SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH
(A Deemed to be University Declared under Section 3 of UGC Act, 1956)
Comprising Sri Devaraj Urs Medical College
[Constituent Unit of Sri Devaraj Urs Educational Trust for Backward Classes (Regd.)]
TAMAKA, KOLAR-563103, KARNATAKA, INDIA
Ph: 08152-243009,+91 9448395232Fax: +918152 -243008 E-mail: registrar@sduu.ac.in/office@sduu.ac.in. Website: www.sduu.ac.in

(With effect from 2016-17 batches)

Choice Based Credit System Based Graduate Curriculum for Bachelor of Science in Radio Therapy Technology

Dean
Faculty of Allied Health Sciences
Sri Devaraj Urs Academy of
Higher Education & Research
Tamaka, Kolar-563 101

Approved as per BOM-41-2016,(Resolution No-XLI-05(3)/16)Dated-19/10/2016

REGULATIONS GOVERNING THE BACHELOR OF SCIENCE (B.Sc.) DEGREE UNDER CHOICE BASED CREDIT SYSTEM

2016

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION & RESEARCH
(Declared as Deemed - to - be University u/s 3 of the UGC Act
TAMAKA, KOLAR – 563 101. KARNATAKA, INDIA.
Ph:+91- 08152-210604, 210605, 243003, 243009, Fax:08152-243008,
Website: www.sduu.ac.in

REGULATIONS GOVERNING

THE BACHELOR OF SCIENCE (B.Sc.)

DEGREE

UNDER CHOICE BASED CREDIT SYSTEM

2016

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION & RESEARCH
(Declared as Deemed - to - be University u/s 3 of the UGC Act
TAMAKA, KOLAR – 563 101. KARNATAKA, INDIA.
Ph:+91- 08152-210604, 210605, 243003, 243009, Fax:08152-243008,
Website: www.sduu.ac.in

REGULATIONS GOVERNING THE DEGREE OF BACHELOR OF SCIENCE (B.Sc.)

CHOICE BASED CREDIT SYSTEM IN ALLIED HEALTH SCIENCES

INTRODUCTION

The University Grants Commission has brought in numerous measures to enhance equity, efficiency and excellence in the higher education system in the country. Consequently, has set considerable effectiveness with noticeable improvements in higher education system. Even though, there existed diversity in the evaluation system in Universities in India and to mitigate tremendous diversity adapted in Universities, UGC issued circular D.O.No. F.1-2/2008 (XI Plan) dated March 2009 and further in its circular D.O.No.F-1-1/2014 dated 12th November 2014 has directed all the Universities in the country to implement the Choice Based Credit system (CBCS) scheme to all the undergraduate and post graduate level degrees Programs mandatorily.

In compliance to the above, Sri Devaraj Urs Academy of Higher Education and research [SDUAHER] has notified with vide No SDUAHER/KLR/ADMN/2063/16-17 dated 20.10.16 and introduced CBCS for undergraduate Programs (B.Sc.) in order to achieve academic excellence, quality improvement and as administrative reforms. Based on this background, SDUAHER has framed REGULATION governing B.Sc. Programs under Faculty of Allied Health Sciences.

This facilitates flexible learning; multifaceted development of students with wide variety of courses viz core, electives in discipline specific, Ability enhancement and open to enhance their knowledge and skills. This qualitative change in the Programs is to the global requirements and aspiration of students and stake holders for mobility both within and across the geographical jurisdiction.

CBCS implementation brings desired uniformity in grading system and method for computing semester grade point average (SGPA) for semester performance and cumulative Grade Point average (CGPA) for overall program performance of students in the examinations.

DEFINITIONS OF KEY WORDS

Applicable to undergraduate, postgraduate level degree, diploma and certificate Programs under the choice based credit system in semester scheme.

1. University: Sri Devaraj Urs Academy of Higher Education and Research Tamaka, Kolar

2. **Academic Year** consists of two consecutive semesters a) Even semester (scheduled from January to June) b) Odd semester (scheduled between July to December).

3. S**emester:** Each semester will consists of 15-18 weeks of academic work equivalent to 90 actual teaching days.

4. **Choice Based Credit System (CBCS):** Provides choice for students to select from the prescribed courses/papers such as core, elective or minor or soft skill courses offered in a Program.

5. **Credit Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

6. **Program:** An educational program leading to award of a Degree, diploma or certificate.

7. **Course** usually referred to as 'papers' is a component of a program. *All courses May not carry the same weight.* The courses should define learning objectives and Learning outcomes. A course may be designed to 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 some of these.

8. **Branch:** Specialization or discipline of B.Sc. Degree Programs are like Medical Laboratory technology, Imaging technology, optometry, renal dialysis technology, operation theater technology, radiotherapy technology etc.

9. **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, C, P, F and Ab

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

11. **Credit:** Each course shall carry certain number of credits. Credits normally represent the weightage of a course and are a function of teaching, learning and evaluation strategies such as number of contact hours, the course content, teaching methodology, learning expectations, etc. In the proposed Programs, credit is a unit by which course work is measured. Credit determines the number of hours of instructions required per week, generally, one credit is equivalent to one hour of teaching [lecture or tutorial] or 2 hours of practical work /field work per week.

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

13. **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.

14. **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.

15**. First Attempt**: A student who has completed all formalities of the semester becomes eligible to attend the examinations and has passed in first sitting; such attempt shall be treated as first attempt.

16 **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 and CGPA earned till that semester.

B.Sc. PROGRAMS STRUCTURE

Semester	Program structure
I	Basic medical sciences Common to all disciplines as mandatory core courses (CC), Compulsory foundation course (FC) Discipline specific elective (DSE)
II	Basic medical sciences Common to all disciplines as mandatory core courses (CC), Compulsory foundation course (FC) Discipline specific elective (DSE) Ability enhancement course (AEC)
III	Core courses discipline wise (CCD) Skill enhancement course (SEC)
IV	Core courses discipline wise Ability enhancement course (AEC)
V	Core courses discipline wise (CCD) Skill enhancement course(SEC)
VI	Core courses discipline wise (CCD) Ability enhancement course (AEC)
VII	Internship

In CBCS, UG degree Programs offered in University are structured to have 7 semesters will have credits in the range of 20 to 26 an average of 23 credits per semester and a total of around 120-156 credits per under graduate program.

STRUCTURE OF B.Sc. PROGRAMS UNDER CBCS SCHEME

Semester	Core courses (1-19)	Discipline specific elective (DSE)	Ability enhancement Compulsory Course (AEC)	Skill enhancement courses (SEC)	Open elective (OE)	Foundation course
I	Paper 1 Paper 2 Paper 3 Paper 4	DSE-1 DSE-2 DSE-3 DSE-4	-	-	-	Basic Computer Application
II	Paper-1 Paper 2 Paper 3	DSE-1 DSE-2 DSE-3 DSE-4 DSE-5 DSE-6	Environmental science	-	-	English communication
III	Paper-1 Paper 2 Paper 3	-	-	SEC-1 (SAFE-I)	-	-
IV	Paper 1 Paper 2 Paper 3	-	Constitution of India	-	-	-
V	Paper 1 Paper 2 Paper 3	-	-	SEC-2 Medical Ethics		-
VI	Paper 1 Paper 2 Paper 3	-	Quality control	-	-	-
VII	Internship					

Types of courses. 3 types, such as core, elective and foundation

Core courses: This is the course/paper which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in a said discipline of study.

Foundation Course: 2 kinds:
1**. Compulsory Foundation courses**: mandatory to all disciplines, which based upon the content that leads to Knowledge enhancement.
2. **Elective foundation courses**: are value-based and are aimed at man-making education.

Elective courses:
This can be chosen from a pool of electives listed in University. It is expected to Support to the discipline of study, provide an expanded scope, enable an exposure to some other discipline/domain and nurture student's proficiency/skill.
An elective may be "Discipline centric" or may be chosen from an unrelated discipline. It may be called an "Open Elective."

3. CREDIT STRUCTURE FOR COURSE
Example : SEMESTER-I

courses	Lectures hours /week In a semester	Tutorials hours /week in a semester	Lab work hours /week in a semester	credits	Total credits
Course-I	02	01	02	2:1:1	04
Course-II	02	01	02	2:1:1	04
Course-III	02	01	02	2:1:1	04
Course-IV	02	01	02	2:1:1	04
Compulsory Foundation course	02	-	02	2:0:1	03
Discipline specific Elective	01	-	-	0:0:1	01
				Total	20

Course-1 Anatomy paper-1
Course-II anatomy paper 2
Course-III Physiology paper1
Course-IV Physiology paper2
Compulsory foundation course: Basics in computer applications
Discipline Specific electives (anatomy histological techniques and Physiology PFT and ECG)

REGULATIONS GOVERNING THE DEGREE OF B.Sc. PROGRAMS AS PER CHOICE BASED CREDIT SYSTEM UNDER THE FACULTY OF ALLIED HEALTH SCIENCES

1. TITLE

The undergraduate programs known as Bachelor of Science abbreviated as B.Sc.

B. Sc. Programs are as under

- Bachelor of science in Medical laboratory Technology
- Bachelor of science in Imaging Technology
- Bachelor of Science in Optometry
- Bachelor of Science in operation Theater Technology
- Bachelor of Science in Renal Dialysis technology
- Bachelor of Science in Radiotherapy Technology

2. DURATIONS

The duration of the under graduate Programs shall be three and half years consists of 7 semesters including internship.

3. CALENDAR OF EVENTS

The calendar of events in respect of each program of study shall be fixed by the University from time to time. The examination in all programs of study shall be conducted at the end of each semester.

4 ELIGIBILITY FOR ADMISSION

A Candidate seeking admission to B.Sc. program

Shall have passed two years Pre University examination conducted by the pre University board of Karnataka state, with English as one of the subject and physics, chemistry and biology as optional subjects.

OR

Shall have passed any other examination conducted by Boards/councils/intermediate examination established by state Government/central Government and recognized as equivalent to two year pre University examination by the Rajiv Gandhi University of health sciences/Association of Indian Universities (AIU) , with English as one of the subjects and physics, chemistry and biology as optional subjects and the candidate shall have passed subjects of English, physics, chemistry and biology individually.

OR

Shall have passed intermediate examination in science of an Indian university/ Boards/council or other recognized examining bodies with physics ,chemistry and biology which shall include a practical test in these subjects and also English as compulsory subject.
the candidate shall have passed subjects of English, physics, chemistry and biology individually.

OR

Candidates with regular three years diploma in respective discipline recognized by Rajiv Gandhi University of health sciences

OR

The minimum marks for the purpose of eligibility shall be forty percent (40%) in optional subjects in case of students belonging to SC/ST and OBC students from Karnataka or as decided by the Government of Karnataka. Provided further that, the student shall have studied and passed English as one of the subjects.

Candidates who have completed diploma or vocational course through correspondence shall not be eligible for Bachelor of Science Programs.

5 LATERAL ENTRY

Candidates passing diploma in concerned discipline and 10+2 or PUC shall be eligible for Lateral entry i.e. admission to II year / semester –III of the B.Sc. Program. However, this will be entertained only if vacancies are available. Applicants should possess minimum of 45 % aggregate marks in PUC (PCMB).

6 ATTENDANCES

Each course comprising theory & Practical and tutorials shall be treated as single unit for the purpose of calculation of attendance. A student shall have to attend a minimum of 75% attendance of the total instruction hours in a course (theory/practical/tutorials) in each semester from the date of commencement of the semester to last working day as notified by the University.

The students shall be informed about their attendance status periodically by the department of Allied health sciences. So that, the students shall be cautioned to make up the shortage. The Department of Allied Health sciences shall submit the list of students who have been eligible to appear examinations and list of detained students due to shortage of attendance by the end of the semester to the Controller of Examinations.

Students lacking in the prescribed attendance and progress in any subject(s) in theory and practical should not be permitted to appear for the examination. Such student shall repeat the course in which he/she is deficient with attendance.

7. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMS

The candidate shall complete the program generally within the twice the number of years of the program from the date of commencement of the program i.e. within six years from the date of admission. If the candidate fails to complete the program with in the period permitted he/she will be discharged from the University. However, fee to be paid for repeating the semesters.

8. **MEDIUM OF INSTRUCTION:** The medium of instruction shall be English.

9. TEMPORARY DISCONTINUATION OF THE PROGRAM

A student, who wishes to temporarily discontinue the program and continue the same subsequently, has to obtain prior permission from the University by applying through the head of the department. Such students have to take readmission to the same semester/year in the subsequent session. However, the student shall complete the course as per the maximum period fixed by the University

10. HOURS OF INSTRUCTION PER WEEK

These number of hours of instruction for each course is defined which includes lectures, tutorials, practical and assignments, as specified to individual courses.

11. COURSE PATTERN

The number of credits per semester may vary from 20 to 26, an average of 23 credits per semester and a total of around 120-153 credits for the program. Generally 1 credit per hour of instruction in theory and 1 credit for 2 hours of practical or project work or internship per week.

The courses offered in a program are divided in to core, foundation, and elective courses. The program patterned indicating hours of instruction in all semesters defined under section -3

12. THE SCHEME OF EXAMINATION

There shall be examinations at the end of each semester as per the calendar of events notified by the university.

13. INTERNAL ASSESSMENT

Regular internal assessment examinations should be conducted on each course in a semester.
There should be a minimum of at least 03 internal assessments examinations in each semester, the number of examination on each course is left to the department. An average of the best two internal assessment examinations should be taken in to consideration during calculation of marks of internal assessment.

The weightage given to the internal assessment is 20% out of the total marks assigned to the course.
Student must secure at least 35% of total marks fixed for internal assessment examination of that course to be eligible to appear for the examination

14. REGISTERING FOR THE EXAMINATIONS

Candidate to be eligible to appear for University examination, shall have undergone satisfactorily the semester of the study, shall have to obtain 75% attendance in theory and practical/tutorial jointly to become eligible to appear for examination in the subject/course,
Shall secure at least 35% of internal assessment from the total marks fixed for IA in a particular subject in order to become eligible for examination, shall fulfil any other requirement that may be prescribed by the University from time to time.
And shall pass in all the courses of that semester. Such eligible students will be allotted Registration Number.

15. VALUATION OF ANSWERSCRIPTS

Each written paper shall be valued by one internal examiner and one external examiner. Each practical examination shall be jointly conducted and evaluated by one internal examiner and one external examiner or two external examiners if there are no internal examiners. But not by two internal examiners. If the difference in marks between two valuations is more than 15% of the maximum marks, the Registrar (Evaluation) or his nominee shall check the entries and the total marks assigned by the two valuers. If there is any mistake in totalling, it shall be rectified. While checking the total, if it is observed that any one or more of the answers is not valued by one of the valuers, the Chairman, BOE shall advise internal members of the Board of Examiners to value that answer. After receiving the marks, the Chairman, BOE shall make the necessary corrections. Despite all these corrections, if the difference between the two valuations is still more than 15%, the Chairman, BOE shall arrange for third valuation by examiners from the approved panel of examiners.

In case of two valuations, the average of the two valuations and if there are three valuations, the average of the nearest two valuations shall be taken for declaring results.

16. RESULTS CLASSIFICATION OF SUCCESSFUL CANDIDATES

The results of successful candidates at the end of each semester shall be declared on the basis of Percentage of Aggregate Marks, converted to grade point and alpha – sign grade for each course on the basis of 10 point scale recommended by UGC.
The following table 1 and 2 shows the final results with grade description and grades

Table 1: Final Result/Grades Description

Semester/ Program % of marks	Semester GPA / Program CGPA	Alpha-Sign/ Letter Grade	Result/Class Description
90.0-100	9.00-10.00	O (Outstanding)	Outstanding
80.0-<90.0	8.00-<9.00	A+ (Excellent)	First Class Exemplary
70.0-<80.0	7.00-<8.00	A (Very Good)	First Class Distinction
60.0-<70.0	6.00-<7.00	B+ (Good)	First Class
55.0-<60.0	5.50-<6.00	B (Above Average)	High Second Class
50.0-<55.0	5.00-<5.50	C (Average)	Second Class
40.0-<50.0	4.00-<5.00	P (Pass)	Pass Class
Below 40	Below 4.00	F (Fail)	Fail/ Reappear
Absent	0	Ab (Absent)	

Table 2 point grading system with letter grade

Grade Point	0	0	4	5	6	7	8	9	10
Letter Grade	Ab	F	P	C	B	B+	A	A+	O
	Absent	Fail	Pass	Average	Above average	Good	Very good	Excellent	Outstanding

17. COMPUTATION OF SEMESTER GRADE POINT AVERAGE (SGPA) AND CUMULATIVE GRADE POINT AVERAGE (CGPA)

17.1 Calculation of SGPA

The following procedure to compute the Semester Grade Point Average

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

$$\textbf{SGPA}\ (Si) = \Sigma\ (Ci \times Gi) / \Sigma Ci$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Note: Grade point denotes the decimal of percentage of marks scored

Example for SGPA (20 Credits)

Papers/courses	P1	P2	P3	P4	P5	Total
Max. marks	100	100	100	100	100	500
% Marks Obtained	77	73	58	76	64	348
Grade Points Earned (GP)	7.7	7.3	5.8	7.6	6.4	-
Credits for the Course(C)	4	4	4	4	4	20
Credit points= GP x C	31	29	23	30	26	139

Semester Aggregate Marks : 348 / **500 = 69.60 %**

Classification of Result **:** First Class

Illustration for SGPA

Course /Core paper	Credit	Grade letter As per 10 point scale	Grade point As per 10 point scale	Credit point (Credit X Grade point)
Course 1	04	A	7.7	4X7.7= 31
Course 2	04	B+	7.3	4X7.3=29
Course 3	04	B	5.8	4X5.8=23
Course 4	04	O	7.6	4X7.6=30
Course 5	04	C	6.4	4X26.4=26
	20			**139**
	SGPA	139/20 = 6.95		

The SGPA shall then be computed by dividing the total credit points of all the courses of a semester of the study by the total credits for the semester.

SGPA = Total credit points / Total Credits = 139 / 20 = **6.95**

Semester Alpha Sign Grade: **B**

17.2 Calculation of CGPA

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

$$\textbf{CGPA} = \Sigma(Ci \times Si) / \Sigma Ci$$

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

Example for CGPA

The Cumulative Grade Point Average (CGPA) at the end of the fourth semester shall be calculated as the weighted average of the semester GPW. The CGPA is obtained by dividing the total of GPW of all the four semesters by the total credits for the program.

ILLUSTRATION I

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total**
Total Marks per Semester	500	500	500	500	500	500	3000
Total Marks Secured	348	460	466	450	400	400	2524
Semester Alpha Sign Grade	B+	O	O	O	A+	A+	-
SGPA	6.95	8.0	7.77	8.5	7.0	7.0	-
Semester total Credits	20	26	24	24	24	24	142

Aggregate Percentage of Marks = 2524 / 3000 = 84.1 **%**

Classification of Result**: Excellent (First class with exemplary)**

Illustration for CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**
Credit 20	Credit 26	Credit 24	Credit 24	Credit 24	Credit 24
SGPA 6.95	SGPA 8.0	SGPA 7.77	SGPA 8.5	SGPA 7.0	SGPA 7.0

$$CGPA = \frac{20(6.95)+26(8.0)+24(7.77)+24(8.5)+24(7.0)+24(7.0)}{\text{Total credits of programme } 142}$$

CGPA = 139+ 208+186.5+ 204+ 168+168 = 1073.50 / 142= 7.56

CGPA 7.56 A (very good) First class with distinction

18. TRANSCRIPT (SCORE CARD /MARKS SHEET) FORMAT

University will issue a transcript format indicating semester performance in terms of score, grade points, SGPA and CGPA. Where the SGPA and CGPA shall be rounded off to 2 decimal places and reported in the Transcripts.

19. MINIMUM FOR A PASS

A candidate shall be declared to have passed the UG, if he/she secures at least a CGPA of 4.0 (Course Alpha-Sign Grade C) in the aggregate of both internal assessment and semester end examination marks put together in each unit such as theory papers / practical / project work / dissertation / viva-voce.

However, candidate has to secure minimum of 35% marks in written theory and practical examination separately and 40% as subject aggregate to be declared as pass. Where the subject has no practical, Viva-voce, internal assessment component, passing criteria is 40%.

20. GRACE MARKS

Any student who completes all the courses in a semester, but failed in any one of the course with a shortage of 5 or less than 5 marks, such candidates will be awarded to maximum of 5 grace marks.

21. CARRY OVER PROVISION

In the first year, candidates who fail in a first semester examinations may go to the second semesters and take the examinations. But he/she has to complete the first year courses before enters to 2^{nd} year 3^{rd} semester. However, candidate is allowed to carry subjects of 3^{rd} and 4^{th} semesters to 5^{th} semester. . But before entering for the 6^{th} semester, he/she has to complete all the carried subjects along with 5th semester courses. However a carryover provision restricted to the maximum period offered to a candidate for completion of the program as per the clause 7.0

22. REVALUATION

There is no revaluation permissible in the regulation

23. POWER TO REMOVE DIFFICULTIES:

i) If any difficulty arises in giving effect to the provisions of these regulations, the Vice-Chancellor may by order make such provisions not inconsistent with the Act, Statutes, Ordinances or other Regulations, as appears to be necessary or expedient to remove the difficulty.

ii) Every order made under this rule shall be subject to ratification by the Appropriate University Authorities.

a)

PREVIEW ONLY, NOT FOR PRINTING

GRADE CARD

SEMESTER - I B.Sc. IMAGING TECHNOLOGY (C.B.C.S)
January 2018 Examination

Register Number : 17IMT001

Student Name : Abhijith K P
Father's Name : Pramod K Das
Mother's Name : Rekha Pramod

Sl. No.	Subject / Paper		Theory / Practical		I.A. / Viva		Total		Cr. Hrs.	Gr. Pts.	Cr. Pts.	Remarks
			Max.	Sec.	Max.	Sec.	Max.	Sec.				
	Core Course											
01	**Anatomy-I :** General Anatomy, Histology and Embryology	Th. Pr.	050 020	041 012	025 005	020 003	075 025	061 015	004	7.6	30.4	Pass
02	**Anatomy-II :** Systemic Histology and Gross Anatomy	Th. Pr.	050 020	027 013	025 005	020 003	075 025	047 016	004	6.3	25.2	Pass
03	**Physiology-I :** Physiological functions of the body	Th. Pr.	050 020	041 018	025 005	021 005	075 025	062 023	004	8.5	34.0	Pass
04	**Physiology-II :** Physiology of Hormonal and Regulatory function	Th. Pr.	050 020	038 017	025 005	021 004	075 025	059 021	004	8.0	32.0	Pass
	Foundation Course											
05	Basic Computer Applications	Th. Pr.	050 020	023 020	- -	- -	050 020	023 020	003	6.1	18.4	Pass
	Discipline Specific Elective											
06	Physiology (ECG)	Th.	030	028	-	-	030	028	001	9.3	09.3	Pass
	Grand Total						**500**	**375**	**020**		**149.4**	

S.G.P.A : 7.47 | **Grade : A (Very Good)**

35% in each Theory and Practical Examination and 40% in Subject aggregate.
College / Department : Allied Health Sciences, SDUAHER

Name & Signature of verifier

Date : 04/04/2018

Controller of Examinations

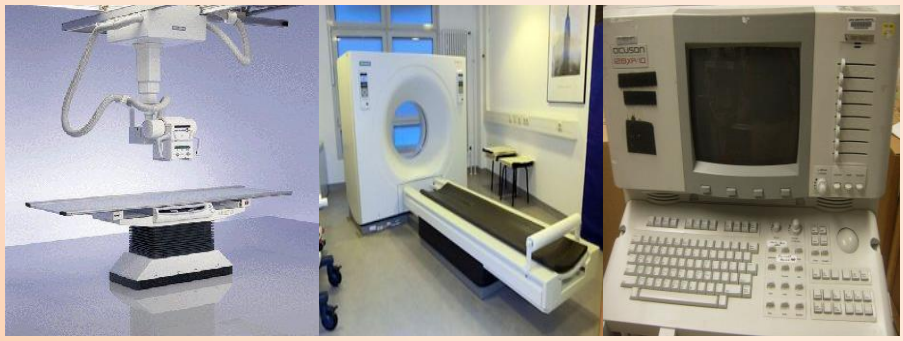
Percentage of Marks	SGPA/CGPA	Alpha-Sign/Letter Grade	Result/Class Description
90.0-100	9.00-10.00	O (Outstanding)	Outstanding
80.0-<90.0	8.00-<9.00	A+ (Excellent)	First Class Exemplary
70.0-<80.0	7.00-<8.00	A (Very Good)	First Class Distinction
60.0-<70.0	6.00-<7.00	B+ (Good)	First Class
55.0-<60.0	5.50-<6.00	B (Above Average)	High Second Class
50.0-<55.0	5.00-<5.50	C (Average)	Second Class
40.0-<50.0	4.00-<5.00	P (Pass)	Pass Class
Below 40	Below 4.00	F (Fail)	Fail/Reappear
Absent	0	Ab	

SDUAHER

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

Deemed to be University u/s 3 of the UGC Act, 1956

BACHELOR OF SCIENCE (B.Sc.)
In Radio Therapy Technology
2016



SYLLABUS UNDER

CHOICE BASED CREDIT SYSTEM

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

KOLAR KARNATAKA

SDUAHER

Adoption of Choice based credit system for Bachelor of Science in Allied Health Science Programme

B.Sc. Radio Therapy Technology

UNDER FACULTY OF ALLIED HEALTH SCIENCES

As per University Grants Commission

2016-17

At a glance this logo is abstract, yet it contains the vital ingredients for an institution like Sri Devaraj Urs Academy of Higher Education and Research.

The institution's medical background, humanitarian values, Compassion, approachability, social commitment and the subsequent research towards the most precious thing, the human life, is the core theme.

The graphic form of a person in the centre of a bud represents the humanity. It denotes the growing process of life and its existence. And the two hands safeguarding them show the care and a sense of security. It is also capable of holding something within the vast expanse of knowledge by the university for the people's benefit. Hence, the motto " Knowledge for Posterity" is very appropriate and gives a punch in Red. The four light blue half circles (smaller to bigger) depict the unending quest for knowledge and imparting it to a wider horizon, growing higher and higher.

And finally, the whole unit is embedded in a "D" shaped graphic template as background to give it a corporate identity.

COLORS USED:

Deep Blue: Credible, Confident and dependable. Represents Peace, tranquility, stability, harmony, trust, security, cleanliness and loyalty.

Light Blue: For sky and water (colour scheme for 4 half circles)

Red: A dominant colour for strengths.

Green: For nature, health and generosity. It's cool quality soothes and has great healing powers.

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

VISION

"**UNIVERSITY OF EXCELLENCE - KNOWLEDGE FOR POSTERITY**"

MISSION

- To be a global center of excellence for Teaching, Training and Research in the field of Higher Education.
- To inculcate scientific temper, research attitude and social accountability amongst faculty and students.
- To promote with value based education for the overall personality development and leadership qualities to serve the humanity.

OBJECTIVES

- To provide need based infrastructure and facilities to students to become responsible professionals with social commitment and accountability.
- To implement effectively innovative programmes in teaching learning and evaluation.
- To impart scientific and socio cultural temperament among students to forge National identity and needs.
- To provide instruction and training in basic and advanced branches of learning.
- To provide facilities for research for the advancement and dissemination of knowledge.
- To undertake extra mural studies, consultancy, extension programmes and field outreach services for the development of society.
- To collaborate with other Universities, Institutions of excellence and Research Organizations within the country and outside for the purpose of teaching, training and research.
- To undertake need based activities for the betterment of socially and educationally backward society.

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION & RESEARCH
Comprising Sri Devaraj Urs Medical College
(A-Deemed-To-Be-University)

Declared under Section 3 of UGC Act, 1956, MHRD GOI No.F.9-36/2006-U.3(A) Dt. 25th May 2007
POST BOX NO.62, TAMAKA, KOLAR-563 101, KARNATAKA, INDIA
Ph:08152-243244, 210604, 210605, Fax:08152-243008, E-mail: registrar@sduu.ac.in/office@sduu.ac.in, **website:** www.sduu.ac.in

No: SDUAHER/KLR/ADMN/ 2063 / 2016-17 **Date: 20.10.2016**

NOTIFICATION

Sub: Implementation of **Choice Based Credit System** for the Undergraduate degree programs under the Faculty of Allied Health science.

Ref: 1.UGC Guideline D.O. No F.1-1/2014 dated 12th Nov.2014
2. Proceedings of the 16th meeting of Board of studies of Health science subjects held on 25.08.2016
3. Proceedings of the committee of the Academic Council meeting held on 13.10.2016
4. Proceedings of the 41st meeting of Board of Management held on 19.10.2016

Sri Devaraj Urs Academy of Higher Education and Research after establishing a department of Allied health sciences has been offering B.Sc. courses in the Medical laboratory Technology, Imaging Technology, Operation Theater technology, Renal Dialysis Technology, Ophthalmic technology and Radiotherapy Technology. All these courses are under semester system but have not followed CBCS as recognized by University Grants Commission. However, in the light of the UGC letter referred above, the University has taken necessary steps to implement CBCS from the Academic Year 2016-17. Accordingly, the subject was placed in the meetings of the authorities of the University as cited above and the University is pleased to announce that the undergraduate courses offered in the Department of allied health Sciences shall follow Choice Based credit system with effect from the Academic year 2016-17 onwards.

By Order,

Sd/-
Registrar

Structure of B.Sc. Radio Therapy Technology Programme under CBCS scheme

Semester	Core courses (1-17)	Discipline specific elective (DSE)	Ability enhancement Compulsory Course (AEC)	Skill enhancement courses (SEC)	Open elective (OE)	Foundation course
I	1&2.Anatomy –I & II 3&4.Physiology – I & II	DSE-1 DSE-2 DSE-3 DSE-4	-	-	-	Basic Computer Application
II	5.Biochemistry 6.Microbiology 7.Pathology	DSE-1 DSE-2 DSE-3 DSE-4 DSE-5 DSE-6	Environmental science	-	-	English communication
III	8 Fundamentals of Physics 9. Radiation safety 10. Medical Physics			SEC-1 (SAFE-I)	-	-
IV	11. Applied Anatomy & Pathology 12. Radiation safety in radiotherapy 13. Radiation Biology and Principles of Radiotherapy		Constitution of India	-	-	-
V	14. Radiation Physics 15. Principle and Practice of Radiotherapy			SEC-2 Medical Ethics	-	-
VI	16. Radiotherapy-I 17. Radiotherapy-II	-	Quality control	-	-	-
VII	Internship					

SEMESTER-I

Papers

1. General Anatomy, Histology & Embryology
2. Systemic Histology & Gross anatomy
3. Physiological functions of the body
4. Physiology of hormonal and regulatory function
5. Basic Computer Application
6. Discipline specific electives (DSE)
    a. Histology Techniques preparation of slides & stains
    b. Museum Preparation
    c. Electro Cardiogram (ECG)
    d. Pulmonary Function Test (PFT)

First semester distribution of hours and credits- CBCS scheme

Subject	Paper & Code	Subjects	Theory		Practical		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
CC-Anatomy	Paper-I A201	General Anatomy, Histology & Embryology	30	**02**	30	**01**	30	**01**	90	**04**
	Paper –II A202	Systemic Histology & Gross anatomy	30	**02**	30	**01**	30	**01**	90	**04**
CC-Physiology	Paper-I A204	Physiological functions of the body	30	**02**	30	**01**	30	**01**	90	**04**
	Paper –II A205	Physiology of hormonal and regulatory function	30	**02**	30	**01**	30	**01**	90	**04**
CF-Compulsory foundation course	A207	Basic computer application	30	**02**	30	**01**	-	**-**	60	**03**
		Total	170	**11**	150	**05**	120	**04**	440	**19**
	A208 A209	Discipline specific electives (DSE)	Anatomy*	1 Histology Techniques preparation of slides & stains (01 credit) 2 Museum preparation (01 credit)						**01**
	A210		Physiology *	1 ECG (01 credit)						
	A211			2 Pulmonary function test (01 credit)						
				Grand Total						**20**

Note: Each student has to choose any one discipline specific elective (DSE) offered during first semester in the core subject.

First semester distribution of marks- CBCS scheme

Subject	Paper &code	Subject	Theory	Theory IA	Viva voce	Practical	Practical I.A	Grand total	
CC-Anatomy	Paper-I A201	General Anatomy, Histology & Embryology	50	10	-	-	-	60	UNIVERSITY LEVEL EXAM
	Paper –II A202	Systemic Histology & Gross anatomy	50	10	-	-	-	60	
	A203	Anatomy common Practical	-	-	30	40	10	80	
CC-Physiology	Paper-I A204	Physiological functions of the body	50	10	-	-	-	60	
	Paper –II A205	Physiology of hormonal and regulatory function	50	10	-	-	-	60	
	A206	Physiology common Practical	-	-	30	40	10	80	
Compulsory foundation course	A207	Basic computer application	50	-	-	20	-	70	
Discipline specific electives (DSE)	A208	Histology Techniques preparation of slides & stains	30	-	-	-	-	30	
	A209	Museum preparation							
	A210	Electrocardiogram (ECG)							
	A211	Pulmonary Function Test (PFT)							
			280	40	60	100	20	500	

Note: As per the following

1. Proceedings of the 19th meeting of the board of Undergraduate and Post graduate studies in Allied Health Sciences held on 9th February 2018. (Agenda No. AHS/XIX-11/18)
2. 17th meeting of Faculty of Medicine held on 24th February 2018.
3. Proceedings of 31st meeting of Academic council held on 3rd November 2018 (Agenda No. AC/XXXI-02/18)
   The two separate physiology practical with respect to physiology theory paper I & II is modified to single practical.
   Similarly the two separate Anatomy practical with respect to Anatomy theory paper I & II is modified to single practical.
   The decision is in effect to 2018-19 admission.

DETAILS OF THE COURSES

Core courses- Anatomy

1. General Anatomy, General Histology, General Embryology,
2. Gross Anatomy, Systemic Histology

Discipline Specific Elective – Anatomy

1. Histology Techniques preparation of slides & stains
2. Museum preparation

Core courses – Physiology

1. Physiological functions of the body
2. Physiology of hormonal and regulatory function

Discipline Specific Elective Physiology

1. Electrocardiogram (ECG)
2. Pulmonary function Tests

Ability enhancement course

-

Compulsory foundation course

1. Basic Computer Application

FIRST SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
First Semester	**Core courses- Anatomy**	1. General Anatomy, General Histology, General Embryology,	04
		2. Gross Anatomy, Systemic Histology	04
	Discipline specific elective – Anatomy	1. Histology Techniques preparation of slides & stains	01
		2. Museum preparation	01
	Core courses – Physiology	1. Physiological functions of the body	04
		2. Physiology of hormonal and regulatory function	04
	Discipline specific elective Physiology	1. Electrocardiogram (ECG)	01
		2. Pulmonary function Tests	01
	Ability enhancement course	-	
	Compulsory foundation course	1. Basic Computer Application	03

SEMESTER-I
B.Sc. Allied Health Science Programmes (Medical Laboratory Technology)
Syllabus
Subject: Anatomy
Paper-I
Paper Title: (General Anatomy, General Histology, General Embryology)
Credits (Theory 02, Practical 01)

Theory lectures: 30

Unit –1

Introduction human body as a whole **08 hours**

Definition of anatomy & its divisions, Terms of location, positions & planes, **Cell** & its organelles, **Basic tissues**- classification with examples, **Epithelium**- definition, classification, describe with examples, functions, **Glands**-classification, describe serous & mucous glands with examples

Unit-2

Locomotion & support **10 hours**

Connective Tissue- components and classification, **Cartilages-** types with example & histology, **Bone**- classification, names of bone cells, parts of long bone, microscopy of compact bone, names of all bones, Vertebral column, Invertebral disc. **Joints**-Classification of joints with examples. **Muscular system**-structure & classfication of muscular tissue. **Nervous System** Neuron, Classification of CNS,

Unit-3

Cardiovascular system **10 hours**

Heart-Size, Location, Chambers, Exterior & Interior, Blood Supply Of Heart, Pericardium Systemic & Pulmonary Circulation, Branches Of Aorta, Common Carotid, Subclavian , Axillary , Brachial , Femoral and Internal Iliac artery, Portal Vein, Great Saphenous vein, Dural Venous Sinuses. **Lymphatic System** Thoracic duct Lymphoid organs- Primary & secondary, Names of regional Lymphatics, Axillary & Inguinal Lymph nodes

Unit-4

General Embryology **02 hours**

Spermatogenesis & oogenesis, Ovulation, Fertilization. Placenta.

PRACTICAL

Experiments **(Credits 01 , Hours 30)**

1. Histology of types of epithelium
2. Histology of serous, Mucous & mixed salivary glands
3. Histology of 3 types of cartilages,
4. Demonstration of all bones showing parts, radiographs of normal bones & joints.
5. Histology of compact bone (TS & LS)
6. Histology of skeletal (TS& LS), smooth & cardiac muscle
7. Histology of peripheral nerve
8. Demonstration of heart & vessels in the body,
9. Histology of large, medium sized arteries, & Large vein,
10. Histology of lymph node, Spleen, Tonsil & Thymus
11. Demonstration of embryology models

Syllabus
Subject: Anatomy
Paper-II
Paper Title: (Gross Anatomy, Systemic Histology **)**
Credits (Theory 02, Practical 01)

Theory lectures: 30

Unit –1

Gastro- Intestinal System **05 hours**

Parts of GIT, Oral Cavity(lip, tongue with histology), Tonsil, Dentition, Pharynx, Salivary glands, Waldeyer's ring, Oesophagus, Stomach, Small & large intestine, Liver, Gall Bladder, Spleen and Pancreas. Thoraco abdominal Diaphragm

Unit-2

Peritoneum 02 hours

Describe in brief Peritoneal folds

Unit-3

Respiratory System **03 hours**

Parts of Respiratory system , Nose, Nasal cavity, Larynx, Trachea, Pleura, Lungs, Broncho pulmonary Segments

Unit-4

Urinary System 03 hours

Gross Anatomy of Kidney, Ureter, Urinary bladder, male & female urethra,

Unit –5

Reproductive System **04 hours**

Male reproductive system - Testis, Vas deferens, epididymis, prostate (gross & histology)
Female reproductive system- Uterus, Fallopian tubes, ovary (gross & histology)
Mammary gland- gross

Unit –6 04 hours

Endocrine glands

Names of all endocrine glands, Pituitary gland, Thyroid gland, Parathyroid gland,Supra renal glands- (gross & Histology)

Unit –7

Neuroanatomy **04 hours**

Cerebrum, Cerebellum, midbrain, pons, medulla oblongata, Spinal cord with spinal, Nerves, Meninges, Ventricles & cerebrospinal fluid, Names of basal nuclei, Blood supply of brain, Cranial nerves,

Unit-8

Sensory Organs **05 hours**

Skin- Histology, Appendages of Skin **Eye-** Parts of Eye & Lacrimal Apparatus, Extra ocular muscles & nerve supply **Ear-** parts of Ear-External, Middle and inner ear and contents.

PRACTICAL

Experiments **(Credits 01 , Hours 30)**

1. Demonstration of Gastro intestinal system, Histology of GIT
2. Demonstration of part of Respiratory System. Histology of lung & trachea
3. Demonstration of parts of Urinary system, Histology of kidney, Ureter, Urinary bladder
4. Demonstration of section of male & female pelvis with organs in situ, Histology of testis, Vas deferens, epididymis, prostate, Uterus, Fallopian tube, ovary
5. Demonstration of glands, Histology of pituitary Thyroid, Parathyroid, Suprarenal glands
6. Demonstration of all nerve plexus and palpable nerves in the body.
7. Demonstration of all parts of brain. Histology of Optic nerve, Cerebrum, Cerebellum, Spinal cord.
8. Histology of Thin and Thick Skin, Demonstration of eye ball, Histology of Cornea & Retina.

Reference Books - Anatomy

1. William Davis (P) understanding Human anatomy and Physiology MC Graw Hill
2. Chaurasia –A text book of Anatomy T.S Ranganathan –A text book of human Anatomy .
3. Fattana, Human anatomy Description & applied) Saunder's & C P Prism publishers, Banglore
4. ESTER.M.Grishcimer, physiology & anatomy with practical Considerations J.P. Lippin cott. Philadelphia.
5. Bhatnagar Essentials of Human Embryology –Revised Edition Orient Blackswan Pvt.Ltd.
6. B.D.Chaurasia Human anatomy CBS publishers
7. Patrick W.Tank and Thomas R Gest Atlas of anatomy Lippincot williams and Wilkins
8. Hollinshed Text book of Anatomy Harper and Row Publishers
9. Willium J Larson Human embryology 3rd edition Churchill Living stone
10. Indebir Singh. Human neuro Anatomy Jaypee brothers
11. Halim A Surface and Radiological Anatomy CBS publishers

SEMESTER-I
B.Sc. Allied Health Science Programmes
Syllabus
Subject: Physiology
Paper-I
Paper Title: (Physiological functions of the body)
Credits (Theory 02, Practical 01)

Theory lectures: 30

Unit –1

Blood **10 hours**

Composition and functions of blood, Plasma proteins types and function, RBC- formation, function physiological variation, Anemia classification-morphological and etiological effects of anemias on the body, Blood indices –colour index, MCV, MCH, MCHC, ESR normal value PCV normal value, WBC- function, life span, normal value, Immunity, Hemoglobin- functions normal value, Types of Hemoglobin, Jaundice, Platelets morphology normal value and function, Blood groups-basis of blood grouping, clinical importance, blood banking and transfusion, Haemostasis, Definition, normal values of clotting and bleeding time mechanism disorders, Anticoagulants

Unit-2

Renal System **05 hours**

Structure and function of nephron, types of nephron, classify nephrons. Steps of urine formation, define GFR, GFR normal value, factors affecting GFR. Micturition reflex. Diuretics Water diuresis and osmotic diuresis, define role of kidney in regulation of Blood pressure.

Unit-3

Digestive System **05 hours**

Basic structure of Digestive system, Composition and functions of Salivary secretion, Gastric secretion, Pancreatic secretion, Intestinal secretion, Bile & Gastro-intestinal movements

Unit-4

Cardiovascular System **05 hours**

List the Properties of cardiac muscle, conducting system of heart. List the events of Cardiac cycle & Heart sounds. Define Cardiac output and give normal value. Effect of exercise on heart. List the mechanism of Regulation blood pressure. Electrocardiogram-physiological basis and applications. Defined shock signs and symptoms of hypovolemic shock

Unit-5

Respiratory System **05 hours**

Functional anatomy, Mechanics of normal respiration, functions of surfactants and lung function test, Lung volumes and capacities, definitions of Hypoxia, cyanosis, dyspnea, asphyxia, artificial respiration, partial pressure of oxygen and carbon dioxide in arterial and venous blood.

PRACTICAL

Experiments **(Credits 01 , Hours 30)**

Hematology Experiments

1. Estimation of Hemoglobin
2. Bleeding time
3. Clotting time
4. PCV
5. ESR
6. Preparation of Peripheral smear.

Syllabus
Subject: Physiology
Paper-II
Paper Title: (Physiology of hormonal and regulatory function)
Credits (Theory 02, Practical 01)

Theory lectures: 30

Unit –1

Muscle And Nerve Physiology **02 hours**

Structure and functions of a neuron and neuroglia. Transmission of nerve impulse, Structure and transmission across neuro-muscular junction, Myasthenia gravis, Types of muscle fibers, Rigor mortis

Unit-2

Endocrinology **09 hours**

Definition, classification of endocrine hormones, Estimation and assessment of Hormones, function of Pituitary hormone, Thyroid hormone, Parathyroid hormone, Adrenal hormone, Pancreatic hormones. List the disease associated with hyper secretion and hypo secretion.

Unit-3

Reproductive System **05 hours**

Male reproductive system: Functions of testis, list the step of Spermatogenesis & factors influencing it. **Female reproductive system:** function of ovary, Ovulation tests, define menstrual cycle, give the average duration, name the hormones influencing menstrual cycle Physiological changes during pregnancy, Pregnancy diagnostic tests. Define contraception. Describe contraceptive methods in males and females.

Unit-4

Central Nervous System **09 hours**

Organization of nervous system, define synapse, synapse receptor, action potential, list sensory nerves and sensations that carry, list the motor tracts, comment on sensation of spinal cord. Higher functions- memory learning speech, Cerebro spinal fluid formation, composition and functions. Lumbar puncture. Reflex arc, functions of cortex, cerebellum, hypothalamus, basal ganglia. Limbic system- components of anterior nervous system and action of heart.

Unit-5

Special Senses **05 hours**

List the special senses and their receptor, visual pathway, Colour vision, refractive errors Visual reflexes-pupillary and light reflex. structure of the middle ear and inner ear, Mechanism of hearing, Pathway of taste, primary taste sensations, receptor for smell.

PRACTICAL

Experiments **(Credits 01, Hours 30)**

Clinical Physiology

1. Pulse
2. Blood pressure
3. Spirometry
4. Pulmonary function tests
5. Electro Cardio Gram (ECG)
6. General physical examination

Reference Books Physiology

1. Guyton (Arthur) Text Book of Physiology. Latest Ed. Prism publishers
2. Chatterjee(CC) Human Physiology Latest Ed. Vol-1, Medical Allied Agency
3. Choudhari (Sujith K) Concise Medical Physiology Latest Ed. New Central Book,
4. Ganong (William F) Review of Medical Physiology. Latest Ed . Appleton
5. Pal G.K. Text book of Medical physiology Avichal publishing company
6. Campbell FJM Clinical physiology ELBS
7. Schmidi R.F. and Thews G Human physiology Springer verlong
8. Parvathi Pal A text book of practical physiology

SEMESTER-II

Papers

1. Elementary aspects of Biochemistry
2. Elementary Microbiology
3. Basics of General ,Systemic, Clinical, hematology and histopathological technique
4. English for Communication
5. Environmental Science
6. Discipline Specific Electives (DSE)
    a. Basic aspects of research
    b. Sample collection, preservation and transportation
    c. Sterilization
    d. disinfection
    e. Antibiotic resistance
    f. Phlebotomy
    g. Museum Technology

Second semester distribution of hours and credit- CBCS scheme

Subject	Paper	Subjects	Theory		Demonstrations/ assignments		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
Core course (CC)	Paper-I B201	Elementary aspects of biochemistry	40	**02**	40	**01**	40	**02**	160	**05**
	Paper-II B202	Elementary microbiology.	40	**02**	40	**01**	40	**02**	160	**05**
	Paper-III B203	Basics of general ,systemic, clinical, hematology and histopathological technique	40	**02**	40	**01**	40	**02**	160	**05**
Compulsory foundation Course (FC)	B204	English for communication	30	**02**			-	-	30	**02**
Ability enhancement course (AEC)	B205	Environmental science	30	**02**	Field visit-	**01**	-	-	30	**03**
		Total	180	**09**	240	**07**	120	**03**	540	**20**
Discipline specific electives (DE)	B206 B207	Biochemistry*		1 Basic aspects of research (01) credit 2 Sample collection, preservation and transportation (01 credit)						**01**
	B208 B209 B210	Microbiology*		1. Sterilization and disinfection (01 credit) 2. Antibiotic resistance (01 credit) 3. Specimen collection and transportation (01 credit)						
	B211 B212	Pathology*		1.Phlebotomy (01 credit) 2. Museum Technology (01credit)						
				Grand Total						**21**

Note: choose any one elective from DSE during second semester in the subject *

Second semester distribution of marks- CBCS scheme

Subject	Paper/code	Subjects	Theory				Practical			
			Theory	Viva voce	I.A	Sub total	Practical	I.A	Sub total	Grand total
CC Bio chemistry	Paper-I B201	Elementary aspects of biochemistry	80	-	20	100	-	-	-	100
CC Micro biology	Paper-II B202	Elementary microbiology.	80	-	20	100	-	-	-	100
CC Pathology	Paper-III B203	Basics of general ,systemic, clinical, hematology and histopathological technique	80	-	20	100	-	-	-	100
Compulsory foundation course (CF)	B204	English for communication	50	-	-	50		-	-	50
Ability enhancement course (AEC)	B205	Environmental science-	60-	--	20	80	--	-	-	80
Discipline specific electives (DE)	B206 Biochemistry B207	1. Basic aspects of research	30	-	-	30	-	-	-	30
		2.Sample collection, preservation and transportation								
	B208	1.Sterilization and disinfection								
	B209	2.Antibiotic resistance								
	B210	3.Specimen collection and transportation								
	B211 Pathology B212	Phlebotomy (01 credit)								
		3.Museum Technology (01credit)								
		Total	**380**		**80**	**460**	**-**	**-**	**-**	**460**

Note: No practical examinations in semester –II Biochemistry, pathology and microbiology

DETAILS OF THE COURSES

I. CORE COURSES- BIOCHEMISTRY

1. Elementary aspects of Biochemistry.

Discipline specific elective biochemistry

1. Basics aspects of Research
2. Sample collection, preservation and transportation

II CORE COURSES – MICROBIOLOGY

1. Elementary Microbiology.

Discipline specific elective Microbiology

1. Sterilization and Disinfection
2. Antibiotic resistance
3. Specimen collection and transportation

Ability enhancement course

1. Environmental Science

Compulsory foundation course

2. English Communication

III CORE COURSES – PATHOLOGY

1. Basics of general, systemic, clinical, hematology and histopathological technique

Discipline specific elective Pathology

1. Phlebotomy (01 credit)

2. Museum Technology (01credit)

SECOND SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
second semester	**Core courses- Biochemistry**	**1. Elementary aspects of Biochemistry**	05
	Discipline specific elective – Biochemistry	1. Basics aspects of research	01
		2. Sample collection, preservation and transportation	
	Core courses – Microbiology	**1. Elementary Microbiology.**	05
	Discipline specific elective Microbiology	1. Sterilization and Disinfection	01
		2. Antibiotic resistance	
		3. Specimen collection and transportation	
	Ability enhancement course	1. Environmental science	03
	Compulsory foundation course	1. English communication	02
	Core courses pathology	**1. Basics of general, Systemic, Clinical, hematology and histopathological technique**	05
	Discipline specific elective Pathology	1. Phlebotomy (01 credit) 2. Museum Technology (01credit)	01

Note: choose any one elective from DSE during second semester in the subject *

SEMESTER-II
B.Sc. Allied Health Science Programmes Syllabus
Subject: Biochemistry
Paper-I
Paper Title: (Elementary aspects of Biochemistry)

Credits (Theory 02, Demonstartion 01)

Theory lectures: 40

Unit –I **04hour**

Laboratory hazards and its prevention

Common laboratory accidents and ways for its prevention. First Aid in the Clinical laboratory, Laboratory precautions, storage and handling of dangerous chemicals, safety measures. Conventional and SI Units

Unit-2 **02 hours**

Definition of Atomic weight, Molecular weight and Equivalent weight of elements and compounds

Unit-3 **05 hours**

Normality, Molarity, Molality – definition and preparation of solutions with examples

Unit 4

Acids and Bases **06hour**

Definition. Properties, theories, Classification, examples of strong and weak acids.

Basic concepts of Acid base reaction, Ionization of water, pH- definition, Henderson's Hassel Bach's equation, its applications and measurement.

Unit-5 **02hour**

Indicators

Definition, concepts, mechanisms of an indicator, use and its limitations, Commonly used indicators and their pH range. Ideal pH indicators used in different titrations. Universal indicators

Unit-6: **04hour**

Buffers

Definition, mechanism of action, various types of buffers with example and applications, Preparation of Buffer solutions using pH meter

Unit-7 **02hour**

Normal values and its interpretations

Unit 8 **06hour**

Biophysics

Various grades of chemicals, reagents and water. Biomedical waste management Waste disposal in the laboratory. Medico legal aspects of laboratory technicians and laboratory ethics

Unit-9 **05hour**

Specimen collection preservation and transportation-blood urine and other body fluids.

Unit 10 **04hours**

Quality control

Definition, types, IQAS and EQAS. Calculation of mean, standard deviation and percentage of coefficient of variation.

SEMESTER-II
B.Sc. Allied Health Science Programmes
Syllabus
Subject: Biochemistry
Paper-I
Paper Title: (1.Elementary aspects of biochemistry)

Demonstrations **(01 credit)**

Unit-1 **08 hours**

Introduction to laboratory apparatus
Pipettes, Types Calibration
Burettes, beakers, petri dishes, depression plates, funnels
Flask, Bottles, Measuring cylinders, test tubes, centrifuge tubes, dispensers, tripod stand, wire gauze, Bunsen burner, desiccator, stop watch (Types - reagent bottles, wash bottles , specimen bottles)

Cuvettes (Types, precautions, uses and limitations)

Maintenance of glassware and apparatus, Significance of borosilicate glass, Care and cleaning of glass ware and plastic ware, Different cleaning solution

Unit-2 **12 hours**

Introduction to instruments
Water bath, Oven, Incubators, Water distillation plant and water deionizers (Use, care and maintenance)
Refrigerators, Cold box, Deep freezers Reflex condenser (Use, care and maintenance)
Centrifuges (Types, Principle, procedure, RPM, Use, care and maintenance, limitations)
Laboratory balances (Types, Use, care and maintenance, procedure for weighing different chemicals)

pH meter (Principle, procedure, types of electrodes use, care, maintenance)

Unit-3 **4 hour**

Dilutions, Reagent dilution techniques, calculating the dilution of a solution (Preparation of 0.1 N NaCl, 1 N Hcl etc.)

Unit –4 **4 hour**

Stock solution, working standard, saturated and super saturated solutions
Preparation of glucose, urea etc. Volumetric flask- uses, limitations in preparing standard solutions

Unit-5 **04 hour**

Preparations of normal solutions Preparation of molar solutions, % solutions, v/v, w/v solutions Conversion of % solution into molar solutions
(Preparation of 1 N Na2 Co3, 1 NaOH, 0.1 N HCl etc)

Unit-6 **02 hours**

Titration of simple acid using a base
Demo- Titration of oxalic acid using NaOH

Unit-7 **02 hours**

Normal values & interpretations –
(Normal reference range)

Reference Books Biochemistry

1. Varley – Clinical chemistry
2. TEITZ – Clinical chemistry
3. Kaplan – Clinical chemistry
4. Ramakrishna(S) Prasanna(KG), Rajna ® Text book of Medical Biochemistry Latest Ed Orient longman Bombay
5. Vasudevan (DM) Sreekumari(S) Text book of Biochemistry for Medical students , LatestEdn
6. DAS (Debajyothi) Biochemistry Latest ED Academic, Publishers, Culcutta
7. Rajagopal G & Ramakrishna –Practical Biochemistry for Medical Students oriental Blackswan Pvt. Ltd.
8. Shivarjshankara Y.M Practical Biochemistry
9. Murray R.K harpers Biochemistry Mc graw Hill
10. Pankaj Naik Biochemistry Jaypee publication..

SEMESTER-II

B.Sc. Allied Health Science Programmes Syllabus

Subject: Microbiology

Paper Title: (Elementary Microbiology)

Credits (Theory 02, Demonstration 01)

Theory lectures: 40

Unit-1 **05 hour**

Bacterial cell*: Anatomy, labeled diagram,

Antibiotics* : Commonly used antibiotics, target sites , misuse of antibiotics
Penicillin, Ceftriaxone, ceftazidime, ciprofloxacin, streptomycin, Erythromycin

Unit-2 **06 hour**

Sterilization & Disinfectants* :

- Define sterilization and disinfection
- Enumerate the different physical methods of sterilization
- Diagram of Autoclave , principle , articles to be sterilized
- Diagram of Hot Air oven, principle , articles to be sterilized
- Enumerate the commonly used chemical disinfectants & their uses.
  Phenol, Aldehydes, halogens, Ethylene oxide, detergents, antiseptics
- Describe disinfection of operation theatre

Unit-3 **03 hour**

Infection :

Types: acute, chronic , Primary, reinfection, secondary, cross, nosocomial, iatrogenic, subclinical, latent, atypical Source and modes of transmission with examples.

Types of infectious diseases : outbreak, endemic, epidemic , pandemic,

Unit-4 **02 hour**

Immunity :

Antigen & its properties
Humoral immunity: classes of immunoglobulins and its biological role
Primary Immune response :
Secondary Immune response / Booster response
Vaccines:
Killed : DPT, IPV
Live : BCG, OPV, MMR
Cell mediated immunity : cells involved , biological role

Unit-5 **04 hour**

Hypersensitivity*

Describe the clinical picture of anaphylaxis and mechanisms of anaphylaxis with clinical importance. Contact dermatitis: mechanism with examples

Unit-6 **02 hours**

Bacterial infections / diseases: *

Draw a map of human body and mark the different lesions/ diseases caused by the following bacteria :

- Mycobacterium tuberculosis
- Vibrio cholera
- Salmonella typhi
- Leptospira
- Treponema pallidium
- Coynebacterium diphtheria
- Staphylococcus ,
- Streptococcus,
- Pneumococcus
- E. coli
- Klebsiella ,
- Pseudomonas

Describe the modes of transmission, cardinal clinical manifestations & samples to be collected in the above infections

Unit-7 **08 hours**

Viral infections / diseases:*

Draw a map of human body and mark the different lesions/ diseases caused by the following Viruses :

- Hepatitis A, B ,C viruses ,
- Rabies ,
- HIV
- Arboviruses – Dengue , chikungunya ,
- Measles , Mumps ,
- Influenza ,
- Herpes, Chicken pox

Describe the modes of transmission , cardinal clinical manifestations & samples to be collected in the above infections

Unit-8 **02 hour**

Fungal infections / diseases :*

Draw a map of human body and mark the lesions / diseases caused by opportunistic fungus

- Candida,
- Cryptococcus,
- Aspergillus,
- Penicillium,
- Mucor ,
- Rhizopus

Describe the modes of transmission , cardinal clinical manifestations & samples to be collected in the above infections

Unit-9 **04 hours**

Parasitic infections / diseases :*

Draw a map of human body and mark the lesions / diseases caused by the following parasites :

- Entamoeba
- Plasmodium
- Leishmania
- Trichomonas,
- Giardia ,
- Heliminths : Hook worm , Round worm , Pork Tape worm , Beef Tape worm, Dog Tape worm , Pin worm , Filarial worms

Describe the modes of transmission , cardinal clinical manifestations & samples to be collected in the above infections Describe the preventive & control measures against the heliminths

Unit-10 **04 hours**

Bio safety

Describe the standard precautions to be followed in the work place
Describe the hand hygiene technique
Describe the segregation and appropriate color coded containers for biomedical waste
Describe the post exposure prophylaxis against HIV, Hepatitis B and Rabies
Describe blood spill management

Note: * these chapters can be asked for long essay

Electives:

- Sterilization and Disinfectants
- Antibiotic Resistance
- Specimen collection and transportation

Reference Books Microbiology

1. Ananthanarayana & Panikar Text book of Medical Microbiology Universities press
2. Text book of Microbiologgy by C.P.Baveja
3. Chatterjee- Parasitology – Interpretation to clinical medicine.
4. Basic laboratory methods in Parasitology, 1st Ed, J.P.boros, New Delhi-199.
5. Basic laboratory procedures in clinical bacteriology 1st Ed, JP.Brothers, New Delhi.
6. Practical microbiology methods for LAB Technicians.
7. Bhatia R : Essentials of medical Microbiology Jay pee New delhi
8. Vandepitte J Basic laboratory procedures in clinical bacteriology Jay pee publications
9. Colle JG Practical Medical Microbiology USA
10. Chatterjee K D parasitology Chatterjee medical publishers

SEMESTER-II

B.Sc. Allied Health Science Programmes Syllabus

Subject: Pathology

Paper-I Paper Title: (Basics of Hematology, clinical pathology and histopathological techniques**)**

Credits (Theory 02, Demonstration 01) **Theory lectures 40**

Unit-1
(Basics in General Pathology)

Cell injury: agents causing cell injury, cellular adaptations (hypertrophy, atrophy, hyperplasia, metaplasia) reversible and irreversible injury.

Inflammation: cardinal signs of inflammation, acute and chronic inflammation. Laboratory tests in inflammation.
Hemodynamics: edema, thromboembolism, shock
Neoplasia: definition of neoplasm, differences between benign and malignant tumors, carcinogenesis
Infections: tuberculosis, leprosy Environmental pollution

Unit-2
(Basics in systemic pathology)
Cardio vascular system (CVS): Atherosclerosis and its complication, hypertensive heart disease, Myocardial infarction.
Leucocytes: causes for leukocytosis and leucopenia, leukemia
Respiratory system; Pneumonia, Lung cancer
GIT: peptic ulcer, gastric cancer
Liver: viral hepatitis, Gall stones
Kidney: UTI Urinary stones
Breast: Fibroadenoma, breast carcinoma
CNS: meningitis

Unit –3
(Basics of hematology and blood banking)
Blood collection, hemoglobin, ESR,PT/aPTT
RBC's: Definition of anemia,iron deficiency anaemia and megaloblastic anaemia
Blood grouping and Rh typing

Unit-4
(Clinical Pathology)
Urine examinations
Collection and transport of various clinical specimens

Unit-5 (Techniques in pathology)
Basics in tissue processing, FNAC, staining techniques.

DEMONSTRATIONS

Hemoglobin estimation.

Erythrocytes sedimentation Rate (ESR)

Urine examination

H&E staining

Blood grouping

Rh typing

Reference Books Pathology

1. Culling Histopathology techniques
2. Bancroft Histopathology techniques
3. Koss – cytology
4. Winifred Greg – Diagnostic cytopathology
5. Orell – Cyto Pathology
6. Todd & Sanford Clinical Diagnosis by laboratory method
7. Dacie & Lewis – Practical Haematology
8. Ramanic Sood, Laboratory Technology (Methods and interpretation) 4th Ed.J.P. Bros, New Delhi
9. Satish Gupta Short text book of Medical Laboratory for technician J.P. Bros, New Delhi
10. Sachdev K.N. Clinical Pathology and Bacteriology 8th Ed, J.P. Bros, New Delhi-
11. Krishna - Text book of Pathology, Orient Longman PVT Ltd.

SEMESTER-III

Papers

1. Fundamentals of Physics
2. Radiation safety
3. Medical Physics
4. Skill Enhancement course
   SAFE -i

B.Sc. in Radiotherapy Third semester distribution of hours and credit- CBCS scheme

Subject	Paper	Subjects	Theory		Practical		Demonstrations/ assignments		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
Core course (CC)	Paper-I C201	Fundamentals of Physics	40	**02**	60	**02**	40	1	40	**02**	180	**07**
	Paper-II C202	Radiation safety	40	**02**	-	**-**	40	1	40	**02**	120	**05**
	Paper-III C203	Medical Physics	40	**02**	-	**-**	40	1	40	**02**	120	**05**
Skill enhancement course (SEC)	C204	Safe-i	30	**03**	-	**-**	-	-	-	**-**	30	**03**
		Total	150	**09**	60	**02**	120	03	120	**06**	450	**20**

B.Sc. in Radiotherapy Third semester distribution of marks - CBCS scheme

Subject	Paper/code	Subjects	Theory				Practical			
			Theory	Viva voce	I.A	Sub total	Practical	I.A	Sub total	Grand total
Core course (CC)	Paper-I C201	Fundamentals of Physics	100	30	20	150	40	10	50	200
	Paper-II C202	Radiation safety	100	30	20	150	-	-	-	150
	Paper-III C203	Medical Physics	100	30	20	150	-	-	-	150
Skill enhancement course (SEC)	C204	Safe-i	50	-	-	50	-	-	-	50
		Total	**350**	**90**	**60**	**500**	**40**	**10**	**50**	**550**

THIRD SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
Third Semester	**Core courses-**	1. Fundamentals of Physics	07
		2. Radiation safety	05
		3. Medical Physics	05
	Skill Enhancement course	SAFE i	03

SEMESTER-III

B.Sc. in Radiotherapy programme Syllabus

Paper 1 Subject: Fundamentals of Physics

Paper Title: Fundamental of physics

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Unit –I 05 Hours

Applied Mathematics:

- Elementary use of algebraic symbols and signs, Fractions & Decimals.
- Indices: Power of 10 simple equations, Logarithms.
- Fundamentals of Trigonometry.
- Fundamentals of Geometry, Application of similar Triangles in finding focal spot.
- Divergence from a point source.
- Graphical representation of a data-linear & semi log plot.
- Measurement of angles. Geometry of triangles.
- Proportion, Inverse square law, Elementary explanation of exponential law.

Unit -2 **12 Hours**

Electromagnetic Radiation, Atomic Structure and Radioactivity:

- Electromagnetic waves and their properties, Inverse square law.
- The quantum theory of Radiation (Planck's concept of quanta, Photon and its characteristic properties), the electromagnetic spectrum, Florescence and Phosphorescence, Photoelectric emission, Photocell, Intensity and quality of electromagnetic radiation.
- The structure of the Atom: Nucleus, Atomic number (Z), Mass number (A), Ionization & Excitation, Isotopes, And the Periodic Tables.
- Radioactivity, Properties of alpha, beta, gamma radiation, Radioactivity transformation process (Radioactivity displacement law), Radioactivity decay (Radioactive disintegration law), decay constant, half-life, Units of Radioactivity.
- Radioactive nuclides in medicine.
- Radioactive disintegration process and radiation emission and daughter products.
- Properties of radium and its daughter elements.
- Radioactive equilibrium.
- Production of artificial radioactive isotopes.
- The principles of the nuclear reactor.
- The curies and specific gamma ray emission.

Unit -3 **13 hours**

Fundamentals of Electricity (Basic of Electronics)

- Electric charges and units of electric charge, Coulombs law, Electric induction, electric potential & potential difference, Capacitance and Capacitors, Resistance.

- Conductors, Insulators and Semiconductors, Electric current, Ohm's law& Kirchhoff's law, circuit laws (Combination of Potential differences in series and parallel, meters, Electrical energy & Power, heating effect of a current.
- The magnetic effects of an electric current (Electromagnetism), electromagnetic induction, Mutual indication and Self-induction.
- Alternating current, The A.C. transformer theory, and construction, Types of transformers its practical aspects, Transformer losses and regulation and rating. Types of transformers used in X-ray equipment.
- Thermionic emission. The vacuum diode, Variation of anode current with anode voltage and filament temperature in the vacuum diode, the effect of gas in the diode, the thermionic gas diode. Meaning of rectification (full wave & half wave rectification).
- Principles of semiconductors, p-n junction diode, High voltage rectifier circuits (self-rectifying circuit, Half-wave pulsating voltage circuit, Full-wave pulsating voltage circuits, shock proofing. Advantages of semiconductor devices over thermionic devices.

Unit -4. **10 Hours**

X-rays (Basic of Radiation Physics):

- Conductivity of electricity through gases at low pressure, Cathode rays – production and properties. Sources of electrons (Discharge through gases, Thermionic emission and photoelectric emission), Discovery of an electron, Concept of electron volt.
- Discovery of X-rays, Production & properties of X-ray, Bremsstrahlung, Factors influencing the intensity and quality of X-ray, Construction and working of Modern X-ray tube (fixed anode and rotatory anode tubes), The physics of X-spectra i,e., the spectrum of radiation from an X-rays tube (Continuous spectrum and line or characteristic spectrum), Factors upon which the X-rays emission depends, Soft and Hard X-rays, Distribution of X-rays in space, The diagnostic X-ray, tubes (inserts and shields), Filament design, anode design (fixed and rotatory), methods of cooling, Basic X-ray Circuit. Linear accelerator-Transmission Type Target.

PRACTICALS ON FUNDAMENTAL PHYSICS: (experiments+charts+ Vivavoce) 60 Hours

List of experiments

1. Study of temperature dependence of total radiation
2. Demonstration of half wave and full wave rectifiers
3. Characteristics of Transistors in CE, CB and CC configuration
4. Study of survery meter and dosimeter cirults
5. Determination of sensitivity of cathode rays oscilloscope
6. Study of raman spectrum using LASER as an excitation source
7. Analsysis of given band spectrum
8. Study of transformers used in diagnostics
9. Film study using x-rays and reason for image sharpness and unsharpness
10. Study of semiconductors (PNP, NPN model)
11. Study of radioactive nucleus in periodic table
12. Determination of Radiation units and calculations
13. Calculations of radioactive material half-life for following
    a) Cobalt-60 b) cesium-137 C) Iridium-192 D) lodine
14. Calculation of photon beam attenuation for a) lead b) Concrete c) wood d) Aluminum
15. Safety and management of radiation protection

SEMESTER-III
B.Sc. in Radiotherapy programme Syllabus
Paper I1 Subject: Radiation safety
Paper Title: Radiation safety

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Syllabus for the training on "Radiation Safety in Radiotherapy as per AERB Guide lines

Unit 1 **7 hours**

Basic Radiation Physics
Atomic structure, Nucleus, Atomic No, Electron orbit and energy levels, Isotopes and isobars, Radioactivity, Radioactive decay, Half-life, Particles radiation, Electromagnetic Radiation, Production of X-rays, Continuous X-ray spectrum, Bremsstrahlung radiation Characteristics X-rays, Filters, Quality of X-rays, Effect of voltage and current on the intensity of X-rays, Properties of X-rays.

Unit 2 **5 hours**

Interaction of Radiation with Matter
Photoelectric effect, Compton Effect, pair production, Ionization of matter, energy absorbed from X-rays, X-rays scattering, X-rays transmission through the medium, linear and mass attenuation coefficient, HVT and TVT, Interaction of charged particle and neutrons with matter.

Unit 3 **3 hours**

Radiation Quantities and Units
Radioactivity, Flux, Fluency, Karma, Exposure, Absorbed Dose, Equivalent dose, weighting factors, effective dose, natural background radiation, occupational exposure limits, dose limits to public.

Unit 4 **10 hours**
Radiation Hazard evaluation and control
Philosophy of radiation protection, effect of time, distance and shielding, calculation of workload, calculation of weekly dose to the radiation worker and general public, good work practices in diagnostic radiology and /or radiotherapy practices (including tele therapy and Brachytherapy), Planning consideration for radiology and/or radiotherapy installation including work load, use factor & occupancy factors, effect of different shielding material.

Unit 5 **5 hours**

Biological effects of radiation

The cell, effect of ionizing on cell, chromosomal aberration and its application for the biological dosimeter, Somatic effects and hereditary effects, stochastic and deterministic effects Acute exposure and chronic exposure, LD 50/60.

Unit 6 **10 hours**

Detection and measurement of radiation & measuring instruments

Ionization of gases, Fluorescence and phosphorescence, effect on photographic emulsion, Ionization chambers, Proportional counters, G.M counters, Scintillation detectors, liquid scintillator, Pocket dosimeters, TL dosimeter and their use in personnel monitoring badges. Advantages and disadvantages of various detectors, appropriateness of different types of detectors for different types of radiation measurement.

SEMESTER-III
B.Sc. in Radiotherapy programme Syllabus
Paper II1 Subject: Medical Physics
Paper Title: Medical Physics

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Unit 1 **3 hours**
Mains Supply

Generation of Electrical Energy, Distribution of Electrical Energy, Use of Electrical Energy, Polyphone Supplies, Availability of Different Voltages, Feeder Cables, Line Voltage Drop; Mains Switches, Fuses, Circuit Breakers. Earthling, Insulation, High Tension Cables Construction, Design.

Unit 2 **5 hours**

Diagnostic High Tension Circuits

Self-Rectified, Half-Wave, Full-Wave, 4 Rectifier, 3 Phase, Capacitor Discharge, Constant Potential. Main Voltage Compensation, Mains Resistance Compensation, Compensations, For Mains Frequency Variation. Control of Tube Voltage, Kilovolt age Compensation; Filament Circuit, Control of Tube Current, Space Charge Compensation. High Tension (Tube Selector) Switch. Meters-Function; Use of Shunts. Meters Commonly Found In Diagnostic X-Ray Equipment, Position In Circuits.

Unit 3 **5 hours**
X-Ray Tubes

Rotating Anode X-Ray Tubes, Design, Rating, and Use of Rating Charts, Care of The X-Ray Tubes; Inherent Filtration and Additional Filtration; Practical Considerations in the Choice of Focus; Speed of Anode Rotation; Angle of Anode Inclination. Grid-Controlled X-Ray Tube.

Unit 4 **7 hours**
Control of Scattered Radiations

Cones, Tube Diaphragms,. Single and Multiyear Grids, Structure and Materials; Grid

Ratio and Lines *fCm*. Parallel and focused Grids, Stationary Grids, Crossed Hatched Grids. Gridded Cassettes, Grid Movement, Potter-Bucky Diaphragms; Single Stroke, Reciprocating And Oscillating Mechanisms; Beam Centering Devices – Centre Finders, Optical Centering Devices, Light Beam Collimators.

Unit 5 **7 hours**

Fluoroscopy and Image Intensifiers:

Equipment

Direct Fluoroscopy, Fluoroscopy Image, Fluoroscopic Screen, Exploratory (Serial Changers, Spot Film Devices) and Accessories. Radiation Protection Including Integrating Timer. Tilting tables. Principles and Construction of Image Intensifiers, Television Cameras Tubes And Cathode Ray Tubes. Recording the Intensified Image, Method Of Viewing The Intensified Image, Equipment For Fluorography and Cine-Fluorography. Radiographic and Fluoroscopic Tables, Tele commands Tables.

Unit 6 **5 hours**

Equipment for Special Procedures:

Special Trolleys and Chairs, Portable and Mobile X-Ray Units, Cordless Mobile X-Ray Equipment, Capacitor Discharge Mobile Equipment, Equipment for O.T. Bi-Plane Radiography, Cranial and Dental Equipment, Skull Tables, Mammography, Mass-Miniature Radiography, Tomography, Multi Section Cassettes, Rapid Cassette Changer, Rapid Film Changer, Magnification Radiography, Subtraction Radiography.

Unit 7 **8 hours**

Care and Maintenance of X-Ray Equipment's:

General Principles of Cleaning Routines. General Care in Use and Special Care or Mobile Equipment's. Simple Test. Uses of Spinning Top and Step Wedge, Checks on Generator Output; check for Integrity of Tomographic Equipment; Procedure For Obtaining Radiograph of The Focal Area. Use of Ma and Timer Wisconsin Test Tool, Test of Kilo Voltage, Wisconsin Test Cassette, Use of Focal Spot Test Tool, Testing Light Beam Diaphragm, Failures of X-Ray Tubes And Ht Cables.

References

1. Christinsen, curry and Dowdey: An Introduction of the physics of Diagnostic radiology [Leafebiger] 2nd edition D.N. and M.O. Chesney, X-ray Equipment for student radiographers

2. W.J. Meredith and J.B. Massey; Fundamental Physics of Radiology [Varghese publishing house] Faiz M. Khan, Physics of Radiation therapy [Williams and Wilkins]

3, S.S.Kapoor and Ramamoorthy; Nuclear Radiation Detectors.

SEMESTER-IV

Papers

1. Applied Anatomy & Pathology
2. Radiation safety in radiotherapy
3. Radiation Biology and Principles of Radiotherapy
4. Constitution of India

B.Sc. in Radiotherapy Fourth semester distribution of hours and credit- CBCS scheme

Subject	Paper	Subjects	Theory		Practical		Demonstrations/ assignments		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
Core course (CC)	Paper-I D201	Applied Anatomy & Pathology	40	**02**	40	**02**	40	1	40	**02**	160	**07**
	Paper-II D202	Radiation safety in radiotherapy	40	**02**	40	**02**	40	1	40	**02**	160	**07**
	Paper-III D203	Radiation Biology and Principles of Radiotherapy	40	**02**	40	**02**	40	1	40	**02**	160	**07**
AEC	D204	Constitution of India	30	**02**	-	**-**	-	-	-	**-**	30	**02**
		Total	150	**08**	120	**06**	120	03	120	**06**	510	**23**

B.Sc. in Radiotherapy Fourth semester distribution of marks - CBCS scheme

Subject	Paper/code	Subjects	Theory				Practical			
			Theory	Viva voce	I.A	Sub total	Practical	I.A	Sub total	Grand total
Core course (CC)	Paper-I D201	**Applied Anatomy & Pathology**	**100**	**30**	**20**	**150**	**40**	**10**	**50**	**200**
		Section A Applied Anatomy	50	15	10	75	20	05	25	
		Section B Applied Pathology	50	15	10	75	20	05	25	
	Paper-II D202	Radiation safety in radiotherapy	100	30	20	150	40	10	50	200
	Paper-III D203	Radiation Biology and Principles of Radiotherapy	100	30	20	150	40	10	50	200
	D204	Constitution of India	50	-	-	50	-	-	-	50
		Total	**350**	**90**	**60**	**500**	**120**	**30**	**150**	**650**

FOURTH SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
Fourth Semester	**Core courses-**	1. Applied Anatomy & Pathology	07
		2. Radiation safety in radiotherapy	07
		3. Radiation Biology and Principles of Radiotherapy	07
	AECC	Constitution of India	02

SEMESTER-IV

B.Sc. in Radiotherapy program Syllabus

Paper I Subject: Applied Anatomy & Pathology

(Section A- Applied Anatomy & Section B Applied Pathology)

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Paper I - Applied Anatomy & Pathology

Section A – Applied Anatomy

Applied Anatomy

Unit 1 Introduction to anatomy – commonly used terms.

Different organ systems and organs:

1. Central nervous system
2. Head and neck
3. Thorox
4. Gastro intestinal tract
5. Genitourinary system
6. Reproductive system
7. Upper Limb and Lower Limbs
8. Lymphatic system

Unit –2 CNS – Brain:

- Definition
- Neuron and functions
- Parts and functions
- CSF and Ventricular system
- Méninges and Blood brain barrier
- Cranial nerves

Spinal Cord :

- Definition and functions
- Spinal cord cross-section
- Spinal nerves
- Radiation tolerance Brain, Brain stem and spinal cord.
- Planning of whole Brain RT.

Unit -3 Head and Neck:

Eye: orbit and extra ocular muscles – parts and function
Ear: Parts and function, Hearing glass – types
Nose & Para nasal sinuses – Terminology, structure and function
Oral cavity: Parts and function , Lymphatic damage, RT tolerance Limits
Mucositis – grading system.
Pharynx: Structure and function,
Nasopharynx- parts and function
Oropharynx - Parts and function
Hypopharynx - Parts and function
Sup, middle and Inferior constrictors.
RT Tolerance Limits
Thyroid gland: Structure and function - Lobes, Isthmus, Follicle
Salivary glands:
Parotid: Location, Structure and function
Submandibular: Location, Structure and function
Sublingual: Location, Structure and function
Skull and Mandible: skull, Neuro cranium, Facial Skeleton, vault, skull base
Bones involved and skull base foramen
Mandibles: Structure and parts, RT tolerance.
TMJ: Structure in brief
Neck node: level I TO VI – Boundaries and areas.

Unit 4 Thorax:

Lungs: Definition, structure: lobes and segments, Alveolar structure, function.
Pleura: Definition, structure and function
RT Tolerance limits of lungs
Heart: 4 chambers and valves
Pate way of blood circulation: Heart – lung – heads- art cru- systemic circulation – vein's.
Blood supply to heart. Pericardium, RT Tolerance limits, Great vessels.
Thymus gland: structure and function in brief.
Esophagus – Cervical, Thoracic - Upper, Mid and Lower 1/3rdand Abdominal parts.
Trachea and Mediastinum.
Breast: structure and function, Lymphatic drainage, Axilla - groups of lymph nodes.
Brachial plexus – in brief and RT tolerance limits,
Chest wall and diaphragm – briefly

Unit 5. Gastro Intestinal Tract:

Parts:
liver- surface marking, Lobes, Histology, Function. RT tolerance limits.
Stomach- Parts of stomach, structures in stomach bed, Lymphatic drainage. RT tolerance limits.
Pancreas : Parts, Lymphatic drainage. RT tolerance limits.

Spleen – Structure and function in brief.
Small intestine, large intestine, colon rectum, anal canal - structure and function in brief.
RT Tolerance limits.

Unit 6 Genitor urinary system:

1. Kidney: Definition and function, location, structure, nephron and function, blood supply
2. Ureters: course in brief, function and cross section
3. urinary bladder: structure and function, trigone, RT tolerance limits
4. urethral: Different structure between male and female, function

Unit 7 - Reproductive system

Female:

1. Uterus – endometrium, myometrium, structure and function, size and parts – cervix, body, fundus, fallopian tubes.

2. Ovaries: structure.

3. Vagina and vulva- Structure and RT tolerance limits.

Male:

1. Testis and scrotum structure in brief

2. Prostate: structure in brief

3. Penis: structure in brief, RT tolerance limits of Penile bulb.

Unit 8 Upper limb and lower limb

Bones and muscles names, attachment and function, major nerves and blood vessels in brief
Upper limb: clavicle, scapula, humorous, radius, urine, carpal bones metacarpals and phalanges.
lower limb: femurs – head, neck, shaft, tibia, fibula and tarsal bones, metatarsals and phalanges.
Major blood vessels and Nerves.
Important surface landmarks.

Unit 9 Lymphatic system:

Neck nodeal levels, Axilla, Mediastinal nodes, Para-aortic nodes, Pelveic nodes, Inguinal nodal area.

PRACTICAL: Applied Anatomy (20 marks)

- Demonstration of various organs and systems of human body
- Surface marking of organs in the human body
- Sectional anatomy
- Identification and examination of organs with pathology with respect to tumor
- Study of regional lymphatics
- Microscopic features of tissues and organs
- Staging and grading of neoplasia

Section B-Applied Pathology

Theory

Pathology of common malignant disease of individual sites (in brief)

- Skin cancer
- Head and neck tumors
- GI tract tumors (esophagus, rectum, and anus)
- Lung cancer
- Lymphomas
- Breast cancer
- Gynecological cancers
- Prostate cancer
- Bladder cancer
- Seminoma
- Pediatric Tumors and others

Practical

Applied pathology (20marks)

1. Demonstration of histopathological examination of squamous cell carcinoma, adenocarcinoma and lymphoma of malignant diseases at individual sites
2. Immunohistochemistry method for confirmation of neoplastic cells
3. Demonstration of pathological specimen and histopathological examination of
   a) skin cancer
   b) head and neck tumors (mouth,nasopharengial, oropharengial, paranasal sinus, salivary gland)
   c) Brain tumor
   d) Lung cancer
   e) Lymphoma
   f) Breast cancer
   g) Prostrate cancer
   h) Bladder cancer
   i) Seminoma
   j) Pediatric tumor

SEMESTER-IV

B.Sc. in Radiotherapy program Syllabus

Paper II Subject: Radiation safety in Radiotherapy

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Paper-II Radiation safety in radiotherapy (as per AERB guidelines)

Unit 1 -Basic Radiation Therapy Physics

Historical development in Radiotherapy, Physical components of Tele cobalt Unit/Linear Accelerator Unit/ Remote After Loading Brachytherapy Unit/Gamma Knife Unit/Simulator of their descriptions, Various types of sources used un Radiotherapy and their properties, Physics of Photons, electrons, protons and neutrons in Radiotherapy, Physical parameters of dosimetry such as percentage Depth Dose, Tissue-Air Ratio, Tissue Maximum Ratio, Physics of Bolus and Phantoms materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices, Port film, processing and development, Special techniques in Radiotherapy such as Percentage Depth Dose, Tissue- Air Ratio, Tissue Maximum Ratio, Physics of Bolus and Phantom materials, Compensators, Wedges, Shielding Blocks, Patient immobilization devices, Port film, processing and development, Special techniques in Radiotherapy such as SRS, SRT, IMRT, IGRT and Tomo therapy.

Unit 2 - QA in Radiotherapy

Accessories and tools used for QA tests in Radiotherapy such as Front pointer, Back pointer, Laser Alignment etc. Optical and radiation field congruence, Beam shaping blocks, Beam shaping jaws, Delineator/Diaphragm movements, Isocentre alignment, Patient support system, Beam on and off mechanisms, Technician's role in QA tests on tele cobalt/Linear Accelerator/ Brachytherapy/ Gamma knife/ Simulator/ CT Simulator machines.

Unit 3- Radiation Emergency Preparedness

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 maintains and Safety Culture, Role of technicians in handling radiation emergencies.

Unit 4 - **Regulatory requirements**

National Regulatory Body, Responsibilities, Organization, Safety Standards, Codes and Guides, Responsibilities of Licensees, registrants and employers and Enforcement of Regulatory requirements.

Unit 5 - **Demonstration:**

- Time, Distance and Shielding, measurement of HVT& TVT
- Familiarization of radiation survey meters and their functional performance checks
- Radiological Protection Survey of Radiotherapy, Simulator and CT Simulator Installations
- QA on X-ray, Simulator and Radiotherapy Equipment(s)
- Procedures followed for calibration of measuring and monitoring instruments.

SEMESTER-IV

B.Sc. in Radiotherapy program Syllabus

Paper III Subject: Radiation Biology and Principles of Radiotherapy

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Paper-III Radiation Biology and Principles of Radiotherapy

Section A

RADIATION BIOLOGY

- The Physics and Chemistry of Radiation Absorption
- DNA strand breaks and chromosomal aberrations
- Cell Survival Curves
- Dose response relationship for normal tissues
- Oxygen Effect and deoxygenation
- Linear Energy transfer and Relative Biological Effectiveness
- Time, Dose and Fractionation in Radiotherapy
- New Radiation Modalities
- Acute Effects of Total Body Irradiation
- Radiation Carcinogenesis, Hereditary Effects,
- Effects on Embryo and Fetus, Catractogenisis
- Radiation Protection
- The Cell Cycle, effects of radiation on the normal cell and abnormal cell. Radio sensitivity of normal tumors cells.

Section B

PRINCIPLES OF RADIOTHERAPY

- Basics of Oncology : Multidisciplinary approach to the management of the Cancer Patient:- Radiation Therapy, Surgery and Chemotherapy.
- Development of neoplasia within the patient
- Clinical signs and symptoms of neoplasia
- Physical effects of neoplasia on the body
- Staging of Cancer (TNM classification).
- External Beam Therapy & Brachytherapy: Rationale, Preparation of Patient, Techniques,
- Dose, Volume, Time, Fractionation, Simulation, Reduplication of Treatments, Results, Survival.
- Altered Fractionation Schedules
- Acute and Late Effects of Radiation Therapy

- Care & assistance during Sedation/Anesthesia
- Physical effects of Radiotherapy, chemotherapy, surgery and other treatments, in combination and alone on the body.
- Prevention and treatment of the acute side effects of Radiotherapy and associated treatments
- Complications associated with cancer and its treatment, Causes of death.

PRACTICAL [for 3rd & 4th semester]

PRACTICAL OF RADIATION THERAPY TECHNIQUES

Note: (E) Denotes Practical Prescribed in University Examinations.

1. Mold Room (E)

a. Equipment's
b. Preparation of
   i. Plaster of Paris cast
   ii. Perspex cast
   iii. Or fit/Aqua last immobilization cast and others
   iv. Shield (use of Styrofoam Cutter)
   v. Tissue Compensators
   vi. Electron Lead Cutout
   vii. Mouth Bite
   viii. Computerized Tissue Compensator Preparation (optional)

2. Tele therapy & Brachytherapy Treatment planning: (E)

a. Iso-dose plotting
b. Studying of dose distribution to tumor and Normal tissues
c. Calculations of Tele therapy & Branch therapy treatment time
d. 3 D Planning (optional)
e. Use of Computers and TPS.

3. Simulation equipment parts, operation, principles: (E)

Simulation of:-

i. AP/PA portals for pelvis in cancer cervix with SSD Techniques.
ii. Simulation of four fields of pelvis in cancer cervix with SAD Techniques.
iii. Simulation of oblique fields for cancer esophagus with SAD Techniques.
iv. Simulation of tangential fields of a case of Ca. Breast
v. Simulation of whole Brain Irradiation
vi. Routine X-ray Chest, Abdomen, Extremities & Patient Positioning and decubitus.
vii. Barium Swallow Radiology Technique, Barium meal, Barium follow through
viii. Intravenous pyelography
ix. CT Simulation.

4. Radiation Safety and Protection (E)

5. Quality Assurance in Radiotherapy (E)

Practicals Scheme Of Examination 80 Marks

(Common Practical)

1. Mold Room	20 Marks
2. Tele therapy & Branchy therapy Treatment planning	20 Marks
3. Simulation equipment parts, operation, principles	20 Marks
4. Radiation Safety and Protection	10 Marks
5. Quality Assurance in Radiotherapy	10 Marks

SEMESTER-V

Papers

1. Radiation Physics
2. Principle and Practice of Radiotherapy
3. Skill Enhancement course
   Medical Ethics

Fifth semester B.Sc. in Radiotherapy distribution of hours and credit

Subject	Paper	Subjects	Theory		Practical		Demonstrations/ assignments		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
Core course (CC)	Paper-I E201	Radiation Physics	40	**02**	60	**02**	40	1	40	**02**	180	**07**
	Paper-II E202	Principle and Practice of Radiotherapy	40	**02**	-	**-**	40	1	40	**02**	120	**05**
Skill enhancement course (SEC)	E203	Medical Ethics	30	**02**	-	**-**	-	-	-	**-**	30	**02**
		Total	110	**06**	60	**02**	80	02	80	**04**	330	**14**

Fifth semester B.Sc. in Radiotherapy distribution of marks - CBCS scheme

Subject	Paper/code	Subjects	Theory				Practical			
			Theory	Viva voce	I.A	Sub total	Practical	I.A	Sub total	Grand total
Core course (CC)	Paper-I E201	Radiation Physics	100	30	20	150	40	10	50	200
	Paper-II E202	Principle and Practice of Radiotherapy	100	30	20	150	40	10	50	200
Skill enhancement course (SEC)	E203	Medical Ethics	50	-	-	50	-	-	-	50
		Total	**250**	**60**	**40**	**350**	**80**	**20**	**100**	**450**

FIFTH SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
Fifth Semester	**Core courses-**	1. Radiation Physics	07
		2. Principle and Practice of Radiotherapy	05
	Skill enhancement course (SEC)	Medical Ethics	02

SEMESTER-V

B.Sc. in Radiotherapy programme Syllabus

Paper I Subject: Radiation Physics

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Paper-1 Radiation Physics

Unit 1 - Principles of Radiation detection and measurement:

- Gas-filled detectors (ion chambers, proportional counters and Geiger Muller counters) scintillation detectors, thermos-luminescent dosimeters (TLD), Reasons for choice of air ionization. Roentgen and Rad. Simple principles of dosimeter. Thimble chamber-electronic equilibrium and dose buildup. Secondary Dosimeter. Elementary principles of Scintillation detectors, Thermoluminisence dosimeters, Semi-conductor devices.

Unit 2 - Biological Effects of Radiation:

- Chemical effects of Radiation, radiolysis of water, production of free radicals, radical are reactions, G-valve. Effects - Stochastic and non – Stochastic effects, chromosome aberrations and mutations. Radiation effects on which body (early effects and late effects). Concept of doubling dose.

Unit 3 - Radiation Protection:

- Philosophy of radiation protection-historical development, Maximum permissible exposure concept; Annual dose equivalent limits (ADEL) ALARA concept; international recommendations and current code of practice. Annual dose limits for public & Radiation workers. Protection of Public and Radiation workers.

- Protective materials: Concrete, lead, lead-impregnated substance, building materials, concept of barriers, lead equivalents and variations with quality. Tele therapy Bunker (Room) Design (Tele cobalt, Linear Accelerator). Radiation protection features taking into account the work load, use factor, occupancy factor. Wall features with respect to primary beam and secondary radiation. Ceiling thickness depending on occupancy on the floor above Tele therapy room. Positioning of Air conditioning outlets.

- Design of Brachytherapy room: difference between public area and restricted areas. Radioactive source movement, control and maintenance of records. Protection instruments and personnel and area monitoring. (Survey meters, area monitors, pocket dosimeters and contamination monitors).

Unit 4 - Production of X- and Gamma Ray Beams for Therapeutic purpose:

- Tubes and high-tension circuits for the production of X-ray from 5 to 500 curie Kv. Insulation and cooling problems in Radiotherapy tubes.
- Mains voltage compensation. Control of tube voltage
- The control panel and control. The filament circuit.
- Timer's safety devices and interlocks.
- Basic principles of mega voltage X-ray Machines

- Distribution of Radiation around the target.
- Gamma ray beam unit.

Unit 5 - Interaction of X and Gamma Rays with Matter:

- Photoelectric absorption; Compton scattering; pair production. Dependence on the nature an atomic number of the absorber and on the radiation energy.
- Range of secondary electron and its practical importance.
- Principles of filtration, protection and beam definition.
- Filters, bean – flattening devices, diaphragms and applicators.

Unit 6 - Measurement of X and Gamma Rays:

- The roentgen and the rad,
- Quality. Half value thickness and its measurement,
- Methods of measurement; ionization; photographic; scintillation; calorimetric; thermos luminescent, their relatives advantages.
- Ionization dosimeters; dose-rate, integrating and capacitor types.
- The Geiger-Muller counter.
- Scintillation counters and dosimeters.

Unit 7 - Practical dosage Measurements and Calculation:

- Initial calibration. Site of focal spot or source; alignment of applicator or diaphragm turntable and of the applicator of diaphragm.
- Variation of dose rate across the beam in air.
- Phantoms and phantom materials. Bolus materials.
- Air, surface and depth doses; factors affecting them.
- Calculation of treatment times.
- Is dose curves.
- The effect of focal spot or surface source site; penumbra.
- Energy absorption in the body tissues and its effects on depth dose.

Unit 8 - Protection:

- Protective materials in common use,
- Room and machine radiation-protection in X- and Gamma –ray beam installations,
- Care and custody of small sealed radioactive sources (for example radium, caesium-137, Strontium 90)
- Precaution to be taken in the use of dispensing of radioactive solutions.
- Personnel-monitoring methods. Department survey. Film badges, capacitor chambers and survey meters. Geiger-Muller detector
- Relevant protection recommendations and current code of practice

Unit 9 - Technical aspects of X and Gamma Ray Therapy:

- Tumor location and verification, principles of simulators.
- Field combinations and treatment planning,
- Beam direction devices,
- Compensating filters (for example wedges)

- Physical principles of moving field and grid therapy,
- Special aspects of Radiotherapy using mega voltage radiations, including electron beam therapy.

Unit 10 - Clinical Dosimetry for Photon and Electron Beams:

- Dose distribution along beam axis
- Dose distribution off axis
- Variation of dose rate with distance and collimator settings
- Manual calculation of treatment times
- Beam modifiers (bolus, wedge, compensators)
- Computer does calculations
- Definition of volumes and their significance
- Single, parallel and multi-field technique
- Effect of change of energy, beam direction, beam collimation, irradiation
- Geometry
- Calculated and applied doses and beams against professional knowledge.

Unit 11 - External Beam Therapy

- **Radiation Equipment**
  - Principles and functioning of low energy x-rays
  - Principles and functioning of Tele-cobalt machines
  - Principles and functioning of linear accelerators.

PRACTICALS on Radiation physics (40 marks)

1. Measurements of output from cobalt therapy machine
2. Measurement of depth dose and calculation of depth dose
3. Brachytherapy planning for manual after loading Cs-137 system.
4. Ir-192 Implant dose calculation
5. Treatment planning of (a)single direct field, (b)two opposite field
6. Treatment planning of (a) 3 fields, (b) cross fire technique
7. Acceptance tests on Cobalt-60 units
8. Uses of simulator for treatment verification.
9. Treatment planning with computer.
10. Radiation survey of Tele therapy installation.

SEMESTER-V

B.Sc. in Radiotherapy program Syllabus

Paper II Subject: Principle and Practice of Radiotherapy

Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

Paper-II Principle and Practice of Radiotherapy

1. Diagnostic Workup and Treatment principles and Radiotherapy Techniques.

Unit I - Radio therapeutic Management of the following Cancer and occasional Benign Diseases

- Skin cancer
- Head and neck tumors
- Brain tumors
- G I tract tumors (esophagus, rectum, anus)
- Lung cancer
- Lymphomas
- Breast cancer Gynecological cancers
- Prostate cancer
- Bladder cancer
- Seminoma
- Pediatric Malignancies

Unit 2 - Clinical applications of techniques of Radiotherapy:

1. **Tele therapy techniques**
    a. use of conventional fields SSD, SAD, Rotation
    b. Use of complex treatment plans-quality assurances, verification etc.
    c. use of radiation sensitizers & radiation protectors and their importance with respect to timing of the radiotherapy exposure
    d. Patient positioning, immobilization, daily reproduction errors and corrections.

2. **Combination of Tele therapy and Brachytherapy**

Unit 3 - PSYCHOSOCIAL MANAGEMENT

- Procedures for adaptation and rehabilitation of the person with cancer-Body Mechanics, Moving & Transferring Patients-Patients with Spinal cord injury, Fractured Extremity, Agitated & Confused patients
- Pediatric, Geriatric Patients.
- Patients with Ostomy, Gastric tube, Tracheotomy.
- Assisting with Drug and Contrast Administration,
- Counselling skills
- Role of effective communication
- Complementary therapies
- Stress and stress management
- Hospice and terminally ill.

Unit 4- QUALITATIVE AND QUANTITATIVE METHODS OF RESEARCH

- Basic statistics, Interpretation of Research Publications
- Report writing

PRACTICAL

RADIOTHERAPY

Note: (E) Denotes Practical Prescribed in University Examinations.

1. Cobalt-60 machine: various parts, its working its Accessories, Beam Direction devices and Control console. **(E)**

2. Linear Accelerator: Various parts, it's working its Accessories, Beam Direction devices and control console. (**E**)

3. Simulation and Treatment Techniques (**E**)

Execution of Treatment as Per Doctors, Prescription in radiation therapy chart Ability to understand the, patient's diseases, patients general condition, shifting the patient into treatment room & couch, patient positioning, use of immobilization devices and preparation of the same, verification and quality assurances align

a. Cancer Esophagus
b. Cancer Cervix
c. Cancer Breast
d. Glottis cancer
e. Nasopharyngeal cancer
f. Bronchogenic Cancer
g. Whole Brain
h. Crania-Spinal Axis Irradiation (optional)
i. Irregular Field (including Mantel Field)
j. Special Techniques (Rotation/Arc etc.)
k. Newer Techniques (optional)

SEMESTER-VI

Papers

1. Radiotherapy-I [Radiotherapy technique in treatment modalities]
2. Radiotherapy-II [Radiotherapy technique in treatment modalities]
3. Skill Enhancement course: Quality control

Sixth semester B.Sc. in Radiotherapy distribution of hours and credit- CBCS scheme

Subject	Paper	Subjects	Theory		Practical		Demonstrations/ assignments		Tutorials		Total	
			hours	**Credits**	hours	**Credits**	hours	**Credits**	hours	**Credits**	Hours	**Credits**
Core course (CC)	Paper-I F201	Radiotherapy-I Radiotherapy technique in treatment modalities	50	**03**	60	**02**	40	1	40	**02**	190	**08**
	Paper-II F202	Radiotherapy-II Radiotherapy technique in treatment modalities	50	**03**	60	**02**	40	1	40	**02**	190	**08**
SEC	F203	Quality control	30	**02**	-	**-**	-	**-**	-	**-**	30	**02**
		Total	130	**08**	120	**04**	80	02	80	**04**	410	**18**

B.Sc. in Radiotherapy Sixth semester distribution of marks - CBCS scheme

Subject	Paper/code	Subjects	Theory				Practical			
			Theory	Viva voce	I.A	Sub total	Practical	I.A	Sub total	Grand total
Core course (CC)	Paper-I F201	Radiotherapy-I	100	30	20	150	40	10	50	200
	Paper-II F202	Radiotherapy-II	100	30	20	150	40	10	50	200
Ability enhancement compulsory course	F203	Quality control	50	-	-	50	-	-	-	50
		Total	**250**	**60**	**40**	**350**	**80**	**20**	**100**	**450**

SIXTH SEMESTER PROGRAMME STRUCTURE

Semester	Course Opted	Course Name	Credits
Sixth Semester	**Core courses-**	1. Radiotherapy-I	08
		2. Radiotherapy-II	08
	Ability enhancement compulsory course (AECC)	Quality control	02

SEMESTER-VI
B.Sc. in Radiotherapy programme Syllabus
Paper I Subject: Radiotherapy-I
Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

RADIOTHERAPY-1

Unit 1 - Dose delivery to the patient

- Immobilization of patient
- Interpretation of the treatment prescription and plan
- Setting up of the prescribed beam parameters and check against reference marks
- Preparation, fixation and care of in vivo dosimeter (if available)
- Registration of the delivered beam parameters on a daily basis
- Documentation of portal verification and results of in vivo dosimetry
- Surveying the patient during the treatment procedure

Unit 2 - Special techniques

- Total body irradiation
- Hemi-body irradiation
- Conformal Beam Radiation Therapy
- Intensity Modulated Radiation Therapy
- Stereo tactic radiotherapy
- Intra –operative radiotherapy
- Image guide radiotherapy
- Tomo therapy

Unit 3 - Technical Aspect of the use of Radioactive Source in the Body:

- Construction, measurement, testing and properties of small sealed radioactive sources,
- Dose calculations involving the inverse square law,
- Physical principles of molds and implants
- Superficial beta ray therapy, Measurement beta ray dose.
- Clinical beta-ray appliances
- Physical principles of the clinical use of unsealed radioactive sources.

Unit 4 - Construction of Cobalt-60 Tele therapy Units:

- Types of source drawers (cylindrical/Rotating Drum)
- Is centric Setup and design of the Unit
- Collimation: Primary, Secondary & tertiary
- Laser beam, Beam direction devices, back pointer, pin & are principles.
- Beam modifying devices: Wedges Filters, Tissue compensators
- Blocks, Breast aspect
- Understanding why strength of Tele therapy source at a given distance, definition of RHM/RMM.

Unit 5 - Construction of Linear Accelerator

- Is centric Setup and design of the Unit
- Collimation: Primary, secondary & tertiary, Symmetric/Asymmetric.

- RF production, Accelerator Tube, Bending Magnet
- Targets of X-ray and Electron beam production
- Radiation safety aspect: Ionization chamber, quality assurance checks.
- Definition of TMR, TRP with respect to high energy x-ray beams
- Concept of monitoring units instead of timer as in Tele cobalt
- Measurement of output factor and it calibration
- Multi leaf collimator: 3D conformal/
- Stereotactic Radiation therapy &Surgery/IMRT.
- Portal imaging/IGRT.

Unit 6 - BRACHYTHERAPY

- Knowledge of use of radionuclides and after loading equipment (low, medium, high and pulsed dose rate)
- Preparation of the source holders (applicators, catheters)
- Preparation of the including radiographs for dosimetry and preparation of the molds
- Monitoring of the patient before, during and after treatment
- Accurate and complete recording of documentation of all the parameters relevant to the treatment
- Aftercare of the used radioactive sources with emphasis on safety
- Clinical Dosimetry for Brachytherapy.

Unit 7 - OTHER TREATMENT MODALITIES

- Gene therapy
- Photodynamic therapy
- Unsealed radioactive nuclides
- Radiation enhancers-hypothermia, radio sensitizers.

Unit 8 - LOCALISATION AND SIMULATION

- Principles and functioning of simulators
- Patient positioning, knowledge of fixation techniques
- Knowledge of simulation techniques for a broad range of indications and use of contrast media
- Contour taking techniques and reference marking
- Use of CT and MR images
- Data recording and transfer.

Unit 9 - **QUALITY ASSURANCE-METHODS**

- Equipment and auxiliary materials (to include care of)
- Treatment procedures- accuracy, reproducibility and verification
- Data handling
- Monitoring and evaluation of QA procedures
- Calibration of instruments
- Emergency procedures

Unit 10 - MOULD ROOM TECHNIQUES

- Immobilization Devices & techniques for patients and their preparation
- Beam shaping devices (block, compensators etc.) and their preparation
- Bolus materials and their preparation
- Modules for Brachytherapy.

Unit 11 - **BASIC RADIAOLOGIC IMAGING TECHNIQUES**

- Radio logic Film – types, exposure, development
- Production of Radiographic Image using simulator, CT Scanner or conventional x-ray machines
- Improving Image Quality
- Fluoroscopy
- Dark Room Procedures

SEMESTER-VI
B.Sc. in Radiotherapy programme Syllabus
Paper II Subject: Radiotherapy-II
Credits (Theory 02, Practical 02, Demonstration 01)

Theory lectures: 40

RADIOTHERAPY-II

Unit 1 -Post & Pre-operative Radiotherapy

Unit 2 - Special Techniques : 3D Conformal RT, IMRT , SRS/SRT-

a. Patient setup, Immobilization
b. Simulation/CT Simulation and Verification with quality assurance checks
c. Use of Immobilization devices & Frames- careful handling
d. Daily reproduction and quality assurance
e. Port filming and iso center verification

Unit 3 - Clinical applications of Special tele therapy techniques.

- Total body irradiation
- Hemi- body irradiation
- Conformal Beam Radiation Therapy
- Intensity Modulated Radiation therapy
- Stereo tactic radiotherapy
- Intra-operative radiotherapy
- Image guided radiotherapy
- Tomotherapy

Unit 4- MEDICAL, LEGAL AND ETHICAL ASPECTS

- Getting the consent of the patient
- Confidentiality, Data handling
- Non-discriminatory practice
- The professional role of the Radiotherapy technologists

Unit 5 - HEALTH AND SAFETY

- Waste management
- legislation: National and international
- Health and safety at work
- Emergency procedures
- Cardiopulmonary resuscitation procedure (CPR)
- Self Help Groups & NGO's and other organization
- Funding agencies

Unit 6 - RECENT ADVANCE IN RADIOTHERAPY

- 3D CRT, IMRT, Particle Beam Therapy, IGRT, Radiation Sensitizer and Protectors, Cyber knife, Tom therapy, Gamma Knife

Practical

Brachytherapy:

1. Manual after loading applicators: Various types: I/c, I/Vaginal, I/L Principles, its care, sterilization, uses, safety measures.
2. (Optional) Remote After Loading machines, -LDR/HDR: Parts, working, operation and precautions.
3. Various after loading sources for Interstitial Implantation: Physical features.
4. Preparation of Radioactive Source for Brachytherapy
5. I/c application cancer cervix. Application simulation study of dose distribution, preparation of sources, loading of source and treatment and care and removal and storage of sources.(E)
6. I/L Radiotherapy application. Application, simulation, study of dose distribution, preparation of sources, loading of sources and treatment and care and removal and storage of sources.
7. Advanced Training
    a. Dynamic Wedges
    b. Stereo Tactic Radiotherapy / Surgery
    c. 3D CRT
    d. IMRT
    e. Portal Imaging Method
    f. HDR Brachytherapy.

Distribution of Type, Number and marks of Questions for Various Subjects

THEORY

Subjects having maximum marks = 100			Total
Type of question	Number of questions	Marks for Each question	
Essay type	02 (no choice)	10	20
Short essay type	12 (Answer any 10)	5	50
Short answer type	12 (Answer any 10)	3	30

Subjects having maximum marks = 80			Total
Type of question	Number of questions	Marks for Each question	
Essay type	02 (no choice)	10	20
Short essay type	8 (Answer any 6)	5	30
Short answer type	12 (Answer any 10)	3	30

Subjects having maximum marks = 50			Total
Type of question	Number of questions	Marks for Each question	
Essay type	02 (no choice)	10	20
Short essay type	5 (Answer any 3)	5	15
Short answer type	7 (Answer any 5)	3	15

Subjects having maximum marks = 40			Total
Type of question	Number of questions	Marks for Each question	
Essay type	01	10	10
Short essay type	4 (Answer any 3)	5	15
Short answer type	6 (Answer any 5)	3	15

-End-