ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF MEDICAL & ALLIED SCIENCES
(RSMAS)

DEPARTMENT OF RADIOGRAPHY & ADVANCE IMAGING TECHNOLOGY

COURSE STRUCTURE & SYLLABUS
(BASED ON NATIONAL EDUCATION POLICY 2020)

FOR

B.Sc. IN RADIOGRAPHY & ADVANCE IMAGING TECHNOLOGY
(4 YEARS SINGLE MAJOR)

W.E.F

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Preamble

The National Education Policy (NEP) 2020 conceives a new vision for India's higher education system. It recognizes that higher education plays an extremely important role in promoting equity, human as well as societal well-being and in developing India as envisioned in its Constitution. It is desired that higher education will significantly contribute towards sustainable livelihoods and economic development of the nation as India moves towards becoming a knowledge economy and society.

If we focus on the 21st century requirements, the higher education framework of the nation must aim to develop good, thoughtful, well-rounded, and creative individuals and must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and twenty-first-century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education should be capable enough to enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. Overall, it should focus on preparing students for more meaningful and satisfying lives and work roles and enable economic independence.

Towards the attainment of holistic and multidisciplinary education, the flexible curricula of the University will include credit-based courses, projects in the areas of community engagement and service, environmental education, and value-based education. As part of holistic education, students will also be provided with opportunities for internships with local industries, businesses, artists, crafts persons, and so on, as well as research internships with faculty and researchers at the University, so that students may actively engage with the practical aspects of their learning and thereby improve their employability.

The undergraduate curriculums are diverse and have varied subjects to be covered to meet the needs of the programs. As per the recommendations from the UGC,introduction of courses related to Indian Knowledge System (IKS) is being incorporated in the curriculum structure which encompasses all of the systematized disciplines of Knowledge which were developed to a high degree of sophistication in India from ancient times and all of the traditions and practises that the various communities of India—including the tribal communities—have evolved, refined and preserved over generations, like for example Vedic Mathematics, Vedangas, Indian Astronomy, Fine Arts, Metallurgy, etc.

At RGU, we are committed that at the societal level, higher education will enable each student to develop themselves to be an enlightened, socially conscious, knowledgeable, and skilled citizen who can find and implement robust solutions to its own problems. For the students at the University, Higher education is expected to form the basis for

knowledge creation and innovation thereby contributing to a more vibrant, socially engaged, cooperative community leading towards a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation."

Radiography and Advance Imaging Technology is a specialty in Allied Health Sciences where trained professionals work on diagnosing pathologies through medical imaging using ionizing and non-ionising radiation.

It involves understanding of medical radiation physics, role of radiation in diagnostic radiology and imaging, hazards of radiation and protection of self, other personnel, patient and public from radiation. It provides hands on training of X-ray unit, DEXA, ultrasound, mammography, DSA, CT and MRI.

Radiography and Advance Imaging Technology is a critical component of patient's treatment. Almost all departments rely on the radiological examinations for the diagnosis of pathologies and conditions. All the patients coming to radiology department have the right to receive optimum quality image with minimum radiation exposure consistent with good patient care.

Abbreviations

1. Cr. - Credit
2. Major - Core Courses of a Discipline
3. Minor - May/may not be related to Major.
4. SEC - Skill Enhancement Course
5. VAC - Value Addition Course
6. AEC - Ability Enhancement Course
7. GEC - Generic Elective Course
8. IKS - Indian Knowledge System
9. AICTE - All India Institute of Technical Education
10. CBCS - Choice-Based Credit System
11. HEIs - Higher Education Institutes
12. MSDE - Ministry of Skill Development and Entrepreneurship
13. NAC - National Apprenticeship Certificate
14. NCrF - National Credit Framework

15. NCVET - National Council for Vocational Education and Training
16. NEP - National Education Policy
17. NHEQF - National Higher Education Qualification Framework
18. NSQF - National Skill Qualifications Framework
19. NTA - National Testing Agency
20. SDG - Sustainable Development Goals
21. UGC - University Grants Commission
22. VET - Vocational Education and Training
23. ME-ME - Multiple Entry Multiple Exit
24. OJT - On-Job Training
25. NCH - Notional Credit Hours

1. 1. Introduction:

The National Education Policy (NEP) 2020 clearly indicates that higher education plays an extremely important role in promoting human as well as societal well-being in India. As envisioned in the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. According to the new education policy, assessments of educational approaches in undergraduate education will integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) that will lead to positive learning outcomes. This will lead to develop creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning, and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. and more in-depth learning.

The NEP highlights that the following fundamental principles that have a direct bearing on the curricula would guide the education system at large, viz.

i. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.

ii. Flexibility, so that learners can select their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests.

iii. Multidisciplinary and holistic education across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world.

iv. Emphasis on conceptual understanding rather than rote learning, critical thinking to encourage logical decision-making and innovation; ethics and human & constitutional values, and life skills such as communication, teamwork, leadership, and resilience.

v. Extensive use of technology in teaching and learning, removing language barriers, increasing access for Divyang students, and educational planning and management.

vi. Respect for diversity and respect for the local context in all curricula, pedagogy, and policy.

vii. Equity and inclusion as the cornerstone of all educational decisions to ensure that all students can thrive in the education system and the institutional environment are responsive to differences to ensure that high-quality education is available for all.

viii. Rootedness and pride in India, and its rich, diverse, ancient, and modern culture, languages, knowledge systems, and traditions.

Royal School of Medical and Allied Sciences imbibes a **National Credit Framework (NCrF)** for its Under Graduate program - Bachelor of Radiography and Advance Imaging Technology (BRIT) from the new academic session which will make learning more student centric, interactive and outcome oriented with well defined aims, objectives and goals. The approach is envisioned to provide a focused, skill based syllabus at the program level with an agenda to structure the teaching-learning process in such a way that the students obtain the much needed 21st Century skills like critical thinking, problem solving, analytical reasoning, cognitive skills, self directed learning's among other such skills. In short, the main focus of the Program is to prepare the graduate level students in the best possible way for both, academia and employability.

The new curriculum will offer students with relevant core papers that help build their foundation in the area of management. The choice of generic electives and skill enhancement courses will enable students to pursue an area of their interest in the field of management & its allied fields . The contents of each course have been carefully designed to prepare students with knowledge and skill sets that will not only make them industry ready but also foster entrepreneurial and innovative thinking.

In order to achieve the program goals following measures would be adopted:

(i) Regulatory curriculum reform based on National Credit Framework.

(ii) Enriching the quality of teaching and research;

(iii) Enlightening learning environment through ICT based hands-on approach to students;

(iv) Involving students in discussions, problem-solving, and out of the box thinking;

(v) Motivating the learners to understand various concepts of management and apply them in real life situations.

Radiography uses the science of radiation to produce images of tissues and organs. It is used by medical professionals to diagnose and treat medical conditions. The diagnostic side of radiography uses specialized equipment to create images, such as x-rays, that show the inside of the human body. X-rays can be recorded on a film or as a computerized image. Radiography can also be used to treat internal malignancies like tumours. A doctor who specializes in this area is called a radiologist, while an assistant is referred as a radiologic technologist. According to the American Society of Radiologic Technologists (ASRT), a radiologic technologist is part of a medical personnel team that is responsible for taking diagnostic images and performing radiation therapy treatments. These professionals are trained in a number of core areas that are important to radiography, such as patient positioning, human anatomy, patient care, radiation safety and protection, equipment handling and protocols etc.

1.2. Credits in Indian Context:

1.2.1. Choice Based Credit System (CBCS) By UGC

Under the CBCS system, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be earned by the students. This framework is being implemented in several universities across States in India. The main highlights of CBCS are as below:

• The CBCS provides flexibility in designing curriculum and assigning credits based on the course content and learning hours.

• The CBCS provides for a system wherein students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

• CBCS also provides opportunity for vertical mobility to students from a bachelor's degree programme to masters and research degree programmes.

1.3. Definitions

1.3.1. Academic Credit:

An academic credit is a unit by which a course is weighted. It is fixed by the number of hours of instructions offered per week. As per the National Credit Framework:

1 Credit = 30 NOTIONAL CREDIT HOURS (NCH)

Yearly Learning Hours = 1200 Notional Hours (@40 Credits x 30 NCH)

30 Notional Credit Hours		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
1 Credit = 15-22 Lecture Hours	**10-15 Practicum Hours**	**0-8 Experiential Learning Hours**

1.3.2. Course of Study:

Course of study indicate pursuance of study in a particular discipline/programme. Discipline/Programmes shall offer Major Courses (Core), Minor Courses, Skill Enhancement Courses (SEC), Value Added Courses (VAC), Ability Enhancement Compulsory Courses (AECCs) and Interdisciplinary courses.

1.3.3. Disciplinary Major:

The major would provide the opportunity for a student to pursue in-depth study of a particular subject or discipline. Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year. Advanced-level disciplinary/interdisciplinary courses, a course in research methodology, and a project/dissertation will be conducted in the seventh semester. The final semester will be devoted to seminar presentation, preparation, and submission of project

report/dissertation. The project work/dissertation will be on a topic in the disciplinary programme of study or an interdisciplinary topic.

1.3.4. Disciplinary/interdisciplinary minors:

Students will have the option to choose courses from disciplinary/interdisciplinary minors and skill-based courses. Students who take a sufficient number of courses in a discipline or an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline or in the chosen interdisciplinary area of study. A student may declare the choice of the minor at the end of the second semester, after exploring various courses.

1.3.5. Courses from Other Disciplines (Interdisciplinary):

All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines given below. These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students are not allowed to choose or repeat courses already undergone at the higher secondary level (12th class) in the proposed major and minor stream under this category.

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

ii. Mathematics, Statistics, and Computer Applications: Courses under this category will facilitate the students to use and apply tools and techniques in their major and minor disciplines. The course may include training in programming software like Python among others and applications software like STATA, SPSS, Tally, etc. Basic courses under this category will be helpful for science and social science in data analysis and the application of quantitative tools.

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

iv. Commerce and Management: Courses include business management, accountancy, finance, financial institutions, fintech, etc.,

v. Humanities and Social Sciences: The courses relating to Social Sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political Science, Psychology, Social Work, Sociology, etc. will enable students to understand the individuals and their social behaviour, society, and nation. Students be introduced to survey methodology and available large-scale databases for India. The courses under humanities include, for example, Archaeology, History, Comparative Literature, Arts & Creative expressions, Creative Writing and Literature, language(s), Philosophy, etc., and interdisciplinary courses relating to humanities. The list of Courses can include interdisciplinary subjects such as Cognitive Science, Environmental Science, Gender Studies, Global Environment & Health, International Relations, Political Economy and Development, Sustainable Development, Women's, and Gender Studies, etc. will be useful to understand society.

1.3.6. Ability Enhancement Courses (AEC): Modern Indian Language (MIL) & English language focused on language and communication skills. Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity. They would also enable students to acquaint themselves with the cultural and intellectual heritage of the chosen MIL and English language, as well as to provide a reflective understanding of the structure and complexity of the language/literature related to both the MIL and English language. The courses will also emphasize the development and enhancement of skills such as communication, and the ability to participate/conduct discussion and debate.

1.3.7. Skill Enhancement Course (SEC): These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students and should be related to Major Discipline. They will aim at providing hands-on training, competencies, proficiency, and skill to students. SEC course will be a basket course to provide skill-based instruction. For example, SEC of English Discipline may include Public Speaking, Translation & Editing and Content writing.

1.3.8. Value-Added Courses (VAC):

i. Understanding India: The course aims at enabling the students to acquire and demonstrate the knowledge and understanding of contemporary India with its historical perspective, the basic

framework of the goals and policies of national development, and the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties. The course would also focus on developing an understanding among student-teachers of the Indian knowledge systems, the Indian education system, and the roles and obligations of teachers to the nation in general and to the school/community/society. The course will attempt to deepen knowledge about and understanding of India's freedom struggle and of the values and ideals that it represented to develop an appreciation of the contributions made by people of all sections and regions of the country, and help learners understand and cherish the values enshrined in the Indian Constitution and to prepare them for their roles and responsibilities as effective citizens of a democratic society.

ii. Environmental science/education: The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living. The course will also deepen the knowledge and understanding of India's environment in its totality, its interactive processes, and its effects on the future quality of people's lives.

iii. Digital and technological solutions: Courses in cutting-edge areas that are fast gaining prominences, such as Artificial Intelligence (AI), 3-D machining, big data analysis, machine learning, drone technologies, and Deep learning with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

iv. Health & Wellness, Yoga education, sports, and fitness: Course components relating to health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person. Sports and fitness activities will be organized outside the regular institutional working hours. Yoga education would focus on preparing the students physically and mentally for the integration of their physical, mental, and spiritual faculties, and equipping them with basic knowledge about one's personality, maintaining self-discipline and self-control, to learn to handle oneself well in all life situations. The focus of sports and fitness components of the courses will be on the improvement of physical fitness including the improvement of various components of physical and skills-related fitness like strength, speed, coordination, endurance, and flexibility; acquisition of sports skills including motor skills as well as basic movement skills relevant to a particular sport; improvement of tactical abilities; and improvement of mental abilities.

1.3.9. Summer Internship /Apprenticeship:

The intention is induction into actual work situations. All students must undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the ***summer term***. Students should take up opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability. Students who wish to exit after the first two semesters will undergo a 4-credit work-based learning/internship during the summer term to get a UG Certificate.

1.3.9.1. Community engagement and service: The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course depending upon the major discipline.

1.3.9.2. Field-based learning/minor project: The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project or part of a major or minor course depending on the subject of study.

1.3.10. Indian Knowledge System:

In view of the importance accorded in the NEP 2020 to rooting our curricula and pedagogy in the Indian context all the students who are enrolled in the four-year UG programs should be encouraged to take an adequate number of courses in IKS so that the **total credits of the courses taken in IKS amount to at least five per cent of the total mandated credits.** The students may be encouraged to

take these courses, preferably during the first four semesters of the UG programme. At least half of these mandated credits should be in courses in disciplines which are part of IKS and are related to the major field of specialization that the student is pursuing in the UG programme. They will be included as a part of the total mandated credits that the student is expected to take in the major field of specialization. The rest of the mandated credits in IKS can be included as a part of the mandated Multidisciplinary courses that are to be taken by every student. All the students should take a Foundational Course in Indian Knowledge System, which is designed to present an overall introduction to all the streams of IKS relevant to the UG programme. The foundational IKS course should be broad-based and cover introductory material on all aspects.

Wherever possible, the students may be encouraged to choose a suitable topic related to IKS for their project work in the 7/8th semesters of the UG program.

1.3.11. Experiential Learning:

One of the most unique, practical & beneficial features of the National Credit Framework is assignment of credits/credit points/ weightage to the experiential learning including relevant experience and professional levels acquired/ proficiency/ professional levels of a learner/student. Experiential learning is of two types:

a. Experiential learning as part of the curricular structure of academic or vocational program. E.g., projects/OJT/internship/industrial attachments etc. This could be either within the Program-internship/ summer project undertaken relevant to the program being studied or as a part time employment (not relevant to the program being studied- up to certain NSQF level only). In case where experiential learning is a part of the curricular structure the credits would be calculated and assigned as per basic principles of NCrF i.e., 40 credits for 1200 hours of notional learning.

b. Experiential learning as active employment (both wage and self) post completion of an academic or vocational program. This means that the experience attained by a person after undergoing a particular educational program shall be considered for assignment of credits. This could be either Full or Part time employment after undertaking an academic/ Vocation program.

In case where experiential learning is as a part of employment the learner would earn credits as weightage. The maximum credit points earned in this case shall be double of the credit points earned with respect to the qualification/ course completed. The credit earned and assigned by virtue of

relevant experience would enable learners to progress in their career through the work hours put in during a job/employment.

AWARD OF DEGREE

The structure and duration of undergraduate programmes of study offered by the University as per NEP 2020 include:

2.1. Undergraduate programmes of either 3 or 4-year duration with Single Major, with multiple entry and exit options, with appropriate certifications:

2.1.1. UG Certificate: Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

2.1.2. UG Diploma: Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

2.1.3. 3-year UG Degree: Students who will undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits and satisfying the minimum credit requirement.

2.1.4. 4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits and have satisfied the credit requirements as given in Table 6 in Section 5.

2.1.5. 4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a Faculty Member of the University. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree (Honours with Research).

(Note: ***UG Degree Programmes with Single Major:*** A student must secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major. For example, in a 3-year UG programme, if the total number of credits to be earned is 120, a student of Mathematics with a minimum of 60 credits will be awarded a B.Sc. in Mathematics with a single major. Similarly, in a 4-year UG programme, if the total number of credits to be earned is 160, a student of Chemistry with a minimum of 80 credits will be awarded a B.Sc. (Hons./Hon. With Research) in Chemistry in a 4-year UG programme with single major. Also the **4-year Bachelor's degree programme with Single Major** is considered as the preferred option since it would allow the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.)

Table: 1: Award of Degree and Credit Structure with ME-ME

Award	Year	Credits to earn	Additional Credits	Re-entry allowed within (yrs)	Years to Complete
UG Certificate	1	40	4	3	7
UG Diploma	2	80	4	3	7
3-year UG Degree (Major)	3	120	x	x	x
4-year UG Degree (Honours)	4	160	x	x	x
Award	**Year**	**Credits to earn**	**Additional Credits**	**Re-entry allowed within (yrs)**	**Years to Complete**
4-year UG Degree (Honors with Research):	4	160	Students who secure cumulative 75% marks and above in the first six semesters		

CREDIT, CREDIT POINTS & CREDIT HOURS FOR DIFFERENT TYPES OF COURSES

3.1. Introduction:

'Credit' is recognition that a learner has completed a prior course of learning, corresponding to a qualification at a given level. For each such prior qualification, the student would have put in a certain volume of institutional or workplace learning, and the more complex a qualification, the greater the volume of learning that would have gone into it. Credits quantify learning outcomes that are subject achieving the prescribed learning outcomes to valid, reliable methods of assessment.

The *credit points* will give the learners, employers, and institutions a mechanism for describing and comparing the learning outcomes achieved. The credit points can be calculated as credits attained multiplied with the credit level.

The workload relating to a course is measured in terms of credit hours. A credit is a unit by which the coursework is measured. It determines the number of hours of instruction required per week over the duration of a semester (minimum 15 weeks).

Each course may have only a lecture component or a lecture and tutorial component or a lecture and practicum component or a lecture, tutorial, and practicum component, or only practicum component. Refer to the Section 1.3.1

A course can have a combination of *lecture credits, tutorial credits, practicum credits and experiential learning credits.*

The following types of courses/activities constitute the programmes of study. Each of them will require a specific number of hours of teaching/guidance and laboratory/studio/workshop activities, field-based learning/projects, internships, and community engagement and service.

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

• **Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work/vocation, or professional practice. Should also refer to the Remedial Classes, flip classrooms and focus on both Slow and Fast Learners of the class according to their merit.

- Practicum or Laboratory work: A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the

chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice.

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

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

• **Studio activities**: Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic-focused experiential work.

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

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

Table:2: Course wise Distribution of Credits

Broad Category of Course	Minimum Credit Requirement	
	3-year UG	4-Year UG
Major (Core)	60	80
Minor Stream	24	32

Interdisciplinary	9	9
Ability Enhancement Courses (AEC)	8	8
Skill Enhancement Courses (SEC)	9	9
Value Added Courses common for all UG	6	6
Summer Internship	4	4
Research Project / Dissertation	NA	12
Total	**120**	**160**

Table 3: Credit Distribution for 3-year Course

Semester	Course Credits							
	Major	Minor	ID	AEC	SEC	VAC	SI	Total
I	6	3	3	2	3	3	0	**20**
II	6	3	3	2	3	3	0	**20**
III	8	4	3	2	3	0	0	**20**
IV	12	6	0	2	0	0	0	**20**
V	12	4	0	0	0	0	4	**20**
VI	16	4	0	0	0	0	0	**20**
	60	**24**	**9**	**8**	**9**	**6**	**4**	120

Table 4: Credit Distribution for 4-year

Semester	Course Credits								Total
	Major	Minor	ID	AEC	SEC	VAC	SI	RP	

I	6	3	3	2	3	3	0	0	**20**
II	6	3	3	2	3	3	0	0	**20**
III	8	4	3	2	3	0	0	0	**20**
IV	12	6	0	2	0	0	0	0	**20**
V	12	4	0	0	0	0	4	0	**20**
VI	16	4	0	0	0	0	0	0	**20**
VII	16	4	0	0	0	0	0	0	**20**
VIII	4	4	0	0	0	0	0	12	**20**
	80	**32**	**9**	**8**	**9**	**6**	**4**	**12**	**160**

LEVEL OF COURSES

4.1 NHEQF levels:

The NHEQF levels represent a series of sequential stages expressed in terms of a range of learning outcomes against which typical qualifications are positioned/located. NHEQF level 4.5 represents learning outcomes appropriate to the first year (first two semesters) of the undergraduate programme of study, while Level 8 represents learning outcomes appropriate to the doctoral-level programme of study.

NHEQF level	**Examples of higher education qualifications located within each level**	**Credit Requirements**
Level 4.5	Undergraduate Certificate. Programme duration: First year (first two semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s).	40
Level 5	Undergraduate Diploma. Programme duration: First two years (first four semesters) of the undergraduate programme, followed by an exit 4-credit skills-enhancement course(s) lasting two months.	80
Level 5.5	Bachelor's Degree. Programme duration: First three years (Six semesters) of the four-year undergraduate programme.	120

Level 6	Bachelor's Degree (Honours/ Honours with Research). Programme duration: Four years (eight semesters).	160
Level 6	Post-Graduate Diploma. Programme duration: One year (two semesters) for those who exit after successful completion of the first year (two semesters) of the 2-year master's programme	160
Level 6.5	Master's degree. Programme duration: Two years (four semesters) after obtaining a 3- year Bachelor's degree (e.g. B.A., B.Sc., B.Com. etc.).	80
Level 6.5	Master's degree. Programme duration: One year (two semesters) after obtaining a 4 -year Bachelor's degree (Honours/ Honours with Research) (e.g. B.A., B.Sc., B.Com. etc.).	40
Level 7	Master's degree. (e.g., M.E./M.Tech. etc.) Programme duration: Two years (four semesters) after obtaining a 4-year Bachelor's degree. (e.g., B.E./B.Tech. etc.)	80
Level 8	Doctoral Degree	Credits for course work, Thesis, and published work

4.2. Course Code based on Learning Outcomes:

Courses are coded based on the learning outcomes, level of difficulty, and academic rigor. The coding structure is as follows:

i. 0-99: Pre-requisite courses required to undertake an introductory course which will be a pass or fail course with no credits. It will replace the existing informal way of offering bridge courses that are conducted in some of the colleges/ universities.

ii. 100-199: Foundation or introductory courses that are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses may also be prerequisites for courses in the major subject. These courses

generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up more advanced courses.

iii. 200-299: Intermediate-level courses including subject-specific courses intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses.

iv. 300-399: Higher-level courses which are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.

v. 400-499: Advanced courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year post-graduate theoretical and practical courses.

vi. 500-599: Courses at first-year PG degree level for a 2-year post-graduate degree programme

vii. 600-699: Courses for second year of 2-year PG or 1-year post-graduate degree programme

viii. 700-799 and above: Courses limited to doctoral students.

COURSE STRUCTURE OF THE FRAMEWORK

Table 6. Semester wise and component wise distribution of credit (Four Year UGP - Single Major)

Year	Semester	Component	Couse code	Number of Courses	Credit per Course	Total credit in the component
First Year	I	Major (Core)	C-101, C-102	2	3	6
		Minor	M-101	1	3	3
		Interdisciplinary	IDC-1	1	3	3
		AEC1- Language	AEC-1	1	2	2
		SEC- (To choose from a pool of courses. To be related to Major)	SEC-1	1	3	3

		VAC- (To choose from a pool of courses)	VAC-1	1	3	3
				7		**20**
	II	Major (Core)	C-103, C-104	2	3	6
		Minor (May or may not be related to major)	M102	1	3	3
		Interdisciplinary	IDC-2	1	3	3
		AEC1- Language	AEC-2	1	2	2
		SEC (To choose from a pool of courses. To be related to Major)	SEC-2	1	3	3
		VAC- (Choose from a pool of courses)	VAC-2	1	3	3
				7		**20**
Second Year	III	Major (Core)	C-201, C-202	2	4	8
		Minor (May or may not be related to major)	M-201	1	4	4
		Interdisciplinary	IDC-3	1	3	3
		AEC1- Language	AEC-3	1	2	2
		SEC- (To choose from a pool of courses. To be related to Major)	SEC-3	1	3	3
				6		**20**
	IV	Major (Core)	C-203, C-204, C-205	3	4	12
		Minor (May or may not be related to major)	M-202, M-203	2	3	6
		AEC1- Language	AEC-4	1	2	2
				6		**20**
Year	**Semester**	**Component**	**Couse code**	**Number of Courses**	**Credit per Course**	**Total credit in the component**
Third Year	V	Major (Core)	C-301, C-302, C-303	3	4	12
		Minor (May or may not be related to major)	M-301	1	4	4
		Internship		1	4	4

				5		**20**
	VI	Major (Core)	C-304, C-305, C-306, C-307	4	4	16
		Minor	M-302	1	4	4
				5		**20**
Fourth Year	VII	Major (Core)	C-401, C-402, C-403, C-404	4	4	16
		Minor (May or may not be related to major)	M-401	1	4	4
				5		**20**
	VIII	Major (Core)	C-405 (RM301)	1	4	4
		Research Methodology	M-402	1	4	4
		Dissertation/Research Project		1	12	12
		Or 400 level advanced course Core (in lieu of Dissertation/Research Project)	C-407, C-408, C-409	3	4	
				3/5		**20**

GRADUATE ATTRIBUTES & LEARNING OUTCOMES

6.1. Introduction:

As per the NHEQF, each student on completion of a programme of study must possess and demonstrate the expected **Graduate Attributes** acquired through one or more modes of learning, including direct in-person or face-to-face instruction, online learning, and hybrid/blended modes. The graduate attributes indicate the quality and features or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study.

The graduate profile/attributes must include,

• capabilities that help widen the current knowledge base and skills,

• gain and apply new knowledge and skills,

• undertake future studies independently, perform well in a chosen career, and

• play a constructive role as a responsible citizen in society.

The graduate profile/attributes are acquired incrementally through development of cognitive levels and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed.
Graduate attributes include,

• *Learning outcomes that are specific to disciplinary areas* relating to the chosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.

• *Generic learning outcomes* that graduate of all programmes of study should acquire and demonstrate.

6.2. Graduate Attributes:

Table: 7: The Learning Outcomes Descriptors and Graduate Attributes

Sl.no.	Graduate Attribute	The Learning Outcomes Descriptors (The graduates should be able to demonstrate the capability to:)
GA1	Disciplinary Knowledge	acquire knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study.
GA 2	Complex problem solving	solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

GA 3	Analytical & Critical thinking	apply analytical thought including the analysis and evaluation of policies, and practices. Able to identify relevant assumptions or implications. Identify logical flaws and holes in the arguments of others. Analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.
GA 4	Creativity	create, perform, or think in different and diverse ways about the same objects or scenarios and deal with problems and situations that do not have simple solutions. Think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by adopting innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence.
GA 5	Communication Skills	listen carefully, read texts and research papers analytically, and present complex information in a clear and concise manner to different groups/audiences. Express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.
GA 6	Research-related skills	develop a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions. Should acquire the ability to problematize, synthesize and articulate issues and design research proposals, define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships.

		Should develop the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work.
GA 7	Collaboration	work effectively and respectfully with diverse teams in the interests of a common cause and work efficiently as a member of a team.
GA 8	Leadership readiness/qualities	plan the tasks of a team or an organization and setting direction by formulating an inspiring vision and building a team that can help achieve the vision.
GA 9	Digital and technological skills	use ICT in a variety of learning and work situations. Access, evaluate, and use a variety of relevant information sources and use appropriate software for analysis of data.
GA 10	Environmental awareness and action	mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.

6.3 Programme Learning Outcomes (PLO)

The outcomes described through learning outcome descriptors in Table 6 are attained by students through learning acquired on the completion of a programme of study relating to the chosen fields of learning, work/vocation, or an area of professional practice. The term

‘programme’ refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes that must be attained for the award of a specific certificate/diploma/degree.

The Departments and Schools of the University are responsible for ensuring that individual programme learning outcomes align with the relevant graduate attributes. Programme learning outcomes (PLOs) include outcomes that are specific to disciplinary areas of learning associated with the chosen field (s) of learning.

The programme learning outcomes would also focus on knowledge and skills that prepare students for further study, employment, and responsible citizenship.

Students graduating with the degree B.Sc. (Radiography & Advance Imaging Technology) will be able to achieve the following:

PROGRAMME OUTCOMES	HEADER	DESCRIPTION
PLO 1	Knowledge of Radiography & Imaging Technology	Possess and acquire scientific knowledge to become a healthcare professional
PLO 2	Develop complex problem-solving skills	Possess skills to solve case-related problems and alteration of imaging parameters depending on the type of patient
PLO 3	Develop analytical & critical thinking skills	Possess qualities to evaluate critical cases, apply proper protocols, and solve real-time problems depending on the patient's

		scenario
PLO 4	Develop the ability to create	Possess creative skills to deal with difficult scenarios by adopting ingenious ways of achieving the goal without compromising the desired outcome
PLO 5	Develop effective communication skills	Communicate effectively and appropriately with the interdisciplinary healthcare team and with the society
PLO 6	Develop research-related skills	Develop an essence of enquiry and investigation for raising relevant and appropriate questions, synthesizing and articulating them for interpretation of data
PLO 7	Develop team building skills	Exhibit team work skills and mindset to support shared goals with the interdisciplinary healthcare team to improve societal health

PLO 8	Develop leadership qualities	Display entrepreneurship, leadership and mentorship skills to practice independently as well as in collaboration with the interdisciplinary health care team
PLO 9	Develop digital and technological skills	Possess technical, information, and communications skills to provide quality health care services using a variety of software applicable as necessary
PLO 10	Create environmental awareness and the ability to address the issues	Possess knowledge and technicality to raise awareness for the benefit of society and maintain proper aspects of radiation safety for patients as well as public

Upon completion of this course the student should be able to:

COURSE LEARNING OUTCOMES	DESCRIPTION
PSO 1	Know and demonstrate understanding of the concepts of physics and other

PSO 2	Capable of analyzing various situations and use proper technique applicable according to the need of the patient.
PSO 3	Develop the knowledge, skills and technology necessary for obtaining good quality images which will aid in the process of diagnosis.
PSO 4	Apply the various technical and analytical knowledge in creation of good radiographs and other high quality imaging films

6.5 The Qualification Specifications:

Table: 8: NHEQF Qualification Specifications

Qualification type	Purpose of the qualification
Undergraduate Certificate	The students will be able to apply technical and theoretical concepts and specialized knowledge and skills in a broad range of contexts to undertake skilled or paraprofessional work and/or to pursue further study/learning at higher levels.
Undergraduate Diploma	The students will be able to apply specialized knowledge in a range of contexts to undertake advanced skilled or paraprofessional work and/or to pursue further learning/study at higher levels.
Bachelor's degree	The students will be able to apply a broad and coherent body of knowledge and skills in a range of contexts to undertake professional work and/or for further learning.
Bachelor's degree (Honours/ Honours with Research)	The students will be able to apply the knowledge in a specific context to undertake professional work and for research and further learning.
	The students will be able to apply an advanced body of knowledge in a range of contexts to undertake professional work and apply specialized knowledge and skills for research and scholarship, and/or for further learning relating to the chosen field(s) of learning, work/vocation, or professional practice.

Teaching Learning Process

Teaching and learning in this programme involves classroom lectures as well as tutorial and remedial classes.

Tutorial classes: Tutorials allow closer interaction between students and teacher as each student gets individual attention. The tutorials are conducted for students who are unable to achieve average grades in their weekly assessments. Tutorials are divided into three categories, viz. discussion-based tutorials (focusing on deeper exploration of course content through discussions and debates), problem-solving tutorials (focusing on problem-solving processes and quantitative reasoning), and Q&A tutorials (students ask questions about course content and assignments and consolidate their learning in the guiding presence of the tutor).

Remedial classes: The remedial classes are conducted for students who achieve average and above average grades in their weekly assessments. The focus is laid to equip the students to perform better in the exams/assessments. The students are divided into small groups to provide dedicated learning support. Tutors are assigned to provide extra time and resources to help them understand concepts with advanced nuances. Small groups allow tutors to address their specific needs and monitor them.

The following methods are adopted for tutorial and remedial classes:

- Written assignments and projects submitted by students
- Project-based learning
- Group discussions
- Home assignments
- Class tests, quizzes, debates organised in the department
- Seminars and conferences
- Extra-curricular activities like cultural activities, community outreach programmes etc.
- Field trip, excursions, study tour, interacting with eminent authors, etc.

1.8 Assessment Methods

	Component of Evaluation	Marks	Frequency	Code	Weightag

					e (%)
A	**Continuous Evaluation**				
I	Analysis/Class test	Combination of any three from (i) to (v) with 5 marks each	1-3	C	25%
Ii	Home Assignment		1-3	H	
Iii	Project		1	P	
Iv	Seminar		1-2	S	
V	Viva-Voce/Presentation		1-2	V	
Vi	MSE	MSE shall be of 10 marks	1-3	Q/CT	
Vii	Attendance	Attendance shall be of 5 marks	100%	A	5%
B	Semester End Examination		1	SEE	70%
	Project				**100%**

BACHELOR DEGREE IN RADIOGRAPHY & ADVANCE IMAGING TECHNIQUE

PROGRAMME STRUCTURE

BRIT 1ST SEMESTER				
SL No	SUBJECT CODE	NAMES OF SUBJECTS	COURSE LEVEL	CREDIT
MAJOR COURSES				
1	RIT242M101/ RIT242M111	Human Anatomy-I(T&L)	100	3
2	RIT242M102/ RIT242M112	Human Physiology-I (T&L)	100	3
3	RIT242M103	Biochemistry-I (T)	100	3
INTERDISCIPLINARY COURSE				
4	IKS992K101	IKS-I	100	3
ABILITY ENHANCEMENT COURSE				
5	CEN982A101 / BHS982A102	Communicative English and Behavioral Science-I	100	2
SKILL ENHANCEMENT COURSE (SEC)				
6	RIT242S101	Hospital Duty & Patient	100	3
VALUE ADDED COURSE				
7	VAC-1	To be selected from the pool of courses offered	100	3
SWAYAAM /MOOCS COURSE				
8		MOOCs course	100	3
TOTAL				23
BRIT 2ND SEMESTER				
MAJOR COURSES				
1	RIT242M201/RIT242M211	Human Anatomy-II (T&L)	100	3
2	RIT242M202/RIT242M212	Human Physiology-II	100	3
3	RIT242M203/RIT242M213	Biochemistry-II(T&L)	100	3
INTERDISCIPLINARY COURSE				

4	IKS992K201	IKS-2	100	3
ABILITY ENHANCEMENT COURSE (AEC)				
5	CEN982A201 &BHS982A202	Communicative English and Behavioral Science-II	100	2
SKILL ENHANCEMENT COURSE (SEC)				
6	RIT242S201	Hospital Duty & Patient Care-II	100	3
VALUE ADEED COURSE				
7	VAC-2	Selected from the pool of courses offered	100	3
SWAYAAM /MOOCS COURSE				
8		MOOCs course	100	3
TOTAL				23
BRIT 3RD SEMESTER				
MAJOR COURSE				
1	RIT242M311	Basic Physics	200	4
2	RIT242M302	Physics of Radiology	200	4
3	RIT242M313	Radiographic Technique I	200	4
INTERDISCIPLINARY COURSE				
4		Selected from the pool of courses offered	200	3
ABILITY ENHANCEMENT COURSE (AEC)				
5	CEN982A301&BHS982A302	Communicative English and Behavioral Science-III	200	2
SKILL ENHANCEMENT COURSE (SEC)				
7	RIT242S301	Medical, Law & Ethics	200	3
SWAYAAM /MOOCS COURSE				
8		MOOCs course	200	3
TOTAL				23

BRIT 4TH SEMESTER				
MAJOR COURSES				
1	RIT242M401	Radiation Hazards & Protection	200	4
2	RIT242M412	Radiographic Technique II	200	4
3	RIT242M403	Techniques of Mammography & Fluoroscopy	200	3
4	RIT242M414	Special Radiographic Procedures	200	4
ABILITY ENHANCEMENT COURSE (AEC)				
5	CEN982A401 &BHS982A402	Communicative English and Behavioral Science-IV	200	2
SWAYAAM /MOOCS COURSE				
6		MOOCs course	200	3
TOTAL				19
BRIT 5TH SEMESTER				
MAJOR COURSES				
1	RIT242M501	Computed Tomography	300	4
2	RIT242M502	Darkroom Technique	300	4
3	RIT242M513	Computer Skills	300	4
4	RIT242M504	Basics of Ultrasound and ECG	300	4
CLINICAL POSTING				
5	RIT242M524	Clinical Posting	200	4
Total				20
BRIT 6th SEMESTER				
MAJOR COURSES				
1	RIT242M611	Magnetic Resonance Imaging	300	4
2	RIT242M602	Orientation in Clinical Sciences	300	4

3	RIT242M603	Basics of Radiotherapy	300	4
4	RIT242M604	Interventional Radiology	300	4
5	RIT242M605	Biostatistics & Research Methodology	300	4
TOTAL				20
BRIT 7TH SEMESTER				
MAJOR COURSES				
1	RIT242M711	Techniques of Routine X-rays	400	4
2	RIT242M712	Techniques of Special X-rays	400	4
3	RIT242M713	Techniques of Computed Tomography	400	4
4	RIT242M714	Techniques of Ultrasound	400	3
5	RIT242M715	Techniques of Mammography & Fluoroscopy	300	3
TOTAL				18
BRIT 8TH SEMESTER				
MAJOR COURSES				
1	RIT242M811	Techniques of MRI	400	7
2	RIT242M812	Techniques of Hybrid Imaging	400	7
3	RIT242M821	Research Project/Dissertation	400	12
TOTAL				24

Level: Semester I

Title of the Paper: HUMAN ANATOMY- I	
Subject Code: RIT242M101/RIT242M111	**Course Level: 100**
Scheme of Evaluation: Theory + Practical	
L-T-P-C: 2-0-1-3	**Total credits: 3**

Course Objectives:

This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the different anatomical structures of the human body.	BT 1
CO 2	**Compare** various body systems and co-relate the anatomy among them all.	BT 2
CO 3	**Apply** different laws in assessing various pathological conditions.	BT 3
CO 4	**Apply** the knowledge of anatomy as necessary in the production of good quality images.	BT 4

COURSE OUTLINE:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	**Introduction:** ● Definition of anatomy and its divisions, Terms of location, positions and planes.	**10**

	• Cell and its organelles, Tissues & its classification, Glands. • **Gastro-intestinal System:** • Parts of the GIT - mouth, pharynx, oesophagus, stomach • Abdominal cavity - divisions and regions • Liver • Pancreas • Spleen • Gall Bladder • Intestine (small and large)	
II	**Respiratory system:** • Parts of Respiratory system; Structure of nose, nasal cavity, larynx, trachea, lungs, pleura, bronchopulmonary segments.	10
III	• **Musculoskeletal system:** • Structure of Bone & its types. • Joints- Classification of joints with examples; details of synovial joint. • Axial skeleton & appendicular skeleton • Bones of appendicular skeleton • Bones of axial skeleton • Locomotor system - bone , cartilage, ligaments and tendons • Muscles & its types	14
IV	• **Cardiovascular System:** • Arteries & veins, Capillaries & arterioles. • Heart- size, location, chambers, blood supply of heart, pericardium. • Systemic & pulmonary circulation. • Major blood vessels of Heart	10
TOTAL		44

Text Books :

1. Sembulingam, K., Sembulingam, P. (2012). Essentials of Medical Physiology, 6th Edition, New Delhi: Jaypee brothers medical publishers.

2. Wilson, J.W., Livingstone, K. C. (1987). Anatomy and Physiology in Health and Illness, 6th Revised Edition, New York: Churchill Livingstone.

Reference Books:

1. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice. 13th Edition. USA: Williams & Wilkins

2. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology. 12th Edition. USA: Elsevier's.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
30 NCH	30 NCH	30 NCH Lab visit - Home assignments - Projects

ANATOMY-I LAB

Credit: 1

Objectives: The objective of the course is to introduce students to the practical gained regarding the anatomy of various structures and the histological appearance of various organs of the human body. Identification of the upper limb bones and their features.

DETAILED SYLLABUS:

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Introduction of the human body • To identify different levels of organisation and types of tissues • Study of compound microscope	4

II	• To identify different planes and cavities of the body • To iednitfy the division of the skeleton and the names of the indivisual bones • To idenitfy commonly used terms of movement • To idenitfy the quadrants and regions of the body	6
III	• To identify humerus • To identify radius • To identify ulna • To identify hand	10
IV	• To identify Clavicle • To identify Scapula	10
TOTAL		30

Text Books:

1. Ross and Wilson (2014), Anatomy and physiology in health and illness, 11th edition, Elsevier publications
2. Chaurasia BD, (2016), Human Anatomy , 7th edition, CBS publisher

References:

1. Frank. N. Nettar, Atlas of human Anatomy,7th Edition, Elsevier
2. Frederic H. Martini, Judi L.Nath, EdwinFB, Fundamentals of Anatomy and Physiology,9th edition, pearson publishers.

Level: Semester I

Title of the Paper: HUMAN PHYSIOLOGY-I	
Subject Code: RIT242M102/RIT242M112	**Course Level: 100**
Scheme of Evaluation: Theory + Practical	
L-T-P-C: 2-0-1-3	**Total credits: 3**

Course Objectives

This subject is designed to impart fundamental knowledge on the physiology and the functioning of the various systems of the human body. It also helps in understanding the homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of physiology.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the normal physiology of the human body and also the reaction of the body with respect to the surrounding.	BT 1
CO2	To **demonstrate** the understanding and scope of human physiology in real-life situations.	BT 2
CO3	To **evaluate** how abnormal physiological conditions might affect normal human functioning.	BT 3
CO4	To **apply** the normal physiological knowledge in assessing abnormal functional findings.	BT 4

DETAILED SYLLABUS:

MODULE	TOPICS & COURSE CONTENT	PERIODS
I	**Blood** • Red Blood Cells- Functions, count,	

	Physiological and pathological variations. Erythropoesis-stages • Hemoglobin-Functions, Physiological variations. • White Blood cells- Functions, count, morphology. • Platelets-count, morphology, functions. Hemostasis-Definition, Mechanism, clotting factors. • Blood groups-ABO system, Rh system, Blood transfusion- Indication, transfusion reactions. Anaemias-classification, effects of anaemia on body.	10
II.	Gastrointestinal System • Physiological Anatomy, functions of GIT. • Salivary Gland-functions of saliva. • Stomach- structure and functions, Gastric secretions-composition, functions,Mechanism • Pancreas- structure, functions, composition of Pancreatic juice. • Liver-Functions of liver. • Bile-Composition, functions. • Jaundice-Types and its causes. • Gall Bladder- Functions • Intestine- Movements of small and large intestine. • Digestion and Absorption of Carbohydrates, Proteins, Fats. Hormones of GIT- Functions of Gastrin, Secretin, CCK-Pz.	14

III	Cardiovascular System • Heart-Physiological Anatomy, Nerve supply • Cardiac Cycle-Events –systole, diastole • Cardiac Output-Definition and factors affecting it. • Heart sounds-normal heart sounds, its causes, areas of auscultations. • Blood Pressure-Definition, normal value, Physiological variations, its measurement. • ECG- normal waves. Shock-Definition, Types.	10
IV	Respiratory System • Physiological Anatomy, Functions of the respiratory system. • Types of respiration, respiratory membrane. • Lung volumes and capacities, vital capacity and factors affecting it. • Transport of Oxygen-Forms of transportation, Oxy-hemoglobin dissociation curveand factors affecting it. • Transport of Carbon-Dioxide- Forms of transportation. • Hypoxia-Definition, types, effects of hypoxia. • Cyanosis-Definition and types. Artificial Respiration- CPR	10
	Total	**44**

Text Books:

1. Arthur, Guyton,Textbook of Medical Physiology, Mosby. 3rd Edition
2. Sembulingam.K,Human Physiology- Vol. 1&2 ,MedicalAllied, 7th Edition.

Reference Books:

3. Chaudhari, S.K ,Concise Medical Physiology, New CentralAgency,Calcutta, 4th Edition
4. Tortora&Grabowski,Harper Collins, Principals of Anatomy and Physiology, Gobal Edition.

CREDIT DISTRIBUTION		
THEORY/TUROTIAL	PRACTICUM	EXPERIENTIAL LEARNING
30 NCH	30 NCH	30 NCH Lab visit - Home assignments - Projects

PHYSIOLOGY-I LAB

Credit: 1

Course Objectives: The objective of the course is to learn about various vitals in normal & the alterations in the physiology of the human body.

DETAILED SYLLABUS:

MODULE	TOPICS & COURSE CONTENT	PERIODS
I	Identification of some laboratory instruments	6
II	Determination of blood hemoglobin level	10
III	Determination of bleeding time	4

	Blood pressure measurement	
IV	Determination of clotting time Blood smear preparation, staining and differential leukocyte count	10
	TOTAL	30

Text Book:

1. Alison,G.Anne,W.(2014). Ross and Wilson Anatomy and Physiology in Health and Illness. Elsevier Health; UK,13th edition.
2. Sembulingam. K, Human Physiology- Vol. 1&2 ,Medical Allied, 7th Edition.

Reference Books:

1. Arthur, Guyton, Textbook of Medical Physiology, Mosby. 4th Edition

Level: Semester I

Title of the Paper: BIOCHEMISTRY-I	
Subject Code: RIT242M103	**Course Level: 100**
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	**Total credits: 3**

Course Objectives

The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions.

Course Outcomes

On successful completion of the course, the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**

CO 1	**Remember** the basic biochemistry of carbohydrates, lipids and proteins	BT 1
CO2	**Understand** the basics of electrolytes and their importance	BT 2
CO3	**Understand** the basics of biophysics	BT 2
CO4	**Analyzation** of physical chemistry and organ function tests	BT 4

COURSE OUTLINE:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Cell**: Morphology, structure & functions of cell, cell membrane, Nucleus, chromatin, Mitochondria, Endoplasmic Reticulum, Ribosomes.	5 **hours**
II.	**Carbohydrates**: Definition, chemical structure, functions, sources, classifications, Monosaccharides, Disaccharides, Polysaccharides, mucopoloysaccharide and its importance, glycoproteins **Carbohydrate Metabolism**: Glycolysis, TCA cycle, Glycogen metabolism, Gluconeogenesis, Maintenance of Blood Glucose. Diabetes Mellitus and its complications.	**15 hours**
III.	**Proteins**: Definition, sources, amino acids, structure of protein, their classification, simple protein, conjugated protein, derived proteins and their properties. **Protein Metabolism**: Transamination, Deamination, Fate of ammonia, urea synthesis and its inborn errors.	**15 hours**
IV.	**Nucleic Acid** : Basic idea of structure of DNA & RNA Functions of DNA and RNA **Water and Electrolyte**, Fluid compartment, daily intake and output sodium and potassium balance	**5 hours**
Total		**40**

Text Book:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger Principles of Biochemistry, 7th Edition; WH Freeman publishers.

2. Robert, K., Murry, Daryl., Granner, K., Victor, W.R. (2015). Harper's Biochemistry, 30th Edition, New Delhi: McGraw-Hill Education / Medical publishers.

Reference Book:

1. Rajagopal, G. & Tura, B.D. (2005). Practical Biochemistry for Medical students. 2nd Edition. Ahuja Publishing House.

2. Harold, Varley. (2005). Practical Biochemistry. 4th Edition. CBS publishers and distributors.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH		30 NCH - Lab visit - Home assignments - Projects

Level: Semester I

Title of the Paper: HOSPITAL DUTY & PATIENT CARE-I	
Subject Code: RIT242S101	Course Level: 100
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	Total credits: 3

Objective : This syllabus has been formulated to impart basics knowledge on Hospitals, First Aid, Record keeping and report writing, Basic care, comfort, sign and symptoms and hygiene of patients.

Course outcome:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL

CO 1	**Demonstrate** understanding of hospital protocols, roles, and responsibilities in various healthcare settings.	BT 1
CO2	**Apply** standard procedures for basic patient care, including hygiene, nutrition, mobility assistance, and vital signs monitoring.	BT 2
CO3	**Exhibit** effective communication and interpersonal skills while interacting with patients, families, and healthcare professionals.	BT 3
CO4	**Follow** infection control practices, patient safety measures, and ethical guidelines during hospital duty.	BT 4

Detailed syllabus:

Modules	Topics (if applicable) & Course Contents	Hours
I.	Hospitals - types and administration Structural organisation of the Radiology department Records and reports Hospital Management and Human Resource Ethical codes	**15 hours**
II.	Quality Management Biomedical waste management Basic care needs Laboratory safety	**10 hours**
III.	Vital signs	10 **hours**
IV	Communication Care of patient Patient rights and responsibilities Negligence Comfort positions for patient	10 **hours**
TOTAL		45

Text Book:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger Principles of Biochemistry, 7th Edition; WH Freeman publishers.

2. Robert, K., Murry, Daryl., Granner, K., Victor, W.R. (2015). Harper's Biochemistry, 30th Edition, New Delhi: McGraw-Hill Education / Medical publishers.

Reference Book:

1. Rajagopal, G. & Tura, B.D. (2005). Practical Biochemistry for Medical students. 2nd Edition. Ahuja Publishing House.

2. Harold, Varley. (2005). Practical Biochemistry. 4th Edition. CBS publishers and distributors.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH	-	30 NCH
		Laboratory Visit Home Assignment Project work

Level: Semester II

Title of the Paper: HUMAN ANATOMY II	
Subject Code: RIT242M201/RIT242M211	**Course Level: 100**
Scheme of Evaluation: Theory + Practicum	
L-T-P-C: 2-0-1-3	**Total credits: 3**

Course Objectives

This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcomes

On successful completion of the course the students will be able to:

SI No	Course Outcome	Blooms Taxonomy Level
CO 1	**Remember** the different anatomical structures of the human body.	BT 1
CO2	**Compare** various body systems and co-relate the anatomy among them all.	BT 2
CO3	**Apply** different laws in assessing various pathological conditions.	BT 3
CO4	**Apply** the knowledge of anatomy as necessary in the production of good quality images.	BT 3

COURSE OUTLINE:

Modules	Topics (if applicable) & Course Contents	Periods
I.	• **Lymphatic System:** • Lymph & Lymph vessels. • Structure of lymph node, names of regional lymphatics, axillary and inguinal lymph nodes.	10
II.	• **Urinary System:** • Parts of Urinary system, location and gross structure of kidney, ureter, urinary bladder, urethra. • **Reproductive system:** • Parts of male reproductive system, gross structure of testis, vas deferens, epididymis, prostate. • Parts of female reproductive system, gross structure of uterus, ovary, fallopian tube, mammarygland.	14

III	• **Nervous system:** • Neuron, classification of NS. • Meninges, ventricles, CSF. • Gross features of cerebrum, midbrain, pons, medulla oblongata, cerebellum, name of basal nuclei. • Blood supply of brain, cranial nerves. • Spinal cord and spinal nerves. • Autonomic nervous system. • Visual & auditory pathways	10
IV	• **Endocrine glands:** • Name of all endocrine glands, gross structure & functions of pituitary gland, adrenal gland, thyroid gland and parathyroid gland. • **Sensory Organs:** • Skin & its appendages. • Structure of eye & lacrimal apparatus, name of extraocular muscles. • Structure of ear: external, middle & inner ear.	10
TOTAL		**44**

Text Book:

1. Sembulingam, K., Sembulingam, P. (2012). Essentials of Medical Physiology, 6th Edition, New Delhi: Jaypee brothers medical publishers.

2. Wilson, J.W., Livingstone, K. C. (1987). Anatomy and Physiology in Health and Illness, 6th Revised Edition, New York: Churchill Livingstone.

Reference Books:

1. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice. 13th Edition. USA: Williams & Wilkins

2. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology. 12th Edition. USA: Elsevier's.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
30 NCH	30 NCH	30 NCH Lab visit - Home assignments - Projects

ANATOMY-II PRACTICUM

Total credits: 1

DETAILED SYLLABUS

Modules	Topics (if applicable) & Course Contents	Periods
I	- To identify Femur - To identify Tibia - To identify Fibula - To identify foot	10
II	To identify the pelvic bones	6
III	To identify the bones of the skull	4
IV	To identify the vertebral bones To identify the bones of the rib cage	10
TOTAL		30

Textbooks:

1. Ross and Wilson (2014), Anatomy and physiology in health and illness, 11th edition, Elesevier publications.

2. Chaurasia BD, (2016), Human Anatomy, 7th edition, CBS publisher.

References:

3. Frank. N. Nettar, Atlas of Human Anatomy,7th Edition, Elsevier
4. Frederic H. Martini, Judi L. Nath, Edwin FB, Fundamentals of Anatomy and Physiology,9th edition, Pearson publishers.

Level: Semester II

Title of the Paper: HUMAN PHYSIOLOGY-II
Subject Code: RIT242M202/RIT242M212 **Course Level: 100**
Scheme of Evaluation: Theory + Practicum
L-T-P-C: 2-0-1-3 **Total credits: 3**

Course Objectives: This subject is designed to impart fundamental knowledge on the physiology and the functioning of the various systems of the human body. It also helps in understanding the homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of physiology.

Course outcomes

On successful completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Understand** the normal physiology of the human body and also the reaction of the body in respect to the surrounding.	BT 1
CO2	To **explain** the understanding and scope of human physiology in real life situations.	BT 2
CO3	To **apply** the normal physiological knowledge in assessing abnormal functional findings.	BT 3
CO4	To **evaluate** how abnormal physiological conditions might affect normal human functioning.	BT 5

Course Outline :

MODULE	TOPICS & COURSE CONTENT	PERIODS
I	Respiratory System • Physiological Anatomy, Functions of the respiratory system. • Types of respiration, respiratory membrane. • Lung volumes and capacities, vital capacity and factors affecting it. • Transport of Oxygen-Forms of transportation, Oxy-hemoglobin dissociation curve and factors affecting it. • Transport of Carbon-Dioxide- Forms of transportation. • Hypoxia-Definition, types, effects of hypoxia. • Cyanosis-Definition and types. • Artificial Respiration- CPR	10
II.	Excretory System o Kidneys-structure of nephron, functions of kidney o Glomerular filtration Rate(GFR) and factors affecting it o Counter Current Mechanism ▪ Bladder-its innervation, micturition reflex	14

	Reproductive System o Male Reproductive System-Stages of spermatogenesis, function of Testosterone ▪ Female Reproductive System-Ovulation, menstrual cycle, functions of Estrogen andprogesterone	
III	Central Nervous System o Structure of neuron, functions of nervous system. o Classification and properties of nerve fibres o Synapse- structure and types o Receptors-Definition, classification, properties, Reflex Arc o Functions of Hypothalamus o Functions of Cerebellum and Basal Ganglia o Functions of Cerebral Cortex o Autonomic Nervous System- Actions of sympathetic and parasympathetic systemand their comparison. o Special Senses-Eye-structure, functions of different parts, Visual acuity,Refractive errors o Ear-structure, functions, General mechanics of hearing.	10

IV	Endocrine System o Classification of Endocrine glands and their hormones. o Thyroid Gland-Physiological Anatomy, hormones secreted, functions, disorders- Hypo and hyper secretion of hormone. o Adrenal Gland-Adrenal Cortex-Physiological Anatomy, its hormones and functions. o Adrenal Medulla-Hormones, functions. o Pituitary Gland- Anterior and posterior pituitary hormones and their functions,disorders. o Pancreas- Hormones and their functions, Diabetes Mellitus-types, pathophysiology, signs and symptoms. • Parathyroid Gland- Hormones and their functions.	10
TOTAL		44

Text Book:

1. Sembulingam, K., Sembulingam, P. (2012). Essentials of Medical Physiology, 6th Edition, New Delhi: Jaypee brothers medical publishers.

2. Wilson, J.W., Livingstone, K. C. (1987). Anatomy and Physiology in Health and Illness, 6th Revised Edition, New York: Churchill Livingstone.

Reference Books:

1. Tandon, O.P., Tripathi, R. (2011). Best and Tailor's Physiological basis of Medical Practice. 13th Edition. USA: Williams & Wilkins

2. Arthur, C. Guyton., Hall, E. J. (2011). Text book of Medical Physiology. 12th Edition. USA: Elsevier's.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
30 NCH	30 NCH	30 NCH Lab visit - Home assignments - Projects

PHYSIOLOGY-II PRACTICUM

Credit: 1

DETAILED SYLLABUS

MODULE	TOPICS & COURSE CONTENT	PERIODS
I	Qualitative test for ABO Grouping	4
II	Determination of Platelet count	6
III	Determination of Erythrocyte Sedimentation Rate	10
IV	Determination of Haematocrit	10
	TOTAL	30

Text Books:

1. Guyton and Hall ,2011, Textbook of medical physiology ,12th edition, Elsevier publications
2. Sembulingam K (2012) , Essentials of Medical physiology, 6th edition, Jaypee Publications.

References:

1. Frederic H. Martini, Judi L.Nath, EdwinFB, Fundamentals of Anatomy and Physiology,9th edition, pearson publishers
2. Elaine N.Mareib,Essential of Human Anatomy and physiology, 10th edition, Pearson publishers.
3. Ross and Wilson (2014), Anatomy and physiology in health and illness, 11th edition, Elsevier publications

Level: Semester II

Title of the Paper: BIOCHEMISTRY-II	
Subject Code: RIT242M203	**Course Level: 100**
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	**Total credits: 3**

Objective: This syllabus has been formulated to impart basic knowledge on principles of radiation physics and modern physics in radiology.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the different anatomical structures of the human body.	BT 1
CO2	**Compare** various body systems and co-relate the anatomy among them all.	BT 2
CO3	**Apply** different laws in assessing various	BT 3

	pathological conditions.	
CO4	**Apply** the knowledge of anatomy as necessary in the production of good quality images.	BT3

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	● Lipids ● Definition and classification of lipids ● Classification of Fatty acid ● Examples and functions of common lipid (phospholipids, glycolipids, steroids) ● Lipid Metabolism ● ß oxidation of fatty acid ● Ketone bodies ● Ketosis and ketoacid osis	15
II.	● ● Vitamins ● Definition and classification according to solubility ● Source and function of individual vitamins ● Deficiency	15
III	● Minerals ● Individual minerals – calcium, phosphorus, iron, magnesium fluslide, copper, selenium, molybdenum etc. - their sources, function and properties.	15

IV	• Enzymes • Definition and classification of enzyme • Basic idea of co-enzyme, iso-enzyme • Mechanism of enzyme action • Factors affecting enzyme action.	15
TOTAL		60

Text Book:

1. Chaurasia BD, (2016), Human Anatomy, 7th edition, CBS publisher.
2. Sembulingam. K, Human Physiology- Vol. 1&2 ,Medical Allied, 7th Edition.

Reference Books:

1. Frank. N. Nettar, Atlas of Human Anatomy,7th Edition, Elsevier
2. Ross and Wilson (2014), Anatomy and physiology in health and illness, 11th edition, Elsevier publications

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH	-	30 NCH
		Laboratory Visit Home Assignment Project work

Level: Semester II

Title of the Paper: Hospital Duty & Patient Care-II	
Subject Code: RIT242S201	**Course Level: 100**
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	**Total credits: 3**

COURSE OBJECTIVE:

This syllabus has been formulated to impart basics knowledge on hospitals, record keeping and report writing, basic care, comfort, sign and symptoms and hygiene of patients.

COURSE OUTCOME

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Recall** the principles and functions of hospital management.	BT 1
CO2	**Explain and demonstrate** the concept of writing good reports and records.	BT 2
CO3	**Apply** the knowledge about quality management and disposal of bio medical waste.	BT 3
CO4	**Apply** the concept of basic care needs and maintaining personal and hospital hygiene to real life hospital situations.	BT 3

COURSE OUTLINE:

MODULE	TOPICS & COURSE CONTENT	PERIODS
I.	• First aid • Artificial respiration - CPR • Hygiene • Bleeding control	10
II.	• Drugs • Methods of drug administration • Injection techniques	6
III.	• Shock • Burn • Poisoning • Syncope • Choking • HAI	10
IV	• International Organisation for standardisation • Regulatory Authority for Nuclear and Radiation facilities • Environmental impact of radiation • Radiation hazard and radiation safety	10

	• Handling of patient during radiological examination	
	TOTAL	36

Textbooks:

1. Hospital Duty and Patient Care in Diagnostic Radiology – Dr. N. K. Karda, , Lalit Agarwal, J.B.D. Publication.
2. Patients Right – A Sampath Kumar (CBS Publication.

References:

1. Fundamentals of Hospital Practice and Patient care – Vyakarnam Nageswar, Paras medical books Pvt. Ltd.
2. Principles of Hospitals Practice and Patient Care – P Srinivasulu Reddy , Paras medical books Pvt. Ltd.
3. Hospital Supporting Services and System – Dr. M A George , Daya Publishing House.
4. Manual of First Aid – L. C. Gupta, Abhitabh Gupta , Jaypee Publication.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH	-	30 NCH
		Hospital Visit Home Assignment Project work

Level: Semester III

Title of the Paper: Basic Physics	Course: Major
Subject Code: RIT242M311	Course Level: 200
Scheme of Evaluation: Theory	
L-T-P-C: 2-0-2-4	Total Credits: 4

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	Bloom's Taxonomy Level
CO 1	**Remember** the different electrical equipment's and the functions of each.	BT 1
CO2	**Demonstrate** the electrical connections of different electrical appliances.	BT 2
CO3	**Apply** the theoretical knowledge practically to check loose wires and correct faulty connections.	BT 3
CO4	**Create** different electrical circuits using different electrical and electronic appliances.	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• **Fundamental of Electricity:** • Electric Charges & Units of Electric Charge. Coulombs Law, Electric Induction, Electric Potential & Potential Difference, Capacitance & Capacitors, Resistance. • Conductors, Insulators & Semiconductors, Electric Current, Ohm's Law & Kirchoff's Law, Circuit Laws (Combination of Potential Difference In Series & Parallel, Meters, Electrical Energy & Power, Heating Effect of A current.	8

	• The Magnetic Effects of An Electric Current (Electromagnetism), Electromagnetic Induction, Mutual Induction & self Induction. • Alternating Current, The A.C. Transformer theory, construction, types of transformers its practical aspects, transformer losses and regulation & rating, types of transformers used in x-ray equipment. • Transistors and its types • 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	
II.	• **X-rays :** • Conductivity of electricity through gases at low pressure, cathode rays-production & properties. Sources of electrons (discharge through gases, thermionic emission & photo electric emission), discovery of an electron, concept of electron volt.	4
III	• **Mains Supply :** • Generation of electrical energy, distribution of electrical energy, use of electrical energy, polyphase supplies, availability of different voltages, feeder cables, line voltage drop; mains switches, fuses, circuit breakers. earthing, insulation, high tension cables construction, design.	4
IV	• **Diagnostic High Tension Circuits :** • Capacitor discharge, constant potential. main voltage compensation, mains resistance compensation, compensations for mains frequency variation. . High	8

	tension (tube selector) switch. meters- function; use of shunts. Meters Commonly Found In Diagnostic X-Ray Equipment, Position In Circuits, Reading Meters.	
TOTAL		24

Textbook:
1. Basic Medical Radiation physics – K Thalayan, Jaypee Brothers Medical Publishers Ltd.

Reference Books:
1.Christensen's Physics of Diagnostic Radiology – Christensen publisher-Wolters Kluwer India Pvt. Ltd.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH	30 NCH	30 NCH - Lab visit - Home assignments - Projects

Level: Semester III

Title of the Paper: Physics of Radiology	Course: Major
Subject Code: RIT242M302	Course Level: 200
Scheme of Evaluation: Theory	
L-T-P-C: 3-1-0-4	Total Credits: 4

Objective: This syllabus has been formulated to impart basics knowledge on principles of radiation physics and modern physics in radiology.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:

SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the key concepts of physics	BT 1
CO2	**Demonstrate** the structure and functions of a modern day x-ray tube	BT 2
CO3	**Apply** various principles of physics in the generation high and low frequency x-rays as per need	BT 3
CO4	**Analyze** various equipment's to identify faulty systems and fix them as per need	BT4

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Structure of atom , Bohr's atomic model • Electromagnetic waves and their properties • Electromagnetic spectrum and Spectrum of white light • History of X-rays • Production of x-ray & its properties • Physics of X-ray spectra – characteristic and bremsstrahlung x-rays • Factors upon which x-ray emission depends, soft and hard x-rays • Interaction of x-ray with matter • Coherent scattering- Thomson scattering, Rayleigh Scattering, Photoelectric absorption, pair production, photo disintegration • Attenuation	14
II.	• X-Ray Tubes • Construction of various x-ray tube & handling • Cathode and Filament design • cathode • Fixed and rotating anode, faults in X-Ray tubes, Grid Controlled X-Ray Tube, • Mammography X-Ray Tube. • Heavy Duty X-Ray Tube, Micro-Focus X-Ray Tube • Tube heat Ratings and methods of heat dissipation	14

	• Line Focus principle, Anode Cooling chart • Tube overload indication, X-Ray Tube over Load Protection Circuits • Grid • Heel effect • Beam limiting devices	
III	• Introduction & Handling of Portable and Non- Portable equipment • Maintenance and care of all X-Ray equipment and accessories	8
IV	• Basics of radioactivity • Ionising Radiation and its quantities and units. • Interaction quantities , Linear attenuation co-efficient, mass attenuation co-efficient • Thermionic emission	10
TOTAL		**48**

Text Book:

1. Textbook of Radiology Physics, Hariqbal singh, Roshan Lodha jaypee publishers
2. Christensen's physics of diagnostic radiology, 4th edition

Reference Books:

1. Holmberg O, Malone J, Rehani M, McLean D, Czarwinski R. Current issues and actions in radiation protection of patients.
2. Radiation physics for Nuclear Medicine edited by Marie Clarie, Christoph Hoeschen, Springers.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	**PRACTICUM**	**EXPERIENTIAL LEARNING**
90 NCH	**-**	**30 NCH** **Group discussion** **Quiz** **Home assignments** **Projects**

Level: Semester III

Subject Name: General Radiographic Technique-I	**Course: Major**
Subject Code: RIT242M313	**Course Level: 200**
Scheme of Evaluation: Theory	
L-T-P-C: 0-0-8-4	**Total Credits: 4**

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the routine and special projections for all the different parts of the human body	BT 1
CO2	**Explain** different radiographic projections taken for different body parts	BT 2
CO3	**Apply** the knowledge of anatomy in producing accurate radiographs	BT 3
CO4	**Create** good quality accurate radiographs by using multiple projection knowledge for particular body part	BT 6

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	• **Upper-limb:** • Routine projections for the whole Hand, Fingers, Wrist	14

	Joint, Forearm, Elbow Joint and Humerus. Supplementary projections for scaphoid, carpal tunnel ball catchers projections, head of the Radius, Supracondylar Fracture and Olecranon Process. ● **Lower limb:** ● Routine Projections For The Whole Foot, Toes, Calcaneum, Ankle Joint, Leg, Knee-Joint, Patella and Femurs. Supplementary Projections For Talo-Calcaneal Joint, Forced Projections For Torn Ligaments, Flat Feet, Club Feet, Intercondylar Projections For Loose Bodies In The Knee, Axial Projection For Patella.	
II.	● **Pectoral Girdle and Thorax:** ● Routine Projections For Shoulder Joint, Scapula, Acromio-Clavicular Joint, Clavicle, Sternoclavicular Joint, Sternum and Ribs. ● Supplementary Projections For The Axial Projections of Clavicle, Bicipital Groove Carotid Process, Classification of Tendons, Subluxation, Upper Ribs and Axillary Ribs. ● **Pelvic Girdle and Hip Region:** ● Routine Projections For The Whole Pelvis, Sacro-Ileac Joints, Hip Joint and Neck of Femur. ● Supplementary Projections For The Greater and Lesser Trochanters of Femur. Frog Leg Projection, Ischeum Symphysis Pubis, Ileum, Accetabulum and Congential Dislocation of Hip Arthrodesis.	14
III	● **Abdomen:** ● Kub, Erect Abdomen and Decubitus Projection, Supplementary Projections For Acute Abdomen.	8
IV	● **Chest:** ● Routine Projections For Lungs, Cardia and Diaphragm. ● Supplemantary Projections For Opaque Swallow,	12

	Thoracic Inlet, Soft Tissue Neck, Decubitus, Apicugrams, Paediatric Cases.	
TOTAL		48

Text Book:

1. Seeram E. Computed Tomography: Physical Principles, Clinical Applications, and Quality Control,4th edition, Elsevier Health Sciences.
2. Radiation protection, Euclid seeram, Lippincott Williams and wilkins.

Level: Semester III

Title of the Paper: Medical Law & Ethics	**Course: Major**
Subject Code: RIT242M304	**Course Level: 200**
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	**Total Credits: 3**

Objective: The course provides an introduction to ethics generally and more specifically to medical ethics, examining in particular the principle of autonomy, which informs much of medical law. The course then considers the general part of medical law governing the legal relationship between medical practitioners and their patients. It considers the legal implications of the provision of medical advice, diagnosis and treatment. Selected medico-legal issues over a human life are also examined. These may include reproductive technologies, fetal rights, research on human subjects, organ donation, and the rights of the dying and the legal definition of death.

Course Outcome:

Upon completion of the course student shall be able to:		
		BLOOMS TAXONOMY

SI NO	COURSE OUTCOME	LEVEL
CO 1	**Define** ethics and its importance in the functioning of the hospital.	BT 1
CO2	**Outline** the various issues related to healthcare setup and also manage the hospital with the various issues that can arise from the legal perspective.	BT 2
CO3	**Recognize** and train the workforce to meet the challenges of changing dynamics in healthcare scenario in terms of the regulations that governs the operational aspects of the hospital.	BT 3
CO4	**Distinguish** the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice.	BT 4

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	Introduction: Basics of Medical Ethics, Values in medicine, ethical problems and the medical profession, goals of medical intervention, patient-doctor relationship	12
II.	Codes of Conduct: historical perspective, international codes of medical ethics- duties of physicians to the sick and to each other	6
III	Informed consent, right of patients- right to life, female foeticide, gender determination, reproductive technologies- adoption, AID, IVF, GIFT, SIFT, surrogacy, ICMR guidelines	6

IV	Introduction: Basic definition and goals, medical profession definition and criteria, clinical ethics, ethical problems, core curriculum for medical ethics and law, code of conduct, malpractice and negligence, UN principles of medical ethics, irrational drug therapy	12
TOTAL		36

Text Book:

1. Medical Ethics 2nd Edition, by CM Francis: Jaypee Brothers

Reference Books:

1. Clinical Ethics: A Practical Approach to Ethical Decisions in Clinical Medicine, 8th Edition, by Albert R. Jonsen, Mark Siegler, William J Winslade.
2. Textbook of Medical Ethics, Erich H. Loewy, M.D.

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH	-	30 NCH Seminar Home assignments Case Study

Level: Semester IV

Title of the Paper: Radiation Hazards & Protection	Course: Major
Subject Code: RIT242M401	Course Level: 200
Scheme of Evaluation: Theory	
L-T-P-C: 3-1-0-4	Total Credits: 4

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	Bloom's Taxonomy Level
CO 1	**Remember** the core concepts and principles of radiation protection	BT 1
CO2	**Demonstrate** various methods of protection with the help of all the protective devices	BT 2
CO3	**Apply** the knowledge of radiation dosimetry in calculating doses received by a particular type of radiation	BT 3
CO4	**Analyze** reasons of high radiation dose in an area and use the principles and methods to reduce the dosage	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	Introduction to Radiation Protection, Units & Quantities- Primary, secondary radiation, need for radiation protection, Exposure, Absorbed dose, absorbed dose equivalent, Effective dose, air KERMA, Radiation weighting factor, Tissue weighting factor, MPD. Aim & Principle of Radiation Protection- Concept of ALARA, Cardinal Principle, ICRP regulation, Radiation Protection in: Radiography, CT, Fluoroscopy, Mammography, Ward radiography, radiation shielding	12

II.		Radiation monitoring: Personnel – Film badge, TLD, OSLD, pocket dosimeter, Area monitoring Devices. Radiobiology: Radiolysis of water, Direct & Indirect effects of radiation, Stochastic, Deterministic effects, Somatic, Genetic effects, dose relationship, Antenatal exposure. 10 day rule, 14 day rule, 28 day rule, exposure control for children, mentally and physically challenged patients and lactating mothers	12
III		Care and maintenance of diagnostic equipment: General principles and preventive maintenance for routine - daily, Weekly, monthly, quarterly, annually: care in use, special care of mobile equipment.	12
IV		Role of Radiographer in Planning, ICRP, NRPB, NCRP and WHO guidelines for radiation protection, pregnancy and radiation protection. NABH guidelines, AERB guidelines, PNDT Act and guidelines	12
TOTAL			**48**

Text Book:

1. Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy., 8th edition, Elsevier Health Sciences
2. Brant WE, Helms CA, editors. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins; 2012

Reference Books:

1. Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures, 4th edition,. Elsevier Health Sciences
2. Radiology for undergraduates and general practioners, Hariqbal singh, Jaypee publishers

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
90 NCH	-	30 NCH - Group Discussion - Seminar/presentations - Projects

Title of the Paper: General Radiographic Technique-II	Course: Major
Subject Code: RIT242C412	Course Level: 200
Scheme of Evaluation: Theory	
L-T-P-C: 0-0-8-4	Total Credits: 4

Objective: This course has been formulated to develop knowledge on radiographic projection commonly encounter in clinical environment

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the routine and special projections for all the different parts of the human body	BT 1
CO2	**Explain** different radiographic projections taken for different body parts	BT 2
CO3	**Apply** the knowledge of anatomy in producing accurate radiographs	BT 3
CO4	**Create** good quality accurate radiographs by using multiple projection knowledge for particular body part	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• **Skull:** • Routine Projections For Craniumand Facial Bones. • Supplementary Projections For Trauma, Towne's & Method, Sella, Turcica, Optic Foramina, Jugular Foramina, Temporal Bones, Mastoids Petrous Bone, Zygomatic Arches, Orbits, Maxillae, Nasal Bones, Mandible, Temporomandibular Joints.	12
II.	• **Vertebral Column:** • Routine Projections For The Greater Occiptal Joint, Cervical Spine, Cervico Thoracic Junction, Thoracic Spine, Lumbar Spine, Lumbo Sacral Region, Sacrum and Coccyx. • Supplementary Projections For The Intervertebral Foramina, Posterior Arch of Atlas, Flexion and Extension of Cervical Spine, Scoleosis, and Kyphosis, Sacro Illeac Joint.	12
III	• **Nasal Sinuses:** • Techniques For Frontal, Maxillary, Ethmoidal and Sphenoid Sinuses, Erect and Horizontal Projections For Fluid Levels. • **Teeth:** • Routine Projections of All Teeth- Intra Oral and Extra Oral Projections. • Supplemantary Projections For Localisation of Roots, Children, Edentulous Subjects and Use of Occlusals and Bitewings, Orthopantomography.	12
IV	• **CR and DR :** • Application of CR, its instrumentations, DRY and Laser printer, CR Printer's application.	12

	• DICOM, Application, Functions, Features and its advantages. • Automatic processor, Application, principal. Working technique, work load handling in automatic processor. • Radiological Information Systems	
TOTAL		48

Text Book:

1. Atlas of breast imaging with Mammography, ultrasound and MRI correlations, Col.CS Pant, 2nd edition, Jaypee Publishers

Reference Books:

1. Fundamentals of Mammography, Sue Williams, Linda Lee, 2nd edition, Elsevier
2. Introduction to ultrasound. Zwiebel WJ, Sohaey R, Saunders publishers

Title of the Paper: Techniques of Mammography & Fluoroscopy	**Course: Major**
Subject Code: RIT242M403	**Course Level: 200**
Scheme of Evaluation: Theory	
L-T-P-C: 3-0-0-3	**Total Credits: 3**

Objective: This course has been formulated to Impart basic knowledge of breast imaging using mammography imaging, mineral density using BMD and other recent advancement related to them.

Course Outcome:

Upon completion of the course student shall be able to:		
		BLOOMS

SI NO	COURSE OUTCOME	TAXONOMY LEVEL
CO 1	**Remember** the historical facts related to mammography and its importance in the medical field	BT 1
CO2	**Understand** the basic principle of mammography and bone mineral density	BT 2
CO3	**Explain** the procedure for producing images in mammography and BMD	BT 3
CO4	**Apply** the knowledge of protection and safety in each modality to produce images maintaining the radiation safety	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• History of mammography and its applications	8
II.	• Mammography: Mammography Equipment's and Basic views in Mammography	14
III	• Clinical Practice Scanning protocol, Indication, Patient preparation, image quality and artifacts in and Mammography	14
IV	• Fluoroscopy and Image Intensifiers: Direct fluoroscopy, fluoroscopy image, fluoroscopic screen, explorators (serial changers, spot film devices) and accessories. Radiation protection including integrating timer. Tilting tables. Principles and Construction of Image Intensifiers, Television Camera Tubes and Cathode Ray Tubes. Recording the intensified image, methods of viewing the intensified image, equipment for fluorography and	10

	cine-fluorography. Radiographic and fluoroscopic tables, telecommand tables. • Equipment for Special Procedures: Special trolleys and chairs, portable and mobile x-ray units, cordless mobile x-ray equipment, capacitor discharge mobile equipment, cranial and dental equipment, skull tables, mammography, mass-miniature radiography, multi section cassettes, rapid cassette change, rapid film changer, magnification radiography, subtraction radiography.	
TOTAL		48

Textbooks:

1.Ross & Galloway: A Hand Book of Radigraphy (Lewis)

Reference Books:

1.Scarrow: Contrast Radiography (Schering Chemicals)

2.Vanderplasts : Medical X-Ray Technique (Mac Millan)

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH		30 NCH - Lab visit - Home assignments - Projects

Title of the Paper: Special Radiographic Procedure	**Course: Major**
Subject Code: RIT242M414	**Course Level: 200**
Scheme of Evaluation: Theory	
L-T-P-C: 0-0-8-4	**Total Credits: 4**

Objective: The aim of this course is to allow students to learn how to approach different radiographic positions for special procedures and apply the same in achieving the best possible images with minimum exposure.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the principle of contrast media, its the composition and adverse reactions	BT 1
CO2	**Explain** different kinds of special procedures based on the different systems of the human body	BT 2
CO3	**Apply** the anatomical knowledge in assessing patient condition and accordingly carrying out different procedures	BT 3
CO4	**Analyzing** different patients complicated situations and providing drugs to relieve the patient from life threating contrast reactions	BT 4

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**

I.	• Introduction to Radiographic Special Procedures Contrast Media- Application, types, safety aspects & administration, Reaction to contrast media and management of contrast reactions.	8
II.	• Gastrointestinal tract: Barium series :Barium swallow, Barium meal , Barium meal follow through (BMFT) , Barium enema	12
III	• Urinary system: Indications, contraindications procedure and technique of : Intravenous urogram (IVU), Micturating Cystourethrogram (MCU), Ascending Urethrogram (ASU)/ RGU , Hysterosalpingography (HSG), lithotripsy	14
IV	• Billiary tract: Oral cholecystography, Intravenous cholecystography, T-tube cholangiogram, Myelogram, Fistulogram, Polytrauma	14

Level: Semester V

Subject Name: Computed Tomography		**Subject Code: RIT242M501**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This course has been formulated to develop knowledge on basic principles of Computed tomography, radiographic projection and positioning.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	Remember the historical facts related to computed tomography and its importance in the medical field	BT 1
CO2	Understand the basic principle of Computed tomography	BT 2
CO3	Develop the skill for producing images in computed tomography	BT 2
CO4	Apply the knowledge of protection and safety in CT scan to produce images maintaining the radiation safety	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Introduction to Computed Tomography and Principle of Computed Tomography History, Advantage and Disadvantages of CT, Basic principle of CT , Generations of Computed Tomography- 1st generation, 2nd generation, 3rd generation, Slip ring technology, 4th generation, Electron beam CT, Dual Source CT, Flat Panel Detector CT Single and Multi slice Technology	10
II.	• Instrumentation-CT scanner gantry, Detectors & Data Acquisition System, Generator, Computer and image processing System Image display system, storage, recording and communication system, CT control console, Options and accessories for CT systems • Image Reconstruction- Basic principle, Reconstruction algorithms, Image reconstruction from projections, Types of data reconstruction Image	16

	Display and Image Quality Image formation and representation, Image processing, Pixel and voxel, CT number Window level and window width, Qualities, Resolution, Contrast, Sharpness, Noise properties in CT	
III	• CT Artefacts- Classification, Types, Causes, Remedies	8
IV	• Patient preparation, patient positioning, performing all non-contrast and contrast computed tomography procedures • Radiation protection and care of patient during procedures including contrast media Management in CT • Various post processing techniques and evaluation of image quality and clinical findings. • Post procedural care of the patient	14
TOTAL		48

Text Book:

1. Step by step CT Scan by D Karthikeyan, Deepa Chegu (Jaypee Publishers)

Reference Books:

1.Textbook of Radiology for Residents and Technician, Satish K Bhargava, Sumeet Bhargava, Fifth edition, CBS Publishers & Distributors Pvt. Ltd.

2.Radiology 101, The Basics and Fundamentals of Imaging, 4th Edition, Wilbur L. Smith, Thomas A. Farrell.

References:

1. Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences; 2015
2. Kak AC, Slaney M. Principles of computerized tomographic imaging. Society for Industrial and Applied Mathematics; 2001

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
60 NCH		30 NCH - Lab visit - Home assignments - Projects

Semester V

Subject Name: Darkroom Technique		**Subject Code: RIT242M502**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This subject is designed to impart fundamental knowledge on the construction and the importance of a darkroom in a Radiology department. Students will also learn about the technique of processing and developing an x-ray film, the different types of films and chemicals used and the physics behind the formation of an x-ray image.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the planning and structure of a darkroom in a	BT 1

	radiology department	
CO2	**Explain** the various types of equipment used and the differences between the conventional and modern types of equipment	BT 2
CO3	**Explain** the construction of the x-ray films, x-ray cassettes, and intensifying screens	BT 2
CO4	**Apply** the knowledge of image processing in creating radiographs of good quality	BT 3

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Dark Room Planning:** • For a Small Hospital, For a Large Hospital • Location of Dark Room • Construction of Dark Room • Ventilation • Wall Protection • Darkroom entrance	8
II.	**Dark Room:** • Instruction To Staff • Dry Bench • Hopper, Drawer, Cupboard • Loading and Unloading Cassettes • Hangers, Types of Hangers and Storage of Hangers • Printing • Wet Bench • Cleanliness, Control of Dust, Dark Room Sink • Hatches • Drier	8

	• Safe Lights, Direct and Indirect, Uses, Factors Affecting Safelight Performance, Safelight Tests	
III	**X-Ray Films :** • Glass, Cellulose and Ployester Bases • Structure of X-Ray Films- Emulsion, Gelatin, Base and Supercoating • Types of X-Ray Films • Single Coated, Duplitised • Spectral Sensitivity • Colour Sensitivity • Grainess of Films • Speed of Films • Screen & Non Screen Films • Various Formats of Films • Films For Special Procedures **Processing Methods:** • Preparation of Solution • Manual Processing Apparatus • Control of Temperature • Rapid Processing • Automatic Processor- Principle and Features, Water Supply, Use of Thermostat, Regeneration of Solutions, Maintenance. Advantage and Limitations, Processing of Cut Films and Roll Films. **Developer:** • Constituents • Characteristics • Manual and Automatic Processors • Effects on Developing Time, Temperature, Agitation	16

	• Replenisher • Exhaustion **Rinsing :** • Acid Stop-Bath • Methods • Objects **Fixer :** • Constituents • Characteristics • Manual and Automatic Processors • Fixing Time and Clearing Time • Factors Affecting Fixing Time • Replenisher1 • Exhaustion **Washing and Drying:** • Objects • Methods • Factors Affecting Washing and Drying • Wetting Agents • Comparison of Different Methods **Day Light Film Handling:** • Day Light System Using Cassettes • Day Light System without Cassette	

IV	**X-Ray Cassette:** • Construction of X-Ray Cassettes • Types of Cassettes • Mounting Intensifying Screens In Cassettes • Identification of Cassettes • Care of Cassettes **Intensifying Screens:** • Fluorescence-Phosphors • Phosphors Employed – Calcium Tungstate – Barium Fluochloride – Rare Earths • Construction of Intensifying Screens • The Influence of Kilovoltage In Different Phosphors • Intensification Factor • Resolving Power of Intensifying Screens • Speed of Screens • Screen Film Contact Tests • Types of Intensifying Screens • Advantages and Limitations of Intensifying Screens	16
TOTAL		**48**

Text Book:

1. D.N. Chesney & M.O. Chesney: Radiographic Imaging (Cbs)

Reference Books:

1. I.C.R.P.: Protection of The Patient In Medical Radiography (Bergaman)
2. Derrick P, Roberts & Nigel L. Smith: Radiographic Imaging A Practical Approach (Churchill Livingstone)

Semester V

Title of the Paper: Computer Skills		Subject Code: RIT242M513
L-T-P-C: 0-0-8-4	Total Credits: 4	Scheme of Evaluation: T

Objective: The course is designed to aim at imparting a basic level appreciation programme for the common man. After completing the course the incumbent is able to the use the computer for basic purposes of preparing his personnel/business letters, viewing information on Internet, sending mails, using internet banking services etc. This allows a common man or
housewife to be also a part of computer users list by making them digitally literate. This would also aid the PC penetration program. This helps the small business communities, housewives to maintain their small account using the computers and enjoy in the world of Information Technology

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	Bloom's Taxonomy Level
CO 1	**Define** the various parts of a computer, the basics of computer architecture and learn about the various components of computer architecture.	BT 1
CO2	**Learn** the different operating systems and learn their uses while handling the various softwares athat comes along with the machines.	BT 2
CO3	**Apply** the knowledge of MS word, excel and powerpoint in creating projects and presentations	BT 3
CO4	**Apply** the knowledge of computer skills in producing, editing and formating various images of the different modalities of the Radiology department in turn producing good quality images.	BT 4

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Computer Applications & Basics:** Introduction, Basic Applications of Computer, Components of Computer, Connecting Computer Components, Computer Hardware & Software **Introduction to Internet, WWW & Web Browsers:** Basics of Computer Networks, Internet, Search Engines, URLs, How to use Web Browser	14
II.	**Computer Operating System:** Basics of Operating System, Linux, Windows, Task Icons, Bars, System Settings, Setting Date & Time, File Management	10
III	**Word Processing:** Introduction, Printing a File, Document Creation & Editing, Saving, Text Formatting **Microsoft Excel & using Spreadsheets**: Introduction, Rows, Columns & Cells, Basics Excel Formulas and Functions	12
IV	**Communications & Collaboration:** Basics of Email, How to use Email, Instant Messaging, Format an Email **Making Small Presentation:** How to Create, Edit, Format, or Delete Slides, Make a Slideshow, Save a Presentation, Printing of Presentation	12
TOTAL		48

Text Book:

1. Computer Fundamentals: Concepts, Systems & Applications Sinha, P. K/ Sinha, P. 3rd ed BPB

Reference Books:

1. Objective Computer Awareness, Arihant Experts

2. Computer fundamentals : Concepts, Systems and Applications , Priti Sinha, Pradeep K Sinha

CREDIT DISTRIBUTION		
THEORY/TUTORIAL	PRACTICUM	EXPERIENTIAL LEARNING
	60 NCH	30 NCH Lab visit Home assignments Projects

Semester V

Subject Name: Basics of Ultrasound and ECG		**Subject Code: RIT242M504**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the principles and concepts of ultrasonography and the physics behind the generation of images	BT 1
CO2	**Explain** and demonstrate various procedures guided by ultrasound	BT 2
CO3	**Apply** the anatomical and technical knowledge to find out the cause of illness	BT 3
CO4	**Create** awareness of the value and benefits of ultrasound	BT 6

	among patients, health care providers and insurers	

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	● Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasound, Equipment description ● Mode of USG & its type	8
II.	● Indication and Clinical Application ● Physics of ultrasound imaging, Physics of transducers, construction & its type, Physics of Doppler USG & its type ● Ultrasound tissue characterization ● Potential for three dimensional ultrasound	6
III	● Artifacts in ultrasound ● Comparison of ultrasound equipment Computerization of data, Image recording, ● Ultrasound jelly & Safety of ultrasound ● USG Contrast Media-Types of Ultrasound Contrast media and its advantages ● Care & maintenance QA & QC & USG equipment	14
IV	● Echocardiography ● Equipment, Introduction, indication and image formation. ● Uses of colour Doppler in echocardiography and equipment description with transducer.	8
TOTAL		36

Text Book:

1. Textbook of diagnostic ultrasonography. Hagen-Ansert SL. Mosby Elsevier

Reference Books:

1. Introduction to ultrasound. Zwiebel WJ, Sohaey R, Saunders publishers
2. Handbook of ultrasound, GS Garkal, 2nd edition, Jaypee Publishers

Semester V

Subject Name: Clinical Posting		**Subject Code: RIT242M524**
L-T-P-C – 0-0-12-6	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: The objective of this course is to educate the students and prepare them for future real-life situations and to enhance the delivery of health care in the Radiology Department.

1. Students will observe the basic functioning of the different modalities present in the Radiology department. They will be introduced to terminologies, equipments and techniques for preparation and management.

2. Students will gain additional skills in clinical preparation, interaction with patients and professional personnel. Students will apply knowledge from previous clinical learning experiences under the supervision of a senior technical officer.

3. Students will improve their skills in clinical procedures. Progressive interaction with patients and professional personnel are monitored a students practice in a supervised setting. Additional areas include problem-solving, identifying machine components and basic side-effect management.

4. The course provides students the opportunity to continue to develop advanced problem solving skill. Students will demonstrate competence in beginning, intermediate and advanced procedures.

Level: Semester VI

Subject Name: Magnetic Resonance Imaging		**Subject Code: RIT242M601**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This course has been formulated to develop knowledge on basic principles of Computed tomography, Radiographic projection and positioning. This course has been formulated to develop knowledge on working principle, instrumentation, and clinical applications of MRI.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the history of different diagnostic modalities of radiology department, their inventors and other important facts on recent advancement	BT 1
CO2	**Understand** the working principle and physic behind the image formation in CT, MRI and BMD	BT 2
CO3	**Explain** the procedure of patient positioning and the technical aspects of each modality	BT 2
CO4	**Apply** the specific knowledge relating to that particular modality in the production of good quality image to aid in diagnosis	BT 4

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	• Introduction and Basic Principle of Magnetic Resonance Imaging History of MRI, Electricity & Magnetism, Laws of magnetism, Atomic structure, Motion within the atom, The Hydrogen nucleus, Precession, Larmor equation, Resonance, MR signal, Free induction decay signal, Relaxation, T1 recovery, T2 decay, Pulse timing& parameters.	4

II.	• MRI Hardware Introduction, Permanent magnets, Electromagnets, Super conducting magnets, Fringe fields, Shim coils, Gradient coils, Radio-frequency coils, the pulse control units, Patient transportation system, Operator interface Encoding, Data collection & Image formation Introduction, Gradients, Slice selection, Frequency encoding, Phase encoding, Scan timing, Sampling, data space, k-space, k-space filling and fast Fourier transformation.	6
III	• MRI Artefacts Introduction, Phase miss-mapping, Aliasing or wrap around, Chemical shift artefact, Chemical misregistration, Truncation artefact/Gibbs phenomenon, Motion of the patient Magnetic susceptibility artefact, Magic angle artefact, Zipper artefact, shading artefact Cross excitation and cross talk MRI contrast agents • Flow Phenomena & MRI angiography Introduction, The mechanisms of flow, Time of flight phenomenon, Entry slice phenomenon, Intravoxel Dephasing. Flow phenomena compensation-Gradient moment rephrasing, Pre saturation, Even echo rephrasing, MR Angiography	8

Text Book:

1.Christensen, Curry & Dowdey: An Introduction of Physics To Diagnostic Radiography (Lea & Febiger)

Reference Books:

1.Step by Step MRI by J Jagan Mohan Reddy , V Prasad Jaypee Publishers.

2. MRI in practice, 4th Edition by Catherine Westbrook, Carolyn Kaut Roth, John Talbot , Wiley-Blackwell.

Reference Books:

1. Catherine Westbrook, Carolyn Kaut Roth, John Talbot-MRI in Practice-Wiley-Blackwell

2. Catherine Westbrook - Handbook of MRI Technique-Wiley-Blackwell

Semester VI

Subject Name: Orientation in Clinical Sciences		**Subject Code: RIT242M602**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This course has been formulated to develop knowledge on radiographic projection commonly encounter.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** diseases of various body systems and how they manifest clinically and histopathologically	BT 1
CO2	**Explain** essential basic pathological processes to the pathogenesis of common and important diseases	BT 2
CO3	**Demonstrate** an understanding of how knowledge of pathological processes can be utilised in the investigation, management and prevention of disease	BT 2
CO4	**Apply** the concepts and knowledge of different diseases in treating patients	BT 3

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods

I.	• Pericarditis , Valvular diseases , Rheumatic Heart Disease , Heart failure, Bronchitis , Emphysema , Bronchitis , Pneumonia , Tuberculosis , Pleura effusion , Phenumo thorax	10
II.	○ Aclasia cardia , Peptic ulcer , Intestinal obstruction, Crohn's disease, Ulcerative colitis , Pancreatitis, Portal Hypertension , Ascitis, Cirrhosis , Cholecystitis ,Melena , Appendicitis • Cholelithiasis , Peritonitis , Suprahrenic Abscess , Appendicitis , Benign Hypertrophy prostate	6
III	• Hematuria , UTI , Hydronephrosis , Horse shoe Kidney , Hydrocele , Glomerulo nephritis , Nephrotic Syndrome , Urinary calculi , Polycystic Kidney disease , Renal failure	6
IV	• Fracture, Type, Mechanism, Healing, Delayed Union, Non- complication , Injuries of the shoulder girdle, Dislocation of shoulder Injuries of the carpal , Dislocation of Hip , Femur, Tibia, Ankle, calcaneum ,Acute & chronic osteo arthritis, Rheumatoid arthritis , Paget's Disease , Ankylosing spondylitis , Club foot , Bone Tumor-Benign Malignant , Perthes diseases	14
TOTAL		36

Text Book:

1. Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy., 8th edition, Elsevier Health Sciences

Reference Books:

1. Grainger & Allison's Diagnostic Radiology E-Book. Elsevier Health Sciences.
2. Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures, 4th edition, Elsevier Health Sciences

Semester VI

Subject Name: Basics of Radiotherapy		**Subject Code: RIT242M603**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This objective of the course is to impart basic knowledge of nuclear imaging and expose students to developments of recent technologies in the field of diagnosis.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the basic principles of radiotherapy and basics of radioactivity	BT 1
CO2	**Understand** the basic principle and advances of nuclear imaging and its diagnostic value	BT 2
CO3	**Explain** the procedures of producing different radionuclides using different nuclear reactors	BT 2
CO4	**Apply** the knowledge of radiotherapy in producing images of the target organs and treatment of certain diseases	BT 3

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**

I.	• Introduction to NMT and Radioactive Transformation Basic atomic and nuclear physics, History of radioactivity, Units & quantities, Isotopes, Isobars, Isomers, Radioactivity and half-life, Exponential decay ,specific activity, Modes of Radioactive decay, parent daughter decay.	12
II.	• Production of Radio nuclides Reactor produced radionuclide, Reactor principles; Accelerator produced radionuclide, Radionuclide generators	8
III	• Radio pharmacy & Handling & Transport of Radio-nuclides Cold kits, Radio pharmacy used in Nuclear medicine, Radiopharmaceuticals used in various procedures, Safe handling of radioactive materials, Procedures for handling spills	14
IV	• Equipments of Radiotherapy Gamma camera, PET, SPECT	12
TOTAL		48

Text Book:

1. Waterstram-Rich KM, Gilmore D. Nuclear Medicine and PET/CT-E-Book: Technology and Techniques. Elsevier Health Sciences; 2016

Reference Books:

1.Principle and practice of Nuclear medicine and correlative medical imaging, RD lele, Jaypee publishers.

2. Walter and Miller's Textbook of Radiotherapy, Radiation Physics , Therapy and Oncology, 8th Eight Edition, Paul Symonds, John A. Mills, Angela Duxbury.

Semester VI

Subject Name: Interventional Radiology		**Subject Code: RIT242M604**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: This course has been formulated to develop knowledge on current interventional radiology procedures including pulmonary angiography and vein embolization.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the role of intervention in medical imaging	BT 1
CO2	**Explain** the theory of operation, functioning and clinical application of different interventional procedures	BT 2
CO3	**Develop** the knowledge to train and educated other hospital staff about operating various interventional equipment	BT 3
CO4	**Apply** the knowledge to perform as a member of multidisciplinary team in a hospital setting	BT 3

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	• Introduction to interventional radiology • Need for interventional procedures Informed consent	10

II.	Equipment • History and overview of angiography, Basics of Angiographic equipment: Single and biplane angiographic equipment Angiographic Table, Image intensifier, Flat panel detector, Recording systems, • Cardiac resuscitation measures - ECG Pressure injector, Catheters, needles, stents, and other tools 3-D rotational angiography, Image processing, Patient monitor, ACT equipment Advancement in interventional radiology	14
III	Procedure: - • Coronary angiography & angioplasty, cardiac • Cardiac cauterization, image • Image-guided biopsy/fnac/drainage, four • Four vessel DSA & aortogram, embolic • Embolism agents, patient preparation, post-procedure care, the role of the radiographer in an interventional procedure	14
IV	• Catheters, guide wires & stents • Venography • Vertebroplasty and kyphoplasty • RF ablation • Crash cart – emergency drugs	10
TOTAL		48

Text Book:

1. Kandarpa K, Machan L, editors. Handbook of interventional radiologic procedures. Lippincott Williams & Wilkins

Reference Books:

1. Bontrager KL, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy-E-Book. Elsevier Health Sciences; 2013

2.Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures, 4th edition,. Elsevier Health Sciences

Semester VI

Subject Name: Biostatistics and Research Methodology		**Subject Code: RIT242M605**
L-T-P-C – 3-1-0-4	**Credit Units: 4**	**Scheme of Evaluation: T**

Objective: The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the principal concepts about bio-statistics and research methodology	BT 1
CO2	**Recognize** the definition of statistics, the subjects and its relation with other sciences	BT 2
CO3	**Explain** the various process of data collection and sampling	BT 2
CO4	**Apply** the testing methods on formulating precise data relating to the particular research	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Introduction: Introduction to research methodology: meaning, objectives of research, types of research, research approaches, significance of research, research process, criteria of good research, Defining research problem: selecting the problem necessity and techniques in defining the problem.	8
II.	• Research, sample design and data collection: Research Design: need and features of good design, types, basic principles of experimental design, developing a research plan. Sample design: criteria for selecting a sample procedure, characteristics of good sampling procedure types of sample design, selecting random samples. Methods of data collection: Collection of primary data, observation method, interview method, collection of data through questionnaire and schedules and other methods. Collection of secondary data, selection of appropriate method for data, collection, case study method, guidelines for developing questionnaire, successful interviewing, survey vs. experiment. Processing and analysis of data: data analysis (elements), statistics in research, measures of central tendency, dispersion, asymmetry, regression analysis, multiple correlation and regression, partial correlation, and association in case attributes.	14
III	• Sampling Fundamentals: Definition, need, central limit theorem, sampling theory, the concept of standard error, estimation, estimating population mean, proportion, sample size and its determination.	14

IV	• Testing of hypothesis: Meaning basic concepts, important parametric tests, limitations of tests of hypothesis. Chi-square test: Applications, steps characteristics, limitations. Analysis of variance and co-variance: basic principles, techniques, applications, assumptions and limitations. Analysis of non-parametric tests	10
TOTAL		48

Text Book:

1.ABC of Research Methodology and Applied biostatistics by MN Parikh and Nithya Gogtay

Reference Books:

1.Comprehensive text book of Biostatistics and Research Methodology by Dr. S. Kartikeyan.

2. Introduction to Biostatistics (A Textbook of Biometry) by Dr. Pranab Kumar Banerjee , S Chand.

SEMESTER VII

Subject Name: Techniques of Routine X-rays		**Subject Code: RIT242M711**
L-T-P-C – 0-0-8-4	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the routine and special projections for all the different parts of the human body	

		BT 1
CO2	**Explain** different radiographic projections taken for different body parts	BT 2
CO3	**Apply** the knowledge of anatomy in producing accurate radiographs	BT 3
CO4	**Create** good quality accurate radiographs by using multiple projection knowledge for particular body part	BT 6

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Upper-limb:** Routine projections for the whole Hand, Fingers, Wrist Joint, Forearm, Elbow Joint and Humerus. Supplementary projections for scaphoid, carpal tunnel ball catchers projections, head of the Radius, Supracondylar Fracture and Olecranon Process. **Lower limb:** Routine Projections For The Whole Foot, Toes, Calcaneum, Ankle Joint, Leg, Knee-Joint, Patella and Femurs. Supplementary Projections For Talo-Calcaneal Joint, Forced Projections For Torn Ligaments, Flat Feet, Club Feet, Intercondylar Projections For Loose Bodies In The Knee, Axial Projection For Patella.	8
II.	**Pectoral Girdle and Thorax:** Routine Projections For Shoulder Joint, Scapula, Acromio-Clavicular Joint, Clavicle, Sternoclavicular Joint, Sternum and Ribs. Supplementary Projections For The Axial Projections of	14

	Clavicle, Bicipital Groove Carotid Process, Classification of Tendons, Subluxation, Upper Ribs and Axillary Ribs. **Pelvic Girdle and Hip Region:** Routine Projections For The Whole Pelvis, Sacro-Ileac Joints, Hip Joint and Neck of Femur. Supplementary Projections For The Greater and Lesser Trochanters of Femur. Frog Leg Projection, Ischeum Symphysis Pubis, Ileum, Accetabulum and Congential Dislocation of Hip Arthrodesis.	
III	**Abdomen:** Kub, Erect Abdomen and Decubitus Projection, Supplementary Projections For Acute Abdomen.	8
IV	**Chest:** Routine Projections For Lungs, Cardia and Diaphragm. Supplemantary Projections For Opaque Swallow, Thoracic Inlet, Soft Tissue Neck, Decubitus, Apicugrams, Paediatric Cases.	12
TOTAL		48

Text Book:

1. Textbook of diagnostic ultrasonography. Hagen-Ansert SL. Mosby Elsevier

Reference Books:

1. Introduction to ultrasound. Zwiebel WJ, Sohaey R, Saunders publishers
2. Handbook of ultrasound, GS Garkal, 2nd edition, Jaypee Publishers

SEMESTER VII

Subject Name: Techniques of Special X-rays		**Subject Code: RIT242M712**
L-T-P-C – 0-0-8-4	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: The aim of this course is to allow students to learn how to approach different radiographic positions for special procedures and apply the same in achieving the best possible images with minimum exposure.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the principle of contrast media, its the composition and adverse reactions	BT 1
CO2	**Explain** different kinds of special procedures based on the different systems of the human body	BT 2
CO3	**Apply** the anatomical knowledge in assessing patient condition and accordingly carrying out different procedures	BT 3
CO4	**Analyzing** different patients complicated situations and providing drugs to relieve the patient from life threating contrast reactions	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Introduction to Radiographic Special Procedures Contrast Media- Application, types, safety aspects & administration, Reaction to contrast media and management of contrast reactions.	8
II.	• Gastrointestinal tract: Barium series :Barium swallow, Barium meal , Barium meal follow through(BMFT) , Barium enema	12

III	• Urinary system: Indications, contraindications procedure and technique of : Intravenous urogram (IVU), Micturating Cystourethrogram (MCU), Ascending Urethrogram (ASU)/ RGU , Hysterosalpingography (HSG), lithotripsy	14
IV	• Billiary tract: Oral cholecystography, Intravenous cholecystography, Percutaneous transhepatic choledochograohy, endoscopic retrograde choeldochopancreatography	14
TOTAL		48

Text Book:

1. Davies SG, Chapman S. Aids to radiological differential diagnosis, 6th edition, Saunders Publishers

Reference Books:

1. Frank ED, Long BW, Smith BJ. Merrill's Atlas of Radiographic Positioning and Procedures, 4th edition,. Elsevier Health Sciences
2. Snopek AM. Fundamentals of Special Radiographic Procedures-E-Book. Elsevier Health Sciences; 2013 .

Subject Name: Techniques of Computed Tomography		**Subject Code: RIT242M713**
L-T-P-C – 0-0-8-4	**Credit Units: 4**	**Scheme of Evaluation: P**

Objective: This course has been formulated to develop knowledge on basic principles of Computed tomography, Radiographic projection and positioning.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the historical facts related to computed tomography and its importance in the medical field	BT 1
CO2	**Understand** the basic principle of Computed tomography	BT 2
CO3	**Develop** the skill for producing images in computed tomography	BT 2
CO4	**Apply** the knowledge of protection and safety in CT scan to produce images maintaining the radiation safety	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• Introduction and Principle of Computed Tomography, Advantage and Disadvantages of CT, Basic principle of CT , Generations of Computed Tomography- 1st generation, 2nd generation, 3rd generation, Slip ring technology, 4th generation, Electron beam CT, Dual Source CT, Flat Panel Detector CT Single and Multi slice Technology	10
II.	• Instrumentation-CT scanner gantry, Detectors & Data Acquisition System, Generator, Computer and image processing System Image display system, storage, recording and communication system, CT control console, Options and accessories for CT systems • Image Reconstruction- Basic principle, Reconstruction algorithms, Image reconstruction from projections, Types of data reconstruction Image Display and Image Quality Image formation and	16

	representation, Image processing, Pixel and voxel, CT number Window level and window width, Qualities, Resolution, Contrast, Sharpness, Noise properties in CT	
III	• CT Artefacts- Classification, Types, Causes, Remedies	8
IV	• Patient preparation, patient positioning, performing all non-contrast and contrast computed tomography procedures • Radiation protection and care of patient during procedures including contrast media Management in CT • Various post processing techniques and evaluation of image quality and clinical findings. • Post procedural care of the patient	14
TOTAL		**48**

Text Book:

1. Step by step CT Scan by D Karthikeyan, Deepa Chegu (Jaypee Publishers)

Reference Books:

1.Textbook of Radiology for Residents and Technician, Satish K Bhargava, Sumeet Bhargava, Fifth edition, CBS Publishers & Distributors Pvt. Ltd.

2.Radiology 101, The Basics and Fundamentals of Imaging, 4th Edition, Wilbur L. Smith, Thomas A. Farrell.

References:

3. Seeram E. Computed Tomography-E-Book: Physical Principles, Clinical Applications, and Quality Control. Elsevier Health Sciences; 2015

4. Kak AC, Slaney M. Principles of computerized tomographic imaging. Society for Industrial and Applied Mathematics; 2001 .

Subject Name: Techniques of Ultrasound		**Subject Code: RIT242M714**
L-T-P-C – 3-1-0-4	**Credit Units: 3**	**Scheme of Evaluation: P**

Objective: This subject is designed to impart fundamental knowledge on the structure of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of anatomy.

Course Outcome: Upon completion of this course the student should be able to:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the principles and concepts of ultrasonography and the physics behind the generation of images	BT 1
CO2	**Explain** and demonstrate various procedures guided by ultrasound	BT 2
CO3	**Apply** the anatomical and technical knowledge to find out the cause of illness	BT 3
CO4	**Create** awareness of the value and benefits of ultrasound among patients, health care providers and insurers	BT 6

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	• Principle & history of Ultrasound, advantages and disadvantages of ultrasound, Types of Ultrasound, Equipment description • Mode of USG & its type	8
II.	• Indication and Clinical Application • Physics of ultrasound imaging, Physics of transducers, construction & its type, Physics of Doppler USG & its type • Ultrasound tissue characterization	6

	• Potential for three dimensional ultrasound	
III	• Artifacts in ultrasound • Comparison of ultrasound equipment Computerization of data, Image recording, • Ultrasound jelly & Safety of ultrasound • USG Contrast Media-Types of Ultrasound Contrast media and its advantages • Care & maintenance QA & QC & USG equipment	14
IV	• Echocardiography • Equipment, Introduction, indication and image formation. • Uses of colour Doppler in echocardiography and equipment description with transducer.	8
TOTAL		36

Text Book:

1. Textbook of diagnostic ultrasonography. Hagen-Ansert SL. Mosby Elsevier

Reference Books:

1. Introduction to ultrasound. Zwiebel WJ, Sohaey R, Saunders publishers
2. Handbook of ultrasound, GS Garkal, 2nd edition, Jaypee Publishers

Subject Name: Techniques of Mammography & Fluoroscopy		**Subject Code: RIT242M715**
L-T-P-C – 3-1-0-4	**Credit Units: 3**	**Scheme of Evaluation: P**

Objective: This course has been formulated to Impart basic knowledge of breast imaging using mammography imaging, mineral density using BMD and other recent advancement related to them.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Remember** the historical facts related to mammography and its importance in the medical field	BT 1
CO2	**Understand** the basic principle of mammography and bone mineral density	BT 2
CO3	**Explain** the procedure for producing images in mammography and BMD	BT 3
CO4	**Apply** the knowledge of protection and safety in each modality to produce images maintaining the radiation safety	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	• History of mammography and its applications	8
II.	• Mammography: Mammography Equipment's and Basic views in Mammography	14
III	• Clinical Practice Scanning protocol, Indication, Patient preparation, image quality and artifacts in and Mammography	14
IV	• Fluoroscopy and Image Intensifiers: Direct fluoroscopy, fluoroscopy image, fluoroscopic screen, explorators (serial changers, spot film devices) and accessories. Radiation protection including integrating timer. Tilting tables. Principles and Construction of Image Intensifiers, Television	10

	Camera Tubes and Cathode Ray Tubes. Recording the intensified image, methods of viewing the intensified image, equipment for fluorography and cine-fluorography. Radiographic and fluoroscopic tables, telecommand tables. • Equipment for Special Procedures: Special trolleys and chairs, portable and mobile x-ray units, cordless mobile x-ray equipment, capacitor discharge mobile equipment, cranial and dental equipment, skull tables, mammography, mass-miniature radiography, multi section cassettes, rapid cassette change, rapid film changer, magnification radiography, subtraction radiography.	
TOTAL		48

Text Book:

1.Ross & Galloway: A Hand Book of Radigraphy (Lewis)

Reference Books:

1.Scarrow: Contrast Radiography (Schering Chemicals)

2.Vanderplasts : Medical X-Ray Technique (Mac Millan)

Semester VIII

Subject Name: Techniques of MRI		**Subject Code: RIT242M811**
L-T-P-C – 0-0-14-7	**Credit Units: 6**	**Scheme of Evaluation: P**

Objective: This course has been formulated to develop knowledge on basic principles of Computed tomography, Radiographic projection and positioning. This course has been formulated to develop knowledge on working principle, instrumentation and clinical applications of MRI.

Course Outcome:

Upon completion of the course student shall be able to:		
SI NO	**COURSE OUTCOME**	**BLOOMS TAXONOMY LEVEL**
CO 1	**Remember** the history of different diagnostic modalities of radiology department, their inventors and other important facts on recent advancement	BT 1
CO2	**Understand** the working principle and physic behind the image formation in CT, MRI and BMD	BT 2
CO3	**Explain** the procedure of patient positioning and the technical aspects of each modality	BT 2
CO4	**Apply** the specific knowledge relating to that particular modality in the production of good quality image to aid in diagnosis	BT 4

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	• Magnetic Resonance Imaging- anatomy, planning, positioning and contrast media • Planning MRI studies of the Head, body including angiograms	10
II.	• Various contrast media used in MRI scanning – indications, dosage, advantages & • disadvantages, safety screening, injection techniques	16

	• Assessing adequacy of acquired MRI images	
III	• Interpretation of MRI anatomical landmarks in acquired images	8
IV	• Quality assurance in MRI • Patient preparation and communication, including MRI safety instruction	14
	Total	**48**

Text Book:

1. Christensen, Curry & Dowdey: An Introduction of Physics To Diagnostic Radiography (Lea & Febiger)

Reference Books:

1. Catherine Westbrook, Carolyn Kaut Roth, John Talbot-MRI in Practice-Wiley-Blackwell

2. Catherine Westbrook - Handbook of MRI Technique-Wiley-Blackwell

Semester VIII

Subject Name: Techniques of Hybrid Imaging		**Subject Code: RIT242M812**
L-T-P-C – 0-0-14-7	**Credit Units: 7**	**Scheme of Evaluation: P**

Objective: This objective of the course is to impart basic knowledge of nuclear imaging and expose students to developments of recent technologies in the field of diagnosis.

Course Outcome:

Upon completion of the course student shall be able to:

SI NO	COURSE OUTCOME	BLOOMS TAXONOMY LEVEL
CO 1	**Understand** the principles of advanced radiological modality techniques like Mammography, PET CT, Gamma Camera, Angiography, and Fluoroscopy	BT 1
CO2	**Interpret and** analyze and interpret imaging results from advanced radiological techniques, identify pathologies, and correlate findings with clinical presentations to aid in accurate diagnosis and treatment planning.	BT 2
CO3	**Ensure** safety protocols, radiation dose management, and quality assurance methods to optimize patient care and ensure safety during the use of advanced imaging technologies.	BT 2
CO4	**Apply** advanced radiological modalities in clinical settings and demonstrate competency in the practical use of Mammography, PET CT, Gamma Camera, Angiography, and Fluoroscopy.	BT 4

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	Overview of advanced imaging techniques and their significance in modern medicine. Fundamentals of each modality: Mammography, PET CT, Gamma Camera, Angiography, and Fluoroscopy. Basic principles of radiology and radiation physics relevant to advanced imaging. Key components and technology behind each modality. Introduction to diagnostic imaging and clinical applications	12

II.	Mammography: Techniques, image acquisition, and interpretation for breast cancer detection. Quality control in mammography, positioning, and standard screening protocols. PET CT: Principles of Positron Emission Tomography (PET) and its integration with Computed Tomography (CT). Clinical applications of PET CT in oncology, neurology, and cardiology. Advanced concepts: tracer technology, radiation dose management, and safety protocols.	8
III	Gamma Camera: Principles of Single Photon Emission Computed Tomography (SPECT) and its clinical applications in nuclear medicine. Image quality, instrumentation, and quality control in gamma camera-based imaging. Angiography: Types of angiography (e.g., coronary, cerebral, peripheral). Procedures, contrast agents, and safety measures in angiography.	14
IV	Fluoroscopy: Principles, techniques, and real-time imaging applications. Fluoroscope in interventional radiology and dynamic studies (e.g., GI tract, musculoskeletal systems). Patient safety and radiation dose management in fluoroscopic procedures.	12
TOTAL		48

Text Book:

1. Waterstram-Rich KM, Gilmore D. Nuclear Medicine and PET/CT-E-Book: Technology and Techniques. Elsevier Health Sciences; 2016

Reference Books:

1.Principle and practice of Nuclear medicine and correlative medical imaging, RD lele, Jaypee publishers.

2. Walter and Miller's Textbook of Radiotherapy, Radiation Physics , Therapy and Oncology, 8th Eight Edition, Paul Symonds, John A. Mills, Angela Duxbury.

Subject Name: Major Project / Dissertation		**Subject Code: RIT242M821**
L-T-P-C – 0-0-24-12	**Credit Units: 12**	**Scheme of Evaluation: P**

Project will be given to a group of 3-5 students. Students will be given with a research topic within the field by the supervisor. Students have to do the experimental plan, summarize the results and present the result of the project.

Project includes use of relevant scientific literature according to the topic given, students should apply experimental methods, collect data for evaluation, use appropriate statistical tools if necessary, document results by writing report. Data collection and project work can be done parallel during the last semester classes.

Student's performance shall be evaluated on written project report, a written abstract and a presentation in the department. The faculty shall submit the assessment records of each student under his/her supervision to the HOD.