharmaceuticals, Up take studies, Scanners, Nuclear Medicine instrumentation, Gamma camera, Radio Immuno Assay, SPECT, PET, PET-CT, PET-MRI					

Course Outcomes:

At the end of the course students can

- Use various diagnostic equipment's
- Apply the principle of different imaging modalities those are used in radiotherapy
- Able to use nuclear medicine equipments for radiotherapy procedures

Recommended books

- The Physics of Radiation Therapy by Faiz M Khan & John P Gibbons, 5th Edition
- Fundamental Physics of Radiology by W.J.Meredith and J.B.Massey, 3rd Edition
- Christensen's Physics of Diagnostic Radiology by James E.Dowdey, Robert C. Murry, and Thomas S.Curry

BASIC ONCOLOGY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To explain the Etiology and epidemiology of cancers
- To understand the different modalities of cancer management
- To discuss in detail the management of cancers with radiation.
- To discuss in detail about the effect of radiation in cancer

Syllabus

Unit	Hrs	Content	Must Know	Good to	Desirable to	Teaching Learning Method	Weightage
Unit I	10hrs	**Introduction to Basics of Oncology:** 1.1.Etiology, Epidemiology of common cancers, Common Clinical signs and symptoms of cancers. Multidisciplinary approach to the management of the Cancer Patient: Radiation Therapy, Surgery and Chemo therapy and Common Drugs used in Chemotherapy	√			Lecture/ Activity	15%
Unit 2	8hrs	**Neoplasia:** 2.1.Development of neoplasia within the patient, Clinical signs and symptoms of neoplasia, Physical effects of neoplasia on the body. Staging and grading Staging of cancers. (TNM classification) other commonly used systems					

Unit 3	6hrs	**Treatment Intent** 3.1.Radical, adjuvant, palliative,Palliation Pain management, Patient's and relatives counseling on end stage management					
Unit 4	6hrs	**Genetics** 4.1.Prevention, Early detection, Signs and symptoms Public awareness on early signs and symptoms, High risk groups					

Unit 5	15hrs	**External Beam Therapy & Brachytherapy** 5.1.Rationale, Preparation of Patient, Techniques. Treatment Planning Target volume, Organs at risk, Tumour dose, Mean, maximum, minimum, Number of fractions, Normal tissue tolerance. 5.2.Dose prescription, Patient's treatment chart. Dose, Volume, Time, Fractionation, Simulation, Reduplication of Treatment, Results, Survival. Altered Fractionation Schedules.					

Unit 6	15hrs	**Acute and Late Effects of Radiation Therapy**. 6.1.Physical effects of radiotherapy, chemotherapy, surgery and other treatments, in combination and alone on the body. 6.2.Prevention and treatment of the acute side effects of radiotherapy and associated treatments. Complications associated with cancer and its treatment, Causes of death					

Course Outcomes:

At the end of the course students can

- Explain the Etiology and epidemiology of cancers
- Understand the different modalities of cancer management
- Discuss in detail the management of cancers with radiation.

Recommended books

- The Modern Technology of Radiation Oncology" by Jacob vanDyk
- Principles and Practice of Radiation Oncology" by Carlos A Perez, Luther W Brady, 6thEdition
- Radiotherapy: Principles and Practice, A Manual for quality in Treatment delivery, Sue E.Griffith, Churchill Living stone.2. Clinical Oncology for Medical St

CLINICAL PRACTICE – RADIOTHERAPY - III

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- Familiarize practically in usage and preparation of various immobilization equipment's used for patient immobilization procedure.
- Acquiring the knowledge of pre simulation procedure

Syllabus

- Study of mould room equipment in Radiotherapy
- Preparation of Mould for head & neck case.
- Preparation of Mould for Chest, Abdomen, and Pelvis case.
- Preparation of Vacloc for Chest, Abdomen, and Pelvis case.
- Breast case simulation using Breast board
- Mouth bite preparation
- Bolus preparation
- Pre simulation verification of vital signs
- Pre simulation preparation of bladder and rectum
- Vulnerable patient simulation

Course Outcomes:

At the end of the course students can

- Familiarize the usage and preparation of various immobilization equipment's practically.
- Apply the acquired knowledge of pre simulation procedure for patient treatment

CLINICAL PRACTICE – RADIOTHERAPY - IV

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- To gain the knowledge of shielding blocks template
- To learn how to prepare shielding blocks.

Syllabus

- Preparation of the cerebond materilas
- Various trays for Photon and electron therapy
- Styrofoam cutting machine
- Preparation of photon block using styrofoam cutting machine
- Preparation of electron block using styrofoam cutting machine
- Usage of the shielding blocks for treatment

Course Outcomes:

At the end of the course students can

- Make the shielding blocks template
- Can prepare shielding blocks for treatment.

COMPUTER APPLICATION

Course: AECC

Credits: 01 **Theory classes: 15 hours**

Course Objectives:

- Describe the usage of computers and why computers are essential in business and society
- Utilize the internet web resources and evaluate online e business system.
- Identify categories of programs, system software and applications.
- Describe various types of network standards and communication software.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I		**Introduction to computer:** 1.1.Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.	√			Lecture/ Activity	15%
Unit 2		**Input output devices:** 2.1.Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems).					
Unit 3		**Processor and memory:** 3.1.The Central Processing Unit (CPU), main memory.					

Unit 4		**Storage Devices:** 4.1.Sequential and direct access devices, magnetic tape magnetic disk, optical disk, mass storage devices					
Unit 5		**Introduction of windows:** 5.1.History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).					
Unit 6		**Introduction to MS Word:** 6.1.Introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.					

Unit 7		**Introduction to Excel:** 7.1.Introduction, about worksheet, entering information, saving work books and formatting, printing the worksheet, creating graphs.					
Unit 8		**Introduction to power-point**: 8.1.Introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.					

Course Outcomes:

At the end of the course students can

- Use computers and utilize the internet web resources.
- Identify categories of programs, system software and applications.
- Describe various types of network standards and communication software.

Recommended books

- Alexis Leon and Mathews Leon (1999): Fundamentals of information technology, Leon Techworld Pub.
- Jain, S.K. (1999): Information Technology "O" level made simple, BPB Pub.
- Jain, V.K. (2000): "O" Level Personal Computer Software, BPB Pub.
- Rajaraman, V. (1999): Fundamentals of Computers, Prentice Hall India.
- Hamacher, Computer Organisation, Mc Graw.

• Sinha, Computer Fundamentals, BPB Pub.

FIFTH SEMESTER

PHYSICS OF RADIOTHERAPY AND BRACHYTHERAPY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- Understanding the principles of radiotherapy and brachytherapy.
- Gaining the knowledge of external beam radiotherapy process
- Understanding the process of brachytherapy, and its applications in intracavitary, intraluminal, interstitial implants etc.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage
Unit I	15hrs	**Physics of External Beam Radiotherapy** 1.1.Clinical Photon Beams; Description, Field size, SSD, SAD, SCD, Equivalent square, collimators; Phantom; Tissue Equivalent material 1.2.Point dose calculations- Percentage Depth dose (PDD), Peak Scatter Factor (PSF), Tissue Air Ratio (TAR), Tissue Maximum Ratio (TMR), Collimator and phantom scatter factor, output factor, Scatter Air Ratio (SAR), Scatter Maximum Ratio Off Axis Ratio. 1.3.Isodose curves and chart, Parameters of Isodose Curves, Isodose distribution of open and wedge field. Treatment time and Monitor unit calculations– SSD and SAD techniques.	√			Lecture/ Activity	15%

Unit 2	10hrs	**Planning and Beam Modifier** 2.1.Combination of Radiation Fields: Single field, Parallel Opposed Fields, Multiple Fields; Isocentric Techniques, Rotation therapy; Integral Dose; Wedge filters, Wedge Field Techniques					
Unit 3	10hrs	**Patient data and various correction factors in planning** 3.1.Acquisition of Patient Data; Treatment Simulation; Treatment Verification, Tissue compensators, Shielding blocks, Field Shaping, Skin Dose, and Field Separation, Corrections for body inhomogeneity; Contour shapes and beam obliquity. 3.2. Basic clinical dosimetry- Factors affecting dosimetry quantities, irregular fields, and collimator and phantom corrections.					
Unit 4	10hrs	**Physics of Electron therapy** 4.1.Clinical Electron Beams: Electron treatment head, Energy selection, Depth dose characteristics (Ds, Dx, R100, R90, Rp, etc.), Beam flatness and symmetry, beam shaping methods.					

Unit 5	15hrs	**Physics of Brachytherapy** 5.1.History and rationale for Brachytherapy, Radio nuclides used in Brachytherapy, criteria for source selection, Radioactive sources and its properties - radium and radium substitutes; Cesium-137; Cobalt-60; Iridium192; lodine-125 sources, etc. Implantation Techniques: Permanent and Temporary Implants, Surface Moulds; Interstitial Therapy; Intraluminal Therapy; Intracavitary Therapy. 5.2.Dosimetry systems - Paterson Parker and Manchester Dosage systems. ICRU 38 and 58 protocols. Classification of brachytherapy techniques based on dose rate, Principles of pre-loaded or after loaded techniques; HDR, LDR, PDR, Dose-rate effects in Brachytherapy,Advantages and disadvantages of manual and remote after loading techniques. 5.3.Calibration of Brachytherapy Sources; RAKR and AKS, Calculation of Dose Distributions – Sievert integral AAPM TG-43/43U1 and other dosimetry formalisms.					

Course Outcomes:

At completion of the course students can

- Understand the concepts of brachytherapy.
- Adopt to the external beam radiotherapy work flow
- Assist Understanding the process of brachytherapy, and its applications in intracavitary, intraluminal, interstitial implants etc.

Recommended Books:

- The Physics of Radiation Therapy by Faiz M Khan & John P Gibbons, 5th Edition
- The Modern Technology of Radiation Oncology" by Jacob van Dyk
- Technical Basis of Radiation therapy" by Seymour H Levitt, James A Purdy, 5th Edition4:"The Physics of Brachytherapy- C A Joslin, A Flynn, Erica Hall
- Radiation therapy Physics" by William R Hendee, 3rd Edition

MANAGEMENT OF VARIOUS MALIGNANCIES

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To be able to enumerate the common cancers prevalent in society
- To be able to give a brief account on types malignant and benign tumours
- To be able to discuss the management of various cancers using radiotherapy

Syllabus

Unit	Hrs	Content	Must Know	Good to	Desirable to	Teaching Learning Method	Weightage
Unit I	10hrs	**Etiology and epidemiology** 1.1.Etiology and epidemiology, signs and symptoms, diagnosis and general management of following cancers and benign tumours	√			Lecture/ Activity	15%

Unit 2	18hrs	**Various Cancers** 2.1.Skin cancrs: Squamous CellCarcinoma,BasalCellCarcinoma,Malignant Melanoma, Skin Appendage Tumors, Head and neck tumors**:** Oral Cavity, Nasal Cavity And Para Nasal Sinuses, Naso Pharynx, Oro Pharynx, Laryngo Pharynx, Larynx, Salivary Glands, Ears Thoracic tumors: Lung, Oesophagus. 2.2. Thymus Gastrointestinal tumors: Stomach Pancreas, Liver, Gall Bladder, Colon, Rectum Anal Canal, Urological tumors**:** Kidney, Ureter, Urinary Bladder, Urethra Gynaecological cancer: Uterus, Ovary, Cervix, Vagina, Vulva Male genital tumors: Prostrate, Testis, Penis Breast Cancer					
Unit 3	10hrs	**Tumors of Lympho, bone and soft tissue:** 3.1.Lympho reticular tumors: Hodgkin's disease, Non-Hodgkin's Lymphoma Osteo Sarcoma, Ewing's Tumour, Fibro Sarcoma,					

Unit 4	12hrs	**Haematological malignancies and Endocrine tumors:** 4.1.Leukaemia, multiple myeloma Endocrine tumors: Thyroid, pituitary, adrenal, Orbital and ocular tumours Metastasis of unknown primary site					
Unit 5	10hrs	**CNS tumors:** 5.1.Gliomas, Meningioma, Medullo Blastoma, Cancer in children Retino Blastoma, Wilm'stumor, Neuroblastoma, Rhabdomyoma Sarcoma					

Course Outcomes:

At completion of the course students can

- specify the common cancers prevalent in society
- give a brief account on types malignant and benign tumours
- discuss the management of various cancers using radiotherapy

Recommended Books:

- Practical Radiotherapy Planning by Ann Barret & Jane Dobbs, 4th Edition
- Principles and Practice of Radiation Oncology by Carlos A Perez, Luther W Brady, 6th Edition

PATIENT CARE IN RADIOTHERAPY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- Understanding the general patient care during the whole course of radiotherapy.
- Acquiring the knowledge of patient safety, first aid kid and BLS procedures
- Applying the knowledge in handling of vulnerable patient, patients with infectious diseases and immuno-compromised patients.

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to	Teaching Learning Method	Weightage
Unit I	15hrs	**General care of the patient** 1.1.General care of the patient, Lifting and moving techniques (chair and stretcher patients) and staff safety, first aid, Basic life support (BLS). 1.2.Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA), early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke	√			Lecture/ Activity	15%

Unit 2	10hrs	**Patient vital signs** 2.1.Patient vital signs temperature, pulse, respiration and blood pressure - normal values and methods of taking and recording.					
Unit 3	10hrs	**Hospital Procedure** 3.1.Hospital staffing and organization; records relating to patients and departmental statistics, professional attitude of the technologist to patients and other members to the staff;					
Unit 4	10hrs	**Care of the Cancer Patient** 4.1.Patient privacy, Nutrition, Skin care, Universal precautions, Dietary advice, Laboratory investigations					
Unit 5	15hrs	**Care Under Specific Circumstances:** 5.1.Catheter care, Stoma care Wound care, Unconscious patient, Bone metastases, Physically disabled, Mentally disturbed, Blind, deaf patients, Diabetics. Patient care and management before, during and after treatment. Legal aspects: Confidentiality, Informed consent, Data protection					

Course Outcomes:

At completion of the course students can

- Be aware of the general patient care during the whole course of radiotherapy.
- Demonstrate how to ensure patient safety, use of first aid kid and BLS procedures
- Apply the acquired knowledge in handling of vulnerable patient, patients with infectious diseases and immuno-compromised patients during the course of the treatment.

Recommended Books:

- A Nurse ‘s Guide to Cancer Care, Brenda M. Nevidjon, Lippincott
- Basic Medical techniques and patient care for Radiology Technologists, Second Edition.

CLINICAL PRACTICE - RADIOTHERAPY-V

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- Be able to familiarize practically in Patient's setup and treatment delivery
- Be able to familiarize practically in various type of Record and Verify system in External Radiotherapy.

Syllabus

- Preparation of patient set-up in SSD technique.
- Preparation of patient set-up in SAD technique.
- Study of difference between SSD & SAD technique.
- Preparation of patient set-up in fixed SSD technique.
- Preparation of patient set-up in Arc dynamic technique.
- Study of Record and Verify system in External Radiotherapy.
- Demonstration of various steps in planning and radiotherapy treatment process
- Patient position procedures at the first fraction of treatment
- Patient position verification using planer and cone beam CT

Course Outcomes:

At completion of the course students

- Will be familiarized practically in Patient's setup and treatment delivery
- Can perform the RT plan execution procedures in various types of Record and Verify system in External Radiotherapy.

CLINICAL PRACTICE - RADIOTHERAPY-VI

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- Familiarization of Brachytherapy facility and unit
- Understanding about radiation safety procedures and usage of the radioisotope.
- Gaining experience by carrying out RT chart QA

Syllabus

- Brachytherapy applicators QA
- Emergency procedure at various emergency situation in brachytherapy
- Radiotherapy chart QA
- Patient specific QA
- Familiarization with Reference Air Kerma Rate (RAKR) and activity measurement of HDR brachytherapy sources using well type ionisation chambers

- **Course Outcomes:**

At completion of the course students

- Can brief about brachytherapy facility and unit
- Can discuss about radiation safety procedures and usage of various radioisotopes in brachytherapy.
- Can perform RT chart QA

MEDICAL ETHICS

Course: VAC

Credits: 2 **No of Hours: 30 Hours**

- **Course Outcomes:**

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

CO1: Increasing the awareness and knowledge of students of the value dimensions of interactions with the patients, colleagues, relations and public.

CO2: Fostering the development of skills of analysis, decision making and judgment.

CO3: Making the students aware of the need to respect the rights of the patient.

- **COURSE CONTENT:**

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Weightage	Type Of Questions
Unit I	3hr	**Introduction to ethics** What is ethics, what are values and norms, freedom and personal responsibility?	□			15%	SA, SE
Unit II	4hrs	**Definition of medical ethics** Major principles of medic ethics.	□			20%	LE, SA

Unit III	4hrs	**Perspective of medical ethics** The Hippocratic oath, The Declaration of Helsinki, The WHO Declaration of Geneva, International code of Medical Ethics (1993), Medical Council of India Code of Ethics (2002).				15%	LE, SA, SE
Unit IV	4hrs	**Ethics of the individual** Truth and confidentiality, the concept of disease, health and healing, the Rightto health.				15%	SE
Unit V	3hrs	**The ethics of human life** Prenatal sex determination.				15%	SA, SE
Unit VI	4hrs	**The family and society in medical ethics** Euthanasia, cancer and terminal care.				10%	LE, SA
Unit VII	4hrs	**Death and dying** Use of life-support systems, the right to die with dignity, suicide–the Ethical outlook.				05%	LE, SA, SE
Unit VIII	4hrs	**Professional Ethics** Contract and confidentiality, malpractice and negligence.				05%	SA, SE

❖ **LA-** Long Essay**, SE-** Short Essay**, SA-** Short Answer

➢ **Recommended Books:**

1. Tsai DF. The WMA medical ethics manual. Journal of Medical Ethics. 2006 Mar 1;32(3):163
2. Loewy EE, Loewy RS. Textbook of healthcare ethics. Springer Science & Business Media; 2004 Jun 29.

SIXTH SEMESTER

RECENT ADVANCES IN RADIOTHERAPY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To be able to describe recent advances in radiotherapy
- To be able to discuss in detail special techniques in radiotherapy
- To be able to discuss in detail Particle therapy in radiotherapy

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to	Teaching Learning Method	Weightage
Unit I	12hrs	**Conformal Radiotherapy (CRT)** 1.1.Principles of 3D-CRT, advantages over conventional methods, treatment planning process CT simulation, Virtual simulation, TPS based simulation, Image registration, plan evaluation and dose volume histogram	√			Lecture/ Activity	15%

Unit 2	18hrs	**Intensity Modulated Radiation Therapy (IMRT)** 2.1.Principles – MLC based IMRT – step and shoot and sliding window techniques – Compensator based IMRT – planning process – inverse treatment planning – Intensity Modulation with Tomotherapy, micro- MLC, Merits and demerits of IMRT – intensity modulated arc therapy (IMAT), Image guided Radiotherapy (					
Unit 3	10hrs	**Stereotactic Irradiation** 3.1.Stereotactic Radio Surgery/radiotherapy principles, Cone and micro MLC based X-knife – Gamma Knife – Cyber knife - immobilization devices for SRS/SRT – Planning procedures					
Unit 4	6hrs	**Adaptive Radiotherapy** 4.1.Respiratory gating, 4D imaging, Time gated (4D) radiotherapy					

Unit 5	8hrs	**Special Techniques in Radiotherapy** 5.1.Introduction to Special techniques in Radiotherapy, Total Body Irradiation (TBI), Total skin electron therapy (TSET), Electron arc treatment, Intra Operative Radiotherapy (IORT).					
Unit 6	6hrs	**Particle Therapy** 6.1.Proton Therapy/Carbon ion Therapy, BNCT (Boron Neutron Capture Therapy)					

Course Outcomes

At completion of the course students

- To be able to describe recent advances in radiotherapy
- To be able to discuss in detail special techniques in radiotherapy
- To be able to discuss in detail Particle therapy in radiotherapy

Recommended Books:

- The Physics of Radiation Therapy by Faiz M Khan & John P Gibbons, 5th Edition
- The Modern Technology of Radiation Oncology by Jacob van Dyk
- Technical Basis of Radiation therapy by Seymour H Levitt, James A Purdy, 5th Edition'
- Practical Radiotherapy Planning by Ann Barret & Jane Dobbs, 4th Edition

RADIATION PROTECTION AND SAFETY

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To explain the basic principles of radiation safety
- To discuss the regulatory requirements
- To demonstrate how to respond in a radiation emergency
- explain the basic Principles of Radiation Protection, Elements of a Radiation Protection Programme, National and International regulations and Standards

Syllabus

Unit	Hrs	Content	Must Know	Good to	Desirable to	Teaching Learning Method	Weightage
Unit I	12hrs	**Radiation Protection Standards** 1.1.Basic concepts of radiation protection standards, Philosophy of radiation protection, Radiation dose to individuals from natural radioactivity and man-made sources, International Commission on Radiological Protection and its recommendations 1.2. System of Radiological Protection – Justification of Practice, Optimization of protection and individual dose limits, Dose limits for occupational exposure, for women and for public. Radiation and tissue weighting factors, Equivalent and effective dose.	√			Lecture/ Activity	15%

Unit 2	12hrs	**Radiation Hazard evaluation and control** 2.1.External and internal exposure, Evaluation of external radiation hazard, Effect of Time, Distance and Shielding, ALARA Principle, Internal radiation hazards, control of contamination, Hazard evaluation by calculation and measurement. HVT & TVT. 2.2.Emergency procedures and radiation safety during source transfer operation, Radioactive waste disposal, permissible limits for disposal of waste, waste disposal facilities. Safety checks of radiological equipment and accessories such as lead aprons and gloves.					

Unit 3	12hrs	**Planning of medical radiation installations** 3.1.General considerations, Regulatory steps for installation and commissioning of a new radiotherapy facility (Teletherapy and Brachytherapy). Layout of installation /Associated facility: Primary, Secondary barriers, leakage and scattered radiation. 3.2. Workload calculation, use factor and occupancy factors, barrier thickness calculations, Calculation of weekly dose to the radiation worker and general public.					
Unit 4	6hrs	**Regulatory requirements** 4.1.National Regulatory Body, Responsibilities, organization, Safety Standards, Codes and Guides, Responsibilities of employer, licensee and RSO. Enforcement of Regulatory requirements, Role of technologist in radiological department.					

Unit 5	12hrs	**Radiation Emergency Preparedness** 5.1.Safety and security of radiation sources, case histories of emergency situations and preparedness, equipment's and tools including role of Gamma Zone Monitor, Regulatory requirements and prevention of emergency, Preventive maintenance and Safety Culture, Role of technicians in handling radiation emergencies.					
Unit 6	6hrs	**Personnel Monitoring:** 6.1.Need for personnel monitoring, Requirement and type of devices for personnel monitoring, Film Badge, Thermo luminescent Dosimeter, Pocket dosimeter. Merits and demerits of each system. Monitoring services and procedures, Proper use of the personnel monitoring devices.					

Course Outcomes:

At completion of the course students

- can understand the basic principles of radiation safety
- can discuss the regulatory requirements and adopt to it
- can demonstrate how to respond in a radiation emergency situation in radiotherapy facility

- can understand the basic Principles of Radiation Protection.

- **Recommended Books:**

- The Physics of Radiation Therapy" by Faiz M Khan & John P Gibbons, 5th Edition
- Principles of Imaging Science and Protection, Michael A. Thompson, Janice D. Hall, Marian P. Hattaway, Steven B. Dowd
- Fundamental Safety Principles, IAEA Safety Standards for protecting people and the environment.
- AERB Safety Code — Teletherapy Installations, Brachytherapy Sources, Medical Diagnostic X ray Equipment and Instillations.

QUALITY ASSURANCE

Course: Core

Credits: 04 **Theory classes: 60 hours**

Course Objectives:

- To be able to explain the basic QA in diagnostic radiology
- To be able to discuss in detail the QA procedures in brachytherapy
- To be able to explain and demonstrate the process quality assurance in various radiotherapy units.
- To be able to discuss the importance of QA in radiotherapy, brachytherapy, and diagnostic radiology

Syllabus

Unit	Hrs	Content	Must Know	Good to Know	Desirable to Know	Teaching Learning Method	Weightage

Unit I	20hrs	**QA in Diagnostic Radiology** 1.1.Verification of Optical and Radiation field congruence, Beam alignment, Focal spot size, Linearity of tube current mA and Timer, Applied potential, HVT and total tube filtration. Contact between film and intensifying screen, Contrast, Resolution, Grid alignment. QA of mammography unit, Computed Tomography (CT) and digital radiogra	√			Lecture/ Activity	15%
Unit 2	25hrs	**QA in External Radiotherapy** 2.1.Periodic Quality Assurance (Daily/Monthly/Weekly/Annual) of radiotherapy equipments (Telecobalt, Medical Accelerator, Imaging System/ Simulator/ CT-Simulator units) as per AERB requirements. Optical and radiation field congruence, Isocentre alignment, Delineator/Diaphragm movements. 2.2. Accessories and tools used for QA tests in Radiotherapy such as Front pointer, back pointer, Laser Alignment etc., Patient support system, Beam on and off mechanisms. Role of Technologist in QA.					

Unit 3	15hrs	**QA in Brachytherapy** 3.1.HDR Brachytherapy unit, Accessories and tools used for QA tests in Brachythearpy , Beam on and off mechanisms, Emergency procedures in brachytherapy					

Course Outcomes:

At completion of the course students

- Can perform the basic QA in diagnostic radiology
- Can discuss in detail the QA procedures in brachytherapy
- Can explain and demonstrate the process quality assurance in various radiotherapy units.

Recommended Books:

- The Physics of Radiation Therapy by Faiz M Khan & John P Gibbons, 5th Edition
- The Modern Technology of Radiation Oncology" by Jacob van Dyk
- Atomic Energy Regulatory Board (AERB) code for Diagnostic Radiology and Radiotherapy.
- Fundamental Physics of Radiology" by W.J.Meredith and J.B. Massey, 3rd Edition

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BIO STATISTICS

Course: AECC

Credits: 02 **Theory classes: 30 hours**

Course Objectives:

- At the end of the course students will be familiar with statistics methods and techniques.
- After the completion of the course students will be able to manage the data with various validations and cleaning process.
- At the end of the course students will be familiar with different types of data analysis techniques.
- At completion of the course students can able to operate the statistical software to describe the data with proper presentation.

Syllabus

Unit	Hrs	Content	Must Know	Good to Desirable to	Teaching Learning Method	Weightage
Unit I	6hrs	**Introduction** 1.1.Meaning, definition, Characteristics of Statistics, Importance of the study of statistics, branches of statistics, statistics and health science including nursing, parameters and estimates, Descriptive and inferential statistics. Variables and their types. Measurement of scales	√		Lecture/ Activity	15%

Unit 2	4hrs	**Tabulation of Data** 2.1.Raw Data, the array, Frequency distribution. Basic principles of graphical representation. Types of diagrams- histograms, frequency polygons, smooth frequency polygon, cumulative frequency curve, Normal Probability Curve.					
Unit 3	4hrs	**Measure of central tendency** 3.1.Need for measures of central tendency. Definition and calculation of Mean- ungrouped and grouped. Meaning, interpretation and calculation of median – ungrouped and grouped. Meaning and calculation of mode. Guideline for the use of various measure of central tendency.					
Unit 4	4hrs	**Measure of variability** 4.1.Need for measure of Dispersion. The range, the average deviation. The variance and standard deviation. Calculation of variance and standard deviation ungrouped and grouped. Properties and use of variance and SO.					

Unit 5	4hrs	**Probability and standard distribution** 5.1.Meaning of Probability of standard distribution. Binomial distribution. Normal distribution. Divergence from normality- skewness, kurtosis.					
Unit 6	4hrs	**Sampling Techniques** 6.1.Need for sampling- criteria for good samples. Application of sampling in community. Procedure of sampling and sampling design error. Sampling variation and tests of significance.					
Unit 7	4hts	**Health indicator** 7.1.Importance of health indicator. Indicators of population, morbidity, mortality, health service, Calculation of rates and rations of health					

Course Outcomes:

At completion of the course students

- will be familiar with statistics methods and techniques.
- will be able to manage the data with various validations and cleaning process.
- will be familiar with different types of data analysis techniques.
- can able to operate the statistical software to describe the data with proper presentation.

Recommended Textbooks:

- Mausner & Bahn: Epidemiology-An Introductory text, 2nd Ed W.B. Saunders Co.
- Richard F. Morton &J. Richard Hebd: A study guide to Epidemiology and Biostatistics,2ndEd., University Park Press, Baltimore.

Sylvia W Smoller, J Smoller, Biostatistics &Epidemiology A Primer for health andBiomedical professionals, 4thedition, Springs, 2015

CLINICAL PRACTICE - RADIOTHERAPY-VII

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- Acquiring the knowledge of various QA and protocols

- Applying the concept to find out various factors

Syllabus

- Mechanical QA of Teletherapy machine
- Electrical QA of Teletherapy machine
- Dosimetry QA of Teletherapy machine
- Daily QA of HDR brachytherapy facility
- Quality Assurance of CT simulator
- Determination of wedge factor
- Determination of hinge angle
- Determination of tray and block factor
- Determination of the couch attenuation factor
- Optical and Radiation field congruence with film

Course Outcomes:

At completion of the course students

- Can understand the machine's performance consistency
- Can find various beam modifier factor
- Can apply the gained knowledge to interpret the obtained values from the QA

CLINICAL PRACTICE - RADIOTHERAPY-VIII

Course: Core

Credits: 04 **Practical classes: 60 hours**

Course Objectives:

- Understanding the concepts of treatment time calculation in teletherapy
- Gaining the knowledge of radiation survey in radiation facility

Syllabus

- Verification Time, Distance and Shielding concepts in radiotherapy
- Measurement of HVT & TVT.
- Calculation of Half life & Tenth life of radioisotopes
- Radiation survey in radiotherapy facility.
- Radiation survey in brachytherapy facility
- Calculation of treatment time for teletherapy cobalt 60
- Calculation of monitor unit for medical linear accelerator

Course Outcomes:

At completion of the course students

- Can understand the treatment time calculation procedures using various beam parameters
- Can ensure the safe work environment in radiation facility by understanding the radiation survey

CLINICAL INTERNSHIP- (1 Year)

Course: Core

Credits: 40 **Duration: 1 year**

Course Objectives:

- To Acquire the clinical knowledge
- To understand the workflow in radiation oncology dept
- To practice in mould room for simulation procedures and observe radiotherapy treatment procedures.

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. Students will demonstrate

competence in beginning, intermediate, and advanced procedures in both areas. Students will participate in advanced and specialized treatment procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for minimum 8 hours per day and this may be more depending on the need and the healthcare setting

Course Outcomes:

At completion of the clinical internship, students

- Can work independently
- Can simulate and treat patient
- Can make relevant log book