ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF BIO - SCIENCES
(RSBSC)
Department of Biochemistry

Syllabus
For
B.Sc Biochemistry
2022-23

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PREAMBLE

Biochemistry, today is considered as an application oriented integrated basic science. It's an interdisciplinary science that has emerged by the confluence of principles of Chemistry, Physics and Mathematics to Biology. Advances in Biochemistry have immense positive implications on the understanding of biochemical interactions, cellular communications, hormonal mechanisms and the cross talks between them. The research in Biochemistry has been translational and there is a shift from hypothesis driven research to data dependent research that promises translational, product oriented research. Much of the advancement in Biochemistry is in the advancement of Biotechnology, as a basic science disciplineBiochemistry lead to Biotechnological advancement. Considering its pivotal role in Biological sciences, it is imperative to strengthen the fundamental concepts of Biochemistry. The current pattern is designed to provide a focused learning outcome-based syllabus at the Honors level providing structured teaching-learning experiences catering to the needs of the students. The honors course will prepare the students academically and prepare them for employability. The program also inculcate various attributes at the Honors level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability. The new curriculum based on learning outcomes of B. Sc. (Honors) in Biochemistry offers basic knowledgeof chemistry in general, including the concepts in organic, inorganic, physical, analytical, spectroscopy and pharmaceutical chemistry. The course defines clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills. The course also offers skills to pursue research in the field of Biological Chemistry and thus would produce best minds to meet the demands of society.

INTRODUCTION TO THE PROGRAMME

ThisLearning Outcome based Curriculum Framework of Biochemistry for undergraduate education has been prepared in consonance with the generic guidelines prepared by UGC that provides the basic template for Universities to follow.

It was severely felt that students from class X and XII standards though studied fundamentals especially the basics of chemistry and mathematics, face great difficulties in understanding the concept of Biochemistry. Therefore some fundamentals are again included in the current template in order to train them to become profitable biochemists in Biotechnology Industries. Through the present curriculum attempt has been made to generate enough interest among students so that they can pursue higher education in Biochemistry to take up the career of teaching, research or to serve the needs of medicine, agriculture related industrial establishments.

The discipline of Biochemistry involves the study of the structure and function of biomolecules and the vital processes that occur in living organisms. It is regarded as Mother of all Biological Sciences disciplines because it unveils the chemical basis of life in all living organisms including plants, animals and microorganisms. Biochemistry has contributed enormously to the growth of modern medical and health science and agriculture. Biochemistry has applications in clinical diagnosis, understanding pathology of diseases, treatment of diseases, designing of drugs and understanding their metabolism and manufacture of various biological products like amino acids, proteins, antibiotics, hormones, enzymes, nutrients, etc. Understanding the biochemical basis of vital processes of plants such as photosynthesis, respiration, hormonal regulation, nutrient assimilation have helped in developing superior varieties of crop plants with better growth attributes and yield. For the estimation of pesticide residues in soil or food grain one has to rely on biochemical tests. The functions and roles of various nutrients are described only by

biochemistry. The composition of food materials including the quality-milk and possible adulterations can be checked by biochemical tests. This discipline has played valuable role in farming, fishery, poultry, sericulture, bee keeping and in environmental remediation.

Keeping in pace with the developmental trends in various subareas of Biochemistry it is expected that the students undertaking Biochemistry (Honours) course at undergraduate level become conversant with the fundamentals of Biochemistry and at the same time at the end of the programme they exhibit certain levels of learning outcomes. Such learning outcomes like understanding of discipline, critical thinking, problem solving, analytical and scientific reasoning, research/industry related skills, etc. will empower the students to develop their future career with a much better and meaningful orientation.

With this background Biochemistry undergraduate model curriculum has been developed, which includes 16 Core Courses comprising of theory papers and corresponding practical papers. The course contents include fundamentals as well as upcoming developments in the discipline of Biochemistry and inter facial sciences.

The course for Biochemistry is prepared on the contours and curricular structure provided by the UGC and may be modified without sacrificing the spirit of CBCS and LOCF.

Nature and extent of the B.Sc. (Hons.) Programme:

The course is designed as per the UGC regulation for a period of 4 years where the students have to study Core courses in Biochemistry, advance courses in Biochemistry known as Discipline Specific Elective Courses, Generic Elective Courses to which the students will study in other departments, skill Enhancement Elective Courses and Ability Enhancement Compulsory Courses. Generic Elective Courses will be opted by the students depending on their choice in other departments as per the courses available in other departments of the particular university/institution. In first four semesters the students are

provided basics of Biochemistry syllabus, besides the courses which they have to opt in other departments.

Aims of Bachelor's degree (Honours) programme in Biochemistry:

The overall aims of Bachelor's degree (Hons) programme in Biochemistry are to:

Provide students with learning experiences that help in still deep interests in learning biochemistry; develop broad and balanced knowledge and understanding of biomolecules, key biochemical concepts, principles and theories related to biochemistry; and equip students with appropriate tools of analysis and with theoretical, technical and analytical skills to tackle issues and problems in the field of biochemistry.

To expose the students to a wide range of careers that combine biology, plants, and medicine.

To provide students with some work experience, for example a summer internship or a research project in a research laboratory to further boost the career prospects.

To develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in biochemistry,

To provide students with the knowledge and skill base that would enable them to undertake further studies in biochemistry and related areas or in multidisciplinary areas that involve biochemistry and h-elp develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

\GRADUATE ATTRIBUTES B. SC. BIOCHEMISTRY (HONORS):

Graduates with strong academic knowledge, discipline-specific and generic skills complemented with social responsibility are greatest asset of the country. The curriculum frame work for Biochemistry graduates aims to build the following attributes;

GA 1:Disciplinary Knowledge:

a) Ability to comprehend fundamental concepts of biology, chemistry and apply basic principles of chemistry to biological systems.

b) Ability to relate various interrelated physiological and metabolic events.

c) Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts

d) Ability to think laterally and in an integrating manner and develop interdisciplinary

e) Good experimental and quantitative skills and awareness of laboratory safety

f) A general awareness of current developments at the forefront in biochemistry and allied subjects.

g) Awareness of resources, and their conservation.

GA 2:Communication Skills:

a) Ability to speak and write clearly in English and local language

b) Ability to listen to and follow scientific viewpoints and engage with them.

c) Ability to understand and articulate with clarity and critical thinking one’s position.

GA 3:Critical Thinking and Problem solving:

a) Ability to conceptualize critical readings of scientific texts in order to comprehend.

b) Ability to place scientific statements and themes in contexts and also evaluate them in terms of generic conventions.

c) Ability make careful observation of the situation, and apply lateral thinking and analytical skills.

GA 4: Analytical Reasoning:

a) Ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments. b. Ability to use scientific evidences and experimental approach to substantiate one's argument in one's reading of scientific texts.

GA 5: Research Skills:

a) Ability to formulate hypothesis and research questions, and to identify and consult relevant sources to find answers.

b) Ability to plan and write a research paper.

GA 6: Teamwork and Time Management:

a) Willingness to participate constructively in class room discussions and contribute to group work.

b) Ability to meet a deadline.

GA 7: Scientific Reasoning:

1. a) Ability to analyze theories and beliefs, evaluate ideas and scientific strategies.
2. b) Ability to formulate logical and convincing arguments.

GA 8: Self-Directing Learning:

a) Ability to work independently in terms of organizing laboratory, and critically analyzing scientific literature.

b) Ability to postulate hypothesis, questions and search for answers.

GA 9: Digital Literacy:

a) Ability to use digital resources, and apply various platforms to convey and explain concepts of biochemistry.

GA 10: Moral and Ethical Values:

a) Ability to interrogate one's own ethical values, and to be aware of ethical and environmental issues.

b) Ability to read values inherited in society and criticism vis-a-vis, the environment, religion, spirituality, and structures of power.

GA 11: Leadership qualities:

a) Ability to lead group discussions, to formulate questions related to scientific and social issues.

GA 12: Life-long Learning:

a) Ability to retain and build on critical thinking skills, and use them to update scientific knowledge and apply them in day to day business.

Qualification descriptors for a Bachelor's degree inBiochemistry:

In the learning outcome based approach, extensive deliberation has been made to identify the minimum learning outcome from a student after completing each course. This entire outcome shall be substantiated by the practical components. Biochemistry can be better understood with parallel practical components. In this regard the committee strongly felt that there shall be a guideline to maintain the students' teacher ratio for both theory and practicalclasses.

The qualification descriptors for the B.Sc. programme in Biochemistry shall be 12 learning attributes such as understanding, use, communication, and demonstration of experimental and theoretical knowledge with a clear understanding etc. The key qualification descriptor for undergraduate Biochemistry shall be clarity of concepts, experimentation, communication as well as critical thinking and ethical awareness. Each undergraduate in Biochemistry should be ableto

- demonstrate a coherent and systematic approach to the experimental and theoretical aspects of biochemistry. This would also include the student's ability to understand and engage with critical concepts, theories anddogmas.
- demonstrate the ability to understand the role of scientific developments, particularly, biological sciences in a changing world from the disciplinary perspective as well as in relation to its professional and everydayuse.
- communicate ideas, opinions and values—both scientific themes and values of life in all shades and shapes—in order to expand the knowledge of the subject as it moves from the classroom/laboratory to industry andsociety.
- demonstrate the ability to share the results of academic and disciplinary learning through different forms of communication such as essays, dissertations, reports, findings, notes, seminars etc, on different platforms of communication such as the classroom, the

media and theinternet.

- recognize the scope of biochemistry in terms of career opportunities, employment and lifelong engagement in teaching, publishing, communication, media, soft skills and other alliedfields.

The programme will strengthen the student's competence, help identify, analyze and evaluate keys issues of current science around in the world and think of ways to find logical and viable solutions. The qualification descriptors for the B.Sc. (Biochemistry)programmeshall thus include understanding of fundamentals, acquiring practical training and application of the subject knowledge in diversified areas of Biochemistry with a clear understanding that this knowledge will equip the students to make them suitable for various Biotech, Pharma, Medicine,Agri-Biotech, Biochemical related laboratories/industries. The key qualification descriptor for Biochemistry shall be acquiring practical training as well as critical knowledge of the Biochemistrysubject.

Teaching-learning processes

The foremost effort of teaching is to impart knowledge to students, factual as well as hypothetical. The manner in which this is communicated to the students determines the success of the teaching process. To be able to see tangible results, it is imperative that the teaching-learning process be bilateral. There are three critical components to the teaching learning process, namely content writing, content delivery and engaging the students to complete the course. A passive flow of information from the teacher to the taught should make way for a vibrant atmosphere of active participation from the students. Teachers participating in the programmewould have a well-structured and well-planned lecture ready for the class that should compel the students to concentrate, understand and enjoy the discourse. Students would be encouraged to think independently and ask pertinent

questions cultivating out-of-the-box thinking. The link between theory and practical would be made evident, as working with their hands reinforces the concepts first introduced in theory classes. The traditional chalk and talk method of teaching is simple but very effective. Diagrams or additional material may be shown as slides but with minimum text-rich content. For concepts that are difficult to explain, power point presentations or videos would be used. Some laboratory experiments will be open ended. Students will be divided into small groups to encourage teamwork, healthy competition and to be able to complete the task in stipulated time frames. Students will be taken out of the classroom and into the world of research institutions as well as industries in the form of simple visits or internships or educational tours for maximum benefit. It will help them to correlate what they learn in the classroom with the real world. Additionally, teachers will use MOODLE platform to create lessons and interact with students to create an open and effective two-way communication channel. Digital initiatives such as the Swayam portal, National digital library and open education resources will be used to greatly facilitate blended learning and flipped class rooms encouraging students to be responsible for learning. Group discussions, debates and scientific talks by external experts will be arranged for facile learning. Students will be encouraged to write comprehensive reviews of papers in a particular topic, reports, essays and short projects to augment their writing skills. Students will also be motivated to deliver seminars to strengthen their oratory skills.

ASSESSMENT METHODS:

Assessment methods are the strategies, techniques, tools and instruments for collecting information to determine the extent to which students demonstrate desired learning outcomes.

Student learning outcomes cannot be ascertained by single evaluation criteria. A combination of direct and indirect assessments would thus be used. Direct methods of assessment will be used for students to demonstrate their learning while indirect methods will be used to observe students reflect on their learning. Written tests, essays, quiz, presentations and seminars will be used as direct methods of assessment, and indirect methods will include surveys, discussions, debates, participation in scientific meetings and festivals. Embedded assessments, in other words "classroom-based" or "continuous" assessments will be utilized as both a grading instrument as well as data for assessing student learning outcomes. Some examples of assessment methods that will be used are given below:

Method	**Description**	**Direct or Indirect Assessment**
Attendance	Regular participation in class activities (Theory and Practicals)	Indirect
Observations	Information can be collected while observing "events"suchasclasses,groupwork,andstudy sessions.	Indirect
Performance	Students can be evaluated on participation in practicals, events, presentations, projects. Encourages public speaking skills.	Direct
Portfolio	Students' work is collected throughout the program which is assessed by faculty using a common scoring guide. Portfolios may contain assignments, reports, class tests, exams, case studies, presentations, practical file record etc.	Direct
Viva Voce or External Review	An interview conducted by external faculty to gauge the depth of theoretical knowledge, clarity, visualization and hands on practical skills of the student. Instills self-confidence to face interviews in their future careers.	Indirect
Internally developed class tests	These are shorter tests held periodically through the semestertoassesshowwellthestudentshavegrasped the concepts and skills. Alsoencourages regular attendance.	Direct

Course Exam	A comprehensive written exam given near the end of every 2 semesters to determine a student's acquisition and application of a particular type of knowledge or skill, as well as the ability to integrate knowledge.	Direct

SCHEME OF EVALUATION

I. Theory Papers (T):	II. Practical Papers (P):	III. Combined Theory & Practical Papers (TP):
Continuous Evaluation: 15% (Assignment, Class Test, Seminar, Quiz : Any Three) Mid-term examination: 10% Attendance: 5% End Term Examination: 70%	Continuous Evaluation: 25% (Skill Test, lab copy, viva, lab involvement: Any Three) Attendance: 5% End term examination: 70 %	Continuous Evaluation: 15% (Assignment. Class Test, Seminar, Lab Experiment, Copy and Viva: Any Three) Mid-term examination: 10% Attendance: 5% End term examination: 70 %

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO 1: The graduating student shall become a professional biochemist.

PEO 2: The graduating student shall become a researcher in the field of biochemistry.

PEO 3: The graduating student will become an entrepreneur or a consultant or a freelancer in the area of biochemistry.

PROGRAM OUTCOME:

On Successful completion of this program the graduates shall have:

PO 1: Knowledge of Biochemistry

Ability to apply the fundamental knowledge of Biomolecules, protein, biochemical techniques in the area ofbiochemistry.

PO 2:Communication Skills

Ability to communicate effectively.

PO 3:Critical thinking and problem solving

Ability to conduct experiment, analyze and interpreted the results.

PO 4:Analytical reasoning

An ability to identify, formulate and solve the problems in the area of biochemistry.

PO 5:Research Skill

An ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.

PO 6:Team work and time management

Ability to function in a multidisciplinary team.

PO 7:Scientific reasoning

An ability to learn a system with its component, or process to meet desired need within realistic constraints.

PO 8:Self direct learning

A knowledge of contemporary issues in the area of biochemistry.

PO 9:Digital Literacy

An ability to use the techniques, skills and modern professional tools necessary for professional practice and for research.

PO 10:Moral and Ethical values

An understanding of professional and ethical responsibilities

PO 11:Leadership qualities

An ability to apply the relevant knowledge and managerial skills to manage the project of multidisciplinary nature.

PO 12:Life long learning

A recognition of the need for and an ability to engage in lifelong learning in the area of biochemistry.

PROGRAM SPECIFIC OBJECTIVES:

PSO 1- Students shall be able to identify, formulate and solve the problems of endocrine disorders in the area of hormone biochemistry.

PSO 2- Students shall be able to conduct the clinical biochemistry, Diagnostic biochemistry experiments as well as to analyze and interpret the results.

PSO 3- Students shall be able to use the biochemical techniques, Genetic Engineering & Biotechnology skills and modern pathological tools necessary for professional practice and for research.

Objectives of the Curriculum Framework:

This framework is meant to bring systematic changes in the higher education system in the University and to align itself with the National Education Policy 2020. The following objectives are kept in perspective while framing this framework –

- to promote holistic development of students having towards becoming a global citizen;
- to provide flexibility to students so that they can choose their learning trajectories and thereby choose their paths in life according to their talents andinterests;
- to promote creativity and critical thinking and to encourage logical decision-making and innovation;
- to promote ethical values, human values & constitutionalvalues;

- to promote multilingualism and the power of language in learning andteaching;
- to impart life skills such as communication, cooperation, teamwork, andresilience;
- to promote research as a requisite for outstanding education anddevelopment;
- to eliminate rigid hierarchies among disciplines/fields of study and silos between different areas oflearning;
- multidisciplinarity and interdisciplinarity education to ensure the unity and integrity in all spheres oflearning.

Features of the CurriculumFramework:

Keeping the objectives in mind, the framework has been designed to reflect the following features –

- Holistic development of the students shall be nurtured through imparting life skills in initial years. These life skill courses shall include courses on Communicative Skills, Behavioural Sciences, Computational Skills and similar such skills shall make the students better equipped to deal with the life'schallenges.
- Flexibility to the students to determine their learning trajectories and pursuance of programmes of study has been well integrated in the framework. It allows students to opt for discipline depending on his/her choice and also being provided with the option of focusing on studying allied courses (GE) of his/her selected areas or diversifying in other areas of study of otherdisciplines.
- Students have also been provided with the flexibility to study SECs and VACs or opt for Internships/In-Plant Training/Projects at an appropriatestage.
- In the fourth year, students shall require to undertake a minor project (flexibility of choosing 2-3 areas or in a combination of areas) which will lead to submission of a major project (in any 1 area out of the chosen 2-3areas).

Knowing the extent of plurality of the Indian society and the diverse background to which

students belong, multiple exits and provision of re-entry have been provided at various stages of the undergraduate programme to accommodate their requirement and facilitate them to complete their studies depending upontheir priorities of life. The earning and accumulation of credits in the Academic Bank of Credit (ABC), and the flexibility to redeem the requisite credit for award of appropriate Certificate/Diploma/Degree, as the per the norms laid down by the UGC and the University, shall be made available to the students to provide the opportunity for lifelong learning as well as for availing academic outreach beyond the superstructure of the programme of study in anotherUniversity.

- This framework has incorporated multidisciplinarity by embedding within the framework the need to opt for generic elective papers from any other discipline(s) other than the one opted as corediscipline(s).
- Modules or systems of study shall be meaningfully laid down to guide the students in choosing their track/academic paths for the desiredoutcome.
- Further, provision for internship/apprenticeship/project/community outreach in 3rd semester shall provide ample opportunity to the students to explore areas of knowledge/activity beyond the classrooms and reach out to the world outside without any dilution of the academic feature of the course of study, he/she is pursuing.
- The framework provides a mandatory course on research methodology as one of the core courses at the 5th semester. They will enrich the students in writing internship report in 5th semester as well as research output in the 4thyear.

AWARD OF DEGREE:

A student pursuing 4 years undergraduate programme with research in a specific discipline shall be awarded an appropriate Degree in that discipline on completion of 8th Semester if he/she secures 180 Credits. Similarly, for certificate, diploma and degree, a student needs to fulfil the associated credits.

An illustration of credits requirements in relation to the type of award is illustrated below:

Sl. No.	**Stage of Exit**	**Mandatory Credits to be secured for the Award**
1	After successful completion of 1st Year	48
2	After successful completion of 1st and 2nd Years	96
3	Aftersuccessful completion of 1st, 2nd and 3rdYears	148
4	After successful completion of 1st, 2nd, 3rd and 4th Years	180

B.SC BIOCHEMISTRY PROGRAMME STRUCTURE							
1ST SEMESTER							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C101	Molecules Of Life	3	1	0	4	4
2	BCH152C102	Cell Biology	3	1	0	4	4
3	BCH152C113	Biomolecules and cell biology practical	0	0	8	4	8
Total credit for core papers						**12**	**16**
Skill Enhancement Course (SEC)							
4	BCH152S121	Biochemical assessment of food products	0	0	4	**2**	**4**
Value Added Course (VAC)							
5		Will choose from the basket	2	0	0	**2**	**2**
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A101	Communicative English - I	1	0	0	1	1
7	BHS982A104	Behavioural Science – I	1	0	0	1	1
Generic Elective							
8	BCH152G101	GE1:Biomolecules	3	0	0	3	3
9	BCH152G102	GE2:Immunity and Health	3	0	0	3	3
TOTAL CREDIT FOR THE SEMESTER						**24**	**28**
2nd SEMESTER							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C201	Proteins and enzymes	3	1	0	4	4
2	BCH152C202	Membrane biology and bioenergetics	3	1	0	4	4
3	BCH152C213	Protein and enzymes practical	0	0	8	4	8
Total credit for core papers						**12**	**16**
Skill Enhancement Course (SEC)							
4	BCH152S211	Food adulteration	0	0	4	**2**	4
Value Added Course (VAC)							
5		Will choose from the basket	2	0	0	**2**	**2**
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A201	Communicative English - II	1	0	0	1	1
7	BHS982A204	Behavioural Science – II	1	0	0	1	1
Generic Elective							
8	BCH152G201	GE-3: Intermediatary metabolism	3	0	0	3	3
9	BCH152G202	GE-4:Biochemical Applications in Forensics	3	0	0	3	3
TOTAL CREDIT FOR THE SEMESTER						**24**	**30**

B.SC BIOCHEMISTRY PROGRAMME STRUCTURE							
3rd SEMESTER							
Sl.No	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C301	Metabolism of biomolecules	3	1	0	4	4
2	BCH152C312	Metabolism practical	0	0	8	4	8
Total credit for core papers						**8**	**12**
Discipline specific course (DSE) (to choose any 1)							
4	BCH152D301	Analytical techniques	3	1	0	**4**	**4**
		Plant Biochemistry	3	1	0	**4**	**4**
4 weeks Internship/In plant training/Project							
5			0	0	0	**4**	**4**
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A301	Communicative English - I	1	0	0	1	1
7	BHS982A304	Behavioural Science – I	1	0	0	1	1
Generic Elective							
8	BCH152G101	GE5: Techniques in biochemistry	3	0	0	3	3
9	BCH152G102	GE6: Immunity and Health	3	0	0	3	3
TOTAL CREDIT FOR THE SEMESTER						**24**	**28**
4th SEMESTER							
Sl.No	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C401	Concepts in Genetics	3	1	0	4	4
2	BCH152C412	Genetics practical	0	0	8	4	8
Total credit for core papers						**8**	**12**
Discipline Specific Elective (DSE) (to choose any 1)							
3	BCH152D401	Clinical Biochemistry	3	1	0	4	4
		General Microbiology	3	1	0	4	4
Skill Enhancement Course (SEC)							
4	BCH152S411	Biochemical analysis of Blood	0	0	4	**2**	4
Value Added Course (VAC)							
5		Will choose from the basket	2	0	0	**2**	**2**
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A401	Communicative English - II	1	0	0	1	1
7	BHS982A404	Behavioural Science – II	1	0	0	1	1
Generic Elective							
8	BCH152G201	GE-7: **Biochemical Correlations of Diseases**	3	0	0	3	3
9	BCH152G202	GE-8: Biochemical Applications in Forensics	3	0	0	3	3
TOTAL CREDIT FOR THE SEMESTER			**18**	**0**	**6**	**24**	**30**

5th SEMESTER							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C501	Gene organization replication and repair.	3	1	0	4	4
2	BCH152C513	Gene practical	0	0	8	4	8
Total credit for core papers						**8**	**12**
Discipline specific course (DSE) (to choose any 2)							
3,4	BCH152D521/2	Bioinformatics and Biostatistics	3	1	0	**4**	**4**
	BCH152D521/2	Nutritional Biochemistry/MOOCS-Basics of Nutrition	3	1	0	**4**	**4**
	BCH152D521/2	Gene Expression and Regulation	3	1	0	**4**	**4**
	BCH152D521/2	Genes and Diseases	3	1	0	**4**	**4**
Value Added Course (VAC)							
5		Will choose from the basket	2	0	0	**2**	**2**
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A501	Communicative English - I	1	0	0	1	1
7	BHS982A304	Behavioural Science – I	1	0	0	1	1
Internship							
8		Mandatory 6 weeks internship after 4th semester exams	0	0	12	6	6
TOTAL CREDIT FOR THE SEMESTER						**26**	**30**

6th SEMESTER							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	BCH152C601	Immunology	3	1	0	4	4
2	BCH152C612	Immunology Practical	0	0	8	4	8
Total credit for core papers						**8**	**12**
Discipline Specific Elective (DSE) (to choose any 3)							
3,4, 5	BCH152D621/2/ 3	Genetic Engineering and Biotechnology	3	1	0	4	4
		Microbial ecology	3	1	0	4	4
		Cancer Biology/MOOCS-Cancer Fundamentals	3	1	0	4	4
		Advanced Cell Biology	3	1	0	4	4
		Human Physiology	3	1	0	4	4
Skill Enhancement Course (SEC)							
4	BCH152S611	Working with proteins	0	0	4	**2**	4
Value Added Course (VAC)							
5		Will choose from the basket	2	0	0	**2**	**2**
Ability Enhancement Compulsory Courses (AECC)							

6	CEN982A601	Communicative English - II	1	0	0	1	1
7	BHS982A604	Behavioural Science – II	1	0	0	1	1
TOTAL CREDIT FOR THE SEMESTER						**26**	**32**

SYLLABUS 1st SEMESTER

CORE PAPER : Molecules of Life

Subject Code: BCH152C101

L-T-P-C: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives

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 inter relations.

Course Outcome

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	The students will be able to find the role and importance of biomolecules in a living system	**BT1&BT2**
CO 2	The course will provide enough scope to understand the importance of each biomolecules-viz. nucleic acid, carbohydrate, lipid, and protein along with vitamins and water.	**BT2**
CO 3	Students will be able to apply the knowledge in analyzing their role in our day to daylife at a chemical level with a biological perspective	**BT3**
CO 4	Students will take part in hands on approach and laboratory techniques.	**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	**12**
	Carbohydrates and glycobiology: Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Disaccharides (examples of disaccharides). Polysaccharides homo- and heteropolysaccharides, structural and storage polysaccharides.	**12**

II	Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates	
III	**Lipids:** Building blocks of lipids - fatty acids, glycerol, 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.	**12**
IV	**Proteins and Amino acids**: Structure and classification, physical, chemical and optical properties of amino acids (hydrophobic, polar and charged). 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, effect of acid and alkali on DNA**.**	**12**
	Total	**48**

Text books:

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. Principles of Biochemistry, 5thEdition. 2011, Robert Horton H, LaurencMoran, Gray Scrimgeour K. Pearsarson Publisher. ISBN978-0321707338.
2. Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 4thEdition, Alpha Science International, 2017. ISBN-10:1842652451.

SYLLABUS 1st SEMESTER

CORE PAPER : Cell Biology
Subject Code: BCH152C102
L-T-P-C: 3-1-0-4
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 outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Students will understand how these cellular components are used to generate and utilize energy in cells	**BT1&BT2**
CO 2	Students will understand the cellular components underlying mitotic cell division..	**BT2**
CO 3	Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function as well use of various tools and techniqunes in understanding those.	**BT3**
CO 4	Students will analyse the application of cell biology in research.	**BT4**

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), cells as experimental models. Structure of different cell organelles: Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi, Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes,	**12**
II	**Cytoskeletal proteins:** Cytoskeletal proteins: Structure and organization of actin filaments. Tread milling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella. Cell wall and extracellular matrix: Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.	**20**
III	**Cell cycle, cell death and cell renewal:** Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.	**8**
IV	**Tools of cell biology:** Brief introduction of Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for sub cellular fractionation.	**8**
	Total	**48**

Text Books:

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. Principles of Human Physiology; 7th Edn. Cindy L. Stanfield Pearson,(2016).
3. Biochemistry Ed. Donald Voet& Judith G. Voet, 4thEdn. John Wiley & Sons, Inc.(2012).
4. Mammalian Biochemistry; White, Handler and Smith, McGraw-Hill, (1986).

CORE PAPER : Biomolecules and Cell Biology Practical
Subject Code: BCH152C113
L-T-P-C: 0-0-8-4
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 Outcomes

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Students can relate the application of biomolecules and cell biology.	**BT1**
CO 2	Students will understand the process of making various buffers, buffering range, and its uses and application in biochemical reactions, enzyme activity and blood group variety testing etc.	**BT2**
CO 3	Along with that students will also learn and apply the knowledge of cell biology in practicals and interpret experimental results.	**BT3**
CO 4	Exhibit the cell division methods and development of practical skills in cell biology.	**BT4**

Course Content

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	1. Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water 2. Preparation of Normal solution- NaOH 3. Preparation of percentage/ vov-vol solutions- Sulphuric acid 4. Preparation of buffers 5. Paper Chromatography- Isolation of the pigments from leaves of Radish 6. Qualitative analysis of Carbohydrate & fats	**28**
III	1. Preparation of stains. 2. Visualization of animal and plant cell by dye (methylene blue). 3. Study of polyploidy in Onion root tip by colchicine treatment.	**28**
IV	1. Study of different stages of Mitosis. 2. Study of different stages of Meiosis. 3. Examination of blood samples: Blood grouping	**20**
Total		**96**

Text books:

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

Reference books:

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

SEC PAPER: Biochemical assessment of food products

Subject Code: BCH152S111

L-T-P-C:0-0-4-2

STUDENT'S SCHEME OF EVALUATION: (P)

Course objectives

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 Outcomes

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the importance of various biomolecule and the various food sources of those biomolecules	**BT1&BT2**
CO 2	Perform the different estimating methods for all the biomolecules in the food sources .	**BT2**
CO 3	Apply the knowledge of biochemistry in practicals and interpret experimental results which will be helpful for them in development of practical skills in biochemistry.	**BT3**
CO 4	Understand metabolisms of the various components present in food. .	**BT4**

Course Contents

Modules	**Course content**	**Period**
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.	**6**
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.	**6**
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.	**6**

IV	**Micro and macronutrients:** Role and food sources of vitamins, macrominerals, microminerals and trace elements. Assessment of micronutrients (Ca, P, Fe, Vitamin A, Vitamin C) status in food samples like milk, fruit juice, vegetables.	**6**
	Total	**24**

Text books:

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

AECC - 1 (1ST SEMESTER)
AECC-1/Subject Name: Communicative English- I: Developing Oral Communication and Listening Skills
Subject Code: CEN982A101
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks** **Component B +C – Viva-Voce + Extempore speech = 40 Marks**

Course Objective:

The objective of the course is to introduce students to oral communication skills in English by engaging them to meaningful discussion and interactive activities.

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Have a knowledge of Communication process, verbal, and non-verbal communication	**BT1**
CO 2	Improve the skill of listening processes	**BT2**
CO 3	Develop a life skill on oral group communication- group discussionleadership	**BT3**

	skills, team management.	
CO 4	Have a basic idea of language styles – oral and written communication. .	**BT4**

Course contents:

Modules	Course Contents	Periods
I.	**Basics of Communication- Introduction** Communication - definition – meaning – elements - basics of communication - communication process - importance of communication Components of Communication pes/forms of Communication (Oral-written, Formal-Informal (Grapevine), Interpersonal-Intrapersonal, Mass- Group, Verbal-Non Verbal External communication, Organizational Communication- Upward, Downward, horizontal, Diagonal) on-verbal Communication - Introduction; Body language- Personal Appearance, Postures, Gestures, Eye Contact, Facial expressions Paralinguistic Features-Rate, Pause, Volume, Pitch/Intonation/ Voice/ modulation Proxemics , Haptics, Artifactics, Chronemics	**4**
II.	**The Listening Process** Types of Listening – Superficial, Appreciative, Focused, Evaluative, Attentive, Emphatic, Listening with a Purpose , Barriers to Communication, Barriers to Listening	**4**
III.	**Focus on Oral Group Communication** Nature of group communication, Characteristics of successful Group Communication Selection of group discussion-subject knowledge, leadership skills, team management Group Discussion Strategies	**4**
IV	**Language Styles- Oral and Written Communication** Technical Style, ABC of technical communication- accuracy, using exact words and phrases, brevity, clarity, Objectivity of Technical Writing - Impersonal language, Objectivity in professional speaking.	**4**
TOTAL		**16**

Textbooks:

1. Rizvi, M. Ashraf. (2018). *Effective Technical Communication* (11 reprint). New Delhi: Tata McGraw Hill.

Reference Books:

1. Koneru, Aruna.(2017) *Professional Communication*. New Delhi: Tata McGraw Hill ISBN-13: 978-0070660021
2. Hair, Dan O., Rubenstein, Hannah and Stewart, Rob. (2015).A *Pocket Guide to Public Speaking*. (5th edition). St. Martin's. ISBN-13:978-145767040.

AECC – 2 (1st Semester)

AECC-2/Subject Name: Behavioural Science - I
Subject Code: BHS982A102
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks** **Component B +C – Viva-Voce + Extempore speech = 40 Marks**

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand self-identity and identity crisis	**BT1**
CO 2	Understand self-esteem	**BT2**
CO 3	Have in depth knowledge of foundation of individual behaviour.	**BT3**
CO 4	Develop a life skill on Time management .	**BT4**
CO 5	Have an idea on barriers of communication	**BT4**

Course contents-

Modules	**Course Contents**	**Periods**
I	**Understanding Self** Understanding of Self ,What is self?, Components of Self-self identity, Identity crisis, Definition self confidence, self image, Johari Window, Self Esteem, High and Low Self-esteem, Erikson's model.	**4**
II	**Foundations of individual behavior** Personality- structure, determinants, personality traits, Perception- Perceptual Process, Attribution, Errors in perception, Stereotyping, Racial Profiling, Learning- Theories of learning.	**4**
III	**Managing self** Time management: Introduction-the 80:20, sense of time management, Three secrets of time management, Effective scheduling, Stress management, effects of stress, kinds of stress-sources of stress, Signs of stress, Stress management tips.	**4**

IV	**Behaviour and communication.** Behaviour as a barrier to Communication , ways to overcome the barriers, Non-verbal communication-body language (voluntary and involuntary body language) forms of body language, Interpreting body language	**4**
		16

Text books

1. Soft skills by Dr.K.Alex, S.Chand, 2019.
2. Organisationalbehaviour by S.P Robbins, Judge , Vohra 18th edition, 2020.

GE Paper: Biomolecules
Subject code: BCH152G101
GE-1/3
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (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 inter relations.

Course Outcomes

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Understand the role and importance of biomolecules in a living system	**BT1 &BT2**
CO 2	Apply the knowledge in analyzing their role in our day to day life at a chemical level with a biological perspective as well as hands on approach and laboratory techniques	**BT3&BT 4**

Course Contents

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

I	**Biomolecules in their cellular environment** The cellular basis of life, structure and function of a cell and its subcellular components (eukaryotes, prokaryotes); Physical properties and structure of water molecule, pH, Buffers, biological buffer systems (body fluids and their principal buffers)	**9**
II	**Amino Acid and Peptides** Introduction, general nature of aminoacids, classification of amino acids, importance of amino acids, modified and standard amino acids, physical and optical properties of aminoacids, ionization of amino acids, buffering of amino acids, peptide bond, biologically important peptides. Introduction to chromatography, separation of amino acid by paperchromatography	**9**
III	**Carbohydrate Chemistry** Introduction; Definition, classification and functions of carbohydrates, monosaccharides, disaccharides, polysaccharides, homo polysaccharides, hetero polysaccharides;	**9**
IV	Chemistry of Lipids Introduction; Definition, classification and functions of lipids; Fatty acids; Essential fatty; acids; Reactions of lipids; Triacylglycerol or neutral fat; phospholipids, glycolipids; cholesterol; Eicosaanoids; prosatglandins; lipoprotein 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, effect of acid and alkali on DNA**.**	**9**
Total		**36**

Text books:

1. Devlin,T.M.,(2016).TextbookofBiochemistrywithClinicalCorrelations.JohnWiley & Sons, Inc. (New York). ISBN:978-0-4710-28173-4.
2. Nelson, D.L. and Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7^{th} ed.).W.H. Freeman & Company (New York), ISBN:13: 9781464126116 / ISBN:10-1464126119.

Reference books:

1. Biochemistry Ed. Donald Voet& Judith G. Voet, 4^{th}Edn. John Wiley & Sons, Inc.(2012).

GE Paper: Immunity and health
Subject code: BCH152G102
GE-2/6
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives

The course will provide the basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, and the molecular events leading to autoimmunity

Course Outcomes

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Demonstrate the basic knowledge of immunological processes at a cellular and molecular level.	**BT1**
CO 2	Compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they are related.	**BT2**
CO 3	Acknowledge the genetic basis for immunological diversity and the generation of immune responses, and molecular basis of allergic and inflammatory responses.	**BT3**
CO 4	Explain the basis of immunological tolerance, autoimmunity and transplantation and immune dysregulation in various disorders .	**BT4**

Course contents

Modules	**Topics / Course content**	**Periods/Hrs**
I	Immunity, Innate Immunity: Elements of innate immunity; Physical barriers, chemical mediator, complement proteins, cytokines, pattern recognition molecule, inflammatory barriers. Adaptive immunity: Adaptive response of adaptive immunity.	**9**
II	Cells and organs of the immune system Cells: Lymphocytes, Natural killer cells, Granulocytes, Monocytes, Dendritic cells. Organs: Lymphatic organs, Bone marrow, Thymus, Secondary lymphoid organs/tissues, spleen, lymph nodes, MALT.	**9**
III	Antigens: Requirements for immunogenicity. Haptens, Antigen antibody interactions, affinity and avidity, cross reactivity, factors affecting antigen antibody reaction. Adjuvants. Immunoglobulin: Structure. Action of antibody. Antigenic determinants.	**9**
IV	Autoimmunity. Auto immune disease, Transplantation. Immunodeficiency disease: SCID, Chediak-Higashi syndrome, Digeorge syndrome. Vaccines.	**9**
Total		**36**

Text Books:

1. Kuby Immunology; Oven, Punt, Stranford, 8thEdn. W. H. Freeman (2018).
2. Roitt's Essential Immunology; Ivan, M. Rohitt&Petrer J Delves 13th (2011) Blackwell Science.

Reference books:

1. Immunology: Roitt et al., Mosby, 13th edition, 2017.
2. Immune System; M. C. Connel et al., Eds. (1981) Blackwell Science.
3. Immunology at a Glance: J.H.L. Playfare [ed.] Blackwell Science, 10th edition, 2012.

SYLLABUS 2ndSEMESTER

CORE PAPER : Proteins and enzymes
Subject Code: BCH152C201
L-T-P-C: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (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 and BT 2**
CO 2	Discuss and interpret core concepts of enzyme kinetics and activity	**BT2 and 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	Topics / 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.	12
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.	12
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 inhibitionReversible (competitive, uncompetitive, non-competitive) and irreversible inhibition.Mechanism based inhibitors.	12
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 cleavagezymogen. Multienzyme complex. Coenzymes.	12
	Total	48

Text Books:

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.

SYLLABUS 2nd SEMESTER

CORE PAPER : Membrane Biology & Bioenergetics
Subject Code: BCH152C202
L-T-P-C: 3-1-0-4
Scheme of Evaluation: Theory (T)

Course Objective: The objective of the course is to provide students with the basic understanding of membrane composition, structure-function relationship, properties of membranes, and concepts of bioenergetics.

Course Outcome:

On Successful Completion of the course the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Summarize and appraise theorganizational and functional details of cell membrane, bioenergetics, membrane transport and photophosphorylation	**BT2 and BT 4**
CO 2	Apply their ideas on membrane dynamics and membrane transport proteins by employing the knowledge of various membrane dynamics techniques	**BT2**
CO 3	Analyze various physiochemical observations which are one or other way related to membrane receptor.	**BT 4**
CO 4	Recall the laws of thermodynamics and relate it to the bioenergetics of oxidative- and photo- phosphorylation	**BT 1 and BT3**

Course Content

Modules	**Course content**	**Periods**
I	Membrane composition and structure Membrane structures: Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture. Membrane dynamics: Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labelling etc.	**12**

	Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity	
II	Membrane transport: Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins. Ionophores - valinomycin, gramicidin. Vesicular transport and membrane fusion: Types of vesicle transport and their function. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin.	**12**
III	Introduction to bioenergetics: Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers. Oxidative phosphorylation: Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation.	**12**
IV	Photophosphorylation General features of photophosphorylation, historical background, Hills reaction, and photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.	**12**
	Total	**48**

Text Books:

1. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M. 4th Edition, 2004, WH

Freeman and Company, New York, USA., 7th edition2017

2. Metzler, D.E., Biochemistry - The Chemical Reactions of Living Cells, Vol. I &II,Elsevier (2002).

References:

1. Berg, J. M., Tymoczko, J. L. and Stryer.,Biochemistry,, W.H Freemanand Co., 9th edition,2019
2. Buchanan, B., Gruissem, W. and Jones, R., Biochemistry and Molecular Biology of Plants, American Society of Plant Biologists, USA., 2nd edition,2015
3. Jain, J.L., Jain, S. and Jain, N., Fundamentals of Biochemistry, S. Chand and Company Ltd. (2005).
4. Glaser, R, Biophysics, Springer(2004).

SYLLABUS 2ndSEMESTER

CORE PAPER : Proteins and Enzyme Practical
Subject Code: BCH152C213
L-T-P-C: 0-0-8-4
STUDENT'S SCHEME OF EVALUATION: PRACTICAL PAPER (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	Applyand translatethe knowledge in basic research projects, biomedical research, clinical applications, industrial applications, etc.	**BT2 and BT 3**
CO 4	Analyzeand criticizethe working principles, significance of practical results	**BT 4**

Course Content

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

I	1. Qualitative tests for amino acids 2. Qualitative tests for proteins 3. Estimation of proteins using UV absorbance and Biuret method. 4. Estimation of proteins using Lowry/Bradford method.	**24**
II	1. Assay of salivary amylase 2. Effect of pH on enzyme activity 3. Effect of temperature on enzyme activity. 4. Determination of Km and Vmax using Lineweaver-Burk plot	**24**
III	**1.** SDS-PAGE analysis of protein. **2.** Separation of amino acids by paper chromatography	**24**
IV	1. Separation of photosynthetic pigments by TLC. 2. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.	**24**
	Total	**96**

Text books:

1. Practical Biochemisty – 3rdEdn. David Plummer.
2. Introductory Practical Biochemistry – S.K.Sawhney and RandhirSingh.

Reference books

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

SEC Paper: Food Adulteration
Subject Code:BCH152S211
Credit Units: 0-0-4-2
Scheme of Evaluation: Practical (P)

Course Objectives

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 and	**BT 1**
CO 2	Describe rules and regulations in relation to the control of food adulteration and power and activity of FSSAI	**BT 2**
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.	**BT 3 and BT 4**

Course contents-

Modules	**Topics / 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	**12**
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	**12**
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	**12**
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	**12**
	Total	**48**

Text books:

1. A laboratory manual on Food Adulteration, Shalini Sehgal, Wiley Publications, 2020, ISBN- 9389633230

2. Food adulteration and its detection, Jesse Park, Wentworth Press, ISBN-9781362422099

References books and websites-

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

AECC – 3 (2NDSEMESTER)

AECC-3/Subject Name: Communicative English- II: Conversation and Public Speaking
Subject Code: CEN982A201
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A = Written Examination = 30 Marks** **Component B + C = Viva-Voce + Extempore speech = 40 Marks**

Course Objective: The objective of the course is to give students a platform to enhance their speaking and conversational skills in English by engaging them in meaningful discussions and interactive activities.

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Illustrate an improved speaking skill.	**BT 3**
CO 2	Demonstrate a life skill on conversation.	**BT 3**
CO 3	Express the skill of public speaking	**BT 2**

Detailed Syllabus:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	**Speaking Skills** Speaking – The Art of Speaking, Goals, Speaking Styles, The Speaking Process Importance of Oral Communication, Choosing the form of Communication, Principles & Guidelines of Successful Oral	**4**

	Communication, Barriers to Effective Oral Communication Three aspects of Oral Communication – Conversing, Listening and Body Language Intercultural Oral Communication	
II.	**Conversational Skills : Listening and Persuasive Speaking** Conversation – Types of Conversation, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, Telephonic Conversation and Etiquette Dialogue Writing, Conversation Control	**4**
III.	**Transactional Analysis** The Role of Intonation , Strokes, Psychological Characteristics of Ego States (The Parent, The Adult, The Child), Structure and Aspects of Human Personality Analysing Transactions – Complementary Transactions, Crossed Transactions, Duplex or Ulterior Transactions, How to Identify the Ego States of Interacting Individuals, How to Manage Conversations, Structural Analysis, Certain Habits of Ineffective Conversationalists	**4**
IV	**Public Speaking** Business Presentation and Speeches – Difference Elements of a Good Speech – Planning, Occasion, Audience, Purpose, Thesis, Material Organising and Outlining a Speech Outline, Types of Delivery Guidelines for Delivery – Verbal Elements, Non-Verbal Elements, Vocal Elements, Visual Elements, Controlling Nervousness and Stage Fright	**4**
TOTAL		**16**

Text books-

1. Mehra, Payal. (2022). *Business Communication for Managers*: Dorling Kindersley (India) Pvt. Ltd. Page 75 – 83. ISBN 978-81-317-5865-6
2. Raman, Meenakshi and Singh, Prakash.(2012). *Business Communication* (2nd Edition): Oxford University Press. Page 123 – 165.ISBN-13:978-0-19-807705-03

Reference Books:

1. Raman, Meenakshi and Sharma, Sangeeta. (2011). *Technical Communication: Principles and Practice* (2nd Edition): Oxford University Press. Page 137 – 148 ISBN-13:978-0-19-806529-6
2. Sengupta, Sailesh.(2011) *Business and Managerial Communication.* New Delhi *: PHI Learning Pvt. Ltd*. Page 136-153.ISBN-978-81-203-4435-8

AECC-4 (2nd Semester)

AECC-4/Subject Name: Behavioural Science - II
Subject Code: BHS982A202
L-T-P-C – 1-0-0-1

Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks** **Component B +C – Viva-Voce + Extempore speech = 40 Marks**

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Express the understanding of culture and personality	**BT 2**
CO 2	Recognize Value.	**BT 1**
CO 3	Demonstrate leadership.	**BT 3**
CO 4	Practice a life skill on motivation	**BT 3**

Course contents-

Modules	**Course Contents**	**Periods**
I	**Culture and Personality** Relation Between Culture and Personality with Relevant Examples, Cultural Iceberg, Overview of Hofstede's Framework, Discussion of the four dimensions of Hofstede's Framework.	**4**
II	**Attitudes and Values** Attitude's definition: changing our own attitudes, Process of cognitive dissonance Types of Values, Value conflicts, Merging personal and Organisational values, changes of values with time, male & female values differences.	**4**
III	**Leadership** Definition of leadership, types of leadership, Leadership Continuum Transformational & transactional Leadership, Ethical Leadership.	**4**
IV	**Motivation** Definition of motivation with example, Theories of Motivation (Maslow & X and Y) Applications of motivation.	**4**
		16

Text books:

1. Organizational Behaviour by Kavita Singh (Vikas publishers, 3rd Edition).
2. Organisationalbehaviour by S.P Robbins, Judge , Vohra 18th Ed.

GE PAPER: Intermediatory Metabolism
Subject code: BCH152G102
GE-3
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives

The objective of this course is to provide the students an understanding of the major metabolic pathways associated with biomolecules within a cell and their regulation. It will also provide knowledge about the possible correlation between various metabolic pathways.

Course outcomes

On Successful Completion of the course the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Memorize and summarize** about metabolic pathways of various biomolecules and their regulation.	**BT1 and BT2**
CO 2	**Sketch** how these pathways are **related** to each other to maintain tissue homeostasis	**BT3 and BT 4**
CO 3	**Apply** the knowledge of the metabolic pathwaysto **demonstrate**how a compromised functioning of the participating substrate and enzyme molecules and/or defects in their concentrationmay lead to several disorders.	**BT 2**
CO 4	**Examine** the observations which could help students plan targeted therapeutic approach to treat metabolic diseases specially those related to lipid, protein, nucleic acid and carbohydrate metabolism	**BT 4**

Course contents

Modules	**Topics / Course content**	**Periods/Hrs**
I	**Glycolysis and gluconeogenesis** Nature of metabolism. Role of oxidation and reduction and coupling of these. ATP as energy currency. Glycolysis a universal pathway, fructose and galactose oxidation, anaerobic glycolysis, fermentation, gluconeogenesis, reciprocal regulation of glycolysis and gluconeogenesis. Pentose phosphate pathway, importance of various pathways and their regulation	**9**

II	**Citric acid cycle and oxidative phosphorylation** Pyruvate dehydrogenase complex, oxidation of acetyl CoA, amphibolic role, regulation and glyoxylate pathway. The respiratory chain in mitochondria, proton gradient powering ATP synthesis, glycerol-3-phosphate and malate-aspartate shuttle, regulation of oxidative phosphorylation.	**9**
III	**Glycogen metabolism** Glycogenolysis, phosphorylase regulation, role of epinephrine and glucagon for glycogenolysis, glycogenesis; reciprocal regulation of glycogenesis and glycogenolysis. Diseases associated with the abnormal carbohydrate metabolism.	**9**
IV	**Fatty acid and amino acid degradation** TAG as energy source, β oxidation of fatty acids in mitochondria and peroxisomes, ketone bodies. Fatty acids activation, regulation of fatty acid oxidation, Protein degradation to amino acids, Role of essential and non-essential amino acids in growth and development. Protein caloriemalnutrition-Kwashiorkar and Marasmus,ureacycle,feeder pathways into TCA cycle. Nitrogen fixation. Diseases associated with the abnormal metabolism.	**9**
Total		**36**

Text books-

1. Berg, J.M., Tymoczko, J.L., Stryer L., (2019) Biochemistry, 9thedition., W.H. Freeman and Company (New York); ISBN:10:1-4292-2936-5,ISBN:13:978-1-4292-2936-4.
2. Campbell, M.K., Farrel, S.O. (2017) Biochemistry, 9thedition, S.O. Brooks/Cole, Cengage Learning (Boston); ISBN: 13:978-1-111-42564-7ISBN:10:1-4292-2936-5.

Reference books-

1. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M. 4th Edition, 2004, WH Freeman and Company, New York, USA., 7th edition2017

GE PAPER: Biochemical Applications in Forensics
Subject code: BCH152G202
GE-4/8
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objective

The course aims to provide an understanding of the applications of biochemistry in forensic sciences through analysis of evidences, which will help students develop analytical and problem-solving skills for real life situation. The course will keep abreast

with all recent developments and emerging trends in forensic science thus helping interested students takeup forensic science as future course of study.

Course Outcome:

On Successful Completion of the course the students will be able to:		
Sl. No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Outline the developments in the field of forensic sciences, learn to examine a crime scene for identification of relevant evidences and samples for forensic analysis.	**BT 1 and BT 4**
CO 2	Design the experiments related to crime investigation, operateanalytical instrumental techniques, collection, packaging and forwarding of print or pattern evidences and mathematical and statistical use in forensic science.	**BT 3 and BT 5**
CO 3	Employing the knowledge of biological and chemical sciences for routine forensic investigation like determination of time of death and toxicology studies.	**BT 3**
CO 4	Identifyingthe physiology and biochemistry behind tests like Narcoanalysis, polygraphy, lie detection and facial reconstruction for an unbiased interpretation of evidences.	**BT2 and BT 3**

Course contents

Modules	Course content	Periods
I	**Introduction to forensic sciences** Basic Principles and Significance; History and Development of Forensic Science; Defining the scene of investigation; Collection, Packaging, Labelling and Forwarding of biological exhibits to forensic laboratories; Preservation of biological evidence; Importance of Health and Safety Protocols in sample collection and analysis.	**9**
II	**Biological science and its application in investigation** Biochemical analysis of various biological evidences like blood, semen & other biological fluids, viscera, bite marks, hair (animal and human), fibers & fabrics, pollen and soil; Establishment of identity of individuals - fingerprints, footprints, blood and DNA analysis, anthropology – skeletal remains, Odontology; Time of death - rigor mortis, liver mortis, algor mortis, forensic entomology. Biochemical basis for determination of cause of death, case studies	**9**

III	**Chemical science and its application in investigation** Detection of drugs of abuse and narcotics in biological samples; Toxicological examination of viscera, detection of petroleum products, food adulteration; Analysis of inks and their use in questioned document identification, blood splatter analysis, stain analysis, case studies.	**9**
IV	**Recent advances in forensics** Narco analysis: theory, forensic significance, future prospect; Brain mapping: introduction, EEG, P-3000 wave, forensic applications, limitation of technique; Polygraph: Principle and technique, polygraph as forensic investigative tool, use of psychoactive drugs in forensic analysis. NHRC guidelines for polygraph test; Facial reconstruction: Method and technique, facial reconstruction in forensic identification; DNA Finger Printing; DNA-Introduction, source of DNA in Forensic casework, Extraction of DNA, Techniques of DNA fingerprinting- RFLP, STR, PCR. DNA fingerprinting in paternity disputes, mass disaster and other forensic case work, case studies.	**9**
Total		**36**

Text books:

1. James, S. H., Nordby, J. J. & Bell, S. (2014). Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition: Taylor & Francis. ISBN 9781439853832

2.Jones,P.,&Williams,R.E.(2020).CrimeSceneProcessingandLaboratoryWorkbook First Edition: CRC Press. ISBN9780429249976

Reference books:

1. Lee, H., Palmbach, T. & Miller, M. (2001). Henry Lee's crime scene handbook, First Edition: Academic Press ISBN 9780080507989

2.Parikh,C.K.(2016).Parikh'stextbookofmedicaljurisprudence,forensicmedicineand toxicology : for classrooms and courtrooms, Seventh Edition: CBS Publishers and Distributors. ISBN 9788123926469

3.Saferstein, R. (2018). Criminalistics: An Introduction to Forensic Science, Twelveth edition: Pearson Education. ISBN 10:0134477596, ISBN 13:9780134477596

4.Tewari, R. K., Sastry P. K., Ravikumar, K. V. (2002). Computer Crime and Computer Forensic, First Edition: Selective & Scientific Books

Veeraraghavan, V. (2009). Handbook of Forensic Psychology, First Edition: Selective& Scientific Books.

Semester III
CORE PAPER : Metabolism of Biomolecules
Subject Code:BCH152C301
L-T-P-C: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (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 thebasic concept of metabolism: catabolism and anabolism.	**BT1 & BT2**
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.	**BT3**
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.	**BT4**

Course content

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.	**12**

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).	**12**
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	**12**
IV	Biosynthesis and catabolism of purines and pyrimidine, Preliminery idea of De novo synthesis and Salvage pathway, Regulation and disease due to defect in nucleotide metabolism	**12**
	Total	**48**

Text Books:

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. Principles of Biochemistry, 4th Edition. Robert Horton H, Laurence A Moran, Gray Scrimgeour K (2006). Pearsarson Publisher. ISBN-13: 978-0321707338.
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.

CORE PAPER : Metabolism Practical
Subject Code: BCH152C312
L-T-P-C: 0-0-8-4
Scheme of evaluation: Practical (P)

Course Objectives

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.	**BT2**
CO 2	Understand how glucose, pyruvate, proteins, cholesterol, and neutral triacylglycerol levels can be measured in various samples, such as blood and urine.	**BT1**
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.	**BT3 & BT4**
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 content-

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**

Text Books:

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.

DSE PAPER: Bioanalytical Techniques

Subject code: BCH152D321

L-T-P-C: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objective: This course aims to introduce students to various techniques and their underlying principles utilized in biological research, emphasizing practical skills so that students may apply this information to increase their comprehension of the subject and execute these techniques more effectively.

Course Outcome:

On Successful Completion of the course, the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Learn and understand the principles and applications of spectrophotometry and fluorimetry.	**BT1 & BT2**
CO 2	Understand the fundamentals of several chromatographic procedures, such as gel filtration and ion exchange.	**BT2**
CO 3	Apply the knowledge of electrophoretic methods and principles in protein and nucleic acid analysis.	**BT3**
CO 4	Apply the principles of sedimentation and compare the various types of centrifuges and rotors.	**BT3 & BT4**

Course content:

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

I	Electrophoretic techniques: Principles of electrophoretic separation. Continuous, free, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, pulse field gel electrophoresis. Spectroscopy: Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry.	**12**
II	Chromatography: Principles of partition chromatography, paper, thin layer, ion exchange and affinity chromatography, gel permeation chromatography, HPLC, gas chromatography.	**12**
III	Centrifugation: Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra centrifugation, determination of molecular weights and other applications, sub cellular fractionation	**12**
IV	Electronmicroscopy:Light,electron(scanningandtransmission),phase contrast, fluorescence microscopy, freeze-fracture techniques, specific staining of organelles or markerenzymes.	**12**
Total		**48**

Text Books:

1. Principles and Techniques of Practical Biochemistry, Keith Wilson and John Walker, 7th Edition, 2010.
2. Physical Biochemistry, application to Biochemistry and Molecular Biology, David Freifelder, 10th Edition,2018.

Reference Books:

1. R. F. Boyer, Modern experimental biochemistry, Benjamin Cummings, San Francisco, 5th ed.,2016.
2. R. F. Boyer, Biochemistry laboratory: modern theory and techniques, Prentice Hall, Boston, 2nd ed.,2012.
3. D. Harvey, Modern analytical chemistry, McGraw-Hill, Boston, 2019.

DSE PAPER: Plant biochemistry
Subject code: BCH152D321
L-T-P-C: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

CourseObjectives

The course aims at providing deep understanding of metabolic processes in plants, plant

growth and development, and plant tissue culture.

Course Outcome:

On Successful Completion of the course, the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Memorize** and understand a plant cell's basic structures, organization, and physiological functions.	**BT1**
CO 2	**Understand** and distinguish carbon assimilation and the methods of carbon assimilation by C3, C4, and CAM plants, photosynthesis and respiration, nitrogen fixation and ammonia assimilation, plant hormones, and plant response against abiotic stresses.	**BT1 & BT2**
CO 3	**Apply** the knowledge in their basic plant research, development of new stress-resistant plant varieties, tissue culture, etc.	**BT3**
CO 4	**Analyze** the difference between C4 and CAM plants, structural differences between various secondary metabolites, and the role of various stresses on plant growths.	**BT4**

Course Contents

Module	Course Contents	Periods
I	**Introduction to plant cell structure andcarbonfixation:** Introduction to Plant cells, Plasma membrane, Vacuole and Tonoplast membrane, Cell wall, Plastids, and Peroxisomes. Photosynthesis and Carbon Assimilation. Structure of PSI and PSII complexes, Light reaction; Cyclic and non-cyclic photophosphorylation, Calvin cycle, and regulation; C4 cycle and Crassulacean acid metabolism (CAM), Photorespiration. Photoinhibition of photosynthesis, Photosynthetic carbon reduction (PCR) cycle, synthesis of polysaccharides in plants.	**12**
II	**Respiration:** Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across the mitochondrial membrane, TCA cycle, electron transport chain, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.	**12**
III	**Nitrogenmetabolism:** Biologicalnitrogenfixationbyfreelivingandinsymbioticassociation;Structureandfunction of the enzyme nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by glutamine synthetase- glutamine oxoglutarate aminotransferase (GS-GOGAT) pathway. Seed	**12**

	storage proteins in legumes and cereals.	
IV	**Regulation of plant growth andstressphysiology:** Introduction to plant hormones and their effect on plant growth and development, regulation of plant morphogenetic processes by light. Plant stress, Plant responses to abiotic and biotic stresses, Water deficit and drought resistance, Flooding, Temperature stress, Salt stress, Ion toxicity, Pollution stress, and potential biotic stress (insects and diseases).	**12**
Total		**48**

Text Books:

1. Principles Plant Physiology by Taiz, L. and Zeiger, E. (2015). (6^{th} ed.).
2. Buchann (2015). Biochemistry and Molecular Biology of the plant. (2^{nd} ed.).

Reference Books:

1. Caroline Bowsher, Martin Steer, Alyson Tobin (2015). Plant Biochemistry. Garland Science.
   Dey, P. M. and JB Harborne, JB, (Editors) (2013). Plant Biochemistry

GE Paper: Techniques of biochemistry
Subject code: BCH152G201
GE-5
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objectives

This course aims to introduce students to various techniques and their underlying principles utilized in biological research, emphasizing practical skills so that students may apply this information to increase their comprehension of the subject and execute these techniques more effectively.

Course Outcome:

On Successful Completion of the course, the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Learn and memorize the principles and applications of spectrophotometry and fluorimetry.	**BT1**
CO 2	Understand the fundamentals of several chromatographic procedures, such as gel filtration and ion exchange.	**BT1**
CO 3	Apply the knowledge of electrophoretic methods and principles in protein and nucleic acid analysis.	**BT3**

CO 4	Apply the principles of sedimentation and compare the various types of centrifuges and rotors.	**BT3**

Course Contents

Modules	**Course content**	**Periods**
I	Spectroscopic Techniques Electromagnetic radiation, interaction of radiation with biomolecules, principle of UV-visible absorption spectrophotometry, Lambert's Law, Beer's Law, working of a spectrophotometer. Applications of UV-visible absorption spectrophotometry in biochemistry. Fluorescence spectrophotometry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, applications of fluorescence in biochemistry	**9**
II	Chromatography Preparation of sample, different methods of cell lysis, salting out, dialysis. Introduction to chromatography. Different modes of chromatography: paper, thin layer and column. Preparativeandanalyticalapplications.Principlesandapplicationsof:Paper Chromatography, Thin Layer Chromatography, Ion Exchange Chromatography, Molecular Sieve Chromatography, AffinityChromatography.	**9**
III	Electrophoresis Basic Principle of electrophoresis, Paper electrophoresis, Gelelectrophoresis, discontinuous, electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels, agarose gel, electrophoresis, buffer systems in electrophoresis, electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification (staining procedures), molecular weight determination, isoelectric focusing of proteins.	**9**
IV	Centrifugation Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient. Various types of centrifuges, low speed centrifuge, high speed centrifuge and ultracentrifuge, types of rotors. Application of centrifugation, differential centrifugation, density gradient centrifugation- zonal and isopycnic.	**9**
Total		**36**

Text Books:

1. Boyer,R.F.(2012).BiochemistryLaboratory:ModernTheoryandTechniques(6th ed.). Boston, Mass: Prentice Hall. ISBN-13: 9780136043027.
2. An Introduction to Practical Biochemistry. (3rd ed.). Tata McGraw Hill Education Pvt. Ltd. (New Delhi). ISBN: 13: 9780070994874 / ISBN:10: 0070994870.

Reference Books:

1. Wiley, J.M., Sherwood, L.M., Woolverton, C.J. (2017). Prescott's Microbiology. (10th ed.). McGraw Hill Higher Education. ISBN13:9781259657573.
2. Cooper, T. G., (2011). The Tools of Biochemistry (2nd ed.). Wiley-Interscience Publication (New Delhi). ISBN: 13:9788126530168.
3. Freifelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology (2nded.). W.H. Freeman and Company (New York), ISBN: 0716713152 /ISBN:0716714442.

GE Paper: Immunity and health
Subject code: BCH152G102
GE-2/6
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives-
The course will provide the basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, and the molecular events leading to autoimmunity

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 knowledge of immunological processes at a cellular and molecular level.	**BT1**
CO 2	**Compare** and contrast the key mechanism ad cellular players of innate and adaptive immunity and their relation.	**BT4**
CO 3	Explain the genetic basis for immunological diversity, immune response generation, and the molecular basis of allergic and inflammatory response.	**BT2**
CO 4	Apply the acquired knowledge to understand immunological tolerance, autoimmunity, Transplantation, and immune dysregulation in various disorders.	**BT3**

Course contents

Modules	**Topics / Course content**	**Periods/Hrs**

I	Immunity, Innate Immunity: Elements of innate immunity; Physical barriers, chemical mediator, complement proteins, cytokines, pattern recognition molecule, inflammatory barriers. Adaptive immunity: Adaptive response of adaptive immunity.	9
II	Cells and organs of the immune system Cells: Lymphocytes, Natural killer cells, Granulocytes, Monocytes, Dendritic cells. Organs: Lymphatic organs, Bone marrow, Thymus, Secondary lymphoid organs/tissues, spleen, lymph nodes, MALT.	9
III	Antigens: Requirements for immunogenicity. Haptens, Antigen antibody interactions, affinity and avidity, cross reactivity, factors affecting antigen antibody reaction. Adjuvants. Immunoglobulin: Structure. Action of antibody. Antigenic determinants.	9
IV	Autoimmunity. Auto immune disease, Transplantation. Immunodeficiency disease: SCID, Chediak-Higashi syndrome, Digeorge syndrome. Vaccines.	9

Text Books:

1. Kuby Immunology; Oven, Punt, Stranford, 8thEdn. W. H. Freeman (2018).
2. Roitt's Essential Immunology; Ivan, M. Rohitt&Petrer J Delves 13th (2011) Blackwell Science.

Reference Books:

1. Immunology: Roitt et al., Mosby (2001).
2. Immune System; M. C. Connel et al., Eds. (1981) Blackwell Science.
3. Immunology at a Glance: J.H.L. Playfair [ed.] Blackwell Science.

SYLLABUS 4thSEMESTER

CORE PAPER I: Concepts in Genetics
Subject code: (BCH152C401)
L-T-P-C: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives

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 Mendels Principle of heredity, gene function and genetics in bacteria, Pedigree analysis, Linkage, crossing over, mapping techniques, and chromosomal aberrations	**BT1 & 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 & 3**
CO 3	Apply their knowledge in testing genetic hypothesis through statistical tools; finding recombinationfrequencies to determine gene order and distance; to build genetic mapping in eukaryotes.	**BT3**
CO 4	Analyze inheritance pattern, cytogenetics mapping, pedigree analysis and chromosomal aberrations.	**BT4**

Course contents:

Modules	**Topics / Course content**	**Periods**
I	**Mendel Principles of Heredity**- Basic principles of heredity, Mendel'slaws of segregation and independent assortment, test cross, expression and interaction of genes, complimentary genes and epistasis. Sutton and Boveri hypothesis. Multiple alleles and pleotropism	**10**
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 chromosome	**10**
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, generalized transduction and specialized transduction. Application of conjugation, transformation and transduction in mapping of genes.	**16**
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	**12**
	Total	**48**

Text books:

1. Genetics,Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore),ISBN: 978- 1-118-09242-2., 7th edition, 2015
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
3. Concepts of Genetics, Williams S Klug, Michael R Cummings, Charolette Spencer and Michael APalladino
4. Genetics, P.K. Gupta, Rastogi Publication • Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, PearsonEducation**Course Objectives**

CORE PAPER II : Genetics Practical
Subject Code: BCH152C412
L-T-P-C: 0-0-4-4
Scheme of evaluation: Practical (P)

Course objectives

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 outcomes

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.	**BT1 & 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 basics techniques to be undertaken while tackling them through genetic engineering	**BT 3**

CO 3	Analyse the online databases such as NCBI Nucleotide, primer designing sites which would help them in future application related to DNA.	**BT3 & 4**

Course contents:

Modules	Topics / Course content	No. of hrs
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**

Text Books:

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

DSE PAPER:CLINICAL BIOCHEMISTRY

SUBJECT CODE: BCH152D421

L-T-P-C = 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: Theory Papers (T)

Course objectives

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

Course Outcomes:

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.	**BT1**
CO 2	Identify and reviewthe various aspects clinical biochemistry, their implications in health, causes and implications of metabolic disorders and the biochemical basis of cancer.	**BT1 and BT2**
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	**BT3**
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**

Detailed Syllabus:

Modules	**Topics (if applicable) & Course Contents**	**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, Aminotic fluid, pH of blood, acid base equilibrium, sodium, potassium, chloride, bicarbonate.	**12**
II	**Inborn errors of metabolism:** Carbohydrate metabolism: galactosemia, Normal levels, renal threshold, Factors influencing blood glucose, Glycogen storage disorders,Pentosuria,Aminoacidmetabolism-alkaptonuria,maple syrup urine disease, phenylketonuria, homocystinuria,proteinuria, albinism, multiplemyeloma.	**12**

	Lipid metabolism: Hyperlipidemia,Hyperlipoproteinemia, Fatty liver. Nucleotide metabolism: Lesch-Nyhan Syndrome, Biochemistry of anemia, thalassemia, porphyria	
III	**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, **Diseases caused by chromosomal abnormalities-** Down, Turner and Klinefelter syndromes.	**12**
IV	**Cancer Biochemistry:** carcinogenesis, characteristicsofcancercell,agentspromotingcarcinogenesis Cellular differentiation,carcinogen, diagnosis of cancer, treatment ofcancer.	**12**
Total		**48**

Text Book:

1. Text book 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

DSE Paper: Microbiology

SUBJECT CODE: BCH152D421

L-T-P-C: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: Theory Papers (T)

Course objectives

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

Course Outcomes

On Successful Completion of the course the students will be able to:		
Sl. No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Identify the different types of microorganisms, their importance, and pathogenesis	**BT1**
CO 2	Distinguish the microbial diversity and physiology	**BT2**
CO 3	Apply their knowledge in exploring microbial growth under various situations	**BT3**
CO 4	Analyze the pathogenic characteristics of different microbes	**BT4**

Course contents:

Modules	**Topics / Course content**	**Periods**
I	**Historyof Microbiology** - History of development 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	**12**
II	**Diversity of Microbial world and Microbial Cell organization** Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms(Bacteria,Archaea,Algae,FungiandProtozoa)withemphasisondistribution, 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 cellmembranes.	**12**
III	**Microbial NutritionandGrowth** Nutritional types of microorganisms, growth factors, culture media-synthetic and complex, typesofmedia;isolationofpurecultures,growthcurves,meangrowthrateconstant,generation time; influence of environmental factors on growth of microbes: effect of pH, temperature, solute, oxygen concentration, pressure and radiations. Sterilization, disinfection and antiseptics.Useofphysicalmethods(heat,lowtemperature,filtration,radiation)andchemical agents (phenolics, halogens, heavy metals,	**12**

	sterilizing gases) in microbialcontrol.	
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.	**12**
Total		**48**

Text Books

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

References

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

SEC Paper: Biochemical analysis of Blood
Subject Code:BCH152S411
L-T-P-C: 0-0-4-2
Scheme of Evaluation: Practical (P)

Course Objective

The objective of this paper is understand various components of blood, disease related and various biomarkers and parameters of such diseases and their analysis

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Identify** the methods of determination of various blood groups, estimation of various molecules and clinical markers in serum or plasma.	**BT1**
CO 2	**Review** the significance of various clinical markers and working principle of their estimation methods.	**BT2**
CO 3	**Apply** their knowledge in conducting practical, basic research projects, biomedical research, and diagnosis etc.	**BT3**
CO 4	**Analyze** the results of various clinical parameters in normal and pathophysiological conditions.	**BT4**

Course contents

Modules	Topics / Course content	Periods
I	**Introduction of Blood** i. Blood cells; Hemoglobin; Blood groups; Coagulation Factors; Anemia & Immunoglobulins	12
II	**Haematology I** i. Collection and preservation of blood; ii. Normal values of important constituents of blood; iii. Serum and plasma preparation	12
III	**Haematology II** i. Basic Hematological Techniques: ii. Blood clotting time; iii. ABO group determination; iv. RBC count; v. WBC count; vi. Hemoglobin estimation	12
IV	**Biochemical Analysis of Blood** i. Biochemical test of Liver function; ii. Biochemical test of Kidney function; iii. Lipid profile test	12
	Total	48

Text Books

1. Textbook of *Pathology - Harsh Mohan* - 8th Edition, 2019
2. Manual Of Selected Biochemical Methods: As Applied To Urine, Blood And Gastric Analysis - Frank P Underhill - 4th Edition, 2007

Reference books-

1. The Chemistry of the Blood – MR DeHaan – 3rd Edition, 2015

GE Paper: Biochemical Correlations of Diseases
Subject code: BCH152G201
GE-7
L-T-P-C:3-0-0-3
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objectives

Objective of the course to introduce students to various diseases arising from imbalance inmetabolism and hormonal action, The course also be focusing on autoimmune diseases in human

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Outline and inferabout how hormonal and metabolic imbalance results in numerous health issue	**BT1 and BT2**
CO 2	Apply their understanding/concept on various health issues and available measure.	**BT3**
CO 3	Analyze the root cause of various diseases	**BT4**

Course Content

Modules	**Topics / Course content**	**Periods/Hrs**
I	**Inherited metabolic diseases** Alkaptonuria, Phenylketonuria, Glycogen storage diseases: Von Gierke, Cori and McArdle, Lipid storage diseases: Gauchers diseases, Niemann-Pick disease, SCID: Adenosine Deaminase deficiency	**9**
II	**Nutritional deficiency and life-style based diseases** Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes Mellitus-II, Inflammatory Bowel Disease (IBD).	**9**
III	**Hormonal imbalances** Hormonal imbalances leading to disease: Diabetes Insipidus, Acromegaly, Gigantism, Dwarfism, Goitre, Cretinism, Cushing and Conn's syndrome, Addison's disease.	**9**
IV	**Autoimmune diseases** Concepts in immune recognition-self and non-self-discrimination, organ specific autoimmune, diseases-Hashimoto's thyroiditis, Graves' disease, Myasthenia Gravis, Diabetes Melitus-I, Systemic diseases: Systemic lupus erythematosus (SLE), Rheumatoid arthritis.	**9**
Total		**36**

Text books:

1. Berg, J.M., Tymoczko, J. L., Stryer, L. (2019). Biochemistry (9th ed.). W.H Freeman and Company (New York)
2. Coico, R., Sunshine, G. (2018). Immunology: A Short Course (6th ed.). John Wiley & Sons, Inc (New Jersey). ISBN; 978-0-470-08158-7.

Reference Books:

1. Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations. John Willey & Sons, Inc. (New York). ISBN:978-0-4710-28173-4.
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

GE Paper: Biochemical Applications in Forensics
Subject code: BCH152G202
L-T-P-C: 3-0-0-3
GE-4/8
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objective

The course aims to provide an understanding of the applications of biochemistry in forensic sciences through analysis of evidences, which will help students develop analytical and problem-solving skills for real life situation. The course will keep abreast with all recent developments and emerging trends in forensic science thus helping interested students takeup forensic science as future course of study.

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Remember various topics related to the forensic science	**BT1**
CO 2	Comprehend the developments in the field of forensic sciences	**BT2**
CO 3	Apply their knowledge in observing a crime scene for identification of relevant evidences and samples for forensic analysis.	**BT3**
CO 4	Analyze the importance of collection, packaging and preservation of samples to ensure reliability of data generated.	**BT4**

Course contents

Modules	**Course content**	**Periods**
I	**Introduction to forensic sciences** Basic Principles and Significance; History and Development of Forensic Science; Defining the scene of investigation; Collection, Packaging, Labelling and Forwarding of biological exhibits to forensic laboratories; Preservation of biological evidence; Importance of Health and Safety Protocols in sample collection and analysis.	**9**

II	**Biological science and its application in investigation** Biochemical analysis of various biological evidences like blood, semen & other biological fluids, viscera, bite marks, hair (animal and human), fibers & fabrics, pollen and soil; Establishment of identity of individuals - fingerprints, footprints, blood and DNA analysis, anthropology – skeletal remains, Odontology; Time of death - rigor mortis, liver mortis, algor mortis, forensic entomology. Biochemical basis for determination of cause of death, case studies	**9**
III	**Chemical science and its application in investigation** Detection of drugs of abuse and narcotics in biological samples; Toxicological examination of viscera, detection of petroleum products, food adulteration; Analysis of inks and their use in questioned document identification, blood splatter analysis, stain analysis, case studies.	**9**
IV	**Recent advances in forensics** Narco analysis: theory, forensic significance, future prospect; Brain mapping: introduction, EEG, P-3000 wave, forensic applications, limitation of technique; Polygraph: Principle and technique, polygraph as forensic investigative tool, use of psychoactive drugs in forensic analysis. NHRC guidelines for polygraph test; Facial reconstruction: Method and technique, facial reconstruction in forensic identification; DNA Finger Printing; DNA-Introduction, source of DNA in Forensic casework, Extraction of DNA, Techniques of DNA fingerprinting- RFLP, STR, PCR. DNA fingerprinting in paternity disputes, mass disaster and other forensic case work, case studies.	**9**
Total		**36**

Text books:

1. James, S. H., Nordby, J. J. & Bell, S. (2014). Forensic Science: An Introduction to Scientific and Investigative Techniques, Fourth Edition: Taylor & Francis. ISBN 9781439853832
2. Jones,P.,&Williams,R.E. (2018).CrimeSceneProcessingandLaboratoryWorkbook First Edition: CRC Press. ISBN9780429249976

Reference Books:

1. Parikh,C.K.(2016).Parikh'stextbookofmedicaljurisprudence,forensicmedicineand toxicology : for classrooms and courtrooms, Seventh Edition: CBS Publishers and Distributors. ISBN 9788123926469
2. Saferstein, R. (2018). Criminalistics: An Introduction to Forensic Science, Twelveth edition: Pearson Education. ISBN 10:0134477596, ISBN 13:9780134477596
3. Tewari, R. K., Sastry P. K., Ravikumar, K. V. (2015). Computer Crime and Computer Forensic, First Edition: Selective & Scientific Books
4. Lee, H.,Palmbach, T. & Miller, M. (2016). Henry Lee's crime scene handbook, First Edition: Academic Press ISBN 9780080507989

SYLLABUS 5thSEMESTER

CORE PAPER I: Gene Organisation, Replication and Repair
Subject code: (BCH152C501)
Credit: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objectives

The objective of the course is to introduce to the students, the basic concepts of genome, DNA structure, genes, chromatin and chromosomes.

Course Outcomes:

On Successful Completion of the course the students will be able to:		
Sl. No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Identify the gene as a physical unit and recognize the structural elements of the chromosome.	**BT1**
CO 2	Describe the process of DNA replication and the various factors involved in regulating the process	**BT2**
CO 3	Distinguish the different types of DNA mutations and the gene expression systems	**BT2**
CO 4	Analyze the different types of DNA repair systems and their importance in living beings	**BT4**

Course contents

Modules	Course Contents	Period
I.	**Introduction to Genetic organization** Genes, chromosome and heredity, definition of a gene, Genome sequence and chromosome diversity, Nucleosome structure and packaging of DNA into higher order structures Coding and non-coding sequences, DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA.	12
II.	**DNA Replication** The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, relationship between replication and cell division, replication in eukaryotes, Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, helicases, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine	**14**
III.	**Mutations & Regulation of Gene Expression** Types of mutations - transition, transversions, frame shift mutations, Types of mutagens. Concept of gene expression in prokaryotes and eukaryotes, operons- inducible operon-Lac operon and repressible operon- Trp oreron	**12**

IV	**DNA repair** Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair.	**10**
	TOTAL	**48**

TEXT BOOKS:

1. Genetics,Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1- 118-09242-2., 7th edition,2015
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., 7th edition, 2019

References:

1. Genetics, M.W. Strickberger, Prentice Hall CollegeDivision, 3rd edition, 2015
2. Genetics, P.J. Russell, Benjamin/Cummings, 5th edition.
3. Principles of Genetics, E J Gardner, John Wiley & SonsInc. 8th edition, 2012
4. Genetics, R. Goodenough, International ThomsonPublishing, 2016
5. Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman andCompany, 2018
6. Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and SonsInc, 7th edition, 2015
7. Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison – Wiesley Publishin

CORE PAPER II : Gene Practical
Subject Code: BCH152C512
Credit Units: 0-0-8-4
Scheme of evaluation: Practical (P)

Course Objectives

The objective of the course is to introduce the students to online nucleotide sequence databases and to the basic knowledge/techniques of DNA-isolation, estimation, amplification, and electrophoretic separation.

Course outcome-

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

		Level
CO 1	**Recognize** the importance of different chemicals in DNA isolation	**BT1**
CO 2	**Distinguish** the different methods to isolate nucleic acids from different sources	**BT2**
CO 3	**Apply** their knowledge to conduct and execute experiments	**BT3**
CO 4	**Analyze** and explain the experimental results on the basis of critical analysis	**BT4**

Course contents-

Module	Course contents	Periods
I	1. Isolation of genomic DNA from plants/bacteria/yeast 2. Estimation of DNA using DPA method 3. Agarose gel electrophoresis of DNA	**24**
II	1. Isolation of plasmid DNA from bacteria 2. Agarose gel electrophoresis of plasmid DNA	**24**
III	1. Basic introduction to nucleotide database 2. Nucleotide sequence retrieval from database 3. Designing of Primer for PCR	**24**
IV	1. Amplification of DNA using PCR 2. Agarose gel electrophoresis of PCR product	**24**
Total		**96**

Text books:

1. Advanced Methods in Molecular Biology and Biotechnology- A Practical Lab Manual. Auhtors: Khalid Z Masoodi, Sameena Maqbool Lone, and Rovidha Saba Rasool, 2018
2. Principles and Techniques of Biochemistry and in Molecular Biology. Keith Wilson and John Walker. 2020

Reference books-

1. Modern Experimental Biochemistry. 3rd Edition. Rodney Boyer
2. Principles and Techniques of Biochemistry and in Molecular Biology. Keith Wilson and John Walker

DSE Paper: Bioinformatics and Biostatistics
Subject code: BCH152D501/2
Credit: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives:
The course is aimed at introducing the application of bioinformatics and statistics in biology.

Course outcomes

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Define the basics of bioinformatics, protein structure visualization, genomics, proteomics, and statistical methods.	**BT1**
CO 2	Identify bioinformatics tools functioning, and the basis for using different statistical methods.	**BT 2**
CO 3	Analyse the bioinformatics tools and learn the hands on techniques	**BT3 & 4**
CO4	Evaluate the different bioinformatics tools and be able to utilize different statistical methods to deal with different types of data	**BT6**

Course contents-

Modules	**Topics / Course content**	**Periods**
I	**Introduction to Bioinformatics**- Computers in Biology, History of Bioinformatics, Databases in Bioinformatics-NCBI tools and data retrieval, Protein information sources- Protein data bank (PDB), UNIPROT, SWISSPROT, Gene database, nucleotide database, sequence retrieval tools, sequence analysis tools. Pathway databases- KEGG database, Reactome Pathway Database	**12**
II	**Basic applications of Bioinformatics**- BLAST, FASTA, pairwise sequence alignment, multiple sequence analysis, introduction to phylogenetic analysis, bioinformatics in drug discovery.	**12**
III	**Data processing:** Concepts of sample and population; sampling methods; tabulation and graphical representation of data; sources of error in measurement of data, theoretical distributions : binomial, poisson and normaldistribution**,** measures of central tendency (mean, median and mode), measures of asymmetry (skewness, kurtosis),and dispersion (standard deviation and standard error of the mean)	**12**
IV	**Statistical tools:** Basis of hypothesis testing: null hypothesis,errors in hypothesis testing, concept of p value and standard error; introduction to probability, difference between	

	parametric and non-parametric tests, Students t test, Chi square test, basic concept of Analysis of variance,correlation and regression	**12**
Total		**48**

Text Books-

1. Lesk A.M. (2013) Introduction to Bioinformatics. Fourth Edition. Oxford University Press.
2. Biostatistics: A Foundation for Analysis in the Health Sciences (2013) 10th ed., Daniel W.W., John Wiley and Sons Inc. ISBN-13: 978-1118302798 ISBN-10:1118302796

Reference books-

1. 1. Grohima M.M. (2010) Protein Bioinformatics. Elsevier Publications.
2. Ghosh Z. and Mallick B. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
3. ResearchMethodology:A Step by Step Guide for Beginners (2005) 2nded., Kumar R.,Pearson Education. ISBN:978-1-4129-6467-8.

Genetic Engineering and Biotechnology
Subject code: (BCH152D501/2)

Credit: 3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER

Course objectives
The objective of the course is to teach the basics of theoretical aspects of recombinant DNA technology and genetic engineering.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe the fundamental concepts of Genetic engineering	**BT1**
CO 2	Distinguish and explain the concepts of Recombinant DNA Technology, including genome organization, manipulation and cloning	**BT 2& 3**
CO 3	Demonstrate proficiency in applying the quantitative and analytical skills necessary for successful laboratory experiments	**BT 3 & 4**
CO4	Explain the experimental results on the basis of critic analysis	**BT 3 & 4**

Course Contents:

Modules	Topics / Course content	Periods
I	**Introduction to recombinant DNA technology-** Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA.	**12**
II	**Cloning vectors for prokaryotes and eukaryotes-** Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals. The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.	**12**
III	**Polymerase chain reaction and DNA sequencing-** Fundamentals of polymerase chain reaction, designing primers for PCR. Studying PCR products. Cloning PCR products. Real time PCR, DNA sequencing by Sanger's method, modifications based on Sanger's method. Automated DNA sequencing. Pyrosequencing.	**12**
IV	**Applications of genetic engineering in Biotechnology**- Site–directed mutagenesis and protein engineering. Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII. Recombinant vaccines. Gene therapy. Applications in agriculture - plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns.	**12**
	TOTAL	**48**

Text Book:

1. Molecular Biotechnology (4th Edition) ©2010 by Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten
2. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA. 7th edition, 2017

Reference books :

1. J.M. Berg, J.L. Tymoczko, L. Stryer. . Biochemistry,9thEdn.(2019) WH Freeman and Company, New York andEngland.
2. R. Verna.. Membrane Technology, Raven Press, New York.,USA.
3. H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell.. Molecular

Cell Biology,8th Edn. WH Freeman and Company, NY andEngland

4. H.R. Petty.. Molecular Biology of Membranes Structure and Function, Plenum Press, New York, USA andLondon.
5. D.F.H. Wallach.. Membrane Molecular Biology of Neoplastic Cells, (1975) Elsevier Scientific Publishing Company, Amsterdam, Oxford and New York.,USA.
6. R.R.C. New. Liposomes a Practical Approach, IRL Press, Oxford, New York., USA. And Tokyo.

Course Objectives

The objective of the course is to introduce the basic knowledge of gene transcription, translation, and its regulation in prokaryotes and eukaryotes.

DSE: Gene Expression and Regulation
Subject code: BCH152D501/2
Credit:3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Recognize various topics under biosynthesis of RNA, RNA splicing, protein synthesis and degradation, and regulation of gene expression.	**BT1**
CO 2	Recognize difference between DNA replication and transcription, the basics of prokaryotic and eukaryotic transcription, key features of the three classes of eukaryotic RNA polymerases, RNA processing, chemistry of splicing, salient features of genetic code, triplet nature, wobble in the anticodon	**BT2**
CO 3	Apply the knowledge of gene expression and regulation in their basic research projects, medical science, agriculture, industry, etc	**BT3**
CO4	Analyze the genetic differences, and molecular mechanisms regulating gene expression between eukaryotes and prokaryotes	**BT4**

Course contents:

Modules	Topics / Course content	Periods
I	**Biosynthesis of RNA in Prokaryotes & Eukaryotes**- RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters, identification of DNA binding sites by DNA foot printing, the three stages of RNA synthesis, initiation, elongation and termination, rho-dependent and rho- independent termination. Inhibitors of transcription. Comparison between prokaryotic and eukaryotic transcription. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their application.	12
II	**Genetic code and RNA splicing-** Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code, Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling, RNA editing.	**12**
III	**Biosynthesis, Targeting & Degradation of Proteins-** Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Post translational modifications, glycosylation, signal sequences for nuclear transport, bacterial signal sequences, import of proteins by receptor mediated endocytosis, specialized systems for protein degradation.	**12**
IV	**Regulation of gene expression in prokaryotes and Eukaryotes-** Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination. Heterochromatin, euchromatin, chromatin remodelling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of miRNA molecules, phosphorylation of nuclear transcription factors.	**12**
	Total	**48**

Text Book:

1. Brown, T. A. Gene Cloning and DNA analysis: an introduction. Blackwell Science,6th edition 2010.
2. Lewin B. Genes IX (2011) & Genes XII (2017), Jones & Bartlett Publ.

Reference books:

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.

3. Watson, J. D. et al. Molecular Biology of the Gene. Benjamin Cummings, 7th edition 2013

Course objectives- The students will be introduced to the role of genes in the development of various diseases. The course will further dwelve into the role of mitochondria in different diseases.

DSE Paper: Genes and Diseases
Subject code: BCH152D501/2
Credit:3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Recognize the effect of mutations on human health	**BT1**
CO 2	Distinguish between the various types of diseases and the different mechanisms that underlie their development	**BT2**
CO 3	Explain the role of different genes in the promotion of diseases	**BT3**
CO4	Distinguish the role of mitochondrial and nuclear genes in diseases.	**BT4**

Course contents:

Module	Topic	Period
1	**Inborn errors of metabolism**- Garrod's hypothesis of inborn errors of metabolism, Genetically based enzyme deficiencies in human- phenylketonuria, albinism, kartagener syndrome, tay-sachs disease, sickle cell anemia, cystic fibrosis- major genes involved and mechanisms	**12**
2	**Life style diseases**- Diabetes, major causes of	**12**

	diabetes, major genes involved in diabetes. Obesity, major genes involved in obesity. Cardiovascular diseases. Major underlying causes. Genes involved in CVD. Major lifestyle driven cancers- oral and esophageal cancer. Major genes associated with oral and esophageal cancer	
3	**Neurodegenerative diseases**- Dementia, definition and causes. Parkinson's and alzheimer's diseases- occurance, mechanisms, major genes involved in promoting the diseases.	**12**
4	**Mitochondrial genetic disorders**- Mitochondria, genes carried by mitochondrial DNA, occurance, mechanism of mitochondrial diseases like Leber hereditary optic neuropathy, mitochondrial encephalopathy, lactic acidosis.	**12**
TOTAL		**48**

Text Books-

1. 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

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

2. Clinical Biochemistry, 2nd Edn. W J Marshall, F I Biol and S K Bangert. Elsevier HealthMosby Saunders. United States of America. ISBN:9780443101861.

3. Biochemistry; Donald Voet, Judith G. Voet, 4th Edition, John Wiley and sons(2010).

SYLLABUS 6thSEMESTER

CORE PAPER I: Immunology
Subject code - BCH152C601
Credit: 3-1-0-4
Scheme of Evaluation: Theory (T)

Course Objectives:
The course will provide the basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, and the molecular events leading to autoimmunity.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Demonstrate the basic knowledge of immunological processes at a cellular and molecular level.	**BT3**
CO 2	Compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they are related	**BT4**
CO 3	Identify the genetic basis for immunological diversity and the generation of immune responses, and molecular basis of allergic and inflammatory responses	**BT2**
CO4	Relate the basis of immunological tolerance, autoimmunity and transplantation and immune dysregulation in various disorders	**BT4**

Course contents:

Modules	**Topics / Course content**	**Periods**
I	**Immune System and Innate Immunity-** Haematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response. Vaccines - active and passive immunization, types of vaccines.	**12**
II	**Immunogens and Antibody structure-** Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes, Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family.	**12**

III	**Complement system and MHC complex-** Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation	**12**
IV	**Auto immunity and Transplantation immunology-** Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites.	**12**
Total		**48**

Text Books:

1. Kuby Immunology; Oven, Punt, Stranford, 8thEdn. W. H. Freeman (2018).
2. Roitt's Essential Immunology; Ivan, M. Rohitt&Petrer J Delves 13th (2011) Blackwell Science.

Reference Books:

1. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
2. Basic and Clinical Immunology; Stites et al., [6thedn] (2011) Lange.
3. Veterinary Immunology: Ian R. Tizard, 10thEdn. I.R. Thomson press.
4. The Immune System. By Peter Parham 4thEdn. Publisher Garland publishing

CORE PAPER II: Immunology Practical
Subject code: BCH152C613
Credit:0-0-8-4
STUDENT'S SCHEME OF EVALUATION: PRACTICAL PAPER (P)

Course objectives
The course will provide the basic laboratory exposure to the students in the field of immunology

Course outcomes-

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

		Level
CO 1	Understand the basic immunology lab approaches	**BT1**
CO 2	Demonstrate the ability to use discipline specific research techniques	**BT3**
CO 3	Apply their skills to conduct and execute experiments	**BT3**
CO4	Explain the experimental results on the basis of critic analysis	**BT2**

Course contents:

Modules	Topics / Course content	No. of hrs
I	1. Separate serum from blood 2. Separate plasma from blood sample	**24**
II	1. Enzyme linked immune-sorbent assay (ELISA) (Demo) 2. To determine the blood groups of humans by A, B, O blood group system	**24**
III	1. Raising antibody and immunodiffusion assay 2. Quantitative immunoprobe assay of a suitable protein	**24**
IV	1. Single radial immunodiffusion assay 2. Ouchterlony double diffusion assay	**24**
Total		**96**

Text Books:

1. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press(2014).
2. Basic and Clinical Immunology; Stites et al., [6thedn] (2011)Lange.

Reference Books:

1. Kuby Immunology; Oven, Punt, Stranford, 8thEdn. W. H. Freeman (2018).
2. Veterinary Immunology: Ian R. Tizard, 10thEdn. I.R. Thomsonpress.
3. The Immune System. By Peter Parham 4thEdn. Publisher Garlandpublishing

DSE Paper: Nutritional Biochemistry
Subject code: BCH152D601/ 2/3
Credits:3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives

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

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe the basic concepts of nutritional biochemistry, biochemical basis and nutritional importance of macronutrients, biochemical mechanisms for the symptoms of vitamin deficiencies and excesses, and mineral macronutrients.	**BT1**
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**
CO 3	Analyze the difference between macronutrients and micronutrients	**BT4**

Course contents

Modules	Topics / Course content	Periods
I	**Introduction to Nutrition andEnergy Metabolism-** Defining nutrition, role of nutrients. Unit of energy, biological oxidation of foodstuff. Physiological energy value of foods, SDA. Measurement of energy expenditure, BMR and RMR- factors affecting BMR. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.	**12**
II	**Macronutrients**- Food sources of carbohydrates, Review functions of carbohydrates. Factors affecting Digestion, absorption and utilization. Glycemic index and glycemic load. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Dietary implications of fats and oils, MUFA, PUFA and SFA Factors affecting Digestion, absorption and utilization. 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. Digestion and absorption of proteins. Essential and Non essential amino acids.	**12**
III	**Micronutrients:Vitamins:** Vitamin A, D, E, K and dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. 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, Adsorption, Distribution, Metabolism and excretion (ADME); role in metabolism and deficiency disease. Biochemical basis for deficiencysymptoms.	**12**
IV	**Micro Minerals andtraceelements-** Calcium, Iron and Phosphorus- Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Iodine, Fluoride, Mg, Cu,Zn,Se,Manganese,Chromium,Molybdenum Distribution in the human body,Physiology, Function, deficiency,	**12**

	Toxicity and Source. Antinutrients- source, metabolism, role in health.	
	Total	**48**

Text Books

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 Freeman and Company, New York,USA

DSE PAPER: Microbial ecology
Subject code: (BCH152D601/2/3/)
Credits:3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives:
The objective of the course is to teach the basics of microbial ecology and their role in the ecology of the environment.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Recognize the different types of microbial flora	**BT1**
CO 2	Analyse the various food webs in the microbial world	**BT 4**
CO 3	Assess the role of microbes in maintaining soil health and agriculture yields.	**BT 6**
CO4	Relate the role of microbes in migitating environmental pollution	**BT 3**

Course contents

Modules	Topics / Course content	Periods
I	Whittaker's Five-kingdom and three-kingdom concept of living organisms (Generalcharacteristics of those groups); General features of Eubacteria and Archaebacteria(major difference with Eubacteria). Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats, Atmosphere: Aeromicroflora and dispersal of microbes, Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.	**12**
II	Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe),barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph. Different types of microorganisms in the air, aerosols, sampling techniques, airbornepathogens, techniques of room sterilization.	**12**
III	Physical and chemical characteristics of various soil types-different microbial groups in soil, method of study,. Rhizosphere, Phyllosphere. Brief account of microbial interactions - (symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism, and predation); Biological nitrogen fixation - symbiotic and asymbiotic; Root - nodule formation in legumes; Biogeochemical Cycles-Carbon, Nitrogen, Phosphorus, and Sulphur Cycles –role of micro organisms in the process, Microbes-mediated key events such as Nitrogen fixation, ammonification, nitrification, denitrification and nitrate, reduction.	**12**
IV	Principles of Coliform test - detection of faecal and non-faecalcoliform); IMViC test;Environmental application of microbes in waste management: Sources and types of solid waste and liquid waste, contribution of the microbial load,Methods of solid waste disposal(composting and sanitary landfill), Microbiological treatment of sewage andindustrial waste water: Composition and strength of sewage (BOD and COD), Primary,secondary (oxidation ponds, trickling filter, activated	**12**

	sludge process and septic tank) and tertiarysewage treatment. Major waterborne pathogens, diseases and mode of sterilization.	
	TOTAL	**48**

Textbooks:

1. Madigan M. T., Martinko J. M., Stahl D. A. and Clark D. P. (2017) Brock Biology of Microorganisms. 14th edition, Pearson.
2. Prescott L.M., Harley J.P. and Klein D.A. (2007) Principles of microbiology, Wm C. Brown Publ.

Reference books-

1. Tortora G.J. et al (2015) Microbiology: An Introduction, 12th edition. The Benjamin / Cummings Pub. Co., Inc
2. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA. 7th edition, 2017\
3. Subba Rao, NS. Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd
4. Rai A.N. (2017) Handbook of symbiotic cyanobacteria, CRC Press

DSE PAPER: Cancer Biology
Subject code: (BCH152D601/2/3/)
Credits:3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objectives:

The objective of the course is to introduce the students to the various molecular aspects of cancer.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe about the basics of cancer and the various genes affecting cancer	**BT1**
CO 2	Analyse the various factors resulting in cancer development	**BT 4**
CO 3	Interpret the roles of various molecular factors in the progression of cancer.	**BT 3**
CO4	Distinguish the efficacy of different methods of cancer treatment	**BT 2**

Course contents:

Modules	Topics / Course content	Periods
I	Fundamentals of Cancer: Definition and Classification of cancer; Cancer epidemiology: Global and Indian perspectives; Difference between cancer cells and normal cells; Morphological changes during transition from normal to cancerous state (hyperplasia, dysplasia etc.) ;Oncogenic viruses, types and mode of action.	**12**
II	Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.Common chemical carcinogens. Life style factors responsible for cancer ; Chromosomal instability and its role in cancer.Cell cycle regulation and Deregulation of cell cycle check point proteins.	**12**
III	Molecular basis of cancer:Oncogenes, proto-oncogenes and tumor-suppressive genes : functions with examples ; Role of P53; Apoptosis inhibition in cancer ; Oncogenic signal transduction pathways: Ras, c-Myc, Akt, Notch-1, TGF-β, EGFR etc. signaling in various cancers; Signal targets and cancer, activation of kinases; Growth factors related to transformation. Telomerases, definition and role in cancer.	**12**
IV	Cancer detection and therapy: Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.Different strategies of cancer treatment; Principle of Radiotherapy and application; Chemotherapy drugs, classification and example; Basis of immunotherapy and gene therapy. Probable mechanism of chemoresistance.	**12**
	TOTAL	**48**

TEXT BOOKS:

1. Weinberg, R.A. "The Biology of Cancer" Garland Science, 2013, ISBN- 978-0815342205
2. McDonald, F etal., " Molecular Biology of Cancer" IInd Edition. Taylor & Francis, 2004.

Reference books-

1. Devlin T. M. (2011) Textbook of Biochemistry with clinical correlations, Wiley-Liss Publ.
2. Hall, J.E. (2015), Guyton and Hall Textbook of Medical Physiology, Elsevier.
3. Litwack G. (2008) Human Biochemistry and Disease, Academic Press, Elsevier Inc.
4. Molecular biology of cancer: Mechanisms, Targets and therapeutics. Pecorino L, Oxford University Press, 2021, ISBN- 978-0198833024

DSE PAPER: Advanced Cell Biology
Subject code: (BCH152D601/2/3/)
Credits:3-1-0-4
STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objectives-
The objective of the course is to introduce the students into the workings of cellular organelles and their functioning.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe about the biogenesis of cellular organelles	**BT1**
CO 2	Distinguish the compartmentalization and biochemical regulation of different cellular processes	**BT 2**
CO 3	Analyze the various factors regulating cell division	**BT 3**
CO4	Interpret the various factors involved in cell death	**BT 4**

Course Contents

Modules	**Topics / Course content**	**Periods**
I	Biogenesis of Cellular organelles – Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.	**12**
II	**Targetting of proteins in cells-** Transport of proteins across nuclear envelope; Regulation of nuclear protein import and export. Overview of the endomembrane system; Targeting, modification and sorting of proteins from and into Endoplasmic Reticulum; Synthesis and targeting Mitochondrial protein; Chloroplast Proteins and Peroxisomal proteins; Mechanism of Vesicular Transport; Coat Proteins and Vesicle Budding; Vesicle Fusion; Targeting of Proteins	**12**
III	**Cell Division and its Regulation-** Overview of the cell cycle; Eukaryotic cell cycle regulation; proteins involved in regulation. Role of hormones and cellular environment in cell cycle regulation. Events of Mitotic Phase; Cytokinesis; Events of Meiosis And Fertilization; Regulation of	**12**

	Cell Division and Cell Growth	
IV	**Cell Death and its Regulation** Introduction to Apoptosis, autophagy and necrosis. Pathways of apoptosis and autophagy. Factors regulating cell death (nutrient status, external stress). Apoptosis and autophagy in relation with Cancer and cardiovascular diseases. Cell death pathways in Viral disease (AIDS) & Organ transplant.	**12**
Total		**48**

Text Books:

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.The Cell: A Molecular Approach. (7th ed.) by Cooper, G.M. and Hausman, R.E., (2009)
2.Cell and Molecular Biology: Concepts and Experiments (8th ed.) by Karp, G., (2010).
3.The World of the cell (7th ed.) by Kleinsmith, L. J., Hardin, H., Wayne G., Becker, M. (2009).

DSE PAPER: Virology
Subject code: (BCH152D601/2/3/)
Credits: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course Objectives:

The Course aims to enable the students to understand the basics of learning virology and to impart knowledge on the implications of human viral diseases and newer emerging viral infections.

Course outcomes-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Define the basics of Virology	**BT1**
CO 2	Recognise the classification and the diversity of viral genomes	**BT 1**
CO 3	Describe the various replication strategies employed by DNA and RNA	**BT 2 & 3**

	viruses	
CO4	Analyse anti-viral therapies and the patterns of emergence of new epidemics	**BT3**

Course contents:

Modules	Topics / Course content	Periods
I	General perspectives: History and Origin: the development of the concept of viruses as living and nonliving entities. General characteristics of viruses: What are viruses? Difference between bacteria and viruses, Components of viruses, sizes, and shapes of different viruses (describe with at least one example).	**12**
II	Classification of viruses based on the nucleic acid content: DNA (dsDNA, ssDNA) and RNA (ssRNA, dsRNA) viruses with examples. Human cancer viruses (SV40, HTLV - 1 & 2, Epstein-Barr virus only) Virus-like agents: viroids & prions.	**12**
III	Viral replication: General characteristics of replication, Replication of T4 phage. Phage growth and the estimation of phage numbers. The lytic and lysogenic life cycle of bacteriophage lambda; mechanism(s) that determines lytic and lysogenic life cycle. Reverse transcription and integration by Retroviruses.	**12**
IV	Viral pathogenesis and cell transformation by viruses. Viral vaccines, Antiviral therapy. The emergence of new viruses and Current viral epidemics with emphasis on SARS-Cov2 and H1N1 Swine Flu, Viral vectors, and gene therapy.	**12**
	TOTAL	**48**

Text Books:

1. Principles of Virology – S J Flints, L W Enquist, R M Krug, V R Racaniello, A M Skalka. ASM Press. 5th edition, 2020
2. Field Virology – David M. Knipe, Peter M. Howley, Diane E. Griffin, Robert A. Lamb, Malcolm A. Martin, Bernard Roizman, Stephen E. Straus.7th edition, 2020

Reference Books:

1. Principles of Molecular Virology – Alan J Cann. 7th edition 2023
2. Virology: Principles and Applications – J Carter, V Saunders, 2nd edition, 2013

DSE Paper: Human Physiology
Subject code: (BCH152D601/2/3/)
Credits: 3-1-0-4

STUDENT'S SCHEME OF EVALUATION: THEORY PAPER (T)

Course objective-

The course is aimed at introducing students to the basics of human physiology and into the functioning of the different organ systems and the co-ordination between them.

Course objectives-

On Successful Completion of the course the students will be able to:		
Sl No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe and comprehend the mechanistic insights and the hormonal regulation of processes like digestion, respiration etc	**BT2**
CO 2	Distinguish the various components of blood and the cardiovascular system.	**BT 2**
CO 3	Explain renal physiology, urine formation, and blood pressure regulation.	**BT2**
CO4	Analyze idea about the neuroendocrine system and relate the gained knowledge in understanding control and co-ordination.	**BT 4**

Course contents

Module	**Topics/Course Contents**	**Periods**
I	**Anatomy and Physiology of Digestive and Respiratory System** Anatomy of Human Digestive System, Physiology of mechanical and chemical digestion of food along the gastrointestinal tract and its accessory organs; Absorption of carbohydrates, proteins, lipids. Hormonal control of secretion of enzymes in Gastro-intestinal tract. Disorders of the digestive system. Functional Anatomy of the lung, mechanisms of respiration: pulmonary ventilation and alveolar ventilation, gaseous exchange, transport of gases in blood, body fluid and electrolyte balance. Disorders of respiratory system.	**12**
II	**Physiology of Circulatory System** Blood-Formed and Fluid components of Blood, Blood Grouping: ABO, MN and Rh Factor, Function of circulatory system in transport of Gases- role of Haemoglobin, Blood Coagulation, Circulatory Pathways, Human Circulatory System, Structure and functioning of Human Heart, Cardiac Cycle, Regulation of Cardiac cycle, ECG, Lymph and Lymphatic System, Disorders of Blood and Circulatory	**12**

	System- Hypertension, Anaemia, Haemophilia, Heart attack, Cardiac arrest etc.	
III	**Human Renal Physiology** Functional Anatomy of Human kidney, function and histology of nephron, Urine formation (glomerular filtration and tubular re-absorption), renal regulation of urine volume and osmolarity, acid-base balance, structure of urinary bladder and micturition. Disorders of the renal system.	**12**
IV	**Human Neuroendocrine System** Human nervous system- Central and Peripheral Nervous System, Origin of resting membrane potential and action potential, electrophysiology of ion channels. Conduction of nerve impulse and its propagation in myelinated and non-myelinated nerve fibres, Synapses and synaptic transmission, Neurotransmitters, reflex action. Endocrine glands- Hypothalamus-pituitary axis; structure and function of pineal, thyroid, parathyroid, adrenal glands, pancreas; hormones secreted by them, their mode of action and regulation. Classification of hormones; Signal transduction pathways for steroidal- and non-steroidal hormones.	**12**
Total		**48**

Text Books:

1. Hall, J. E. (2015). Guyton and hall textbook of medical physiology (13th ed.). W B Saunder
2. Lehninger Principles of Biochemistry, Nelson, D.L., Cox, M.M., WH Freeman and Company, New York, USA. 7th edition, 2017

Reference books:

1. The Cell: A Molecular Approach. (7th ed.) by Cooper, G.M. and Hausman, R.E., (2009)
2. The World of the cell (7th ed.) by Kleinsmith, L. J., Hardin, H., Wayne G., Becker, M. (2009).
3. Ross and Wilson. Anatomy and Physiology in Health and Illness (14th Edition) (International Edition). Oswald Books and Learning.
4. Molecular Cell Biology; Lodish et al., 9th edition, 2021. W.H. Freeman and Co.

Paper SC4: Working with proteins

Subject Code: BCH152S621

L-T-P-C:0-0-4-2

STUDENT'S SCHEME OF EVALUATION: (P)

Course objectives

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	Recognize the biochemistry behind protein isolation	**BT1**
CO 2	Distinguish the differences in isolating proteins from different sources.	**BT 2**
CO 3	Analyse the importance of transferring proteins from gel to the membrane	**BT4**
CO4	Compare the different amino acid functional groups in the protein.	**BT 4**

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. Seperation of proteins using 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**

Text books-

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.