THE ASSAM
ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYALSCHOOLOF BIO-SCIENCES

(RSBSC)

DEPARTMENT OF BIOCHEMISTRY

COURSE STRUCTURE & SYLLABUS

(BASEDONNATIONALEDUCATIONPOLICY2020)

FOR

B.SC. IN BIOCHEMISTRY

(4YEARSSINGLEMAJOR)

WEF

AY - 2023- 2024

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1. 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 practices 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."

The new curriculum of BSc in Biochemistry under The Assam Royal Global University will be– more flexible, multi-disciplinary and holistic. Overall, the revamped BSc in Biochemistry curriculum at The Assam Royal Global University will empower students with a well-rounded education, preparing them to tackle the dynamic and complex challenges of the modern world while fostering a lifelong passion for biological sciences.

2. 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,andfosteringtheunique capabilitiesofeachstudentto 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 forthelocal 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-qualityeducation is available for all.

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

2.1 CreditsinIndianContext:

ChoiceBasedCreditSystem(CBCS)ByUGC

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 creditsbased 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.

2.2 Definitions

2.2.1 AcademicCredit:

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 [2];

1 Credit = 30 NOTIONAL CREDIT HOURS (NCH)

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

30NotionalCreditHours		
Lecture/Tutorial	**Practicum**	**ExperientialLearning**
1Credit=15-22Lecture Hours	10-15Practicum hours	0-8ExperientialLearning Hours

Looking at all these new concepts and progress, the detailed syllabus of B.Sc. in Biochemistry has been designed and decided to be implemented. Biochemistry deals with the structure and function of biomolecules and the vital processes that occur in living organisms including plants, animals and microorganism. Biochemistry has application in clinical diagnosis, understanding pathology of diseases and treatment options, drug designing, food adulteration, and understanding the metabolism

of various biological products like amino acids, proteins, antibiotics, hormones, nutrients, enzymes etc. As it covers a diverse range of topics, modern biochemists need to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. in Biochemistry is designed to cater to the needs of students in view of the evolving nature of animal science as a subject. The present framework is intended to allow for flexibility and innovation in programme design and syllabi development, teaching-learning process, assessment of student learning levels.

3. APPROACHTO CURRICULUMPLANNING

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery, and review of academic programmes. Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) be able to do at the end of their programme of study. To this extent, the course content of Biochemistry is committed to allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes.

The key outcomes that underpin curriculum planning and development at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes. The undergraduate education is based on specific learning outcomes and academic standards expected to be attained by graduates of a programme of study. However, an outcome-based approach identifies moves way from the emphasis on what is to be taught to focus on what is learnt by way of demonstrable outcomes. This approach provides greater flexibility to the teachers to develop—and the students to accept and adopt—different learning and teaching pedagogy in an interactive and participatory ecosystem. The idea is to integrate social needs and teaching practices in a manner that is responsive to the need of the community. HEIs, on their turn,

shall address to the situations of their students by identifying relevant and common outcomes and by developingsuch outcomes that not only match the specific needs of the students but also expands their outlook and values.

B.Sc. in Biochemistry is a recognized and structured undergraduate degree in tertiary education. It offers specialized knowledge, skills, and values that students can use to pursue professional opportunities or continue their studies at the postgraduate level. The purpose of the present curriculum of B.Sc. Biochemistry is to prepare students for professional careers or further studies in various job fields. Graduates can pursue a wide range of jobs or continue their education at an advanced level.

3.1 Courseof 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.

3.2 DisciplinaryMajor:

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.

3.3 Disciplinary/interdisciplinaryminors:

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.

3.4 CoursesfromOtherDisciplines(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.

- ***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.
- ***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.
- ***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)
- ***Commerce and Management:*** Courses include business management, accountancy, finance, financial institutions, fintech, etc.
- ***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., andinterdisciplinary 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.

3.5 Ability Enhancement Courses (AEC):

Modern Indian Language (MIL) & English language focused on language and communication skills. Students are requiredtoachievecompetencyinaModernIndianLanguage(MIL)andinthe 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 articulatetheir arguments and present their thinking clearlyand 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.

3.6. 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 berelated to MajorDiscipline. 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. A student shall have the choice to choose from a list, a defined track of coursesoffered from 1stto 3rdSemester.

3.7. Value-AddedCourses(VAC):

- ***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. Thecourse 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.

- ***Environmental science/education:*** The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes, and values requiredto take appropriate actions for mitigating the effects of environmentaldegradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlifeconservation, andsustainabledevelopmentandliving.Thecoursewill 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.
- ***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 wovenintoundergraduateeducationforenhancingtheemployabilityoftheyouth.
- ***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 variouscomponents of physical and skills-related fitness like strength, speed,coordination, endurance, and flexibility; acquisition of sports skills includingmotor skills as well as basic movement skills relevant to a particular sport; improvement of tactical abilities; and improvement of mental abilities. These are a common pool of courses offered by different disciplines and aimed towards embedding ethical, cultural and constitutional values; promote critical thinking. Indian knowledge systems; scientific temperament of students.

3.8 SummerInternship /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.

3.9 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.

3.10 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, andto 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 thedevelopmentprocess.They would have the opportunity to gain an understanding of the complex socio-economicproblemsinthecommunity,andinnovativepracticesrequiredtogenerate solutionsto theidentifiedproblems. Thismay beasummer termproject orpartof a major or minor course depending on the subject of study.

3.11 IndianKnowledgeSystem:

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 programmes should be encouraged to take an adequate number of courses in IKS sothat the ***total credits of the courses***

taken in IKS amount to at least five per cent ofthe total mandated credits *(i.e. min. 8credits for a 4 yr. UGP & 6 credits for a 3 yr. UGP).* 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.ThefoundationalIKScourseshouldbebroad-basedandcoverintroductory material on all aspects. Wherever possible,thestudents maybeencouragedto chooseasuitabletopicrelatedto IKS for their project work in the 7/8thsemesters of the UG programme.

3.12 ExperientialLearning:

One of the most unique, practical & beneficial features of the National CreditFramework 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:

- ***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 totheprogrambeingstudied-uptocertainNSQFlevelonly).Incasewhere 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.
- ***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.

4. AWARDOF DEGREE

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

Undergraduate programmesof either 3 or 4-year duration with a Single Major, with multiple entry and exit options, with appropriate certifications:

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 thefirst 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.

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.

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.

4-yearUG Degree (Honours): A four-year UG Honours degree in themajor 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.

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 of50%

credits from themajordisciplinefor the3-year/4-year UG degreeto 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 asper the choices of the student.)

award	**year**	**credits toearn**	**additional credits**	**re-entryallowed 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**	**Creditsto earn**	**Additionalcredits**	**Re-entryallowed within(yrs)**	**Years tocomplete**
4-yearUGDegree(HonorswithResearch):	4	160	Studentswhosecurecumulative75%marksandaboveinthefirstsix semesters		

5. GRADUATE ATTRIBUTES & LEARNING OUTCOMES

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 oflearning,including directin-personorface-to-faceinstruction, 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 learningand generic learning outcomes that are expected to be acquired by a

graduate on completion of the programme(s) of study.

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.

Graduateattributesinclude,

- ***learning outcomes that are specific to disciplinary areas*** relating to thechosen field(s) of learning within broad multidisciplinary/interdisciplinary/ transdisciplinary contexts.
- ***generic learning outcomes*** that graduate of all programmes of study should acquire and demonstrate.

Table:TheLearningOutcomesDescriptorsandGraduate Attributes

Sl.no.	**GraduateAttribute**	**TheLearningOutcomesDescriptors*(Thegraduatesshould beabletodemonstrate the capability to:)***
GA1	Disciplinary Knowledge	Acquireknowledgeand coherent understandingofthechosendisciplinary/interdisciplinarya reas of study.
GA 2	Complexproblem solving	Solvedifferentkindsofproblemsinfamiliarand nonfamiliar contexts and apply the learning toreal-lifesituations.
GA 3	Analytical&Critical thinking	Apply analytical thought including the analysis andevaluationofpolicies,and practices.Ableto identifyrelevant assumptions or implications.
GA 4	Creativity	Create, perform, or think indifferent and diverse waysabout the same objects or scenarios and deal withproblems and situations that do not have simple solutions.Think ‘out of the box’ and generate solutions to complexproblems in unfamiliar contexts by adopting innovative,imaginative,lateralthinking,interpersonalskill s, andemotional 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 effectivelyinwritingandorallyandcommunicatewithother susingappropriatemedia.

GA 6	Research-related skills	Developakeensenseofobservation,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,formulatehypotheses,testhypotheses 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/doingethicsinthefield/ inpersonalresearchwork.
GA 7	Collaboration	Workeffectivelyandrespectfullywithdiverse teams in the interestsof acommon causeandworkefficientlyasamember ofa team.
GA 8	Leadership readiness/qualities	Plan the tasks of a team or an organization and setting direction by formulating an inspiringvisionandbuildingateamthatcanhelpachieve the vision.
GA 9	Digital andtechnologicalskills	UseICT inavarietyoflearning and worksituations.Access,evaluate,anduseavarietyof relevant information sources and useappropriatesoftwareforanalysisofdata.
GA 10	Environmental awarenessand action	Mitigate the effects of environmental degradation, climate change, and pollution. Should develop the technique of effective waste management,conservationofbiologicaldiversity, management of biological resources and biodiversity,forestandwildlifeconservation,andsustainabledevelopmentandliving.

6. PROGRAMMELEARNINGOUTCOMES

PO-1: Knowledge of Biochemistry

Upon completion of the Biochemistry program, graduates will demonstrate the ability to apply fundamental knowledge of Biomolecules, protein, biochemical techniques in the area of Biochemistry.

PO-2:Ability to solve Complex problems

Upon completion of the Biochemistry program, graduates will possess advanced skills in complex problem-solving, enabling them to address intricate challenges in biochemistry and allied sciences.

PO-3:Develop analytical and critical thinking

Graduates will exhibit advanced capabilities in analytical and critical thinking, allowing them to assess scientific data, conduct rigorous research, and evaluate complex biological issues with precision and insight.

PO-4:Develop the ability to create

Graduates will demonstrate innovative and creative thinking, fostering novel approaches to address biological challenges and contribute to advancements in biochemistry research and innovation.They will harness the ability to learn a system with its component, or process to meet desired need within realistic constraints.

PO-5:Develop effective communication skills

Graduates will possess strong communication skills, effectively conveying complex scientific concepts and findings to diverse audiences, fostering collaboration and promoting public awareness of biological issues.

PO-6:Develop research related skills

Upon completion of the Biochemistry program, graduates will possess the ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.

PO-7:Develop skills for Collaborative/Team Work

The students will exhibit strong collaboration skills, effectively working with multidisciplinary teams to address complex challenges and promote collective efforts towards biochemistry research and its application in human welfare.

PO-8:Develop Leadership qualities

Upon completion of Biochemistry program, graduates will demonstrate exceptional leadership qualities, inspiring and guiding teams in the field of biochemistry and allied sciences to foster innovation, conservation, and sustainable practices.

PO-9:Enable students to adopt to evolving digital and technological skills

Graduates will possess proficient digital and technological skills, utilizing cutting-edge tools and methodologies to enhance research, data analysis, and communication in the field of biochemistry, biotechnology, and bioinformatics, promoting advancements and efficiency in their work.

PO-10:Develop environmental awareness and develop suitable skills to address to problems

Upon completion of theprogram, graduates will display a heightened environmental awareness, incorporating ecological principles into their work, and taking proactive actions to promote sustainability and conservation efforts in the realm of biology.

7. PROGRAMMESPECIFICOUTCOMES

PSO1: Ability to apply knowledge of Biochemistry to realize and explain notions and complexities of biological and allied sciences.

PSO2: Abilityto comprehend the relationship of organisms at all levels: molecular, cellular, and organismaland students shall be able to conduct the clinical biochemistry, diagnostic biochemistry experiments as well as to analyze and interpret the results.

PSO3: Students shall be able to use the biochemical techniques, genetic engineering &biotechnology skills and modern pathological tools necessary for professional practice and conduct empirical studies for scientific research as well asto validate,analyzeandinterpretthem.

8. TEACHING LEARNING PROCESS

Teaching and learning in this programme involve classroom lectures, tutorials, flipped classrooms, seminars/presentations, hands-on practical, and in-housed and out-housed internships and research projects.

The various aspects are shown below:

- Written assignments and projects submitted by students
- Project-based learning, group discussion, home assignments, quizzes and class tests
- Reflective learning and flipped classrooms
- PPT presentations, seminars, interactive sessions, co-curricular activities, etc.
- Industrial Tour or Field visit

9. ASSESSMENT METHODS

Methods	Weightage
SemesterEndExamination	70%
InternalAssessment	30%
Total	**100%**

Internal assessment is based on:

- 25%- Mid-semester Examination, Class test, Assignment, Project, Viva-voce, Seminar, etc.
- 5%- Attendance of the student.

BSc Biochemistry Programme Structure				
1st Semester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course level**	**Credit**
Major (Core) Subjects				
1	BCH152M101	Biomolecules	100	3
2	BCH152M111	Biomolecules and Cell Biology Practical	100	3
Total Credit for Major Papers				**6**
Minor Subjects				
3	BCH152N101	Nutritional Biochemistry	100	3
Interdisciplinary				
4		IKS-1	100	3
Skill Enhancement Course (SEC)				
5	BCH152S111	Biochemical Assessment of Food Products	100	3
Value Added Course (VAC)				
6		To be chosen from Basket	100	3
Ability Enhancement Compulsory Course				
7	CEN982A101	Communicative English-I	100	2
Total Credit for the Semester				**20**
2nd Semester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credit**
Major (Core) Subjects				
1	BCH152M201	Proteins and Enzymes	100	3
2	BCH152M213	Protein and Enzymes Practical	100	3
Total Credit for Major Papers				**6**
Minor Subjects				
3	BCH152N201	Introduction to Cytology	100	3
Interdisciplinary				
4		IKS-2		3

Skill Enhancement Course (SEC)				
5	BCH152S211	Food Adulteration	100	3
Value Added Course (VAC)				
6		To be chosen from Basket		3
Ability Enhancement Compulsory Course				
7	BHS982A201	Communicative English-II		2
Total Credit for the Semester				**20**
3rdSemester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credit**
Major (Core) Subjects				
1	BCH152M301	Metabolism of Biomolecules	200	4
2	BCH152M313	Metabolism Practical	200	4
Total Credit for Major Papers				8
Minor Subjects				
3	BCH152N301	Clinical Biochemistry	200	4
Interdisciplinary/Indian Knowledge System (IKS)				
4		To be chosen from Basket		3
Skill Enhancement Course (SEC)				
5	BCH152S311	Working with proteins		3
Ability Enhancement Compulsory Course				
6		Communicative English-II		2
Total Credit for the Semester				**20**
4thSemester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credit**
Major (Core) Subjects				
1	BCH152M401	Concepts of Genetics	200	4
2	BCH152M402	Human diseases and Basic Ayurveda	200	4
3	BCH152M413	Practical-IV (Genetics)	200	4
Total Credit for Major Papers				**12**

Minor Subjects				
4	BCH152N401	Microbiology	200	3
5	BCH152N402	Biochemical Correlation of Diseases	200	3
Total Credit for Minor Papers				**6**
Ability Enhancement Compulsory Course				
6		AEC1 (Language)		2
Total Credit for the Semester				20
5th Semester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credits**
Major (Core) Subjects				
1		Molecular Biology	300	4
2		Microbiology	300	4
3		Molecular Biology Practical	300	4
Total Credit for Major Papers				**12**
Minor Subject				
4		Environmental Biochemistry	200	4
5		**Internship**		4
Total Credit for the Semester				20
6thSemester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credit**
Major (Core) Subjects				
1		Cell Biology and Membrane Biology	300	4
2		Immunology	300	4
3		Biophysics and Bioenergetics	300	4
4		Practical-VI	300	4
Total Credit for Major Papers				16
Minor Subjects				
5		Basics of Genetic Engineering	200	4
Total Credit for the Semester				**20**
7thSemester				

Sl. No.	Subject Code	Name of the Subject	Course Level	Credit
Major (Core) Subjects				
		Genetic Engineering and Biotechnology	400	4
		Research Methodology, Bioethics, and Scientific Writing	400	4
		Plant Biochemistry	400	4
		Practical-VII	400	4
Total Credit for Major Papers				16
Minor Subjects				
		Cancer Biology	300	3
Total Credit for the Semester				**20**
8thSemester				
Sl. No.	**Subject Code**	**Name of the Subject**	**Course Level**	**Credit**
Major (Core) Subjects				
		Bioanalytical techniques	400	4
Total Credit for Major Papers				**4**
Minor Subjects				
		Microbial Ecology	300	4
		Dissertation/Research Project		12
		Or		
		Virology		**4**
		Bioethics		**4**
		Molecular Endocrinology		**4**
		Total for alternate component		**12**
Total Credit for the Semester				**20**

SYLLABUS 1st SEMESTER

MAJOR PAPER: Biomolecules
Course level: 100
Subject Code:
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles and functions, and interrelations.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Define and distinguish the different biomolecules in a living system	**BT1 & BT2**
CO 2	Summarize the importance of each biomolecules-viz. nucleic acid, carbohydrate, lipid, and protein along with vitamins and water.	**BT2**
CO 3	Illustrate and sketch the chemical structures of major biomolecules and their building blocks.	**BT3**
CO 4	Apply the knowledge to analyze the critical role of biomolecules as the foundation of living organisms	**BT4**

Course Contents

Modules	**Course content**	**Periods**

I	**The foundations of biochemistry:** Cellular and chemical foundations of life**.** **Water:** Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant, and fitness of the aqueous environment. **Vitamins:** Structure and active forms of water-soluble and fat-soluble vitamins, deficiency diseases and symptoms, hypervitaminosis	**15**
II	**Carbohydrates and glycobiology:** Monosaccharides –the structure of aldoses and ketoses, the ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, the structure of biologically important sugar derivatives, oxidation of sugars. Disaccharides (examples of disaccharides). Polysaccharides homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins, and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates	**15**
III	**Lipids:** Building blocks of lipids - fatty acids, glycerol, and ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution, and role of membrane lipids.	**15**
IV	**Amino acids and Proteins**: Structure and classification, physical, chemical and optical properties of amino acids (hydrophobic, polar and charged). Proteins and peptide bonds. Nucleic acids: Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA, and rRNA. Nucleic acid chemistry- UV absorption, the effect of acid and alkali on DNA**.**	**15**
	Total	**60**

Textbooks:

Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA, 7th edition,2017.

Victor Rodwell, David Bender, P. Anthony Weil, Peter Kennelly. Harpers Illustrated Biochemistry 31th Edition, 2018.

Reference books:

Principles of Biochemistry, 5thEdition. 2011, Robert Horton H, LaurencMoran, Gray Scrimgeour K. Pearsarson Publisher. ISBN978-0321707338.

Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 4thEdition, Alpha Science International, 2017. ISBN-10:1842652451.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom

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MAJOR PAPER: Practical I (Biomolecules Practical)
Course level: 100
Subject Code:
L-T-P-C: 0-0-6-3
Scheme of evaluation: Practical (P)

Course Objective

The objective of this paper is to offer insights about the practicals based on analysis of biomolecules as well on the cell biology.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Identify and recall basic laboratory equipment and technique commonly used in Biochemistry and relate the understanding of biomolecules to cell biology.	**BT1**
CO 2	Describe and demonstrate various buffers preparation, buffering range, its uses and application in biochemical reactions, enzyme activity and blood group variety testing etc.	**BT2& BT3**
CO 3	Apply the knowledge of cell biology in practical and interpret	**BT3**

	experimental results.	
CO 4	Illustrate the process cell division practically and develop practical skills in cell biology.	**BT4**

Course Contents

Modules	Course content	Periods
I	**Basic Lab requirements:** Volumetric flask, falcons, mortar and pestle, watch glass, wash bottle, beaker, measuring cylinder, dropper, burette, spatula, reagent bottle, test tube stand, pipette stand, tripod stand,Bunsen burner, wire gauze, crucible, funnel,centrifuge tubes **Instruments:** Separatory funnel, centrifuge, pH meter, Electric balance, hot plate	**20**
II	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water Preparation of Normal solution- NaOH Preparation of percentage/ vol-vol solutions- Sulphuric acid Preparation of buffers Paper Chromatography- Isolation of the pigments from leaves of Radish Qualitative analysis of Carbohydrate & fats	**26**
III	Preparation of stains. Visualization of animal and plant cell by dye (methylene blue). Study of polyploidy in Onion root tip by colchicine treatment.	**24**
IV	Study of different stages of Mitosis. Study of different stages of Meiosis. Examination of blood samples: Blood grouping	**20**
	Total	**90**

Textbooks:

1. An Introduction to Practical Biochemistry – 3rd edition, 2017, David Plummer.
2. Introductory Practical Biochemistry – 4th edition, 2017, S.K.Sawhney and RandhirSingh.

Reference books:

1. Practical Clinical Biochemistry, Harold Varley, 6th edition, 2022, CBS Publishers.
2. Practical Clinical Biochemistry: Methods and Interpretation, 4th edn. RanjnaChawla, Jaypee Brothers Medical Publishers.
3. Practical and Clinical Biochemistry for Medical Students, ed. T.N. Pattabhiraman, Gajanna Publishers.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

MINOR PAPER: Nutritional Biochemistry
Course level: 100
Subject Code:
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

The course aims at providing deep understanding of various nutrients, their metabolism, functions, and deficiency diseases to students.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the basic concepts of nutritional biochemistry, biochemical basis	**BT1&**

	and nutritional importance of macronutrients, biochemical mechanisms for the symptoms of vitamin deficiencies and excesses, and mineral macronutrients.	**BT2**
CO 2	Apply the knowledge on their diet management, selection of nutrient-rich foodstuffs, maintaining good health, and distinguishing various diseases and disorders caused by nutrient deficiency	**BT3 & BT4**
CO 3	analyze the difference between macronutrients and micronutrients	**BT4**
CO 4	Analyze the application of Nutritional Biochemistry in human health and related research.	**BT2 and BT3**

Course Contents

Modules	**Course content**	**Periods**
I	**Introduction to Nutrition and Energy Metabolism:** Defining nutrition, role of nutrients. Unit of energy, biological oxidation of foodstuff. Physiological energy value of foods, SDA. BMR and RMR- factors affecting BMR. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.	**15**
II	**Macronutrients**- Food sources of carbohydrates, Review functions of carbohydrates. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Dietary implications of fats and oils, MUFA, PUFA and SFA. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Essential and Non-essential amino acids. Digestion of carbohydrates and proteins.	**15**
III	**Micronutrients:**Vitamin A, D, E, K and dietary sources, RDA, Deficiency. Role of Vitamin A as an antioxidant, and immunity. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology .The B Complex vitamins- Dietary sources, RDA, role in metabolism and deficiency disease. Biochemical basis for deficiencysymptoms.	**15**
IV	**Micro Minerals and Trace elements:** Calcium, Iron and Phosphorus- Distribution in the body. Sources, RDA. Iodine, Fluoride, Mg,Cu,Zn,Se,Manganese,Chromium,Molybdenum.Distributioninthehumanbody,Physiology, Function, deficiency, andSource.Antinutrients- source, role in health.	**15**
	Total	**60**

Textbooks:

1. Biochemistry by U. Satyanarayana& U. Chakrapani (6thedn), Elsevier, ISBN 978-8131264355, 2021
2. Textbook of Biochemistry for medical students by DM Vasudevan, Sreekumari S, and VK Vaidyanathan (8thedn) ,Jaypee Brothers Medical Publishers, ISBN- 978-9354656484, 2022

Reference books:

1. Coombs Jr. G. F., (2008). The vitamins, Fundamental aspects in Nutrition andHealth.
2. Voet, D. and Voet, J.G. (2011) Biochemistry. Fourth Edition, John Wiley & Sons
3. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M. 7thEdition, 2017, WH Freemanand Company, New York,USA

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Group discussion Flipped classroom

SECPAPER: Biochemical assessment of food products
Course level: 100
Subject Code:
L-T-P-C: 0-0-6-3
Scheme of evaluation: Practical (P)

Course Objective

The aim of the course is to familiarize students with basic food components and their assessment in day to day used food products. The course will acquaint students with the methods of estimating the various basic food components like carbohydrates, lipids, proteins and macro/micro nutrients using different methods.

Course Outcome

On Successful Completion of the course, the students will be able to:

Sl. No.	Course Outcome	Blooms Taxonomy Level
CO 1	Outline and discuss the role of each biomolecule and their various food sources	**BT1&BT2**
CO 2	Review and demonstrate the different estimating methods for each biomolecule in the food sources.	**BT2 & BT3**
CO 3	Apply the knowledge of biomolecules practically and interpret experimental results which will be helpful in development of practical skills in biochemistry.	**BT3**
CO 4	Categorize and test the various components present in different food sources.	**BT4**

Course Contents

Modules	Course content	Periods
I	**Carbohydrates:** Introduction to carbohydrates. Determining the presence of carbohydrates in food samples like rice, fruit juice by Fehling's tests, Benedict's tests. To understand the color tests for reducing and non-reducing sugars. To test the presence of starch in food material (potato tubers, green leaves) and to reveal its biological importance and chemical nature.	**24**
II	**Lipids:** Classification of lipids. Role of lipid in human health. Lipid deficiency in human body. Determining the presence of fats and oils in almond seeds, groundnut etc. To test the presence of cellulose in the cotton threads or filter paper and to reveal the biological significance and chemical nature of cellulose.	**24**
III	**Protein:** Types of protein. Significance of protein in human health. Deficiency of protein and diseases related to it. Determining the presence of protein in food samples like pulses, egg, milk by Xanthoproteic Test, Biuret test, Millon's Test.	**24**
IV	**Micro and macronutrients:** Role and food sources of vitamins, macrominerals, microminerals and trace elements. Assessment of micronutrients (Ca, P, Fe, Vitamin A, and Vitamin C) status in food samples like milk, fruit juice, vegetables.	**18**
	Total	**90**

Textbooks:

1. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA, 7th edition,2017
2. Victor Rodwell, David Bender, P. Anthony Weil, Peter Kennelly. Harpers Illustrated Biochemistry 31th Edition, 2018.

Reference books:

1. Practical Biochemisty – 3rd edition, 2017, David Plummer.
2. Introductory Practical Biochemistry – 4th edition, 2017, S.K.Sawhney and Randhir Singh.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

SYLLABUS 2nd SEMESTER

MAJOR PAPER: Proteins and Enzymes
Course level: 200
Subject Code: BCH152M201
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

To provide overview of protein biochemistry and enzymology to undergraduate students since proteins and enzymes are the most versatile functional entities in life. The biochemical, structural, functional and aspects of interaction of proteins and enzymes will be introduced in this course.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms**

		Taxonomy Level
CO 1	Describe and summarize the molecular, chemical and structural foundations of proteins and enzymes.	**BT1 & BT 2**
CO 2	Discuss and interpret core concepts of enzyme kinetics and activity	**BT2 & BT3**
CO 3	Apply their knowledge in various applications associated with life sciences research as well as in industry and biomedicine.	**BT 3**
CO 4	Analyze outcomes of performed laboratory experiments related to protein biochemistry and enzymology.	**BT 4**

Course Contents

Modules	Course content	Periods
I	Introduction to proteins and their structural organization: Amino acids and their properties. Peptides and their biological significance - hormones, antibiotics and growth factors. Diversity of proteins and their functions. Protein sequence - Edman degradation. Solid phase peptide synthesis. Organization of protein structure -primary, secondary, tertiary and quaternary structures. Conjugated proteins, multimeric proteins and metalloproteins. Bonds in protein structures-covalent and non-covalent. Dihedral angles. Ramachandran map, Secondary structure - helices, sheets and turns.	**15**
II	Three-dimensional structures and protein folding Characteristics of tertiary and quaternary structures. Motifs and domains. Structure-function relationship in proteins. 3D structures of myoglobin and hemoglobin. Oxygen binding curves, influence of pH and effector molecules. Concerted and sequential models for allosteric proteins. Hemoglobin disorders. Protein folding-denaturation and renaturation. Role of chaperones. Protein misfolding and aggregation diseases.	**15**
III	Introduction to enzymes, their characteristics and kinetics Nature of enzymes - protein and non-protein (ribozyme, abzymes). Cofactor and prosthetic group, apo- and holo-enzymes. Features of enzyme catalysis. Classification of enzymes and nomenclature. Fischer's lock& key and Koshland's induced fit hypothesis. Enzyme specificity. Enzyme kinetics- Michaelis-Menten equation, Lineweaver-Burk plot. Determination of Km, Vmax, Kcat. Factors affecting enzyme activity. Enzyme Inhibition: Reversible (competitive,	**15**

	uncompetitive, non-competitive) and irreversible inhibition. Mechanism based inhibitors.	
IV	Mechanism of enzyme action and enzyme regulation General mechanisms of action. Acid-base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes. Allosteric regulation and feedback inhibition (ATCase). Reversible covalent modification (glycogen phosphorylase). Proteolytic cleavage zymogen. Multienzyme complex. Coenzymes.	**15**
	Total	**60**

Textbooks:

1. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA. 7th edition, 2017.
2. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. and James Darnell, J. Molecular Cell Biology, Freeman, 9th edition 2021.

Reference books:

1. Berg, J. M., Tymoczko, J. L. and Stryer., Biochemistry,, W.H Freemanand Co., 9th edition, 2019.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter P. Molecular Biology of the Cell. Garland Science, 7th edition, 2022.
3. Branden, C. &Tooze, J. Introduction to Protein Structure. Garland, 2nd edition,1999.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom Group discussion

MAJOR PAPER: Proteins and Enzymes Practical
Course level: 200
Subject Code:BCH152M212
L-T-P-C: 0-0-6-3
Scheme of evaluation: Practical (P)

Course Objective

Objective of the course is to get students exposed to a biochemistry laboratory and develop good laboratory practices with hands on experience of simple but important biochemical experiments.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe the working principles of various qualitative and quantitative analysis methods.	**BT 2**
CO 2	Employ a hands-on experience on handling various laboratory equipments, chemicals and instruments.	**BT 3**
CO 3	Apply and translate the knowledge in basic research projects, biomedical research, clinical applications, industrial applications, etc.	**BT2 & BT 3**
CO 4	Analyze and criticize the working principles, significance of practical results	**BT 4**

Course Contents

Modules	Course content	Periods
I	Qualitative tests for amino acids Qualitative tests for proteins Estimation of proteins using UV absorbance and Biuret method. Estimation of proteins using Lowry/Bradford method.	**24**
II	Assay of salivary amylase Effect of pH on enzyme activity Effect of temperature on enzyme activity. Determination of Km and Vmax using Lineweaver-Burk plot	**24**
III	SDS-PAGE analysis of protein. Separation of amino acids by paper chromatography	**20**
IV	Separation of photosynthetic pigments by TLC.	**22**

	Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.	
	Total	**90**

Textbooks:

1. Practical Biochemistry – 3rd Edn. David Plummer.
2. Introductory Practical Biochemistry – S. K. Sawhney and Randhir Singh.

Reference books:

1. Practical Clinical Biochemistry, ed. Harold Varley, 4th edn. CBSPublishers.
2. Practical Clinical Biochemistry: Methods and Interpretation, 4th edn. RanjnaChawla, Jaypee Brothers Medical Publishers.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

MINOR PAPER: Introduction to Cytology
Course level: 100
Subject Code: BCH152N201
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

The objective of this paper is to offer insights into the basic structure and function of a cell and cellular organelles as well as on the various techniques. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms**

		Taxonomy Level
CO 1	Recall the types of cells and distinguish their cellular components	**BT2 & BT3**
CO 2	Recognize the role of different cell organelle structure in relation to cell physiology	**BT3**
CO 3	Summarize various cell biology processes such as cell cycle, cell division, types of cell death and vesicular transport and apply this knowledge to predict deviations from normal cell physiology	**BT4**
CO 4	Analyze the application of cell biology in research.	**BT2 and BT3**

Course Contents

Modules	Course content	Periods
I	**Introduction to cell structure:** Introduction to cell structure: Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells. Structure of different cell organelles: nuclear envelope and membrane, ER, Organization of Golgi apparatus, Ribosomes, Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Biogenesis of Mitochondria and chloroplast. Cell recognition and membrane transport.	**15**
II	Cell wall and extracellular matrix: Prokaryotic and eukaryotic cell wall, cell-matrix proteins. Types of Cytoskeletal proteins: Tubulin, Actin and Intermediate filaments. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions, and plasmodesmata. Cilia and Flagella.	**15**
III	**Cell cycle, cell division, and cell death:** Eukaryotic cell cycle,cell cycle stages: G0, G1, S, G2, M phase, restriction point, and checkpoints. Chromosomal organization, Sister chromatids and nucleosome. Cell division: concepts of mitosis and meiosis.	**15**
IV	Vesicular transport and membrane fusion: Types of vesicle transport and their function. Molecular mechanism of vesicular transport. Phagocytosis, Pinocytosis and receptor mediated endocytosis: General Mechanism.	**15**
	Total	**60**

Textbooks:

1. Molecular Biology of the Cell, 7th edition, 2022, Bruce Alberts, Dennis Bray, JulianLewis, Martin Raff, Keith Roberts, and James D Watson. Publisher New York: GarlandScience
2. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA. 7th edition, 2017.

Reference books:

1. Lipid Biochemistry; 5th Edn. Michael I. Gurr, John L. Harwood and Keith N. Frayn, Blackwell Science (2002).
2. Biochemistry Ed. Donald Voet& Judith G. Voet, 4thEdn. John Wiley & Sons, Inc.(2012).

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom Quizzes

SEC PAPER: Food Adulteration
Course level: 200
Subject Code:BCH152S211
L-T-P-C: 0-0-6-3
Scheme of evaluation: Practical (P)

Course Objective

To educate about common food adulterants and their effects on health as well as to teach them various biochemical analysis methods for detection of food adulterants.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms**

		Taxonomy Level
CO 1	Identify classes of foods and their contamination by various adulterants	**BT 2**
CO 2	Describe rules and regulations in relation to the control of food adulteration and power and activity of FSSAI.	**BT 3**
CO 3	Examine various biochemical methods and analyze adulterants in milk and milk products, oils and fats, and salt and spices, confectionary, food grains, and beverages etc.	**BT2 & BT 3**
CO 4	Analyzeandcriticizethe working principles, significance of practical results	**BT 4**

Course Contents

Modules	Course content	Periods
I	**Common adulteration and detection in milk** I. Adulteration – definition, types; New adulterants in foods. II. Physical test for adulteration of milk - Physical Tests, Detergent Test, Flow test III. Chemical test for adulteration of milk - Test for starch in Milk, Test for cane sugar in Milk, Test for soda in milk	**24**
II	**Common adulteration and detection in fat and oil** I. Adulteration of ghee – test for vegetable fat – nitric acid test, soda ash test II. Test for added alkali - Baudovin test III. Adulteration of Paneer: Presence of starch in paneer IV. Test for rancidity in oils	**22**
III	**Common adulteration and detection in spices and condiments** I. Coriander power: Test for starch & horse dung power II. Chilli powder. Test for oil soluble dyes, powdered bran, saw dust and brick powder III. Turmeric Powder: Test for metanil yellow and lead chromate polish	**22**
IV	**Common adulteration and detection in spices and condiments** I. Wheat flour: Test for sand, dirt, husk and chalk powder II. Whole grain; adulteration with datura III. Test for urea in parched rice	**22**

	Total	**90**

Textbooks:

1. A laboratory manual on Food Adulteration, ShaliniSehgal, Wiley Publications, 2020, ISBN- 9389633230
2. Food adulteration and its detection, Jesse Park, Wentworth Press, ISBN-9781362422099

Reference books:

1. Food Science, B Srilaxmi, 7th Edition, New Age Publication, 2018, ISBN- 9386418894
2. https://fssai.gov.in/cms/food-safety-and-standards-act-2006.php

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

SYLLABUS 3rdSEMESTER

MAJOR (Core) PAPER: Metabolism of Biomolecules
Course level: 200
Subject Code:BCH152M301
L-T-P-C: 3-1-0-4
Scheme of evaluation: Theory (T)

Course Objective

The objective of this course is to provide an understanding of metabolism of all the biomolecules, the enzymes involved in such metabolic pathways, their regulation, and importance with regards to metabolic disturbances.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the basic concept of metabolism: catabolism and anabolism.	**BT1 & BT 2**
CO 2	Remember the various metabolism of biomolecules: biosynthesis and degradation pathways and their regulations.	**BT1**
CO 3	Apply the knowledge of metabolic pathways to understand how defects in concentration and imbalanced functioning of the participating substrate and enzymes may lead to several disorders.	**BT 3**
CO 4	Analyze the various disorder's observations and plan targeted therapeutic approaches to tackle metabolic diseases, especially those related to lipid, protein, nucleic acid, and carbohydrate metabolism.	**BT 4**

Course Contents

Modules	Course content	Periods
I	Concept of metabolism, catabolism, and anabolism, Carbohydrate metabolism : glycolysis, gluconeogenesis, fates of pyruvate, formation of acetyl coenzyme A, TCA cycle, ATP yield from complete oxidation of glucose, pentose phosphate pathway. Oxidative Phosphorylation and Electron Transport Chain.	**15**
II	Basic structure of Phospholipids, saturated and unsaturated fatty acids, Beta-oxidation of fatty acids, biosynthesis of saturated and unsaturated fatty acids (precursors and site of synthesis, ketone bodies).	**15**
III	Amino acid metabolism General reactions of amino acid metabolism, (oxidative deamination, transamination, decarboxylation etc.), glucogenic and ketogenic amino acids, urea cycle, biosynthesis of essential and non-essential amino acids.	**15**
IV	Biosynthesis and catabolism of purines and pyrimidine, Preliminary idea of De novo synthesis and Salvage pathway, Regulation and disease due to defect in nucleotide metabolism.	**15**
	Total	**60**

Textbooks:

1. Principles of Biochemistry, 8th Edition. Nelson, D.L. and M.M. Cox (2021). WH Freemen and Co.ISBN: 9781319381493.
2. Fundamentals of Biochemistry: Life at the molecular level, 4th Edition. D. Voet, J.G. Voet and W. Pratt(2016). John Wiley & Sons Inc. ISBN: 978-1-118-91840-1.

Reference books:

1. Principles of Biochemistry, 4th Edition. Robert Horton H, Laurence A Moran, Gray Scrimgeour K(2006). Pearsarson Publisher. ISBN-13: 978-0321707338.
2. Rodwell, V. W., Bender, D., & Botham, K. M. (2018). *Harper's illustrated biochemistry*. McGraw-Hill.
3. Introductory Practical Biochemistry. SK Sawney and R. Singh (2000). Narosa Publisher. ISBN 9788173193026 4. An Introduction to Practical Biochemistry 3rd Edition. Plummer D.T. (1998). Tata McGrawhillPublication. ISBN: 1118357728.
4. Satyanarayana, U. (2013). *Biochemistry*. Elsevier Health Sciences.
5. Michal, G., & Schomburg, D. (Eds.). (2012). *Biochemical pathways: an atlas of biochemistry and molecular biology*. John Wiley & Sons.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom

MAJOR (Core) PAPER: Metabolism practical
Subject Code: BCH152M312
L-T-P-C: 0-0-8-4
Scheme of evaluation: Practical (P)

Course Objective

Objective of the course is to make students understand methods of assessing levels of different

physiologically important molecules such as glucose, pyruvate, specific amino acids, triacylglycerol, and cholesterol and then compare the level with normal physiological level.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Classify the various biological samples and hands-on training to understand the basic working techniques.	**BT 2**
CO 2	Understand how glucose, pyruvate, proteins, cholesterol, and neutral triacylglycerol levels can be measured in various samples, such as blood and urine.	**BT 1**
CO 3	Apply the gained knowledge to analyze and understand how changes in the physiological level of glucose, triacylglycerols, cholesterol, etc., ultimately result in various health issues.	**BT 3& BT 4**
CO 4	Apply a preliminary basic experimental approach to understanding the level of neutral lipid content, glucose, cholesterol, etc., normal vs. disease models.	**BT3 & BT4**

Course Contents

Modules	**Course content**	**Periods**
I	1. Colorimetric estimation of soluble sugars 2. Colorimetric estimation of pyruvate 3. Measurement of soluble sugars and pyruvate in yeast/bacterial cells in different growth conditions	**24**
II	1. Colorimetric estimation of amino acids 2. Colorimetric estimation of proteins (Biuret method) 3. Estimation of tryptophan residues in a protein.	**24**
III	1. Measurement of respiration by oxygen consumption. 2. Effects of inhibitors / uncouplers on respiration 3. Measurement of NAD/NADH in yeast/bacterial cells.	**24**
IV	1. Estimation of blood glucose. 2. Isolation and estimation of triacylglycerols. 3. Isolation of cholesterol from egg yolk and its estimation.	**24**

	Total	**96**

Textbooks:

1. Practical Biochemistry – 3rdEdn. David Plummer.
2. Introductory Practical Biochemistry – S.K.Sawhney and Randhir Singh.

Reference books:

1. Practical Clinical Biochemistry, ed. Harold Varley, 4th ed. CBSPublishers.
2. Practical Clinical Biochemistry: Methods and Interpretation, 4th ed. Ranjna Chawla, Jaypee Brothers Medical Publishers.
3 Introductory Practical Biochemistry. SK Sawney and R. Singh (2000). Narosa Publisher. ISBN 9788173193026 4. An Introduction to Practical Biochemistry 3rd Edition. Plummer D.T. (1998). Tata McGrawhillPublication. ISBN: 1118357728.
4 Tiwari, A. (2015). *Practical biochemistry: A student companion*. LAP Lambert Academic Publishing.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

MINOR PAPER: CLINICAL BIOCHEMISTRY
Subject Code: BCH152N301
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

To introduce the various parameters that determine a healthy and diseased state and to understand the workings of disease progression and development.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy**

		Level
CO 1	Identify the method of specimen collection and analysis and outline metabolic disorders, syndromes arising out metabolic disorders and the biochemistry of cancer.	**BT 1**
CO 2	Identify and review the various aspects clinical biochemistry, their implications in health, causes and implications of metabolic disorders and the biochemical basis of cancer.	**BT 1 and BT 2**
CO 3	Apply the knowledge gained to deliberate on clinical findings, check the relation of metabolites and syndromes associated with build-up of metabolites and the biochemical reasons leading to cancer progression.	**BT 3**
CO 4	Analyze the relation of body metabolites and their deregulation with appearance of metabolic syndromes and relate the build-up of cancer specific conditions in the progression of cancer.	**BT4**

Course Contents

Modules	Course content	Periods
I	**Specimen collection and analysis:** Concepts of accuracy, Precision, Reliability, Reproducibility, Normal values, Specimen collection and processing, Blood Collection-Anticoagulants, Venipuncture, Urine collection, CSF, Amniotic fluid, pH of blood, acid base equilibrium, sodium, potassium, chloride, bicarbonate.	**15**
II	**Inborn errors of metabolism:** Carbohydrate metabolism: galactosemia, Normal levels, renal threshold, Factors influencing blood glucose, Glycogen storage disorders, Pentosuria Lipid metabolism: Hyperlipidemia, Hyperlipoproteinemia, Fatty liver.	**15**
III	Amino acid metabolism- alkaptonuria, maple syrup urine disease, phenylketonuria, homocystinuria, proteinuria, albinism, multiple myeloma. Nucleotide metabolism: Lesch-Nyhan Syndrome, Biochemistry of anemia, thalassemia, porphyria	**15**
IV	**Disease caused by metabolic disorders of endocrine glands:** Diabetes, obesity, atherosclerosis, Conn's syndrome, Addison's disease, Cushing's syndrome, hypo- and hyperthyroidism, gonadal dysfunction, dwarfism and gigantism,	**15**

	Diseases caused by chromosomal abnormalities- Down, Turner and Klinefelter syndromes.	
	Total	**60**

Textbooks:

1. Textbook of medical biochemistry by S. Ramakrishnan, K G Prasannan 3rd Edition.
2. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M. 7thEdition, 2017, WH Freeman and Company, New York, USA.

Reference books:

1. A C Deb Fundamentals of Biochemistry, 10thedition, (2018), New Central Book Agency, London.
2. Berg, J.M.,Tymoczko,J.L.andStryer. Biochemistry,W.H. FreemanandCo.,9thedition,2019.
3. Allan Gaw, Michael Murphy, Rajeev Srivastava, Robert Cowan, Denis O'Reilly, Clinical Biochemistry, 6thEdition, 2017
4. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). *Clinical Biochemistry E-Book: An Illustrated Colour Text*. Elsevier Health Science
5. Blanco, A., & Blanco, G. (2017). *Medical biochemistry*. Academic Press.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom

SEC PAPER: Working with proteins
Subject Code: BCH152S311
L-T-P-C: 0-0-4-2
SCHEME OF EVALUATION: Practical (P)

Course Objective

To introduce the students to the basic laboratory skills needed to work with proteins.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Define the biochemistry behind protein isolation	**BT 1**
CO 2	Explain the differences in isolating proteins from different sources.	**BT 2**
CO 3	Analyze the importance of transferring proteins from gel to the membrane	**BT4**
CO 4	Compare the different amino acid functional groups in the protein.	**BT2**

Course Contents

Modules	Course content	Periods
I	Isolation of proteins from – I. Blood II. Plant tissue III. Animal tissue	**6**
II	Estimation and separation of protein- I. Estimation of isolated protein using Bradford, Lowry methods II. Separation of proteins using chromatographic and electrophoresis methods	**6**
III	Transferring proteins to membrane I. Demonstration of transferring proteins to membrane from gel and detection using Indian Ink staining II. Demonstration of immunoblotting of specific proteins.	**6**
IV	Amino acid estimation in protein I. Estimation of thiol group in a protein. II. Estimation of tryptophan residues in a protein	**6**
	Total	**24**

Textbooks:

1. Plumer D.T. (2017) An Introduction to Practicals in Biochemistry, Tata McGraw-Hill.
2. Jayaraman J. (2011) Laboratory Manual in Biochemistry, New Age Int. Pub.

Reference books:

1. Sadasivam S. and Manickam A. (2018) Biochemical Methods, New Age Int. Pub. Delhi.
2. Segal I.H (2010) Biochemical Calculations, John Wiley.
3. Gupta P.P and Gupta N. (2018) Essentials of Practical Biochemistry, Jaypee Brothers med. pub.
4. Introductory Practical Biochemistry. SK Sawney and R. Singh (2000). Narosa Publisher. ISBN 9788173193026 4. An Introduction to Practical Biochemistry 3rd Edition. Plummer D.T. (1998). Tata McGrawhillPublication. ISBN: 1118357728.
5. Practical Clinical Biochemistry: Methods and Interpretation, 4th ed. Ranjna Chawla, Jaypee Brothers Medical Publishers.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

SYLLABUS 4thSEMESTER

MAJOR (Core) PAPER: Concepts of Genetics
Course level: 200
Subject Code:BCH152M401
L-T-P-C: 3-1-0-4
SCHEME OF EVALUATION: Theory (T)

Course Objective

The aim of the course is to provide knowledge of both mendelian and non-mendelian concepts in genetics to students with a focus on the molecular basis of genetics.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Remember various topics under Mendel's Principle of heredity, gene function and genetics in bacteria, Pedigree analysis, Linkage, crossing over, mapping techniques, and chromosomal aberrations.	**BT1 & BT 2**
CO 2	Understand Mendel's laws and ratios; relationship between genetic inheritance, mechanisms of genetic exchange in prokaryotes; the of concept of recombination and linked genes; use recombination frequencies to determine gene order and distance; genetic mapping in eukaryotes using test crosses; the difference in the genetic basis of sex determination in Humans and Drosophila.	**BT 2& BT 3**
CO 3	Apply their knowledge in testing genetic hypothesis through statistical tools; finding recombination frequencies to determine gene order and distance; to build genetic mapping in eukaryotes.	**BT 3**
CO 4	Analyze inheritance pattern, cytogenetics mapping, pedigree analysis and chromosomal aberrations.	**BT 4**

Course Contents

Modules	Course content	Periods
I	**Mendel Principles of Heredity**- Basic principles of heredity, Mendel's laws of segregation and independent assortment, test cross, expression and interaction of genes, complimentary genes and epistasis. Sutton and Boveri hypothesis. Multiple alleles and pleiotropism	**15**
II	**Linkage and crossing over**- Basic principles of linkage and crossing over, Morgan' experiments showing linkage. Crossing over and genetic recombination. Examples of crossing over and genetic recombination in drosophila. Linkage maps of drosophila chromosomes and human chromosomes.	**15**
III	**Bacterial genetics**- Analysis of bacterial genetics, auxotrophs, prototrophs. Discovery of conjugation in bacteria, sex factor, transfer of sex factor, Hfr strains. Transformation, natural transformation and engineered transformation. Transduction	**15**

	generalized transduction and specialized transduction. Application of conjugation, transformation and transduction in mapping of genes.	
IV	**Basics of human genetics**- Pedigree analysis, chromosomal numerical abnormalities- Trisomy and monosomy. Euchromatin and heterochromatin. Sex chromosome, sex-linked inheritance, sex determination, dosage compensation and chromosomal aberrations	**15**
	Total	**60**

Textbooks:

1. Genetics,Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore),ISBN: 978-1-118-09242-2., 7th edition, 2015
2. 2. Genetics - A Conceptual Approach,Pierce, B.A., W.H. Freeman & Co. (NewYork), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1., 4th edition,2012

Reference books:

1. iGenetics, P.J.Russell,Benjamin/Cummings,Pearson Education 3rd edition, ISBN- 978-0321569769, 2009 2. Principles of Genetics, DP Snustad and MJ Simmons, John Wiley &SonsInc, ISBN: 978-1-119-14228-7, 2015
2. 3. Concepts of Genetics, Williams S Klug, Michael R Cummings, Charolette Spencer and Michael APalladino
3. 4. Genetics, P.K. Gupta, Rastogi Publication • Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, PearsonEducation
4. Jorde, L. B., Carey, J. C., & Bamshad, M. J. (2015). *Medical genetics e-Book.* Elsevier Health Sciences.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Flipped classroom

MAJOR (Core) PAPER: Human diseases and Basic Ayurveda
Subject Code: BCH152M402
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

To introduce students about the major diseases in India and the basics of ayurveda.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Define the multifactorial causes of diseases, facilitating better prevention and treatment strategies	**BT 1**
CO 2	Explain the interrelation of diseases	**BT 2**
CO 3	Define Ayurvedic philosophy, diagnosis, and treatment modalities	**BT 1 and BT 2**
CO 4	Analyze the role of medicinal herbs in ayurveda	**BT 4**

Course Contents

Modules	Course content	Periods
I	**Etiology of Diseases:** Introduction to Disease Etiology; Genetic Factors in Disease; Environmental Factors; Lifestyle Factors; Immunological Factors. Overview of the global burden and epidemiology of diabetes, obesity, and atherosclerosis. **Pathophysiology of Diabetes:** Mechanisms underlying insulin resistance and beta-cell dysfunction leading to complications of diabetes. **Pathogenesis of Obesity:** Discussion on the role of genetic, environmental, and behavioral factors in obesity development. **Atherosclerosis and Cardiovascular Disease:** Pathogenesis of atherosclerosis, and its relationship with heart attack and stroke.	**15**
II	**Interrelation of Diseases:** Concept of disease comorbidity, common pathways and mechanisms; syndromic associations, secondary diseases arising from primary conditions, side effects of medications, disease	**15**

	clustering in populations. **Understanding Cancer:** Overview of cancer types and prevalence; Introduction to cancer genetics and risk factors; Cell cycle dysregulation and genetic mutations; Major cancer types and their characteristics; Understanding tumor heterogeneity; Imaging and molecular diagnostic methods; Importance of early detection and screening; Overview of surgery, radiation, and chemotherapy; Targeted therapies and immunotherapy approaches.	
III	**Basic concepts of Ayurveda**: Origin and history of Ayurveda; Ayurvedic concepts of health and disease. Concept of Panchamahabhutas (Five Elements: space, air, fire, water, and earth and their relation with the human body); Tridosha Theory (Vata, Pitta, and Kapha); Sapta Dhatu (Seven Tissues); Agni (Digestive Fire); Ama (Toxins); Ayurvedic Diagnosis (Techniques of Ayurvedic diagnosis); Ayurvedic Lifestyle Practices (Daily routine, Dietary guidelines, Importance of yoga, meditation, and pranayama for health); Ayurvedic Therapies (Detoxification therapies, remedies, oils, and massages).	**15**
IV	**Role of Herbal Medicine in Ayurveda**:- History and significance of medicinal herbs in Ayurvedic tradition; Classification of ayurvedic herbs based on properties and actions. Therapeutic properties, traditional uses and health benefits of Amla (Emblica officinalis), Ashwagandha (Withania somnifera), Neem (Azadirachta indica), Triphala, Tulsi (Ocimum sanctum).	**15**
	Total	**60**

Textbooks:

1. Lehninger - Principles of Biochemistry; David L. Nelson and Michael M. Cox, 6th Edition, W. H. Freeman (2013). 46
2. Alagappan R (2017) Medicine For Ayush Students 1st Edition , Atithi books, New Delhi

Reference books:

1. Biochemistry- The Chemical Reactions of Living Cells; David E. Metzler, 2nd Edition, Academic Press(2001).

2. Outlines of Biochemistry; Eric E. Conn, Paul K. Stumpf, George Breuning, Roy H. Doi, 5th Edition, John-Wiley and sons(2009).

3. Biochemistry- The Chemical Reactions of Living Cells; David E. Metzler, 2nd Edition, Academic Press (2001).

4. Ravindra Angadi (2017) Classical Compendium Of Ayurvedic Pharmaceutical Science, Athithi Medical books Pvt Ltd, New Delhi.

5. Kshirsagar, M., & Magno, A. C. (2012). *Ayurveda: a quick reference handbook*. Lotus Press.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Quiz Seminar Flipped classroom

MAJOR (Core) PAPER: Genetics Practical
Subject Code: BCH152M412
L-T-P-C: 0-0-8-4
SCHEME OF EVALUATION: Practical (P)

Course Objective

The objective of the course to introduce the students the basic knowledge of simple experiment related to the field of genetics such as pedigree analysis, karyotyping in diseased and normal conditions., isolation of plasmid DNA, restriction-digestion of plasmid DNA, and amplification of a DNA of interest towards understanding of basics of genetic engineering.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand and have a practical knowledge of karyotyping of human chromosomes, pedigree analysis, plasmid isolation and restriction digestion of the same, and amplification of a DNA of interest.	**BT 1& BT 2**
CO 2	Apply the knowledge gained and the basic techniques learnt in setting up research question in future involving in human genetic disorders and basicstechniques to be undertaken while tackling them through genetic engineering	**BT 3**
CO 3	Analyze the online databases such as NCBI Nucleotide, primer designing sites which would help them in future application related to DNA.	**BT 3 & BT 4**

Course Contents

Modules	**Course content**	**Periods**
I	1. Buccal smear for Barr body analysis 2. Karyotyping of normal and turner/down's syndrome from supplied photographs	**24**
II	1. Isolation and analysis of plasmid DNA from bacteria 2. Restriction digestion of Plasmid DNA	**24**
III	1. Preparation of chromosome from mouse bone marrow 2. Study of different stages of meiosis in grasshopper testis	**24**
IV	1. Designing of primer for PCR 2. Amplification of DNA using PCR 3. Agarose gel electrophoresis of PCR product	**24**
	Total	**96**

Textbooks:

1. Brown, T. A. Gene Cloning and DNA analysis: an introduction. Blackwell Science, 6th edition 2010.
2. Genetics,Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore),ISBN: 978-1-118-09242-2., 7th edition, 2015

Reference books:

1. Modern Experimental Biochemistry. 3rd Edition. Rodney Boyer
2. 2. Advanced Methods in Molecular Biology and Biotechnology- A Practical Lab Manual. Auhtors: Khalid Z Masoodi, Sameena Maqbool Lone, and Rovidha Saba Rasool
3. 3. Principles and Techniques of Biochemistry and in Molecular Biology. Keith Wilson and John Walker
4. 4. Ptashne, M and Gann, A. Genes and Signals, Cold Spring Harbor Laboratory Press.
5. 2001
6. 5. Watson, J. D. et al. Molecular Biology of the Gene. Benjamin Cummings, 7th edition 2013.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
0 hours	90 hours	0 hours

MINOR PAPER: General Microbiology
Subject Code: BCH152N401
L-T-P-C: 2-1-0-3
SCHEME OF EVALUATION: Theory (T)

Course Objective

The course will provide the fundamental concepts of Microbiology including structure and classification of bacteria, microbial diversity and pathogenesis.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms**

		Taxonomy Level
CO 1	Define the different types of microorganisms, their importance, and pathogenesis	**BT 1**
CO 2	Compare the microbial diversity and physiology	**BT 2**
CO 3	Apply their knowledge in exploring microbial growth under various situations.	**BT 3**
CO 4	Analyze the pathogenic characteristics of different microbes	**BT 4**

Course Contents

Modules	Course content	Periods
I	**History of Microbiology** - History of microbiology as a discipline, Spontaneous generation versus biogenesis, contributions of Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Richard Petri, Charles Chamberland, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei Winogradsky, Alexander Fleming, Elie Metchnikoff and Emil vonBehring	**15**
II	**Microbial Cell organization and Diversity of Microbial world** Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and morphology. Cell-wall: Composition and detailed structure of Gram positive and Gram-negative cell walls, mechanism of Gram's staining. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.	**15**
III	**Microbial Nutrition and Growth** Nutritional types of microorganisms, growth factors, culture media-synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; influence of environmental factors on growth of microbes: effect of pH, temperature, solute, oxygen concentration, pressure and radiations. Sterilization, disinfection and antiseptics. Use of physical methods (heat, low temperature, filtration, radiation) and chemical agents (phenolics, halogens, heavy metals, sterilizing gases) in	**15**

	microbial control.	
IV	Pathogenicity of Microorganisms and Antimicrobial Chemotherapy- Introduction to pathogenic microbes; Bacteria, Viruses, Algae, protozoa and fungi. General Characteristics of antimicrobial drugs, determining the level of microbial activity: dilution susceptibility test and disc diffusion test. Range of activity and mechanism of action of penicillin, vancomycin and tetracycline.	**15**
	Total	**60**

Textbooks:

1. Lippincott's Illustrated Review of Microbiology by William A Strohl, 5th edition, 2017
2. Willey, J., Sherwood, L., Woolverton, C. (2017). Prescott's Microbiology (10th ed.). McGraw Hill international. ISBN 13:9781259657573

Reference books:

1. Chan,M.J., Krieg E. C. S., Pelczar, N. R. (2004) Microbiology (5th ed.). McGraw Hill International. ISBN 13:9780094623206.
2. Prescott, Harley, Wiley, J.M., Sherwood, L.M., Woolverton, C.J. (2018). Klein's Microbiology. (7th ed.). Mc Graw Hill International Edition (New York) ISBN: 978- 007-126727
3. Lehninger - Principles of Biochemistry; David L. Nelson and Michael M. Cox, 6th Edition, W. H. Freeman (2013).
5. iGenetics, P.J.Russell,Benjamin/Cummings,Pearson Education 3rd edition, ISBN- 978-0321569769, 2009 2. Principles of Genetics, DP Snustad and MJ Simmons, John Wiley &SonsInc, ISBN: 978-1-119-14228-7, 2015

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Presentations

MINOR PAPER: Biochemical Correlations of Diseases
Subject Code: BCH152N402
L-T-P-C: 2-1-0-3
Scheme of evaluation: Theory (T)

Course Objective

To provide knowledge about common lifestyle disorders and the molecular details of their development.

Course Outcome

On Successful Completion of the course, the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Review the basic relation between cells, tissues and organs	**BT 2**
CO 2	Define and describe the causes of different diseases	**BT1 & BT2**
CO 3	Discover the different underlying causes of diseases	**BT3**
CO 4	Explain the functioning of vaccines	**BT 5**

Course Contents

Modules	**Course content**	**Periods**
I	Introduction and brief description of cells, tissues and organs, their functions; Body fluids and their composition. Introduction to molecules as building blocks. Definition and differentiation of disease and disorder, types and causes.	**15**
II	Diabetes, major causes of diabetes, major genes involved in diabetes. Obesity, major genes involved in obesity. Cardiovascular diseases. Major underlying causes. Genes involved in CVD.	**15**
III	Alcoholic liver disease and fatty liver- Biochemical mechanisms, Causes, Prevention and dietary management. Nephrotic syndrome, Acute and Chronic renal failure- Biochemical mechanisms, Causes, Prevention and dietary management	**15**
IV	Viral infections- HIV/AIDS: Biochemistry of HIV infection, ART	**15**

	and social issues. Vaccines against HIV. Biochemistry of SARS-COVID I and II viral infections.	
	Total	**60**

Textbooks:

1. Biochemistry; Donald Voet, Judith G. Voet, 4th Edition, John Wiley and sons (2010).
2. Lehninger - Principles of Biochemistry; David L. Nelson and Michael M. Cox, 6th Edition, W. H. Freeman (2013). 46

Reference books:

1. Biochemistry- The Chemical Reactions of Living Cells; David E. Metzler, 2nd Edition, Academic Press(2001).
2. Outlines of Biochemistry; Eric E. Conn, Paul K. Stumpf, George Breuning, Roy H. Doi, 5th Edition, John-Wiley and sons(2009).
3. Biochemistry- The Chemical Reactions of Living Cells; David E. Metzler, 2nd Edition, Academic Press (2001).
4. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). *Clinical Biochemistry E-Book: An Illustrated Colour Text*. Elsevier Health Science
5. Blanco, A., & Blanco, G. (2017). *Medical biochemistry*. Academic Press.

Credit Distribution		
Lecture/Tutorial	**Practical**	**Experiential Learning**
60 hours	0 hours	30 hours Assignment Seminar Presentations