DEPARTMENT OF BIOCHEMISTRY

(DST-FIST Sponsored Department)

BHARATHIDASAN UNIVERSITY

(NAAC Re-accredited with Grade A^+)

SCHOOL OF LIFE SCIENCES

BHARATHIDASAN UNIVERSITY

TIRUCHIRAPPALLI 620-024

SYLLABI AND COURSE OF STUDY FOR

M.Sc. DEGREE PROGRAMME IN BIOCHEMISTRY

(Semester Pattern – Autonomous)

BASED ON CHOICE BASED CREDIT SYSTEM

Effective from 2021 - 2022 onwards

PROGRAMME OUTCOMES

PO1	• PG Gradaunds are Professionally Competent with characteristic **Knowledge-bank, Skill-set, Mind-set** and **Pragmatic Wisdom** in their chosen fields.
PO2	• PG Gradaunds demonstrate the desired sense of being **seasoned** and exhibit unequivocal **Spiritedness** with excellent qualities of productive contribution to **society** and **nation** in the arena of Science and Technology.
PO3	• PG Gradaunds are mentored such that they exert **Leadership Latitude** in their chosen fields with **commitment to novelty** and **distinction**.
PO4	• PG Graduates are directed in understanding of ethical principles and responsibilities, moral and social values in day-to-day life thereby attaining **Cultural** and **Civilized** personality.
PO5	• PG Graduates are able to Collate the information from different kinds of sources and gain a coherent understanding of the subject.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	• The course aims at gaining an understanding of the processes of metabolic transformation at the molecular level and how these processes are studied.
PSO2	• It is important to study enzymes, the rate limiting molecule of all the chemical reactions and understanding enzymes could pave research ideas.
PSO3	• Students can make the Knowledge of the relationship between structure and function at organ and/or organism level, of important cell biological communication principles and processes, and how they are regulated.
PSO4	• Students are able to Characterize certain functionalities of biomolecules by using spectroscopic technique
PSO5	• Students will gain conceptual understanding of subject matter, scientific reasoning skills, laboratory manipulative skills.
PSO6	• It is important to study enzymes, the rate limiting molecule of all the chemical reactions and understanding enzymes could pave research ideas.
PSO7	• The course aims to give participants a basic knowledge of mechanisms of signal transduction and the significance of signal transduction in physiology and pathophysiology.
PSO8	• Students can understand the capacity to evaluate and synthesize information from a wide range of sources in order to communicate ideas, concepts and construct arguments in both non-scientific and scientific language.

REGULATIONS

I. Name of the Program

Bharathidasan University is offering a two-year M.Sc. Degree Program in Biochemistry to be conducted in the Department of Biochemistry, School of Life Sciences, Bharathidasan University.

II. Eligibility for Admission to the Program

A pass in B.Sc. with Biochemistry / Biotechnology / Microbiology / Molecular Biology / Biology / Agriculture / Life Sciences / Botany / Zoology / Food Science & Nutrition / Chemistry from any recognized university in India or abroad.

III. Duration of the Program

The Program is for a period of two years. Each year shall consist of two semesters, viz. Odd and Even semesters. Odd semester shall be from June/July to October/November and Even semester shall be from November/December to April/May. There shall be not less than 90 working days which shall comprise 450 teaching clock hours for each semester (exclusive of the days for the conduct of university end-semester examinations).

IV. Course

Each Course is designed with lectures/tutorials/laboratory/seminar/ practical training/assignments/term paper or report writing etc., to meet effective teaching and learning requirements.

V. Semesters

In each semester, Courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examinations and evaluation purposes. Each week shall have 30 working hours spread over 5/6 days a week.

VI. Credits

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. For instance, a six-hour Course is assigned

four to six credits, four/five-hour Course is assigned three to five credits. However, in no instance the credits of a Course can be greater than the hours allotted to it. The total minimum credits required for awarding M.Sc. Biochemistry is 90.

VII. Condonation

Students must have 75% of attendance in each semester to appear for the examination. Students who have attendance between 65% and 74% shall apply for condonation in the prescribed form with the prescribed fee. Students who have attendance between 50% and 64% shall apply for condonation in prescribed form with the prescribed fee along with the Medical Certificate.

Students who have attendance below 50% are not eligible to appear for the examination. They shall re-do the semester(s) after completion of the Program (i.e. after 2 years).

VIII. Examinations

1. There shall be examinations at the end of each semester, for odd semesters in the month of October/November; for even semesters in April/May.
2. A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October/November or April/May. However, candidates who have arrears in Practical's shall be permitted to appear for their arrears in Practical examination only along with Regular Practical examination in the respective semester.
3. A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond the condonation limit/regulation prescribed OR belatedly joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the course.
4. Viva-voce: Each candidate shall be required to appear for the Viva-voce Examination in defense of the Project only.

IX. Project

Each candidate shall be required to take up a Project Work at fourth semester and submit it at the end of the final year. The candidate will be permitted to take up the project in recognized institutions in India and Abroad. The Head of the Department shall assign the Guide for those candidates who prefer to do their project work

within the department. A copy of the Project Report will be submitted to the Department through the Head of the Department on or before the date fixed by the Department. The Project will be evaluated by an internal and an external examiner nominated by the Head of the Department. The candidate concerned will have to defend his/her Project through a Viva-voce.

X. Question Paper Pattern

Section A: 10 Questions x 2 Marks = 20 Marks (Two questions from each unit)

Section B: 5 Questions x 5 Marks = 25 Marks (Internal Choice and one set of questions from each unit)

Section C: 3 Questions x 10 Marks = 30 Marks (Answer any three out of 5 questions and one question from each unit)

XI. Evaluation

The performance of a student in each Course is evaluated in terms of percentage of marks with a provision for conversion to grade points. Evaluation for each Course shall be done by a continuous internal assessment (CIA) by the Course teacher concerned as well as by an end semester examination and will be consolidated at the end of the semester. The components for continuous internal assessment are:

Theory (Internal)		**Practical (Internal)**	
Best 2 CIA out of 3 Marks	- 15 Marks	Continuous performance	- 10
Seminar	- 5 Marks	Model practical	- 5 Marks
Assignments	- 5 Marks	Record	- 5 Marks
	---	Viva	- 5 Marks
Total	25 Marks		---
	---		25 Marks

Attendance need not be taken as a component for continuous assessment, although the students should secure a minimum of 75% attendance in each semester. In addition to the continuous evaluation component, the end semester examination, which will be a written-type examination of at least 3 hours duration, would also form an integral component of the evaluation. The ratio of marks allotted to continuous internal assessment and to the end semester examination is 25:75. The evaluation of laboratory components, wherever applicable, will also be based on continuous internal assessment and on an end-semester practical examination with 25:75 ratio.

XII. Passing Minimum

A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the University Examinations and 40% marks in the CIA and not less than 50% in the aggregate, including CIA and University Examinations marks.

Candidates who have secured the pass marks in the end-semester Examination (U.E.) and in the CIA, but failed to secure the aggregate minimum pass mark (U.E. + C.I.A.) are allowed to secure an aggregate minimum pass mark by appearing for the University Examination only.

Candidates who have failed in the Internal Assessment are permitted to appear for their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and assignments.

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

XIII. Ranking: University Rank Examination

1. The University Rank Examination shall be conducted for the topper (First Ranker) of the university department along with all the colleges (topper having passed their examinations in the first appearance within the prescribed duration of the program) including autonomous / non-autonomous streams and they are required to write an examination. Absence from an examination shall not be taken as an attempt.
2. The question papers of the examinations comprise objective type questions covering the core courses of Biochemistry stream.
3. The top scorers in this University Rank Examination would be declared as University Rank Holders, irrespective of their grades in their respective University end semester examinations.

XIV. Grading System

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in Table 1.

From the second semester onwards the total performance within a semester and the continuous performance starting from the first semester are indicated by

Semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$$\text{GPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{WAM (Weighted Average Marks)} = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$$

where 'Ci' is the Credit earned for the Course i; 'Gi' is the Grade Point obtained by the student for the Course i . 'M' is the Marks obtained for the course i and 'n' is the number of Courses **passed** in that semester.

CGPA = Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

a) The classification of final results shall be based on the CGPA, as indicated in Table 2.

b) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as "Outstanding". Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective program as "Excellent", "Very Good", "Good", and "Above Average" respectively.

c) Absence from an examination shall not be taken as an attempt.

Table 1 Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	N.A.	R.A.

Table 2 Final Result

CGPA	Corresponding Grade	Classification of Final Results
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
below 5.00	R.A.	Re-Appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100)

DEPARTMENT OF BIOCHEMISTRY, BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI-24

M.Sc. Biochemistry Course Structure (2021-2022 onwards)

S. No	Semester	Category	Course Code	Course Title	Hrs/week	Credit
1	I	Core 1	BC101CR	Chemistry of Bio molecules	6	5
2		Core 2	BC102CR	Enzymology	6	5
3		Core 3	BC103CR	Analytical Biochemistry	6	5
4		Core 4	BC104CR	Laboratory Course-I	6	5
5		Value added course	*BC001VAC	Food Processing and Technology	3	0
6		@Elective	BC105DCE	Cell Biology	3	3
			BC106DCE	Research Methodology		
			BC107DCE	Developmental Biology		
			BC108DCE	Genetics		
			BC109DCE	General Microbiology		
				TOTAL	**30hrs/Week**	**23**
7	II	Core 5	BC201CR	Intermediary Metabolism	5	5
8		Core 6	BC202CR	Molecular Biology	5	5
9		Core 7	BC203CR	Biochemistry of Signal Transduction	5	5
10		Core 8	BC204CR	Laboratory Course-II	6	5
11		Value added Course	*BC002VAC	Detection methods of Food Adulteration	3	0

12		@Elective	BC205DCE	Chromatin and Epigenetics	3	3
			BC206DCE	Bioinformatics		
			BC207DCE	Molecular Endocrinology		
			BC208DCE	Ecology and Environmental Biology		
			BC209DCE	Human Physiology		
13		Non-Major Elective	#	Non-Major Elective 1	3	2
				TOTAL	**30hrs/Week**	**25**
14	III	Core 9	BC301CR	Immunology	5	5
15		Core 10	BC302CR	Genetic Engineering	5	5
16		Core 11	BC303CR	Clinical Biochemistry	5	5
17		Core 12	BC304CR	Laboratory Course-III	6	5
18		Value added Course	*BC003VAC	Value addition in Food	3	0
19		@Elective	BC305DCE	Bio-entrepreneurship	3	3
			BC306DCE	Genomics and Proteomics		
			BC307DCE	Reproductive Biology		
			BC308DCE	Concept in Neurochemistry		
			BC309DCE	Nutritional Biochemistry		
20		Non-Major Elective	#	Non-Major Elective 2	3	2
				TOTAL	**30hrs/Week**	**25**
21	IV	Core 13	BC401CR	Proposal writing	30	25

				Research based project Project Dissertation Project Viva-Voce		
				TOTAL	**30hrs/Week**	**25**
TOTAL CREDITS						**98**

***No credits will be awarded for Value Added Course**

@ Students will be offered one elective course based on their choice in each semester

 # Students have to choose Non-Major Elective papers offered by other departments

Courses offered under Choice Based Credit system in **M.Sc. BIOCHEMISTRY**

CORE COURSES (COMPULSORY 20 CREDITS EACH SEMESTER)

S.No	Course Code	Course Title	Hrs/week	Credit	Semester
1	BC101CR	**Chemistry of Biomolecules**	6	5	I
2	BC102CR	**Enzymology**	6	5	
3	BC103CR	**Analytical Biochemistry**	6	5	
4	BC104CR	**Laboratory Course-I**	6	5	
5	BC201CR	**Intermediary Metabolism**	5	5	II
6	BC202CR	**Molecular Biology**	5	5	
7	BC203CR	**Biochemistry of Signal Transduction**	5	5	
8	BC204CR	**Laboratory Course-II**	6	5	
9	BC301CR	**Immunology**	5	5	III
10	BC302CR	**Genetic Engineering**	5	5	
11	BC303CR	**Clinical Biochemistry**	5	5	
	BC304CR	**Laboratory Course-III**	6	5	
12	BC401CR	**Proposal Writing** **Research based project** **Project Dissertation** **Project Viva-Voce**	30	25	IV

Discipline Centric Electives (DCE)

S.No	Course Code	Course Title	Hrs/week	Credit	Semester
1	BC105DCE	**Cell Biology**	3	3	I
2	BC106DCE	**Research Methodology**	3	3	
3	BC107DCE	**Developmental Biology**	3	3	
4	BC108DCE	**Genetics**	3	3	
5	BC109DCE	**General Microbiology**	3	3	
6	BC205DCE	**Chromatin and Epigenetics**	3	3	II
7	BC206DCE	**Bioinformatics**	3	3	
8	BC207DCE	**Molecular Endocrinology**	3	3	
9	BC208DCE	**Ecology and Environmental Biology**	3	3	
10	BC209DCE	**Human Physiology**	3	3	
11	BC305DCE	**Bio-entrepreneurship**	3	3	III
12	BC306DCE	**Genomics and Proteomics**	3	3	
13	BC307DCE	**Reproductive Biology**	3	3	
14	BC308DCE	**Concept in Neurochemistry**	3	3	
15	BC309DCE	**Nutritional Biochemistry**	3	3	

VALUE ADDED COURSES

S.No	Course Code	Course Title	Hrs/week	Semester
1	BC001VAC	**Food Processing and Technology**	3	I
2	BC002VAC	**Detection Methods of Food Adulteration**	3	II
3	BC003VAC	**Value addition in Food**	3	III

Non-Major Electives (NME): These courses are open to students of other Departments except Biochemistry

S.No	Course Code	Course Title	Hrs/week	Credit	Semester
1	BC001NME	**Biochemistry**	3	2	ODD
2	BC002NME	**Molecular Basis of diseases**	3	2	EVEN

SEMESTER I

CATEGORY	CODE	SUBJECTS	HOURS	CREDITS
Core 1	**BC101CR**	**Chemistry of Biomolecules**	**6**	**5**
Core 2	**BC102CR**	**Enzymology**	**6**	**5**
Core 3	**BC103CR**	**Analytical Biochemistry**	**6**	**5**
Core 4	**BC104CR**	**Laboratory Courses-I**	**6**	**5**
Value Added Course	**BC001VAC**	**Food process and technology**	**3**	**0**
Elective	**BC105DCE to BC109DCE**	**Elective 1**	**3**	**3**
		Total credits for Semester I	**30**	**23**

SEMESTER – I

COURSE NAME - CHEMISTRY OF BIOMOLECULES

Course Code	BC101CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				5	1	-	5		
Pre-requisite	Knowledge on basic idea of Biochemistry								

Course Objectives:

- To understand the structure and functions of important biological macromolecules.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The students will be able to understand the source, chemical structure, properties, function and uses of various polysaccharides.	K2
CO2	• The students will be able to understand amino acid structures, their physical and chemical properties, and primary, secondary, tertiary and quaternary structure of proteins.	K2,K3
CO3	• The students will understand the structure of nucleic acids and its chemical synthesis.	K4,K5
CO4	• The students will understand the biological importance of vitamins and minerals in the biological system.	K7

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **HOMO AND HETEROGLYCANS** **8 Lectures**	Polysaccharides - Occurrence, structure, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitin, xylans and galactans. Occurrence, structure, properties and functions of heteroglycans - hyaluronic acid, keratan sulphate and chondroitin sulphate. Bacterial cell wall polysaccharides, Blood group substances, Sialic acid. Glycoproteins and their biological functions. Lectin structure and functions.
UNIT - II **PROTEINS** **8 Lectures**	Classification, structure and properties of amino acids, Essential and non-essential amino acids. Non protein amino acids. Proteins - Classification based on solubility, shape, composition and function. Properties of proteins. Denaturation and renaturation of proteins. Structure of peptide bonds. Chemical synthesis of polypeptides. Protein structure - Primary, secondary, tertiary and quaternary structures of protein. Forces stabilising the secondary, tertiary and quaternary structures of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoprotein and nucleoproteins.
UNIT - III **LIPIDS** **8 Lectures**	Definition and classification of lipids. Fatty acids - classification, nomenclature, structure and properties. Triacylglycerols. Classification, structure and function of prostaglandins, thromboxanes and leukotrienes. Chemical properties and functions of phospholipids and their structures - lecithins, cephalins, phosphatidylserine, phosphatidylinositol,

	plasmalogens. Glycolipids (cerebrosides and gangliosides), Isoprenoids and sterols (cholesterol and zymosterol), steroids (steroid hormones), bile acids and bile salts. Types and functions of plasma lipoproteins.
UNIT - IV **NUCLEIC ACIDS** **8 Lectures**	Structure of purines and pyrimidines. Components of nucleic acids - nucleosides, nucleotides, and polynucleotides. Occurrence and isolation of nucleic acids. Properties of DNA: buoyant density,viscosity, hypochromicity, denaturation and renaturation– the cot curve. Chemical synthesis of oligonucleotides. DNA: structure of different types (A, B and Z DNA), biological role, polymorphism. Structure and role of different types of RNA.
UNIT - V **VITAMINS AND PORPHYRINS** **8 Lectures**	Immunotechniques: Agglutination and precipitation technique. Immuno – electrophoresis, RIA, immunoblotting, Avidin – biotin mediated immunoassay.Immunohistochemistry – immunofluorescence, immunoferritin technique. Fluorescent immunoassay, fluorescence activated cell sorting (FACS). Cytokines assay: ELISA and ELISPOT. Lymphocytes transformation test (LTT); Lymphoblastoid cell lines. Experimental animal models: inbred strains, SCID mice, nude mice, knockout mice fully cloned animals. **(www.biologydiscussion.com/biochemistry/immunochemical...)**
Unit VI	Recent developments in the design of biomolecule based nanostructures in clinical research.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. L. Stryer. 2002. Biochemistry, 5th edition. W.H.Freeman&Company, New York
2. Horton, R., Moranm, LA., Scrimgeour, G, MarcPerry and David Rawn. 2006. Principles of Biochemistry, 4th edition.
3. A. L. Lehninger, Nelson &Cox. 2007. Principles of Biochemistry, 5th edition, CBS, India.
4. Murray R. K. et al. Harpers Illustrated Biochemistry, 2009, 28th edition. Lange Medical Books/McGraw-Hill.
5. Zubay, 2005. Principles of Biochemistry, 4th edition. Prentice hall.
6. Richard Harvey, Denise Ferrier. 2005. Lippincott. Outlines of Biochemistry, 5th edition.

SEMESTER – I

COURSE NAME - ENZYMOLOGY

Course Code	CBC102CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				5	1	-	5		
Pre-requisite	Basic knowledge on Enzymes								

Course Objectives:

- Students will obtain basic knowledge about the relationship between properties and structure of the enzymes, their mechanism of action and kinetics of enzymatic reactions.
- Students can understand to compare and contrast the historical uses of enzyme technology with current applications in a diverse range of industries.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The student could able to analyze the structure/function relationships in bio catalyzed reactions	K4
CO2	• Students able to research a contemporary application of enzyme technology or metabolic engineering and present the results in a well-structured oral presentation.	K4
CO3	• The student could able to understand the significance of enzyme kinetics.	K2
CO4	• Describe the Mechanism of enzyme action, Therapeutic, diagnostic and Industrial	K3

	Applications of Enzyme.	
CO5	• At the end of the course students will be explored to understand the use of enzymes in medicine, food, organic synthesis, genetics and other areas sectors that favor a wide reach for them.	K6
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION OF ENZYMES** **8 Lectures**	Definitions (catalytic power, specificity, reactivity, regulation, transformation of different forms of energy, Holoenzyme, Apoenzyme, coenzymes and cofactors). Enzyme Nomenclature and IUB system of enzyme classification. Active site- Fisher and Koshland models. Formation of enzyme substrate complex evidence. Basic concepts of bioenergetics: The collision theory, activation energy and transition state theory. Measurement and expression of enzyme activity – enzyme assays, Investigation of subcellular compartmentation of enzymes and marker enzymes. Enzyme units.
UNIT - II **ENZYME KINETICS** **8 Lectures**	Definitions (catalytic power, specificity, reactivity, regulation, transformation of different forms of energy, Holoenzyme, Apoenzyme, coenzymes and cofactors). Enzyme Nomenclature and IUB system of enzyme classification. Active site- Fisher and Koshland models. Formation of enzyme substrate complex evidence. Basic concepts of bioenergetics: The collision theory, activation energy and transition state theory. Measurement and

	expression of enzyme activity – enzyme assays, Investigation of subcellular compartmentation of enzymes and marker enzymes. Enzyme units.
UNIT - III **ENZYME INHIBITION** **8 Lectures**	Reversible and Irreversible inhibition - Competitive, Non-competitive and mixed inhibition. Substrate inhibition and Feedback inhibition.Determination of inhibitor constant.Therapeutic, diagnostic and industrial applications of enzyme inhibitors.Mechanism of enzyme action: Factors contributing to the catalytic efficiency - proximity and orientation, covalent catalysis, acid-base catalysis, metal ion catalysis, strain and distortion theory. Mechanism of action of Lysozyme, Carboxypeptidase, Chymotrypsin and Ribonuclease.
UNIT - IV **INTRODUCTION OF CO-ENZYMES** **8 Lectures**	Structure and functions – Pyridine and flavin nucleotides, coenzyme A, Pyridoxal phosphate and thiamine pyrophosphate, tetrahydrofolate and B_{12}coenzymes. Allosteric Interactions: Enzyme regulation, allosteric enzymes. Allosteric kinetics (MWC and KNF models), symmetry and sequential models. Hill's equation andHill's coefficient. Enzyme repression and covalent modification of enzymes. Zymogen activation. Isozymes.
UNIT - V **MULTIENZYME SYSTEM**	Multifunctional enzymes. Multi-enzyme complexes (Pyruvate dehydrogenase complex, fatty acid synthase and Na - K ATPase), Oligomeric enzymes and Metalloenzymes.

8 Lectures	Modern concepts of evolution of catalysts: Catalytic RNA (Ribozymes), abzymes. Immobilised enzymes and their industrial applications. Chemical modification and site-directed mutagenesis of enzymes. Industrial applications of enzymes - food and pharmaceutical enzymes. Biosensors.
UNIT - VI	Recent advancement in enzyme technology and its applications. Influence of covid-19 infections on the level of enzymes.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	S
CO5	S	S	S	M	S
S-Strong; M-Medium; L-Low					

Text book:

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edition,2008 Trevor Palmer and Philip Bonner

Recommended References:

1. Principles of Biochemistry, 1993. A.L. Lehninger, Nelson &Cox (CBS, India) and new edition.
2. Biochemistry, 2004, Donald Voet and Judith Voet, John Wiley and sons. ISBN - 047119350
3. Biochemistry, 5th edition, by Lubert Stryer, New York: W H Freeman; 2002, ISBN-10: 0-7167-3051-0.
4. Text Book of Biochemistry with clinical correlations, 4th edition – Thomas M. Devlin.
5. Text of Biochemistry, 1908 – West &Todd, MacMillian Publications
6. Principles of Biochemistry, by G. L. Zubay, 1995, Wm. C. Brown
7. Biochemistry 2nd edition Christopher K.Mathews and K.E.VanHoldge (1995) (Benjamin and cumming).
8. Enzymes. Dixon and Webb 3rded. Longmans, 1979.
9. Enzymes in Food Technology. CRC Press, 2001. Whitehurst RJ.
10. Industrial Enzymes and their applications. Uhlig H. John Wiley, 1998.
11. Fundamentals of enzymology 2nd edition,1989by Nicholas C. Price and Lewis Stevens.

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SEMESTER – I

COURSE NAME- ANALYTICAL BIOCHEMISTRY

Course Code	BC103CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				5	1	-	5		
Pre-requisite	Knowledge on basic idea of Analytical Biochemistry								

Course Objectives:

- This course will introduce some of the experimental techniques used in biochemistry and molecular biology.
- Students can able to learn methods for purifying proteins, expressing recombinant proteins in bacterial cells, and analyzing biological molecules by electrophoresis, Western blotting, and enzyme activity assays. To provide insights in the techniques used in biochemical analysis

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• To be able to communicate and discuss General principles of biochemical investigation	K2
CO2	• Familiarity with working principles, tools and techniques of analytical techniques	K5
CO3	• Describe the principles of electrophoresis and realize its applications	K4
CO4	• Students can understand the knowledge for the separation of proteins/peptides by selecting appropriate separation techniques.	K5
CO5	• Students can able to characterize certain functionalities of biomolecules by using spectroscopic	K6

	technique.	

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **UNITS OF MEASUREMENT OF SOLUTES IN SOLUTION** **8 Lectures**	Normality, Molarity, molality and milliosmol. Ionic strength.pH, pOH, Henderson – Hesselbalch equation, buffers, pH of body fluids. Measurement of pH by indicators, Zwitterions.pH dependent ionization of amino acids and proteins. Colloids and their application, Viscosity, surface tension and Donnan membrane equilibrium.Principles of electrochemical techniques – measurement of pH by glass electrode and hydrogen electrode.Oxygen electrode – principles, operation of a Clarke electrode and its applications.
UNIT - II **CELL FRACTIONATION TECHNIQUES** **8 Lectures**	Cell lysis, differential and density gradient centrifugation, Salting in, Salting out, Dialysis, Ultrafiltration. Ultra Centrifugation - preparative and analytical ultracentrifuge, Svedberg's constant, Sedimentation velocity and Sedimentation equilibrium, Schleiran optics.
UNIT - III **CHROMATOGRAPHIC TECHNIQUES** **8 Lectures**	Principles and Applications of Paper, Column, TLC, Adsorption, Ion exchanges, Gel filtration, Affinity, GLC, Chromato focusing, HPLC, FPLC.

UNIT - IV **ELECTROPHORETIC TECHNIQUES** **8 Lectures**	Polyacrylamide gel electrophoresis, SDS-PAGE, 2D – PAGE, Isoelectric focusing, Visualizing protein bands – CBB &Silver staining. Agarose gel Electrophoresis, pulse field electrophoresis, high voltage electrophoresis, Capillary Electrophoresis, Isotachophoresis, RFLP, FISH. Blotting techniques and its applications – Western, Northern & Southern.
UNIT - V **SPECTROSCOPIC AND RADIO ISOTOPE TECHNIQUES** **8 Lectures**	**Spectroscopic technique:** Colorimetry, spectrophotometry – UV &visible, Principle – Beer &Lambert's law, Extinction coefficient. Principle and application - AAS, Fluorimetry.Basic principle and application of mass spectra, NMR, ESR, ESI-MS, MALDI-TOF, CD, MRI, CTscans.Biochips (DNA chips, Protein chips and Sensor chips).Vibration Spectra – IR and Raman – Principles and Applications.X-ray crystallography – protein crystals, Bragg's law. **Radio isotope technique:** Radioactive decay constant, half life of an isotope, Detection and measurement of radio activity, Geiger Muller counters, scintillation counting, auto radiography and RIA, Application of isotopes in biological studies.
UNIT - VI	Application of analytical techniques in diagnostics. Ex: qRT-PCR and its application with specific context to identification of Covid-19 infection.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	M	S	S	M	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Wilson and Walker. A biologist's guide to principles and techniques of practical biochemistry. 5th ed. Cambridge University Press 2000.
2. Boyer, R. Modern Experimental Biochemistry. 3rd ed. Addison Weslery Longman, 2000.
3. Upadhyay, Upadhyay and Nath. Biophysical Chemistry Principles and Techniques. Himalaya Publ. 1997.
4. Simpson CFA &Whittacker, M. Electrophoretic techniques.
5. Sambrook. Molecular Cloning. Cold Spring Harbor Laboratory, 2001.
6. Friefelder and Friefelder. Physical Biochemistry – Applications to Biochemistry and Molecular Biology. WH Freeman &Co. 1994.
7. Pavia et al. Introduction to Spectroscopy. 3rd ed. Brooks/Cole Pub Co., 2000.

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SEMESTER - I

COURSE NAME - **LABORATORY COURSE - I**

Course Code	BC104CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				-	1	5	5		
Pre-requisite	Basic knowledge of Enzymes and Analytical Chemistry								

Course Objectives:

- The objective of the course is to provide hands on training of basic experiments related to biomolecules, enzymes and bio-analytical techniques using different techniques.

Expected Course Outcomes:

On the completion of the course the student will be able to

Cos	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students will develop the habit of being cautious, safe and will learn to follow basic laboratory rules.	K1
CO2	• Students will be able to design an experiment and learn to troubleshoot	K2
CO3	• The course helps to understand the principles of instrumentation and promote working ability.	K3
CO4	• Students will have intense working knowledge on basic scientific equipment and to analyze the data.	K5
CO5	• Laboratory studies can create a learning environment that encourages students to question, thereby fostering critical thinking.	K6
CO6	• Students will gain conceptual understanding of subject matter, scientific reasoning skills, and laboratory manipulative skill.	K6, K7

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

Experiments

1. Estimation of a sugar, amino acid, protein, lipids, vitamin, nucleotide / nucleic acids by appropriate chemical and biological methods.
2. Kinetic characterization of any one enzyme.
3. Sub cellular fractionation of functional mitochondria by differential centrifugation and identification using marker enzyme.
4. Separation of amino acids/lipids by thin layer chromatography/Column chromatography

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	M	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	M	M	S	S	S
CO6	S	S	M	S	M
S-Strong; M-Medium; L-Low					

Recommended References:

1. Manuals in Biochemistry – Dr. J. Jayaraman, New Age International Pub, 2000.
2. Instrumental Methods of Chemical Analysis Bk.Sharma, Goel publications, Meerut, 2000
3. Laboratory Manual in Bio Chemistry, Jayaraman, New Age International Pub, 2000.
4. Laboratory manual in Biochemistry T.N.Pattabiraman. All India publishers, 1998.

5. Lab Manual in General Microbiology - N Kannan, Palaniappa Brothers, 2000.

6. Lab Manual in Microbiology - Dr P Gunasekaran, New Age International Pub, 2000

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SEMESTER – I

COURSE NAME FOOD PROCESSING AND TECHNOLOGY

Course Code	BC001VAC	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	0		
Pre-requisite	Knowledge on basic idea of Food Technology								

Course Objectives:

• To acquire knowledge of emerging / alternative technologies applied to food processing.
• To enable a student to know the relative advantages / disadvantages over existing technologies.
• To understand the economics and commercialization of newer technologies.
• To study about microbial safety of foods by emerging methods

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Develop an appreciation about need of different emerging techniques used in food processing and preservation.	K2
CO2	• Apply their knowledge on high pressure processing, pulsed electric processing, irradiation and hurdle technology in	K3

	various food industries.	
CO3	• Understand the concepts related to membrane technology, supercritical fluid extraction and quality assessment of food using ultrasonic techniques	K3
CO4	• Get an overview on principles, mechanism and application of nanotechnology in food	K4
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **CEREALS** **8 Lectures**	Processing of rice, wheat, corn, barley, oat and its products. Feed for livestock from wheat bran and germ.
UNIT - II **BEVERAGES** **8 Lectures**	Non-alcoholic beverages, Processing of tea, coffee and cocoa, Tea-waste utilization as feed for livestock and poultry.
UNIT - III **FISH AND MEAT** **8 Lectures**	Freshness criteria and quality assessment of fish; Spoilage of fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, smoking, curing, fermentation (fish sauce). : Fish byproducts, Production of non-food items from fish processing wastes. Meat processing - curing and smoking; Fermented meat products (sausages and sauces); Frozen meat &meat storage; By-products from meat industries and their utilization.
UNIT - IV **POULTRY**	Egg processing, By Product Utilisation-commercial processing of lecithin and other egg solids, Utilisation of egg-derived

8 Lectures	products as food ingredients; Fertiliser from shells.
UNIT - V **MILK, EDIBLE FAT AND OILS** **8 Lectures**	Processing of evaporated and dried milk products – Milk powder, SCM, etc.; Cream, butter, ghee, Ice-cream, Infant formulae, Stabilisers and emulsifiers as additives in milk products. Dairy processing by-products – Fermented, condensed and dried products from whey, Production of lactose and protein from whey. Processing of oils – Degumming, refining, bleaching, deodorization, fractionation; Pyrolysis of fats, toxicity of frying oil. Plastic fat – Winterization, hydrogenation, esterification, inter-esterification and emulsification; Application of plastic fat. By-products of fat/oil processing.
UNIT - VI	Application of emerging techniques like high pressure processing, pulsed electric focussing, nanotechnology etc., in food processing and marketing.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	S	M	S	M
CO3	S	M	S	S	S
CO4	S	M	S	S	M

S-Strong; M-Medium; L-Low

Recommended References:

1. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar 2017.
2. Processed Meats; Pearson AM &Gillett TA; 1996, CBS Publishers.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA &Pasch S; 1988, Elliswood Ltd.
4. Fish Processing Technology , Rogestein & Rogestein

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Discipline Centric Electives (DCE) offered by the Department under CBCS in First semester

SEMESTER - I

COURSE NAME - CELL BIOLOGY

Course Code	BC105DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Biology								

Course Objectives:

- Cell Biology course will enable you to consider the most exciting current problems in the field. This course will give you a unique opportunity to study the mechanisms that define and regulate the function of cells and organisms.
- As this is a research-focused master's course, one will take an interactive approach to learning, rather than taking traditional lectures, through seminars, small group tutorials and research placements.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students will demonstrate their mastery of cell biology concepts	K2
CO2	• Learn the most significant functions of cell organelles in molecular level.	K3
CO3	• Acquire knowledge on internal organization of cell.	K2
CO4	• Understand the concepts of cell cycle, Regulation of	K3

	CDK check points. Apoptosis and Cancer.	
CO5	• Understand the concept of Stem cell Morphology Differentiation, Origin and Types of Stem cells.	K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **THE CELL** **8 Lectures**	History of the Cell, Cell theory, Protoplasm and Organismal theory, Broad classification of cell types – Bacteria, Archea (Prokaryotes) and Eukaryotes, Cells and Genomes: Universal features of cells, Diversity of Genomes and the Tree of life. ***Cell Membranes:*** Basic properties of Cell Membranes – The lipid Bilayer: Composition and Structural Organisation, Membrane proteins: Structure and basic functions, Membrane transport of small molecules and the electrical properties of Membranes, Endocytosis and Exocytosis. The plant Cell wall.
UNIT - II **CELL ORGANELLES** **8 Lectures**	Organelles bounded by Double membrane Envelopes [Nucleus and Mitochondria], Organelles bound by single membrane [Peroxisome, ER, GA, Lysosomes], Ribosomes, Dictyosomes, Microbodies, Peroxisome, Plastids, Chloroplast, Chromoplast and Leucoplast. Vacuoles and Centrosome.

UNIT - III **INTERNAL ORGANIZATION OF THE CELL** **8 Lectures**	***The Cytoskeleton:*** Components of Cytoskeleton, Structure and basic functions of Microtubules, Microfilaments, Intermediate filaments. ***Cell Communication****:* Cell- Cell Junctions, Tight Juction, Gap Junction, Cell – Matrix Anchoring junctions: Desmosomes, Adhering Junctions. Cell-Cell Adhesion proteins: Cadherins,,Catenins, Scaffold Proteins, Connexins, Integrins, Selectins. Plasmodesmata in Plants. The extracellular Matrix of Animals, Collagens, Elastins, Fibronectin, Laminin.
UNIT - IV **CELL CYCLE** **8 Lectures**	**Overview of Cell cycle**: Mitosis and Meiosis, Stages of Mitosis, Meiosis and Fertilization, Fertilization and Inheritance, Crossing over and Linkage. Model organisms and methods to study the cell cycle. Regulation of CDK activity and role of check points. Apoptosis and Cancer
UNIT - V **STEM CELLS** **8 Lectures**	***Overview/Concepts*:** History and Scientific Background, Introduction to Concepts inStem Cell Biology-Potency, Plasticity, Self Renewal and Expansion, Properties, Stem Cells. Classification and Sources. Embryonic Stem cells, Stem cell Morphology Differentiation, Origin and Types of Stem cells. Stem cells and Tissue Renewal.

UNIT - VI **APPLICATIONS AND METHODS IN CELL BIOLOGY**	**Microscopy:** Light microscopy, fluorescent microscopy, confocal microscopy, Phase contrast microscopy, electron microscopy. SEM, TEM. Freeze fracture technique, FACS, Tunnel assay, commet assay, clonogenic assay and cell toxicity assays.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	M	S	M
CO5	S	S	S	S	S
S-Strong; M-Medium; L-Low					

TEXT BOOK(S)

1. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White, Jeremy S. Hyams. Cell Biology – A short Course. Third Edition, Wiley-Blackwell Publication, 2011
2. George Plopper, David Sharp, Eric Sikorski. Lewin's Cells – THIRD Edition, Johnes&Bartlett Student Edition, 2015.
3. Lodish, Harvey et al., "Molecular Cell Biology", 7th Edition, W.H.Freeman, 2005
4. Cooper, G.M. and R.E. Hansman "The Cell: A Molecular Approach", VIIth Edition, ASM Press, 2007

5. Sadava, D.E. "Cell Biology: Organelle Structure and Function", Panima Publishing, 2004

6. Stem Cells- Scientific Facts and Fiction (Elsevier) By Christine Mummery, Sir Ian Wilmut,

7. Anja van de Stople, Bernard A J Roelen. 2011.

Recommended References:

1. Alberts, Bruce et al., "Essential Cell Biology", IVth Edition, Garland Press (Taylor &Francis), 2004.

2. Bruce Alberts et al., Molecular Biology of the Cell. Sixth Edition, 2015

3. Becker, W.M. et al., "The World of the Cell", 9th Edition, Pearson Education, 2003

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SEMESTER - I

COURSE NAME - **RESEARCH METHODOLOGY**

Course Code	BC106DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Research								

Course Objectives:

- The course emphasizes on various statistical methods and its significance.
  .
- The students are expected to understand the concepts and solve relevant problems pertaining to each topic.
- To provide sufficient background to be able to interpret statistical results in research

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students will able to describe various application of biostatistics, bioinformatics in Research	K2
CO2	• Will able to distinguish different types of data and sampling techniques	K2
CO3	• To compare different population sample using ANOVA	K3
CO4	• Will able to compute and interpret the result of correlation and regression analysis	K4
CO5	• To compare different population sample using	K6

	ANOVA	
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **RESEARCH METHODOLOGY** **8 Lectures**	Introduction: meaning of research; objectives of research; types of research; research approaches; significances of research; Components of a research, research methods; importance of knowing how research is done; Computer application in scientific research: Finding scientific articles. Defining the research problem; What is the research problem? Selecting the problem; Techniques involved in defining the problem; Research design; Need for research Design; different types of research designs; basic principles of experimental designs.year books, & monographs, journals, conference proceedings, abstracting & indexing journals, index & References cards, internet, magazines.
UNIT - II **DATA COLLECTION**	Primary and secondary Data collection. Sampling: Sampling and Population, Techniques sampling selection, Characteristics of a good sample, Sampling errors and how to reduce them. Techniques of Data Collection: Data schedule, Observation, Opinionnaire, Questionnaire, Interview schedules, Bibliometrics, Webometrics. Report writing; Preparation of manuscript- plan of the report, review of literature & its use in designing a research work, designing of methodology, interpretation of data & thesis

8 Lectures	layout.Scientific writing.Characteristic of scientific writing, essential features of an abstract, presentation of data, writing of results & discussions.Bibliography, oral presentation; precautions for writing research reports; conclusions.
UNIT - III **DESCRIPTIVE STATISTICS** **8 Lectures**	Tabulation, organization and graphical representation of quantitative data. Measures of central tendencies: Mean Median and Mode. Measures of ariability: Range. Q.D; S.D; A.D; and Coefficient of Variation Measures of Relative Position: Percentiles, Percentile Ranks, Standards Scores, Stanine Scores, T- Scores Normal Probability Distribution, properties of normal curve, applications of normal curve, Hypothesis testing: What is Hypothesis? Basic concepts concerning testing of hypothesis; procedure for hypothesis testing; Probability; Markov models and Hidden Markov Models; Probability distribution; Binomial; Poisson; Normal distribution and Multiple testing Methods ANOVA; Test of significance-t-test; F-test.
UNIT - IV **BIOINFORMATICS** **8 Lectures**	Origin and overview of bioinformatics. Applications of bioinformatics. Research in bioinformatics, Biological Databases: Literature databases, Sequence databases, Structure databases, Structural classification databases, Metabolic pathways database, Pattern and Motif searches: PROSITE, BLOCKS, PRINTS, PFAM. Sequence alignment: Pairwise sequence alignment - Local and Global alignments. Dotplot -Dynamic programming methods.

	Scoring or Substitution matrices - Database searching - FASTA and BLAST searches - Multiple sequence alignment. ClustalW. T-Coffee .Tools for Drug discovery / drug design.
UNIT - V **GENOMICS AND PROTEOMICS** **8 Lectures**	Genome features of Prokaryote and Eukaryote. - Genome projects: HGP, E.coli, A.thaliana and Human-Genomic variations (SNP). Genome expression (Microarray). Comparative Genomics: MUMMER,Etc. Proteomics: Protein sequence and structure characterization - Proteomics tools in Expasy server. Primary Structure Prediction by Computing there pi, Secondary structure prediction: GOR and Chou Fasman – Tertiary structure prediction: Homology modeling. Ab initio Modelling, Protein Structure and Function Determination, Protein structure visualization tools: RasMol and Swiss PDB Viewer, online Analyzing Tools.
UNIT - VI **PRACTICE PROBLEMS**	Describing Data, The Normal Distribution, Sampling Distributions, Confidence Intervals, Hypothesis Testing, Proportions, Linear Regression, Survival Analysis.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Statistical Methods, 4thEdition- Gupta, S.P, Sultan Chand &Son Publishers. 2012.
2. Biostatistical Analysis, 5thEdition- Zar, J.H, Pearson Education, 2010.
3. Biostatistics - Daniel, W.W. A Foundation for Analysis in Health Sciences, 10thEdition, John Wiley and Sons, Inc., 1999.
4. Kothari. C.R. 2004 Research Methodology – Methods and Techniques, New Age International(P)Ltd
5. E Balagurusamy. Programming in ANSI C Tata McGraw Hill
6. RandaL.Schwartz,tomphoenix,learningperl,third edition
7. Research Methodology. Methods &Techniques : Kothari, C.R.
8. Tests, Measurements and Research Methods in Behavioural Sciences . Singh, A.K.
9. Statistical Methods . Y.P. Aggarwal.
10. Methods of Statistical Analysis . P.S. Grewal
11. Analysis of Genes and Proteins, Third edition, Wiley-Interscience. D.W. Mount, Bioinformatics - Sequence and Genome Analysis, 2nd edition, CBS publishers.
12. D. Higgins and W. Taylor (Eds), Bioinformatics- Sequence, structure and databanks, Oxford University Press.
13. M.Campbell& L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, Pearson Education.

14. S.R. Pennington & M.J. Dunn, Proteomics .from protein sequence to function, Viva Books Pvt. Ltd.,

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SEMESTER - I

COURSE NAME - DEVELOPMENTAL BIOLOGY

Course Code	BC107DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Biology								

Course Objectives:

- Understand the molecular and cellular mechanisms of development and learn about basic embryology

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• To understand the basic concepts and theories related to developmental biology	K2
CO2	• Understand reproductive organs, gametogenesis and fertilization.	K3
CO3	• Understand the concept of cell differentiation and gene action in development	K4
CO4	• Understand the cellular and molecular mechanism of embryogenesis in Plants and Animals.	K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION TO EVOLUTION** **8 Lectures**	Emergence of evolutionary thoughts: Lamarks; Darwin – concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontancity of mutations; the evolutionary synthesis, Origin of cells and unicellular evolution; Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT - II **CONCEPTS OF DEVELOPMENT**	Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell

8 Lectures	lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
UNIT - III **FERTILISATION IN ANIMALS AND PLANTS** **8 Lectures**	Gametogenesis, Fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilisation in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.
UNIT - IV **DEVELOPMENT OF ANIMALS** **8 Lectures**	Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, organogenesis – vulva formation in Caenorhabditiselagans; eye lense induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.
UNIT - V	Morphogenesis and organogenesis in plants: Organization

DEVELOPMENT OF PLANTS **8 Lectures**	of shoot and root apical meristem; shoot and root development; lead development and phyllotaxy; transition to flowering, floral development in Arabidopsis and Antirrhinum.

UNIT - VI **LATEST RESEARCH AND NEWS**	Recent advances in Developmental Biology. Short talk presenters and detailed discussion of original research articles in class.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Developmental Biology (Looseleaf), 10th Edition, Scott F. Gilbert, Sinauer Associates, Inc., 2013, ISBN: 978-1605351926.
2. Principles of Development. 3rdedition, by L. Wolpert, 2006, Oxford University press, incorporated; ISBN: 9780198709886.

3. Developmental Biology. 3rdedition, by Lewis Wolpert, 2006, Oxford University Press, USA; ISBN: 1405122161

4. Developmental Biology, 6th edition by Scott Gillbert, 2000, Sunderland (MA): Sinauer Associates; ISBN-10: 0-87893-243-7

5. Evolutionary developmental biology, 2ndedition by Brain K. Hall.1998, Springer; ISBN-10: 0412785803

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SEMESTER -I

COURSE NAME - GENETICS

Course Code	BC108DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Genetics								

Course Objectives:

- Identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.
- Transmission genetics problems, make accurate predictions about inheritance of genetic traits, and map the locations of genes
- To identify the parts, structure, and dimensions of DNA molecules, RNA molecules, and chromosomes, and be able to categorize DNA as well as describe how DNA is stored
- To describe what causes and consequences of DNA sequence changes and how cells prevent these changes, as well as make predictions about the causes and effects of changes in DNA
- To describe applications and techniques of modern genetic technology, as

well as select the correct techniques to solve practical genetic problems

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.	K2
CO2	• Transmission genetics problems, make accurate predictions about inheritance of genetic traits, and map the locations of genes.	K4
CO3	• To identify the parts, structure, and dimensions of DNA molecules, RNA molecules, and chromosomes, and be able to categorize DNA as well as describe how DNA is stored.	K1
CO4	• To describe what causes and consequences of DNA sequence changes and how cells prevent these changes, as well as make predictions about the causes and effects of changes in DNA.	K2
CO5	• To describe applications and techniques of modern genetic technology, as well as select the correct techniques to solve practical genetic problems.	K3
CO6	• To carry out genetics laboratory and field research techniques.	K6
CO7	• To describe experimental results in written format both informally and in formal manuscript format.	K4
CO8	• To accurately diagram and describe the processes of replication, transcription, translation, as well as predict the outcomes of these processes.	K6

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **INTRODUCTION TO GENETICS** **8 Lectures**	Brief history/basic concepts of genetics, Cell division and chromosomes. Mendelian genetics/monohybrid, dihybrid cross. Mendelian genetics/trihybrid cross, probability. Modification of Mendelian ratios/incomplete and codominance. Modification of Mendelian ratios/incomplete and codominance. Structure of Gene - Interaction of Gene - Commentary Factors, Supplementary Factors, Inhibitory and Lethal Factors - Atavism. ***(https://www.slideshare.net/vanessaceline/intorduction-to-genetics)***
UNIT - II **CHROMOSOME ABNORMALITIES** **8 Lectures**	Diploid chromosomes number- Sex differentiation and sex determination.The X chromosomes, Barr bodies, the Lyon hypothesis. Aneuploidy and polyploidy: Gene deletion, duplication, inversions and translocation. Sex Linkage in Drosopohila and Man, Sex Influenced and Sex Limited Genes - Non-Disjunction and Gynandromorphs - Cytoplasmic Inheritance - Maternal Effect OnLimnaea (Shell Coiling), Male Sterility (Rode's Experiment).CO2 sensitivity In Drosophila, Kappa particles in Paramecium, Milk Factor in Mice. ***(Blended mode of teaching)***
UNIT - III **BLOOD GROUPS AND**	Blood Groups and their Inheritance in Human - Linkage and Crossing Over:- Drosophila - Morgans' Experiments - Complete and Incomplete Linkage, Linkage Groups,

CROSSING OVER **8 Lectures**	Crossing Over types, Mechanisms - Cytological Evidence for Crossing Over, Mapping of Chromosomes - Interference and Coincidence.
UNIT - IV **NATURE AND FUNCTION OF GENETIC MATERIAL** **8 Lectures**	Fine Structure of the Gene - Cistron, Recon, Muton - Mutation - Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations - Numerical and Structural Examples from Human.
UNIT - V **APPLIED GENETICS** **8 Lectures**	Animal Breeding - Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics, Evolutionary genetics, Hardy Weinberg Law - Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Euthenics, Bioethics. ***(www.goldiesroom.org/...)***
UNIT - VI **PRACTICE PROBLEMS**	Genetic Principles and their application in medical practice; Case studies (Interacting with patients, learning family history and drawing pedigree chart); Syndromes and disorders: definition and their genetic basis - Cystic fibrosis and Tay Sach's Syndrome; Phenylketonuria and Galactosemia; Ethical issues with clinical genetics.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	M	M	S	S
CO3	S	M	S	S	M
CO4	S	S	S	S	S
CO5	M	S	M	M	M
CO6	M	S	S	S	S
CO7	S	M	S	S	M
CO8	M	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Genetics by Verma, P.S. and V. K.Aggarwal.
2. Genetics by Russell P.J.
3. Genetics analysis and principles by Brooker R.J and McGraw Hill.
4. Basic Genetics my Miglani G.S.
5. Genetics: Analysis of genes and genomes by Hartl D.L and Jones E.W.

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SEMESTER -I

COURSE NAME - GENERAL MICROBIOLOGY

Course Code	BC109DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Microbiology								

Course Objectives:

- The student will be able to identify common infectious agents and the diseases that they cause.
- The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
- The student will be able to recall microbial physiology including metabolism and regulation.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions.	K1
CO2	• Students able to know the composition and functions of cell appendages and inclusions.	K2
CO3	• Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology.	K4
CO4	• Students will Gain the knowledge about Microbial Diversity.	K3

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **CLASSIFICATION OF MICRO-ORGANISM** **8 Lectures**	History of bacterial classification. Haeckel's three kingdoms concept, Whittaker's five kingdom concept, three domain concept of Carl Woese; Basis of microbial classification, molecular approaches in microbial classification, concept of microbial species; Principle and classification of bacteria on the basis of Bergey's manual of Determinative bacteriology; Cyanobacteria and Prochlorons.
UNIT - II **MORPHOLOGY AND FINE STRUCTURE OF BACTERIA** **8 Lectures**	Morphological types – size, shape and arrangements; cell walls of archaea, Gram negative, Gram positive eubacteria, eukaryotes; L forms – cell wall synthesis, antigenic properties, cell membranes – structure, composition and properties. Reserve materials, inorganic and organic inclusions.
UNIT - II **STRUCTURE AND FUNCTION OF CELL APPENDAGES AND INCLUSIONS** **8 Lectures**	Capsule types, composition and function; flagella, fimbrae, pili, cilia, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobillisomes, nucleoid, plasmids (types of plasmids and function); Bacterial spores: Regulation of spore formation.

UNIT - IV **MICROBIAL TECHNIQUES** **8 Lectures**	Aerobic, anaerobic, shaking, static cultures, nutritional types, culture media, culture methods pure culture techniques, Growth curve, generation time, synchronous, batch and continuous culture; Measurement of growth and factors affecting growth, Sterilization and disinfection-heat, UV radiation, ionizing radiation, filtration. Chemical disinfectants.
UNIT - V **MICROBIAL DIVERSITY AND EXTREMOPHILES** **8 Lectures**	Microbial diversity, distribution ecological niche, abundance and density. Extremophiles – Psychrophiles, acidophiles, alkaliphiles, thermophiles, barophiles etc., non-culturable bacteria (Metagenomics). Methanogens, Methanotrophs and Methylotrophs.
UNIT - VI **APPLICATIONS**	Design a mechanism that would allow a bacterium to protect its nitrogenase from oxygen. Analyze the symbiotic relationship that some N2-fixing bacteria have with plants. Identify what the bacteria contribute and what the plant contributes. Describe the process of methanogenesis in terms of electron transport and energy generation. The interactions of microorganisms among themselves and with their environment are determined by their metabolic abilities (e.g. quorum sensing, oxygen consumption, nitrogen transformations).
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	M
CO4	S	M	S	S	M
S-Strong; M-Medium; L-Low					

Recommended References:

1. Microbiology by Lansing M Prescott, Donald A Klein, John P Harley, McGraw Hill
2. Principles of Microbiology by Ronald M. Atlas (1995), Amy Mc Cullen
3. Microbiology: Principles and Explorations by Jacquelyn Black
4. General Microbiology by Roger Y Stanier, John L Ingraham, Mark L Wheelis
5. Microbiology by Michael J Pelczar
6. Fundamental Principles Of Bacteriology A J Salle
7. General Microbiology by Power and Daginawala, Himalaya Publishing House,
8. Foundations in Microbiology by Kathleen park Talaro, McGraw Hill. science
9. Microbiology: An Introduction by Gerard J Tortora, Berdell R Funke, Christine L Case,Dorling Kindersley(india) Pvt Ltd
10. Microbiology by Stuart Walker, W B Saunders.

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SEMESTER – II

CATEGORY	CODE	SUBJECTS	HOURS	CREDIT
Core 5	**BC201CR**	**Intermediary metabolism**	**5**	**5**
Core 6	**BC202CR**	**Molecular Biology**	**5**	**5**
Core 7	**BC203CR**	**Biochemistry of Signal transduction**	**5**	**5**
Core 8	**BC204CR**	**Laboratory Course-II**	**6**	**5**
Value Added Course	**BC002VAC**	**Detection methods of Food Adulteration**	**3**	**0**
Elective	**BC205DCE to BC209DCE**	**Elective II**	**3**	**3**
Non Major Elective	**#**	**Non-Major Elective 1**	**3**	**2**
		Total credits for Semester II	**30**	**25**

 # - Students have to choose Non-Major Elective papers offered by other departments

SEMESTER - II

COURSE NAME – INTERMEDIARY METABOLISM

Course Code	BC201CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Immunology and Vaccines								

Course Objectives:

- To learn the metabolism and integration of biomolecules that takes place in the human system
- Integrate the various aspects of metabolism &their regulatory pathways
- Students can understand the fundamental energetic of biochemical processes
- To elaborate the relation between biochemical defects and metabolic disorders.
- To follow the organization of signaling pathways

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• To learn the metabolism and integration of biomolecules that takes place in human system.	K2
CO2	• Integrate the various aspects of metabolism &their regulatory pathways	K1
CO3	• Students can understand the fundamental energetics of biochemical processes	K2
CO4	• To understand the relation between biochemical defects and metabolic disorders.	K3
CO5	• To understand the organisation of signalling pathways.	K2
CO6	• To understand the role of membrane processes in	K4

	metabolism.	
CO7	• Overall, gaining an understanding of the processes of metabolic transformation at the molecular level and how these processes are studied	K7
CO8	• Provide students with the opportunity to understand the relevance/applications of biochemistry in our daily activities.	K5
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION** **8 Lectures**	Overview of major classes of biomolecules, forces stabilising biomolecules. General scheme of metabolism, historical and experimental details in derivation of a metabolic pathway, catabolic, anabolic and amphibolic pathways. Thermodynamics and metabolism: Cell bioenergetics, laws of thermodynamics, standard free energy, enthalpy, entropy. Exergonic and endergonic reactions.Definition of open, closed and isolated systems – Oxidative phosphorylation. Electron transport chain. Standard free energy change of a chemical reaction, redox potentials, ATP and high energy phosphate compounds.*(Blended Mode of teaching)*
UNIT - II **CARBOHYDRATES METABOLISM** **8 Lectures**	Glycolysis and gluconeogenesis – pathway, key enzymes and co-ordinate regulation.The citric acid cycle and its regulation.The pentose phosphate pathway.Metabolism of glycogen and regulation.Key junctions in metabolism– glucose-6-phosphate, pyruvate and acetyl CoA. Blood glucose homeostasis– role of tissues and hormones.*(chalk*

	and talk)
UNIT - III **AMINO ACID METABOLISM** **8 Lectures**	**B**iosynthesis and degradation of amino acids and their regulation. Transamination and deamination, ammonia formation, the urea cycle and regulation of ureogenesis
UNIT - IV **LIPIDS METABOLISM** **8 Lectures**	**Lipogenesis:** biosynthesis of fatty acid, triglycerides, phospholipids, and cholesterol. Regulation of triacylglycerol, phospholipids and cholesterol biosynthesis. Oxidation of lipids. Role of carnitine cycle in the regulation of β -oxidation. Ketogenesis and its control.Lipoprotein metabolism - exogenous and endogenous pathways.
UNIT V **NUCLEIC ACID METABOLISM** **8 Lectures**	Biosynthesis and catabolism of purines and pyrimidines and their regulation. (https://www.slideshare.net/senchiy/nucleic-acids-and-nucleotide**)**
UNIT – VI	Current aspects on metabolism:metabolic changes after covid-19 infections.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	S
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	M
CO5	M	S	M	M	M
CO6	M	S	S	S	M
CO7	S	M	S	S	M
CO8	M	S	S	S	M
S-Strong; M-Medium; L-Low					

References Books:

1. Biochemistry – L. Stryer.
2. Principles of Biochemistry – R. Horton et al.
3. Lehninger's Principles of Biochemistry-D. L. Nelson and M. M. Cox.
4. Harpers Biochemistry- R. K. Murray et al.
5. Principles of Biochemistry- G. L. Zubay.
6. Outlines of biochemistry- Lippincott.

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SEMESTER – II

COURSE NAME- MOLECULAR BIOLOGY

Course Code	BC202CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Molecular Biology								

Course Objectives:

- This course is about genes - their structure and function - therefore, students will study the mechanics of replication, repair, transcription, and translation in bacteria, archaea and eukaryotes. A central goal is to understand gene regulation at all levels, and the structure-function relationships of nucleic acids and proteins

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The course gives deep insight of molecular mechanisms behind the existence of life.	K2
CO2	• Students will understand structure and organization of genomes and its functions in lower to higher forms of life.	K4
CO3	• Students will learn will about the regulation of gene expression	K3
CO4	• Course covers the fundamental molecular causes behind the several non- communicable disease and communicable disease. Which enables the students to purse career in health care and clinical research	K5, k7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation;		

K7- Evaluation

UNIT - I **CENTRAL DOGMA OF LIFE** **8 LECTURES**	History of 20th &21st century molecular biology, Genomics &'Post-Genomics.'DNA as the genetic material, supercoiling, hybridization. Hierarchy of Chromatin Organisation, Central Dogma, Unique sequence DNA, Repetitive DNA – SINEs, LINEs, Satellite, Minisatellite and Microsatellite DNAs, CValue Paradox. E.Coli Chromosome and plasmids, Mitochondrial and Chloroplast Genomes. Concept of genes. Structure of Protein-coding genes in prokaryotes and eukaryotes. structures of DNA/RNA components, the different forms of nucleic acids (A, B, Z) and the types of amino acids that mediate backbone and sequence-specific binding.
UNIT - II **DNA REPLICATION, REPAIR AND MUTATION** **8 Lectures**	**DNA in prokaryotes and eukaryotes**: Mode of replication; experimental findings of Meselson &Stahl. Enzymes involved in replication, events on the replication fork and termination, mechanism of replication. Inhibitors of DNA replication and DNA repair mechanisms (Direct repair, excision repair, mismatch repair, recombination repair, SOS response, Eukaryotic repair system).Type of damages and mutation – point mutation and frameshift mutation. Suppressor Gene mutation and chromosomal aberration.

UNIT - III **TRANSCRIPTION** **8 Lectures**	**Organisation of transcriptional units** – prokaryotes and eukaryotes. RNA polymerases – structure and functions. Promoters, transcription factors, transcription complex assembly and mechanism of transcription- Operon model. Transcriptional regulation –hormonal (steroid hormone receptors), phosphorylation (STAT proteins). Molecular biology of HIV [and other retroviruses], influenza virus, and how current genomics projects (e.g., comparative and functional, and other '-omics') are altering our understanding of molecular biology. Activation of transcriptional elongation by HIV tat protein. Posttranscriptional processing. Alternative splicing. Catalytic RNA (ribozymes), antisense RNA. Inhibitors of transcription.
UNIT - IV **TRANSLATION** **8 Lectures**	**The genetic code** – specificity, redundancy and wobble hypothesis. Mitochondrial and chloroplast genetic codons. Components of protein synthesis– mRNA, rRNA and tRNA. Mechanism of protein synthesis. Regulation of protein synthesis - constitutive and narrow domain regulation. Inhibition of protein synthesis. Co- and post-translational modifications. Protein targeting- the signal sequence hypothesis, targeting proteins to membranes, nucleus and intracellular organelles. Protein degradation - ubiquitin pathway. Protein folding - models,

	molecular chaperones.
UNIT - V **GENE EXPRESSION AND REGULATION** **8 Lectures**	Levels of gene expression. Principles of gene regulation. Upregulation, downregulation, induction and repression. Comparison of gene regulation strategies in prokaryotes and eukaryotes. Genetic and epigenetic gene regulation by DNA methylation. Methylation and gene regulation in mammals and plants. Epigenetic gene regulation by DNA methylation in mammals - role of imprinting and Xchromosome inactivation
UNIT - VI **MOLECULAR INHIBITORS OF CENTRAL DOGMA**	Role of antibiotics and other inhibitors of Prokaryotic and eukaryotic replication/transcription/translation
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	M	S	M	S
CO4	S	S	S	S	M
S-Strong; M-Medium; L-Low					

Recommended References Books:

1. Molecular Cell Biology, 5th edition, Harvey Lodish, Arnold Berk, Paul Matsudaira, chris A.

Kaiser, Monty Krieger, Mathew P Scott, Lawrence Zipursky, James Darnell, W.H Freeman &Co. 2004, ISBN - 0716743663

2. Genes VIII, Benjamin Lewin, Pearson Prentice Hall, 2004, ISBN - 0131238264
3. Molecular Biology, David Friefelder, Jones &Bartlett Publishers ISBN 0867200693 (0-86720-069-3)
4 .Molecular Biology of The Cell, 4th edition, Bruce Alberts, Alexander Johnson, Julian Lewis,

Martin Raff, Keith Roberts, and Peter Walter, Garland edition, ISBN-10: 0-8153-4072-9

5. Cell Biology and Histology, 6th edition, Gartner et al., Lippincott William and Wilkins Publishers, ISBN - 1608313212.
6. Cell Biology and Molecular Biology, 8th edition, EDP De Robertis and EMF De Robertis, Lippincott Williams and Wilkins, 2006, ISBN - 0781734932
7. Molecular Biology of the Gene, 6th edition, James D Watson, 2008, Cold Spring Harbor Laboratory, ISBN 978-080539592-1
8. Becker's World of The Cell, 8th edition, Jerrf Hardin, Gregory Bertoni, Lewis Kleinsmith, 2011, Pearson Publications, ISBN – 0321709780
9. Cell and Molecular Biology Concepts &Experiments, 5th edition, Gerald Karp, 2008, wiley Publications, ISBN - 978-0-470-04214-4

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SEMESTER – II

COURSE NAME - BIOCHEMISTRY OF SIGNAL TRANSDUCTION

Course Code	BC203CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Signal Transduction								

Course Objectives:

- The objective of this course is to examine in detail the biochemical basis of the transmission of molecular signals from a cell's exterior to its interior and how this can bring about changes in cellular behavior and gene expression.
- The course emphasises the biochemical concepts underlying signal transduction and the types of experimental analysis that are employed to study signaling pathways.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students should be able to recognize emerging patterns of pathway organization and give examples. They should be able to identify similarity and differences between pathways and apply their knowledge to novel problems.	K2
CO2	• Students are expected to be able to identify and describe the biochemical mechanisms of how pathways are turned on and off including allosteric mechanisms.	K3
CO3	• Students should be able to describe mechanisms of how the cell achieves specificity in signaling pathways.	K4

CO4	• They should appreciate that pathways are interconnected and form networks. A basic understanding of how network regulation is studied is expected.	K6

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **REGULATION OF TRANSCRIPTION** **8 Lectures**	**Regulation of transcription in prokaryotes -** positive and negative control, repressor and inducer, concept of operon, lac and trp operons, regulons. Regulation in eukaryotes- gene families, regulatory strategies in eukaryotes, gene alteration, regulation of synthesis of primary transcripts, hormonal control, transcription factors, transcription factors: targets of signalling pathways. DNA binding motifs in pro and eukaryotes - helix turn helix, zinc fingers, leucine zippers/ b zip, helix loop helix motifs. Regulation at the level of translation in prokaryotes and eukaryotes
UNIT - II **CELL SURFACE RECEPTORS AND SIGNALLING** **8 Lectures**	**Signal transduction** – definition, signals, ligands and receptors. Endocrine, paracrine and autocrine signalling. Receptors and signalling pathways- cell signalling, cell surface receptors. G Protein coupled receptors- structure, mechanism of signal transmission, regulatory GTPases, heterotrimeric G proteins and effector molecules of G Proteins. Receptor tyrosine kinases - Role of phosphotyrosine in SH2 domain binding, Signal transmission via Ras proteins and MAP kinase pathways. Signalling molecules- cAMP, cGMP, metabolic pathways for the formation of inositol triphosphate from phosphatidyl inositol diphosphate, Ca^{2+}, DAG and NO as signalling molecules, ryanodine and other Ca^{2+} receptors, phosphoregulation of inositol and the calcium channel activation. Ser/Thr-specific protein kinases and

	phosphatases
Unit - III **SIGNALLING IN NERVE IMPULSE TRANSMISSION, VISION AND MUSCLE CONTRACTION** **8 Lectures**	**Sensory Transduction :** Nerve impulse transmission – Nerve cells, synapses, reflex arc structure, Resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmitters, neurotransmitter receptors. Rod and cone cells in the retina, biochemical changes in the visual cycle, photochemical reaction and regulation of rhodopsin. Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.
UNIT - IV **NUCLEAR RECEPTOR AND SIGNALING** **8 Lectures**	**Signalling by nuclear receptors-** ligands, structure and functions of nuclear receptors, nuclear functions for hormones/metabolites - orphan receptors; cytoplasmic functions and crosstalk with signalling molecules, signalling pathway of the steroid hormone receptors. Cytokine receptors- structure and activation of cytokine receptors, Jak-Stat pathway, Janus kinases, Stat proteins.
UNIT - V **CELL CYCLE AND ITS REGULATION** **8 Lectures**	**Regulation of the cell cycle-** Overview of the cell cycle, cell cycle control mechanisms, Cyclindependent protein kinases (CDKs), regulation of cell cycle by proteolysis, G1/S Phase transition, G2/M Phase transition, cell cycle control of DNA replication, DNA damage checkpoints. Cancer, types of cancer, factors causing cancer-physical, chemical and biological agents. Errors in function of signal proteins and tumorigenesis. Oncogenes, proto-oncogenes and tumour suppressor genes. Tumou suppressor protein p53 and its role in tumour suppression. Tumour suppressor APC and Wnt/β-Catenin signaling
UNIT - VI	Discuss the latest advances on identification of signaling pathways in pre-clinical and clinical research.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

REFERENCE BOOK(S)

1. Biochemistry of Signal Transduction and Regulation. 5thEdition. Gerhard Krauss, 2014 WILEY-VCH Verlag GmbH &Co. KGaA, Weinheim ISBN: 978-3-527-33366-0
2. Molecular biology- David Freifelder, Narosa Publishing House Pvt. Limited, 2005
3. Molecular Biology of the Cell, 4th edition, Bruce Alberts. New York: Garland Science; 2002.ISBN-10: 0-8153-3218-1ISBN-10: 0-8153-4072-9
4. Molecular Cell Biology, 4th edition, Harvey Lodish. New York: W. H. Freeman; 2000. ISBN10: 0-7167-3136-3.
5. Principles of cell and molecular biology- Lewis Kleinsmith, 2ndedition, illustrated, HarperCollins, 1995.

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SEMESTER - II

Laboratory Course – **LABORATORY COURSE-II**

Course Code	BC204CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				-	1	5	5		
Pre-requisite	Basic knowledge of Molecular Techniques								

Course Objectives:

- To provide hands on training in the techniques used in industries and research
- To apply the principles studied

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• A sound knowledge on methodological repertoire allows students to innovatively apply these in basic and applied fields of biological research.	K4
CO2	• Familiarized to annotation of DNA sequences for efficient design, tracking, and management of cloning experiments in the laboratory.	K4

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

Experiments

1. NCBI database
2. BLAST and FASTA analysis

3. Multiple sequence alignment

4. Primer Design. Online tools

5. Principle and operations of lab equipment: Autoclave, Laminar Airflow, Incubator, Shaking incubator, PCR, Electrophoresis and Western blot

6. Isolation of Genomic DNA

7. Amplification of Gene by PCR

8. Isolation of Plasmid DNA

9. Preparation of insert DNA and expression vector

10. DNA ligation and Transformation

11. Over expression of Recombinant Protein

12. Isolation of recombinant protein by Affinity chromatography

13. Separation of protein by SDS-PAGE Electrophoresis

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. M. R. Green, J. Sambrook. Molecular Cloning: A Laboratory Manual (Cold Spring Harbor, ed. 4, 2014).

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SEMESTER –II

COURSE NAME - DETECTION METHODS OF FOOD ADULTERATION

Course Code	BC002 VAC	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	0		
Pre-requisite	Knowledge on basic idea of Bioinformatics								

Course Objectives:

- To exemplify different food adulterants
- To elucidate the adulterants in food products
- To Evaluate the food quality

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Understand the adulteration of common foods and their adverse impact on health	K2
CO2	• Comprehend certain skills of detecting adulteration of common foods.	K3
CO3	• Be able to extend their knowledge to other kinds of adulteration, detection and remedies.	K4
CO4	• The students would also learn different methods of tests to predict the quality of oils.	K5, K7

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **TESTING**	**Test A:** Adulteration of Milk Physical Tests: Detergent Test Filter Test Flow. Test B: Chemical Tests: Clot on

ADULTERATION OF MILK **8 Lectures**	boiling test. Test for starch in Milk Test for cane sugar in Milk Test for Buffaloes Milk in Cow's Milk Test for added colours in Milk Test for skim milk power in milk Detect the presence of added carbonates and bicarbonates in milk Test for soda in milk. Test for glucose.
UNIT - II **ADULTERATION OF GHEE:** **8 Lectures**	**Test for vegetable fat:** Nitric acid test Soda ash test Valenta test Test for added alkali. Baudovin test. Analysis of butter:Test for Dalda in butter. Adulteration of Khoa: Test for starch in Khoa. Adulteration of Paneer: Presence of starch in paneer**.**
UNIT - III **TESTING ADULTERATION OF OILS AND FATS:** **8 Lectures**	Test for sesame oil in other oils Halphen test for cotton seed oil Hexa bromide test for linseed oil Test for added mineral oil Test for added castor oil Detection of argemone oil in other oils Test for rancidity in oils Kries test for testing quality of oil.
UNIT - IV **TESTING ADULTERATION OF SPICES:** **8 Lectures**	**Extraction of flavour. Coriander power:** Test for starch &horse dung power. Chilli powder. Test for oil soluble dyes, powdered bran, saw dust and brick powder. Turmeric Powder: Test for metanil yellow and lead chromate polish. Cloves: Test for exhausted cloves. Curry powder: Test for metallic colours.
UNIT - V **TESTING ADULTERATION IN SEEDS** **8 Lectures**	**Poppy seeds:** Test for Amaranths seeds. Sajeera: Test for sand, stones and other seeds. Mustard seeds: Visual examination. Pepper: Test for papaya seeds. Saffron: Detection of maize cob tendrils. Cumin seeds; Cinnamon: plant bark.
UNIT - VI	Visit to Food processing and analyzing lab. Food and adulteration

awareness campaign – know your food quality

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	M	M	S	S	S
CO3	S	S	S	M	S
CO4	M	S	M	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S)

1. Rapid detection of food adulterants and contaminants Theory and practice. Shyam Narayan Jha. 2015.

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SEMESTER -II

COURSE NAME - CHROMATIN AND EPIGENETICS

Course Code	BC205DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Human Reproductive system								

Course Objectives:

- This course is designed to familiarize the students with basic and

more advanced concepts of an emerging and rapidly evolving field of epigenetics
• To address fundamental questions in Epigenetics and Genetics Regulation

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• On Successful Completion of this course the students will have a sound knowledge about the Epigenetic contribution in cellular functions.	K2
CO2	• Students can understand the function of DNA packaging within the cell and use examples to illustrate how packaging is achieved in various organisms;	K4
CO3	• Students can describe in detail the protein components of the nucleosome and key modifications to nucleosome components, and understand the interactions between the DNA double helix and the nucleosome;	K4
CO4	• Students can understand the various chromatin states within the interphase nucleus – their degrees of compaction and the hierarchy of chromatin assembly	K7
CO5	• The students would also learn the critical analysis, thinking of research papers and problem solving skills	K2
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **CHROMATIN**	DNA and Histones, Structure of Histones, , Histone-DNA Interactions, Nucleosomes, organization of Nucleosomes, Chromatin, Chromosomal architecture.

STRUCTURE **8 Lectures**	Histone variants, Non-histone proteins.
UNIT - II **EPIGENETICS** **8 Lectures**	Genetics Vs Epigenetics, Regulation of gene expression and cell fate, Regulation from zygote to multipotent cells. Epigenetics of Tissue development, Homeostasis and regeneration. Epigenetic process of chromatin modification by transcriptional regulation, Hetero chromatin and Euchromatin.
UNIT - III **EPIGENETIC MODIFICATIONS** **8 Lectures**	Chromatin remodeling by DNA binding proteins, SWI/SNF family repositioning nucleosomes. Chromatin modifications by spontaneous conformational change, covalent modifications, Epigenetic modifications: DNA methylation and Post translational modification of Histones
UNIT - IV **EPIGENETIC CONTROL OF CHROMATIN** **8 Lectures**	**Locus specific control:** NURD, SIN3A, methyl transferase and kinase complexes. Coordination among Chromatin modifying complexes. Epigenetic control of Cell specific gene expression, Mitotic cell cycle, Gene imprinting, Cellular differentiation. Reversibility of Epigenetic modifications: Reprogramming epigenome by somatic cell nuclear transfer, cell fusion and by cell extracts.
UNIT - V **EPIGENETICS AND DISEASES** **8 Lectures**	Predisposition to disease, Imprinting based disorders, Epigenetics of Memory, neurodegeneration and mental health, Kidney, Diabetes and cardiovascular disorders

UNIT - VI	Recent advances in chromatin and Epigenetics. Short talk presenters and detailed discussion of original research articles in class.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Reference books:

1. Chromatin Structure and Function by Alan P. Wolffe. Academic Press. 3rd Edition 2012.
2. Chromatin Kensal E. van Holde · 2012
3. Epigenetics. Lyle Armstrong. 2020

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SEMESTER – II

COURSE NAME - BIOINFORMATICS

Course Code	BC206DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Food adulteration								

Course Objectives:

- The purpose of studying this paper is to apply computational facility in different fields of life sciences, physical and chemical sciences.
- After completion, students could learn drug designing through computer based modification programs using synthetic or natural source.
- Most important application of Bioinformatics is in the field of drug discovery where it reduces more than 60% of the time, money and labor

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.	K2,K4
CO2	• Explain about the methods to characterise and manage the different types of Biological data.	K3
CO3	• Introduction to the basics of sequence alignment and analysis	K4,K6
CO4	• Introduce to identify the protein structure visualization tools. Genome databases- Prokaryotic Genome Database with comparison with Human genomes like HGP, GENECLUSTER, DNA Microarray, SWISS-2DPAGE.	K7,K6

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **BIOINFORMATICS** **8 Lectures**	An overview, Definition &History; Bioinformatics databases &tools on the Internet- NCBI, EBI, PIR, Swiss-Prot, GenBank ; pattern and motif searches- BLOCKS, PRINTS, PFAM
UNIT - II **PROTEINS AMINO ACIDS** **8 Lectures**	Levels of protein structure – Ramachandran Map. Protein Secondary structure prediction - ChouFasmann rules, Gamier-Osguthorpe-Robson (GOR) methods; Predicting 3D structure – homology modeling, threading - fold recognition and ab initio methods - Rosetta – CASP.
UNIT - III **BIOLOGICAL SEQUENCE ANALYSIS** **8 Lectures**	Pairwise sequence comparison – Sequence queries against biological databases – BLAST and FASTA - Multiple sequence alignments –Phylogenetic alignment. **Algorithms and Matrices**: Scoring matrices- PAM and BLOSUM; dynamic programming, Algorithms, Needleman and Wunsch, Smith-Waterman;
UNIT - IV **PROTEIN STRUCTURE VISUALIZATION TOOLS** **8 Lectures**	RasMol, HEX, Argus Lab Swiss PDB Viewer - Structure – Classification, alignment and analysis – SCOP, CATH, FSSP, UNIX.
Unit - V **FUNCTIONAL GENOMICS (METABOLISM AND REGULATION) IN BIOCHEMISTRY** **8 Lectures**	Sequencing genomes– Genome databases on the web, Prokaryotic Genome Database with comparison with Human genome, HGP, GENECLUSTER, DNA Microarray, SWISS-2DPAGE Database, TIGR,WIT, CYTOSCAPE and DRUG DISCOVERY

UNIT-VI	Using Bioinformatics tool to predict protein models in disease related pathways
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	M	S	M
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S):

1. Bioinformatics-Sequence and Genome Analysis- David W.Mount, Cold Spring Harbor
2. Laboratory Press (2004).
3. Introduction to Bioinformatics, Attwood, T.K. and D.J. Parry-Smith, Pearson Education Ltd., New Delhi (2004).
4. Bioinformatics – Westhead, D.R., Paris J.H. And R.M. Twyman, Instant Notes: Viva Books Private Ltd, New Delhi (2003).
5. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press, New Delhi (2003).
6. Bioinformatics- Sequence, structure and databanks, Higgins D. and W. Taylor (Eds), Oxford University Press, New Delhi (2000).
7. Bioinformatics; A practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience, Baxevanis, A. and B.F. Ouellette , Hoboken, NJ (1998).
8. Introduction to computational Biology, Michael, S. Waterman, Chapman & Hall, (1)

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SEMESTER – II

COURSE NAME – MOLECULAR ENDOCRINOLOGY

Course Code	BC207DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Immunology and Vaccines								

Course Objectives:

- Study the molecular mechanisms of hormone and growth factors action.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students will be able to identify the organs involved in endocrine system, hormones	K2
CO2	• Students will able to understand key human endocrine disorders	K5
CO3	• Students will understand know the major hormones that are produced by these organs and will know the physiological effect of these	K4
CO4	• The students know the clinical evaluation of endocrine system	K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I	Definition and scope of Endocrinology- Historical and anatomical aspects of mammalian endocrine system.

BASICS OF ENDOCRINE SYSTEM **8 Lectures**	Definition of a hormone- chemical nature of mammalian hormones- types of hormone receptors- secondary messenger system general mechanism of peptide and non-peptide hormones action. Feed-back regulation of Endocrine System
UNIT - II **ENDOCRINES OF HYPOTHALAMUS AND THYROID GLAND** **8 Lectures**	The Endocrines of Hypothalamus - Hypo-Physiotropic hormones- Neurovascular hypothesis. Pituitary gland hormones- chemistry and biochemical functions. Pineal gland hormones- chemistry- biochemical functions- mechanism of action. Thyroid gland hormones- chemistry- biochemical functions- mechanism of action. Parathyroid glands- biochemical functions
UNIT - III **HORMONES OF ADRENAL AND PANCREAS** **8 Lectures**	Adrenal gland: Hormones of adrenal gland- chemistry- mechanism of actionbiochemical functions. Pancreas- Insulin/glucagon: chemistry- biochemical functions- mechanism of action. Somatostatin. Hormones involving in calcium metabolism- chemistry- mechanism of action. Neuro-hormones- the brain-reninangiotensin, Urotensin-neuropeptides.
UNIT - IV **HORMONES OF FEMALE AND MALE REPRODUCTIVE SYSTEM** **8 Lectures**	Hormones of female and male reproductive system: Ovarian steroid hormoneschemistry- biosynthesis and transport; Synthesis, chemistry and metabolism of androgens- dynamics of steroid hormone production and metabolism mechanisms of action of sex steroid hormones. Testicular and ovarian determining genes – Mullerian-inhibiting substance genes- molecular basis of male and female contraception

UNIT - V **ENDOCRINOPATHIES** **8 Lectures**	Endocrinopathies: Hypo-physeal, Thyroid, parathyroid, adrenal and pancreas. Disorders of pituitary hormone axis- thyrotoxicosis- hypothyroidism- Hashimoto's thyroiditis- metabolic bone diseases- Cushing syndrome- Addison's diseasesDiabetes mellitus- androgen deficiency syndromes- Testicular neoplasm: Klinefelter's syndrome and Turner's syndrome. Clinical evaluation of endocrine functions-overview.
UNIT – VI	Discussion on recent research in key human endocrine disorders
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Text Books:

1. Lehninger's Principle of Biochemistry.: Nelson Cox. 3rd ed. MacMillian Worth Publ. 2000.
2. Endocrinology: Mac E. Hadely. 5th ed. Pearson Education, 2000.

References Books:

1. Henry M. Kronenberg, Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen. William Textbook of Endocrinology, 11th ed. Saunders Elsevier 2008

2. Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.

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SEMESTER – II

COURSE NAME- ECOLOGY AND ENVIRONMENTAL BIOLOGY

Course Code	BC208DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Ecology also environmental Biology								

Course Objectives:

- To study the physical and biological characters of the environment and the interrelationship between biotic and abiotic components of nature as well as relationship among the individuals of the biotic components

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Develop an appreciation of the modern scope of scientific inquiry in the field of Ecology.	K2

CO2	• Become familiar with the variety of ways that organisms interact with both the physical and the biological environment.	K5
CO3	• Develop an understanding of the differences in the structure and function of different types of ecosystems	K4
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION TO ENVIRONMENT AND ECOLOGY** **8 Lectures**	The Environment: definition, types of environment and their importance: physical environment; biotic environment; social environment; biotic and abiotic interactions. Ecology: scope of ecology; historical background; ecology in India; terminology of ecology; basic concepts of ecology.
UNIT - II **ENVIRONMENTAL COMPLEX** **8 Lectures**	Environmental complex, Environmental and ecological factors-Direct and indirect factors; four categories of ecological factors-climatic, topographic, edaphic and biotic factors; interaction of ecological factors. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
UNIT - III **POPULATION ECOLOGY** **8 Lectures**	Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations .

UNIT - IV **COMMUNITY ECOLOGY** **8 Lectures**	Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Habitat and Niche:Concept of habitat and niche, types of niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement
UNIT - V **ECOLOGICAL SUCCESSION** **8 Lectures**	Ecological succession types, mechanisms, changes involved in succession, concept of climax. Ecosystem Ecology: Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
UNIT - VI **APPLIED ECOLOGY**	Environmental pollution-Types, global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	M	M	M	S
S-Strong; M-Medium; L-Low					

TEXT BOOKS:

1. Cell Biology, Genetics, Molecular Biology, Evolution And Ecology, P.S. Verma and V.K.Agarwal, S. Chand Company Ltd 2005.
2. Ecology and Environmental Biology, T.K.Saha, Books and Allied (P) Ltd, Kolkata 2011.
3. Modern concepts of Ecology, H.D.Kumar, 8thed, Vikas Publishing House Pvt Ltd, 2008.
4. Fundamentals of Environment Biology, Dr. Biswarup Mukherjee, Silverline publications, 2008.

Recommended References Books:

1. Hand Book of Environmental Science, S S Negi, 2008.
2. A Text Book of Environmental Pollution, P.Panday, 2010.
3. A Text Book of Environmental Science, V. Thakur, 2012.
4. A Textbook of Environmental Science, Prabhat Patnaik, 2011.
5. Textbook of Ecology, S.K. Dubey, 2012.

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SEMESTER – II

COURSE NAME - HUMAN PHYSIOLOGY

Course Code	BC209DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Human Physiology								

Course Objectives:

• Physiology may be defined as the study of the functions of living organisms.
• It address on how organs and systems within the human body perform their functions at the molecular and cellular level, and the impact of these functions on the entire human body.
• This course is designed to provide students with an understanding of the function & regulation of the human body and physiological integration of the organ systems to maintain homeostasis.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• At the end of the course students should.	K2
CO2	• Have an enhanced knowledge and appreciation of mammalian physiology.	K3
CO3	• Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems.	K4
CO4	• Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail.	K4
CO5	• Be able to perform, analyze and report on experiments and observations in physiology	K4, K5
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **BODY FLUIDS AND CIRCULATORY SYSTEM** **8 Lectures**	Characteristics of Life, Tissues/Organ Systems. Extracellular fluid, Intracellular fluid: Lymph & Blood. Osmolarity of the body fluids, ionic composition, electrolytes, body buffers. Circulation: Structure and functions of Heart and blood vessels, cardiac cycles, cardiac factors controlling blood pressure, artherosclerosis, myocardial in fraction electrocardiogram. ***Respiration*:** Anatomy and physiology of respiration, pulmonary surfactant, Gas Exchange & Transport: exchange of gases between lung and blood and between blood and tissues. Role of lung in acid-base balance
UNIT - II **SKELETAL AND MUSCULAR SYSTEM** **8 Lectures**	Physiology of bone, ligaments and tendons. Role of minerals in bone strength. Osteoporosis, rickets. Types and functions of muscles and muscle proteins. Mechanism of muscle contraction. *Retinal physiology:* Anatomy and Function of Retina, Rhodopsin - Retinal Visual Cycle. The Sense of Hearing, Tympanic Membrane and the Acicular System, Chemical Senses -Taste and Smell
UNIT - III **NERVOUS SYSTEM** **8 Lectures**	**Physiology:** Nervous Tissue & Organization. Structure of neurons, axon and dentrites. Sensory Physiology; Peripheral Nervous System, Central nervous system. Membrane Potentials, Impulse Communication and Nerve Impulse Conduction; Resting potential and action potential, Synaptic transmission. Brain - chemical composition, metabolism, metabolic adaptation, neurotransmitters and cAMP. Biochemical aspects of learning and memory. Enkephalins and

	endorphins.
UNIT - IV **DIGESTIVE SYSTEM** **8 Lectures**	**Digestive system:** Anatomy of the digestive system, Salivary, Gastric and Biliary Secretions- composition and functions. Pancreatic secretions. Ingestion of food, Gastrointestinal hormones, movements in Gastro intestinal tract, Digestion and absorption of carbohydrates, lipids and proteins in small intestine and large intestine.
UNIT - V **EXCRETORY SYSTEM** **8 Lectures**	Excretory system: Structure and functions of kidney. Urine - composition and formation. Renal regulation of acid-base balance. Role of kidney in excretion. Determinants of the GFR, Renal Blood Flow, Physiologic Control of Glomerular Filtration and Renal Blood Flow. *Endocrinology*: Basics of hormones, Endocrine glands, hormones produced by endocrine glands. Physiology of hormones. Mechanism of hormonal action. Hhormonal disorders.
UNIT - VI **APPLICATIONS**	Describe how the body works in health and how it responds and adapts to the challenges of everyday life, recognition and identification of principle tissue structure
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M

CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

TEXTBOOKS

1. Widmaier, Raff, & Strang: Vander's Human Physiology: The Mechanisms of Body Function, 12th edition, McGraw Hill, 2008. ISBN 978-0-07-337810-7
2. McArdle, Katch & Katch, edition, Exercise Physiology: Nutrition, Energy, and Human Performance, seven edition, Lippincott Williams & Wilkins, 2010. ISBN 978-0-7817-9781-8
3. Guyton and Hall, Medical Physiology, 11th edition, Elsevier-Saunders, 2006.
4. Textbook in Medical Physiology and Pathophysiology: Essentials and clinical problems, Copenhagen Medical Publishers 1999 – 2000 Access at: http://www.mfi.ku.dk/PPaulev/content.htm.

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SEMESTER III

CATEGORY	CODE	SUBJECTS	HOURS	CREDIT
Core 9	**BC301CR**	**Immunology**	**5**	**5**
Core 10	**BC302CR**	**Genetic Engineering**	**5**	**5**
Core 11	**BC303CR**	**Clinical Biochemistry**	**5**	**5**
Core 12	**BC304CR**	**Laboratory Course-III**	**6**	**5**
Value Added Course	**BC003VAC**	**Value addition in Food**	**3**	**0**
Elective	**BC305DCE to 309DCE**	**Elective III**	**3**	**3**
Non Major Elective	**#**	**Non-Major Elective II**	**3**	**2**
		Total credits for Semester III	**30**	**25**

 # - Students have to choose Non-Major Elective papers offered by other department

SEMESTER - III

COURSE NAME - IMMUNOLOGY

Course Code	BC301CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Immune System								

Course Objectives:

- Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
- Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses
- Define the basic mechanisms that regulate immune responses and maintain tolerance
- To demonstrate the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health and disease
- Describe basic and state-of-the-art experimental methods and technologies

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity.	K2
CO2	• Define the basic mechanisms that regulate immune responses and maintain tolerance.	K3
CO3	• Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses.	K5
CO4	• Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health	K4

	and disease.	
CO5	• Describe basic and state-of-the-art experimental methods and technologies	K7
CO6	• Integrate knowledge of each subsystem to see their contribution to the functioning of higher-level systems in health and disease.	K6
CO7	• Apply understanding of basic and state-of-the-art experimental methods and technologies in the design of research plans to test specific hypotheses	K5, K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION TO IMMUNOLOGY** **8 Lectures**	**Historical perspective:** contribution by metchnikoff, Edward Jenner, Louis Pasteur and Wu and Kabat. Types of immunity – innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs – Thymus, bone marrow, spleen, lymph nodes and other peripheral lymphoid tissues – MALT, GALT and CALT. Cells of the immune system- lymphocytes, mononuclear phagocytes – dendritic cells, granulocytes, NK cells and mast cells. Immunoglobulins – structure, classification and functions. Idiotype network hypothesis. Antigen, types of antigen, antigen Vs immunogens, Haptens. Factors influencing immunogenicity.Isotypes, allotypes and idiotypes.(Blended mode of teaching)
UNIT - II **COMPLEMENT PATHWAYS**	**Complement system:** components of complement activation and its biological consequences – classical, alternative and lectin pathways.

8 Lectures	**Clonal selection theory.** Organization and expression of immunoglobulin genes, generation of antibody diversity. Class switching. **Overview of B cell &T cell**, types of immune response, T – cell, B- cell receptors, Antigen recognition – processing and presentation to T- cells. Interaction of T and B cells. Effector mechanisms – macrophage activation. Cell mediated cytotoxicity, Cytokines types, regulation of immune response : immune tolerance and immunosuppression.*(Chalk and talk)*
UNIT - III **MAJOR HISTOCOMPATIBILITY COMPLEX** **8 Lectures**	Major Histocompatibility complex (MHC): MHC genes and products. Polymorphism of MHC genes, role of MHC antigen in immune response, MHC antigens in transplantation. Transplantation types, allograft rejection mechanism. Immune response to infectious diseases – Viral, bacterial and Protozoal. AIDS and other immunodeficiency disorders. Autoimmunity: Mechanism of induction of organ specific and systemic autoimmune diseases. **Hypersensitivity** – types. Immune response to cancer, immunotherapy.
UNIT - IV **VACCINES** **8 Lectures**	**Immunisation practises** – active and passive immunisation. Vaccines – killed, attenuated – toxoids. Recombinant vector vaccines – DNA vaccines, synthetic peptide vaccines – anti idiotype vaccines. Humanized antibodies and plantibodies. Production of polyclonal and monoclonal antibodies. Principles, techniques and application. Genetically engineered

	antibodies. Abzymes.
UNIT - V **IMMUNO-TECHNIQUES** **8 Lectures**	**Immunotechniques:** Agglutination and precipitation technique. Immuno – electrophoresis, RIA, immunoblotting, Avidin – biotin mediated immunoassay.Immunohistochemistry – immunofluorescence, immunoferritin technique. Fluorescent immunoassay, fluorescence activated cell sorting (FACS). Cytokines assay: ELISA and ELISPOT. Lymphocytes transformation test (LTT); Lymphoblastoid cell lines. Experimental animal models: inbred strains, SCID mice, nude mice, knockout mice fully cloned animals. **(www.biologydiscussion.com/biochemistry/immunochemical...)**
UNIT – VI **Recent development**	Recent studies on Auto-immune disorders, Hypersensitivity. Dynamics of the immune response. The immune response in health and disease. Immunity against covid-19 infections
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	S

CO5	S	S	S	M	S
CO6	S	S	M	S	S
CO7	S	S	S	M	S
S-Strong; M-Medium; L-Low					

TEST BOOK:

1. Janis Kuby - (1997), immunology, 3rd edition, W.H. Freedom &co (Sd).

Recommended References:

1. Geoffrey Zubay - (1972), Immunology, 4th edition, W.M.C. Brown publishers.
2. Kenneth M. Murphy, Paul Travers, Mark Walport - (2007), Janeway's Immunobiology, 7th edition,Garland Science.
3. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt - (2006),Roitt's EssentialImmunology, 11thedition, Wiley-Blackwell.
4. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober- (1994), Cellular and molecular immunology, 2nd edition, B. Saunders Company.
5. Donald Mackay Weir &Stewart John - (1997), Immunology, 8thedition, Churchill Livingston.

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SEMESTER – III

COURSE NAME- GENETIC ENGINEERING

Course Code	BC302CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Genetic Engineering								

Course Objectives:

• This course enable the students to gain, knowledge on main aspects of implementation and transmission of a genetic material at molecular and cellular levels.
• The methods of change of a genetic material and construction of transgenic organisms with the given properties.
• To understand the function of creative use of modern tools and techniques for manipulation and analysis of genomic sequences

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The course covers the fundamentals of genome, gene cloning and gene transfer techniques	K2
CO2	• Students will understand the general plant tissues culture technique along gene therapy strategies.	K5
CO3	• Students will understand the basic molecular techniques and techniques involved in the field of forensics	K4

CO4	• The course also covers the humam genome project and biosafety levels which enables the students to acquire good laboratory practices	K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Unit - I **INTRODUCTION TO GENE CLONING** **8 Lectures**	Restriction and modification enzymes. Cloning vectors: Characteristics, Natural &artificial plasmids as vectors - advantages and disadvantages. Vectors used for cloning in E.coli., yeast, higher plants (Ti plasmid derivatives, caulimovirus) and animal cells (constructs of SV 40 and retroviruses). Characteristics of expression vectors. Construction of DNA libraries - genomic and cDNA libraries. Screening of recombinants. *(Blended of teaching)*
UNIT - II **TRANSGENICS** **8 Lectures**	Transposons and transposable elements: Transgenic animals - Gene transfer methods in animals. Recombinant selection and screening. Totipotency, haploids, growth of animal cell lines. Competent cells preparation, electroporation, microinjection and particle bombardment method, and selection of transformants. Transgenic plants - Use of agrobacterium for genetic engineering in plants. Plant cell cultures for the production of important compounds. Plant tissue culture – Micropropagation, protoplast isolation, somatic hybrids. Identification of transformed cells into callus and regeneration of transgenic plants.

UNIT III **MOLECULAR TECHNIQUES** **8 Lectures**	Polymerase chain reaction – principle, types and applications. Sanger's and Maxam-Gilbert's method for DNA sequencing. DNA Fingerprinting - RAPD, RACE (Rapid Amplification of cDNA Ends), RFLP and AFLP analysis and its application in forensic science, pedigree analysis, biodiversity, genetic counselling and germplasm maintenance. DNA footprinting. Chromosome walking, chromosome jumping. Mutagenicity test – Ames test. Markers linked to drug and disease resistant genes. Antisense technology and its application. Microarray technology: genomic and cDNA arrays.(*https://www.slideshare.net/drmalathi13/molecular-techniques)*
UNIT IV **GENE THERAPY** **8 Lectures**	Ex-vivo, Invivo, Insitu gene therapy Strategies of gene therapy: Gene augmentation – ADA deficiency, CFTR, Antisense therapy, Ribozymes, Protein Aptamers, Intrabodies. Stem cell therapy - Embryonic and adult Stem Cells, Totipotent, Pluripotent and Multipotent Cells. Testing and generation of embryonic stem cells, Testing for adult stem cells and differentiation, Potential use of stem cells – Cell based therapies
UNIT V **GENOME PROJECT AND BIOETHICS**	Human genome projects, gene bank. Genetically modified organisms (GMOs) in developed and developing countries. Genetically modified foods – benefits and risks. Bioethics: Laws and regulations in

8 Lectures	biotechnology, patent laws, and Intellectual property rights (IPR). Biosafety, types of biosafety, advantage and disadvantage. Ethics in cloning and stem cell research.

UNIT-VI

THERAPEUTIC APPLICATION OF GENETIC ENGINEERING TOOLS	Discuss on recent techniques in genetic engineering that help understand diseases and treating the same .

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	M	M	M	S
CO4	S	S	S	S	M
S-Strong; M-Medium; L-Low					

Recommended References Books:

1. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Frisch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000
2. DNA Cloning : a Practical Approach, DM Glover and BD Hames, IRL Press
3. Molecular and Cellular methods in Biology and Medicine. PB Kaufman,W.Wu.D Kim and LJ Cseke, CRC
4. DNA Science. A first Course in Recombinant Technology, DA Mickloss and GA Freyer, Cold Spring Harbour Laboratory Press, New York 1990
5. Molecular Biotechnology (2nd Edn) SB Primrose, Blackwell Scientific Pub. Oxford, 1994

6. Milestones in Biotechnology. Classic papers on Genetic Engineering. JA Davies and WS Reznikoff, Butterworth-Heinemann, Boston, 1992
7. Route Maps in Gene Technology, MR Walker and R Rapley, Blackwell Science Ltd, Oxford 1997
8. Molecular Biotechnology. Glick Principles of Gene Manipulation by Old and Primrose, Blackwell publication.

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SEMESTER - III

COURSE NAME - CLINICAL BIOCHEMISTRY

Course Code	BC303CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				4	1	-	5		
Pre-requisite	Knowledge on basic idea of Clinical Biochemistry								

Course Objectives:

- The course aims to provide an advanced understanding of the biochemical mechanisms and pathophysiological processes responsible for common biochemical disorders. The course provides an overview of normal and abnormal metabolic functions, the impact of disorders on metabolic processes, an overall picture about the molecular basis of diseases and novel strategies to prevent the diseases.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The students will understand the basic concepts and principles of Clinical Biochemistry, detail on the various biological specimens including the process of collection, preservation and storage	K2
CO2	• The students will understand the aetiology, types, clinical manifestations and treatment of various metabolic disorders of carbohydrate, protein and lipids	K4
CO3	• The students will understand the pathophysiological processes responsible for common inherited disorders	K4
CO4	• The students able to understand the Hepatobiliary system and find the differential diagnosis tests for bilirubin metabolism.	K3
CO5	• The course covers the fundamentals disorder, therapeutic, metabolic disorders in human.	K6, K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I

BIOCHEMICAL LABORATORY - ROUTINE ANALYSIS IN URINE AND BLOOD

8 Lectures

Introduction to Biochemical laboratory: Roles of biochemical laboratory, Mechanisation and automation in clinical biochemistry. Quality control in clinical laboratories - Total laboratory uncertainty, accuracy and precision. Selection and optimization of laboratory methods. Clinical evaluation of laboratory methods. Biochemical analysis in blood and urine. Analysis of proteins - Plasma protein spectrum during inflammation, paraproteins. Blood gases. Electrolytes and acid – base balance. Regulation of electrolyte content of body fluids and maintenance of pH reabsorption of electrolytes. Acidosis &Alkaloids and their determination in clinical laboratory

UNIT - II **DISORDERS OF CARBOHYDRATE METABOLISM** **8 Lectures**	Glucose level in normal blood, renal threshold, hyper and hypoglycemia and glycosuria - qualitative tests for sugars in urine - intravenous and other types of glucose tolerance tests - fructose levels in blood, lab diagnosis of early and latent diabetes mellitus - diabetic coma, secondary degenerative changes associated with diabetes mellitus. Glycogen storage disorders, Pentosuria, and galactosemia
UNIT - III **DISORDER OF PROTEIN AND PROTEIN METABOLISM** **8 Lectures**	Agammaglobulinemia, Alpha – fetoprotein, Amyloidosis. Cryoglobulinemia. Hypo and hyper immune gamma – globulinemia. Abnormalities in Nitrogen Metabolism – uremia and factors affecting nitrogen balance, porphyrias and porphyrinuria. Disorders of lipids: Plasma lipoproteins, cholesterol, triglycerides &phospholipids in health and disease. Hyperlipidemia, hyperlipoproteinemia, ketone bodies, fatty liver. Major Cardiovascular diseases – Atherosclerosis – risk factors, pathogenesis. Laboratory diagnosis of acute myocardial infarction. Inborn error of metabolism: Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Leish – Nyhan syndrome, Histidinemia, Gaucher's disease, Tay – sachs and Niemann – Pick disease.
UNIT – IV **DISORDERS OF LIVER**	Hepatobiliary system - Hepatobiliary function tests - lab findings and differential diagnosis of jaundice - metabolism of bilirubin - cirrhosis, hepatic coma,

AND KIDNEY **8 Lectures**	hepatitis, gallstones, cholecystitis and tumours. Diagnostic Enzymes – Enzymes in health and diseases. Excretory system - Renal function tests - Biochemical changes and laboratory findings in acute and chronic renal failure - clearance of tests - urinary calculi, renal hypertension - principles of peritoneal and hemodialysis.
UNIT - V **DISORDERS OF ENDOCRINE SYSTEM** **8 Lectures**	Blood and coagulation - disturbances of blood clotting mechanisms - systematic analysis of hemorrhagic disorders - coagulation and prothrombin time, determination - haemoglobin-anaemia - abnormal hemoglobins and their identification. Endocrine system: Laboratory diagnosis and investigations related to disorders of thyroid, pituitary, adrenal cortex, adrenal medulla, testes, ovaries - plasma and urinary assays of hormones related to various endocrine disorders.
UNIT - VI	Seminar talks on recent research topics in diabetes and cardiovascular diseases.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	M
CO4	S	S	M	S	S

CO5	S	S	S	M	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Rodney F. Boyer - (2010). Biochemistry Laboratory: Modern Theory and Techniques, 2th edition, Pearson Prentice Hall.

2. Undurti N. Das - (2011). Molecular Basis of Health and Disease, 1stedition,Springer.

3. Nanda Maheshwari – (2008). Clinical biochemistry, 1stedition, JAYPEE.

4. MN Chatterjea, Ranashinde – (2012). Textbook of Medical Biochemistry, 8thedition, JAYPEE.

5. By William J. Marshall, S. K. Bangert – (1995). Clinical Biochemistry: Metabolic and Clinical Aspects, 1stedition, Churchillivingstone.

6. Michael Lieberman, Allan D. Marks – (2009). Marks'Basic Medical Biochemistry: A Clinical Approach, 3rdedition, Lippincott Williams &Wilkins.

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SEMESTER - III

COURSE NAME - LABORATORY COURSE III

Course Code	BC304CR	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				-	1	5	5		
Pre-requisite	Knowledge on basic idea of Biochemistry								

Course Objectives:

- This course is intended as an introduction to cell culture basics, covering topics such as getting familiar with the requirements of a laboratory dedicated to cell culture experiments, laboratory safety, aseptic technique, and microbial contamination of cell cultures, as well as providing basic methods for passaging, freezing, and thawing cultured cells.
- During this course a lot of practical knowledge, which is necessary for successful application of cell and tissue cultures in biological sciences, will be obtained

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Knowing the principles of cell culture techniques, importance of sterility and good aseptic technique.	K3
CO2	• Manipulations with cell cultures, student's aseptic technique during these manipulations, student's accuracy and awareness during manipulations and sub culturing of human and animal cells in vitro.	K4
CO3	• Ability to characterise cell culture problems, present possibilities, applications and future perspective. Knowing the required conditions for cell cultures, required media and the equipment	K7

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

List of experiments:

1. Biology of cultured cells
2. Principle and operations of lab Equipment: Biosafety cabinet, CO_2 Incubator, Real time PCR
3. Aseptic techniques, and safety protocols
4. Cell line repository
5. Preparation of Media
6. Plating of cells
7. Determination of Contamination
8. Adherent Subculture
9. Counting cells using a hemocytometer
10. Cryopreservation and Storage
11. Analysis of cell viability
12. Extraction of total RNA and cDNA synthesis
13. Reverse transcriptase Polymerase chain reaction
14. Extraction of protein
15. Separation of protein by SDS PAGE Electrophoresis
16. Identification and validation of protein by western blot analysis.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S

S-Strong; M-Medium; L-Low

Reference books:

1. Doyle A., Griffiths J. B., Cell and Tissue Culture: Laboratory Procedures in Biotechnology. John Wiley &Sons Publications. 1999.

2. Butler M., Animal Cell Culture and Technology. Garland Science publications. 2004

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SEMESTER -III

COURSE NAME - VALUE ADDITION IN FOOD

Course Code	BC003VAC	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	0		
Pre-requisite	Knowledge on basic idea of Dairy & Food grains								

Course Objectives:

• To study the process of and provide a new perspective on value adding, with an emphasis towards 'authenticity' in food
• This course delivers new knowledge and provides future direction to small scale farming Producers and the wider food industry

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The principles of preservation behind the methods of preservation	K2
CO2	• Acquire skills to formulate fruits based preserved products with value addition for nutritional benefits	K6
CO3	Explore the principle of preservation in vegetables based products with nutritive value.	K4
CO4	• Prepare cereals and pulses based preserved products focusing the principle of preservation.	K7
CO5	• Develop new products with maximum retention of essential nutrients.	K1
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **FOOD SCIENCE AND TECHNOLOGY** **8 Lectures**	Methods of food preservation, Use of non-thermal technologies, alternate-thermal technologies, infrared biological technologies - antimicrobial enzymes and bacteriocins in food processing.
UNIT - II **FRUITS AND VEGETABLES**	Value addition and storage of fruits and vegetables. fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, chips, pickles. Dehydrated fruits and vegetables. Fermented foods and beverages from fruit and

8 Lectures	vegetables
UNIT - III **FOOD GRAINS, SPICES AND PLANTATION CROPS** **8 Lectures**	Anti-nutritional factors in food grains and oilseeds. Value added food grain products like breads, biscuits, cakes, doughnuts, buns, pasta goods, extruded, Instant ready mixtures, puffed foods, confectionary products, breakfast cereals, snack foods, malted food products, legume based food products.
UNIT - IV **DAIRY PRODUCTS** **8 Lectures**	Reconstituted and flavoured milks**.** Technology of fermented milks. Milk products processing viz. cream, butter, ghee, cheese, condensed milk, evaporated milk, whole and skimmed milk powder, ice cream, khoa, channa, paneerand similar products. **Food Fortification:** Fortification of bread, pasta, noodles, biscuits, and breakfast cereals. Micronutrient fortification of snack products. Other special fortified products - salt, sugars, milk and oils. Safety limits
UNIT - V **MEAT FISH AND POULTRY PRODUCTS**	Meat and poultry preservation like curing, smoking, freezing, canning and dehydration Value addition and byproducts utilizations. Factors influencing keeping quality of meat. Processing and preservation of fish and its

8 Lectures	products. Preservation canning, smoking and freezing of fresh and sea water fish and its products. Utilization of byproducts from fish processing industries. Preservation methods of shell eggs and egg products freezing-pasteurization- desugarisation . Technology of egg products viz. egg powder, albumen and flakes.
UNIT - V **FOOD PROCESSING USING VALUE ADDITION**	Examples of how to make value-added food products like making salsa out of your tomatoes, make jam or jelly out of your berries
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S)

1. Food Science by Potter

2. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
3. Principles of Food Science, Vol-I by Fennma Karrel
4. Preservation of Fruits &Vegetables by Girdhari Lal, Sidhapa and Tandon
5. Post-Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
6. Food Science by Mudambi
7. Processed Meats; Pearson AM &Gillett TA; 1996, CBS Publishers.
8. Meat; Cole DJA &Lawrie RA; 1975, AVI Pub.
9. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
10. Developments in Meat Science – I &II, Lawrie R; Applied Science Pub. Ltd.
11. Egg Science &Technology; Stadelman WJ &Cotterill OJ; 1973, AVI Pub.
12. Fish as Food; Vol 1 &2; Bremner HA; 2002, CRC Press.
13. Fish &Fisheries of India; Jhingram VG; 1983, Hindustan Pub Corp
14. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press
15. Fish Processing Technology , Rogestein &Rogestein

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SEMESTER – III

COURSE NAME - BIO-ENTREPRENURSHIP

Course Code	BC305DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Biosciences in Business								

Course Objectives:

- To teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.
- Illustrate the basics of bio-business in various emerging biological field
- Build critical thinking capability and design methodologies for entrepreneur
- Create the ability for planning, commencing, executing and managing business

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students should be able to gain entrepreneurial skills, understand the various operations involved in venture creation, identify scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centers and various agencies	K2
CO2	• The knowledge pertaining to management should also help students to be able to build up a strong Network within the industry.	K3
CO3	• Evaluate and develop critical thinking leading to Innovative skills related to business.	K4

CO4	• Develop the protocol to approach funding agencies both government and non-government	K7
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I **INTRODUCTION TO BIO BUSINESS** **8 Lectures**	Introduction to Bio-business, Fundamentals of Biotech fo Business, Contemporary Vs antique Bio-business, Wealth Crea Bio-business. Entrepreneurship development programs of publ private agencies (MSME, DBT, BIRAC, Make in India), st dimensions of patenting & commercialization strategies.
UNIT - II **BIOSCIENCES IN BUSINESS** **8 Lectures**	Healthcare, Biomedical sciences, Industrial Life Sciences, Biotechnology, Agriculture based business, Food Industry; Where Things Stand: A Quick Survey of Regional and Global Strengths and Capabilities. Business related to Environment Management, Bioremediation, Bioleaching and waste management.
UNIT - III **BIO MARKETS - BUSINESS STRATEGY AND MARKETING** **8 Lectures**	Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio-business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.
UNIT - IV **PROTECTING THE**	Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights,

INTELLECTUAL PROPERTY **8 Lectures**	industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of 'prior art': invention in context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.
UNIT - V **PATENTING: BASICS OF PATENTS** **8 Lectures**	types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patentingrequirement, procedures and costs; financial assistance for patenting-introduction to existing schemes; publication of patents-gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientistsuniversity/organizational rules in India and abroad,

	collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and noncommercial incentives.
UNIT-VI **FINANCE AND ACCOUNTING**	Business plan preparation including statutory and legal requirements, Business feasibility study, and financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. Adams, D. J., & Sparrow, J. C. (2008). Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences. Bloxham: Scion.
2. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
4. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, Government of India.

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SEMESTER –III

COURSE NAME - GENOMICS AND PROTEOMICS

Course Code	BC306DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Genomics								

Course Objectives:

- The objectives of this course is to provide introductory knowledge concerning genomics, proteomics and their applications

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students should be able to acquire knowledge and understanding of fundamentals of genomics and proteomics	K2
CO2	• Understand the Transcriptomics and metabolomics and their applications in various applied areas of biology.	K3
CO3	• Knowledge about Overview of protein chips and functional proteomics; clinical and biomedical applications of proteomics.	K4
CO4	• Students able to know the emerging diseases and design new drugs, determining gene location in genome sequence.	K6.K7

1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **BASICS OF GENOMICS AND PROTEOMICS** **8 Lectures**	Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast.
UNIT – II **GENOME MAPPING** **8 Lectures**	Genetic and physical maps; markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, *in situ* hybridization, comparative gene mapping
UNIT – III **GENOME SEQUENCING PROJECTS** **8 Lectures**	Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web.
UNIT – IV **COMPARATIVE GENOMICS** **8 Lectures**	Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs; use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs; determining gene location in genome sequence.
UNIT – V **PROTEOMICS** **8 Lectures**	Aims, strategies and challenges in proteomics; proteomics technologies: 2D-PAGE, isoelectric focusing, mass spectrometry, MALDI-TOF, yeast 2-hybrid system, proteome databases.
UNIT – VI	Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking

FUNCTIONAL GENOMICS AND PROTEOMICS **8 Lectures**	and characterization of chromosomes, mining functional genes in genome, gene function- forward and reverse genetics, gene ethics; protein-protein and protein-DNA interactions; protein chips and functional proteomics; clinical and biomedical applications of proteomics; introduction to metabolomics, lipidomics, metagenomics and systems biology.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	M	S	M
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S):

1. Primrose, S. B., Twyman, R. M., Primrose, S. B., &Primrose, S. B. (2006).
2. Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.
3. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology.

   Totowa, NJ: Humana Press.
4. Campbell, A. M., &Heyer, L. J. (2003). Discovering Genomics, Proteomics, and
5. Bioinformatics. San Francisco: Benjamin Cummings.

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SEMESTER - III

COURSE NAME - REPRODUCTIVE BIOLOGY

Course Code	BC307DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Human Reproductive system								

Course Objectives:

- Study the molecular mechanisms of human reproduction.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Student will able understand the molecular basis behind human reproduction	K2
CO2	• Knowledge of the endocrine and neuroendocrine regulation of reproduction.	K4
CO3	• The students will understand the asthenozoospermia and ligozoopermia.	K4
CO4	• Explain Regulation of reproductive cycle in female	K7
CO5	• Knowledge of pre-fertilizer	K2
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

UNIT - I

SPERMATOGENESIS **Theory Sex determination and differentiation:** Mechanism of Sex determination, differentiation of gonad and the genital tract. Stem cell renewal in testis,

8 Lectures	Spermatogenesis: structural and molecular events, experimental approaches to study spermatogenesis; Seminiferous epithelial cycle; Sertoli cell: structure and function.
UNIT - II **STEROIDOGENESIS** **8 Lectures**	**Leydig cell:** generation of Leydig cell, steroidogenesis; Leydig and Sertoli cell proliferation during foetal and postnatal development; Regulation of testicular functions. Epididymal maturation of spermatozoa; Capacitation, Signal transduction pathway in acrosome reaction.
UNIT - III **MALE STERILITY** **8 Lectures**	**Male sterility:** azoospermia, oligozoospermia, asthenozoospermia, varicocele; Genetic basis for male infertility, Mutational analysis in genes for hormones, receptor and gamete development. Follicular development and selection; Role of extra-and intra-gonadal factors in folliculogenesis; Oocyte maturation and its regulation
UNIT - IV **FEMALE REPRODUCTIVE SYSTEM** **8 Lectures**	Ovulation: factors involved in follicular rupture; Luteinization and luteolysis; Follicular atresia. Regulation of reproductive cycle in female: menstrual cycle in human, estrous cycle in rat, estrous behaviour in cycling animals; Female reproductive disorder: amenorrhea, polycystic ovary
UNIT - V **FERTILIZATION AND CONTRACEPTION**	Fertilization:A comparative account on pre-fertilization events in oviparous animals (echinoderms-amphibians-mammals), activation of egg, candidate molecules involved in fertilization; Contraception leading to prevention of

	polyspermy: surgical, hormonal and immunocontraception
8 Lectures	
UNIT-VI	Seminar talks on recent research topics in male infertility
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

Reference books:

1. The Physiology of Reproduction, Vol 1 and 2, Ernst Knobil and Jimmy D. Neil, (ed), Raven Press.
2. Male Reproductive Function, Christina Wang, (ed), Kluwer Academic Publishers.
3. The ovary, (ed), Solly Zuckerman Zuckerman, Barbara J. Weir, T. G. Baker. Academic Press.
4. The ovary, Peter C.K. Leung and Eli Y. Adashi, (ed), Elsevier (Academic Press), 2004.
5. Cell and Molecular Biology of Testis, (ed), Claude Desjardins and Larry L. Ewing.

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SEMESTER – III

COURSE NAME - CONCEPTS IN NEUROCHEMISTRY

Course Code	BC308DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Neuroscience								

Course Objectives:

- To introduce basic concepts about the organization, structure, and function of the human central nervous system; To enable students to apply these fundamental principles toward understanding nervous system function and dysfunction and toward clinical problem-solving in relation to disorders that affect the nervous system, with emphasis on the central nervous system.

PRE-REQUISITE:

- Neuroscience is a stand-alone course but it is expected that students have a basic understanding of human anatomy and physiology and the basic vocabulary of the anatomical sciences.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• To have in depth insight in basic brain structure and function reaching from the molecular to systems level.	K2
CO2	• To understand how neural systems contribute to sensory experiences, thoughts, emotions, behavior	K5
CO3	• To apply and adopt experimental methods to gain new knowledge	K4

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **CNS OVERVIEW** **8 Lectures**	Introduction to the Brain; Overview of brain systems and general principles of their functional organization: From cortical maps and subcortical loops to the micro-structure of brain circuits and their interconnections. CNS Organization; CNS Topography; Neuroembryology. VASCULATURE: Metabolism, Cerebral blood flow, CSF; Blood Supply; Stroke.(*https://www.msdmanuals.com › ... › Biology of the Nervous System)*
UNIT - II **CELL BIOLOGY OF NEURONS AND GLIA** **8 Lectures**	Nucleus and gene expression and regulation, Protein synthesis &translational control (including RNAi), Protein sorting &trafficking (signal peptides, Golgi, secretory and endocytic pathways), Cytoskeleton &transport (cytoskeleton, actin, microtubules, intermediate filaments, dendritic and axonal localization/transport, motors and adaptor), Signaling Pathways. Mitochondria, energy homeostasis and free radicals/energy metabolism in the neuron, Overview of glial cell biology &myelination (types of glia, morphology and function, myelination in CNS and PNS).*(Blended mode of teaching* *)*
UNIT - III **ELECTRICAL PROPERTIES OF NEURONS** **8 Lectures**	Overview of membrane structure &membrane transport, membrane potential, Ion channels and Ion Channel activity (electrochemical gradient), Action potentials, Propagation of action potentials along axons, Modulating action potential, Electrophysiological techniques for studying action potentials and ion channels .
UNIT - IV **SYNAPTIC**	Overview of synaptic communication/structure of the synapse, Neural Signaling:- Neurotransmitters; Action

TRANSMISSION **8 Lectures**	potentials:- Resting potential; Excitatory; Inhibitory; Threshold; Depolarization; Hyperpolarization; Synapse: Formation; Synaptic communication; Neural circuits, synaptic plasticity: LTP/LTD, Spike Time dependent plasticity. Mechanism of neurotransmitter release, postsynaptic response: electronic properties of dendrites, basic integration, Ionotropic (v) metabotropic receptors, Neurochemical transmission: Glutamate, GABA, Glycine, Acetylcholine (Synthesis, storage, release and inactivation), Dopamine, Norepinephrine, epinephrine, serotonin, histamine, Neuropeptides &atypical neurotransmitters, Electrical synapses (gap junctions).
UNIT - V **DEVELOPMENT AND PLASTICITY** **8 Lectures**	Overview of nervous system development/ comparative embryology, Neural induction, Regionalization, Neurogenesis &migration, Mechanisms of axon guidance &target cell recognition, Synapse formation &elimination, Neuronal Death.*(Chalk and talk)*
UNIT - VI **TRAUMA AND DISEASE**	Development disorders; Degenerative disorders; Psychiatric disorders; Injury disorders; Others like Epilepsy; Visual Pathways; Occular Movements; Vascular syndromes; Sensory and Motor Syndrome.
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	M
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S):

1. J. W. Baynes, M. H. Dominiczak, Medical Biochemistry, 2nd ed., Elsevier Mosby, Philadelphia, New York, Toronto, 2005.
2. G. Siegel, R.W. Albess, S. Brady, D. Price, Basic Neurochemistry, 7th Edition, Amsterdam. Tokio, 2006.
3. George J Siegel, MD, Editor-in-Chief, Bernard W Agranoff, MD, R Wayne Albers, PhD, Stephen K Fisher, PhD, and Michael D Uhler, PhD. Basic Neurochemistry, 6th edition Philadelphia: Lippincott-Raven; 1999.
4. Dale purves , George j. Augustine, David fitzpatrick , William c. Hall, Anthony-samuel lamantia , James o. Mcnamara , S. Mark williams. Neuroscienc ethird edition Publishers Sunderland, Massachusetts U.S.A, 2004.
5. Siegel, George and R. Wayne Albers, Scott Brady and Donald Price Basic Neurochemistry, 7th edition: Molecular, Cellular and Medical Aspects Academic Press/2005
6. Haines, Duane Neuroanatomy - An Atlas of Structures, Sections and Systems, 5th edition Lippincott Williams and Wilkins/2000.

Reference Books

1. Afifi and Bergman, Functional Neuroanatomy, Text and Atlas, McGrawHill, 2nd Edition, 2005.
2. Haines, Neuroanatomy: An Atlas of Structures, Sections and Systems, 7th ed. Ed. Lippincott William and Wilkins, 2007.
3. Blumenfeld, Neuroanatomy Through Clinical Cases (Paperback), Sinauer Associates; 2nd edition (2010).

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SEMESTER - III

COURSE NAME - NUTRITIONAL BIOCHEMISTRY

Course Code	BC309DCE	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	3		
Pre-requisite	Knowledge on basic idea of Chemistry and Biochemistry								

Course Objectives:

• To review the biological system of energy metabolism
• To study the chemical/biochemical properties and metabolic pathways of carbohydrates, lipids, and proteins
• To examine the regulatory mechanisms of macronutrient metabolism and associated signaling pathways
• To understand the research techniques used in basic biochemistry and nutritional biochemistry research
• To evaluate and criticize the experimental approaches and scientific information presented in the research articles related to nutritional biochemistry

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Capable of describing biochemical pathways relevant in nutrient metabolism	K2
CO2	• Capable of describing biochemical techniques that are relevant for the investigation of the Nutrient metabolism.	K5
CO3	• To introduce latest concept of dietary Management.	K3

CO4	• Describes the metabolic functions and deficiency of micro & macro nutrients	K7

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **SOURCES, FOOD COMPOSITION, PROPERTIES AND STORAGE OF COMMON FOODS** **8 Lectures**	Functions of food in relation to health- classification of foods based on nutrients. Food preservation reasons for preserving foods, methods of preservation – an understanding of the principles involved, food additive in processed food and their effects. Food groups to provide nutritive requirement for normal health- body building foods, energy foods and protective foods.
UNIT - II **BASICS FOR COMPUTING NUTRIENT REQUIREMENTS** **8 Lectures**	Latest concepts in dietary recommendations, RDA – ICMR and WHO: their uses and limitations. Definition of unit of energy – cal, RQ, SDA and NPU. Energy metabolism: Basal and resting metabolism – influencing factors, Methods to determine energy requirements and expenditure. The sources and functions of essential nutrients – proteins (high biological and low biological value), carbohydrates and fats. Sources and functions of dietary fibre, Pro and Prebiotics.
UNIT - III **MICRO AND MACRO MINERAL NUTRIENTS** **8 Lectures**	Distribution sources, metabolic functions and deficiency manifestations – Calcium, Phosphorus, Sodium, Potassium, Iron, Copper, Selenium and Zinc. Fat and water soluble vitamins – Occurrence, properties and function – Hyber and Hypovitaminosis. Role of Vitamin as Antioxidant
UNIT - IV **NUTRITION THROUGH**	Special needs of Infants, children, adolescents, pregnant and lactating women, convalescents and old persons

LIFE CYCLE **8 Lectures**	
Unit - V **PRINCIPLES OF DIET THERAPY** **8 Lectures**	Diet during stressed conditions- laborers. Patients- therapeutic diets for anemia, malnutrition, obesity, diabetes mellitus and allergy.
UNIT – VI	Uncover the vital information about the role diet plays in the establishment, development, and prognosis of physical diseases such as cancer, diabetes, heart disease, and stroke
Total Lectures – 40	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	S	S	M	S	S
CO3	S	M	S	S	M
CO4	S	S	M	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

1. L. Stryer. 2002. Biochemistry, 5thedition. W.H.Freeman&Company, New York
2. Horton, R., Moranm, LA., Scrimgeour, G, MarcPerry and David Rawn. 2006. Principles of Biochemistry, 4thedition.
3. A. L. Lehninger, Nelson &Cox. 2007. Principles of Biochemistry, 5thedition, CBS, India.

4. Murray R. K. et al. Harpers Illustrated Biochemistry, 2009, 28thedition. Lange Medical Books/McGraw-Hill.
5. Zubay, 2005. Principles of Biochemistry, 4thedition. Prentice hall.
6. Richard Harvey, Denise Ferrier. 2005. Lippincott. Outlines of Biochemistry, 5th edition.

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Non-Major Electives (NME): These courses are open to students of other Departments except Biochemistry

CATEGORY	CODE	SUBJECTS	HOURS	CREDIT
Non-Major Elective Odd semester	**BC001NME**	**Biochemistry**	**3**	**2**
Non-Major Elective Even semester	**BC002NME**	**Molecular basis of diseases**	**3**	**2**

SEMESTER – ODD SEMESTER

COURSE NAME- **BIOCHEMISTRY**

Course Code	BC001NME	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	2		
Pre-requisite	Knowledge on basic idea of Biochemistry								

Course Objectives:

- To understand the structure and functions of important biological macromolecules.

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• Students can understand the fundamental energetics of biochemical processes	K2
CO2	• To understand the relation between biochemical defects and metabolic disorders.	K5
CO3	• To understand the organisation of signalling pathways.	K4
CO4	• To understand the role of membrane processes in metabolism	K6
CO5	• Overall, gaining an understanding of the processes of metabolic transformation at the molecular level and how these processes are studied.	K1

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **CARBOHYDRATE** **8 Lectures**	Definition, classification, structure and biological significance of monosaccharide (glucose, fructose, & ribose), Disaccharide (lactose, maltose & Sucrose), Polysaccharide – Homopolysaccarides (cellulose, starch and glycogen), Heteropolysacchrides (chondratin sulphate, Heparin and hyaluronate).
UNIT - II **AMINO ACIDS AND PROTEINS** **8 Lectures**	Classification, Zwitter ion, Physical properties. Peptide bond –Classification and biologically important peptides. Protein – Definition, classification and structure of proteins (Primary, secondary, tertiary and quaternary).
UNIT - III **NUCLEIC ACIDS** **8 Lectures**	Definition, Nucleoside & Nucleotide, functions of nucleotides Watson & Crick model of DNA structure, various forms and functions of DNA. Types, structure and functions of RNA (mRNA, tRNA, rRNA).
UNIT - IV **LIPIDS AND PORPHYRINS** **8 Lectures**	Definition, Classification. Fatty acids - classification, Simple lipids –Triglycerides. Compound lipids: Structure and functions of phospholipids and glycolipids, Steroids – Structure and function of cholesterol. Structure of Porphyrins, Structure and function of Heme, Cytochromes and Chlorophyll**.**
UNIT - V **VITAMINS AND MINERALS** **8 Lectures**	Definition, sources, functions, deficiency syndromes of Fat soluble vitamins (A, D, E and K) and Water soluble vitamins (B complex and C). Calcium, Phosphorous, Magnesium, Sodium, Potssium, Iron, Zinc, Iodine, Fluoride, Copper Selenium, Manganese

	and Chromium. Other trace elements: Molybdenum, boron, nickel, lithium, antimony, aluminium and lead.
Unit-VI **Current contour**	Using the basic understanding on various biomolecules, identify its importance in drug development, immunology, pathology, pharmacy, vaccine development, etc.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	M	M	M	S
CO4	S	S	S	S	M
CO5	M	S	S	M	M
S-Strong; M-Medium; L-Low					

Recommended References:

1. Biochemistry – L. Stryer.
2. Principles of Biochemistry – R. Horton et al.
3. Lehninger's Principles of Biochemistry - D. L. Nelson and M. M. Cox.
4. Harpers Biochemistry- R. K. Murray et al.
5. Principles of Biochemistry- G. L. Zubay.
6. Outlines of biochemistry- Lippincott

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SEMESTER – ODD SEMESTER

COURSE NAME - MOLECULAR BASIS OF DISEASES

Course Code	BC002NME	Course Type	Core	L	T	P	C	Syllabus version	2021-2022
				2	1	-	2		
Pre-requisite	Knowledge on basic idea of Metabolic disorder								

Course Objectives:

- To impart thorough knowledge about the biochemical basis of various diseases and disorders. To study various diagnostic and therapeutic methodologies available for diseases and disorders

Expected Course Outcomes:

On the completion of the course the student will be able to

COs	COURSE OUTCOMES	KNOWLEDGE LEVEL
CO1	• The students will understand the basic concepts and principles of various diseases, and on the various biological specimens including the process of collection, preservation and storage.	K2
CO2	• The students will understand the aetiology, types, clinical manifestations and treatment of various metabolic disorders of carbohydrate, protein and lipids.	K3
CO3	• The students will understand the pathophysiological processes responsible for common inherited disorders	K4
CO4	• To the knowledge of Disorders of lipids and health disease.	K3
CO5	• To understand the Excretory system also Blood and coagulation.	K2

K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation

UNIT - I **BIOCHEMICAL LABORATORY - ROUTINE ANALYSIS IN URINE AND BLOOD** **8 Lectures**	**Introduction to Biochemical laboratory**: Roles of bioch laboratory, Mechanization and automation in clinical bioche Quality control in clinical laboratories - Total laboratory unce accuracy and precision. Selection and optimization of lab methods. Clinical evaluation of laboratory methods. Biochemical analysis in blood and urine. Analysis of proteins - Plasma protein spectrum during inflammation, paraproteins. Blood gases. Electrolytes and acid – base balance. Regulation of electrolyte content of body fluids and maintenance of pH reabsorption of electrolytes. Acidosis &Alkaloids and their determination in clinical laboratory.
UNIT - II **DISORDERS OF CARBOHYDRATE AND PROTEIN METABOLISM:** **8 Lectures**	**Disorders of carbohydrate metabolism**- Glucose level in normal blood, renal threshold, hyper and hypoglycemia and glycosuria - qualitative tests for sugars in urine - intravenous and other types of glucose tolerance tests - fructose levels in blood, lab diagnosis of early and latent diabetes mellitus - diabetic coma, secondary degenerative changes associated with diabetes mellitus. Glycogen storage disorders, Pentosuria, and galactosemia
UNIT - III **IIIDISORDER OF PROTEIN METABOLISM**	Agammaglobulinemia, Alpha – fetoprotein, Amyloidosis. Cryoglobulinemia. Hypo and hyper immune gamma – globulinemia. Abnormalities in Nitrogen Metabolism – uremia and factors affecting nitrogen balance, porphyrias and porphyrinuria.

8 Lectures	
UNIT - IV **DISORDERS OF LIPIDS AND INBORN ERRORS OF METABOLISM** **8 Lectures**	**Disorders of lipids:** Plasma lipoproteins, cholesterol, triglycerides &phospholipids in health and disease. Hyperlipidemia, hyperlipoproteinemia, ketone bodies, fatty liver. Major Cardiovascular diseases – Atherosclerosis – risk factors, pathogenesis. Laboratory diagnosis of acute myocardial infarction. **Inborn error of metabolism:** Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Leish – Nyhan syndrome, Histidinemia, Gaucher's disease, Tay – sachs and Niemann – Pick disease
UNIT - V **DISORDERS OF LIVER AND KIDNEY** **8 Lectures**	**Hepatobiliary system** - Hepatobiliary function tests - lab findings and differential diagnosis of jaundice - metabolism of bilirubin - cirrhosis, hepatic coma, hepatitis, gallstones, cholecystitis and tumours. Diagnostic Enzymes – Enzymes in health and diseases. Excretory system - Renal function tests - Biochemical changes and laboratory findings in acute and chronic renal failure - clearance of tests - urinary calculi, renal hypertension - principles of peritoneal and hemodialysis. Blood and coagulation - disturbances of blood clotting mechanisms - systematic analysis of hemorrhagic disorders - coagulation and prothrombin time, determination - haemoglobin-anemia - abnormal hemoglobins and their identification.
UNIT - VI **DIAGNOSIS**	Laboratory diagnosis and investigations related to disorders of thyroid, pituitary, adrenal cortex, adrenal medulla, testes,

ovaries - plasma and urinary assays of hormones related to various endocrine disorders.

Total Lectures – 40

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S
S-Strong; M-Medium; L-Low					

Recommended References:

TEXT BOOK(S)

1. Clinical Biochemistry, 5th Edition, Gaw , Murphy , Srivastava and Cowan , O'Reilly, 2013, ISBN: 9780702051791.

REFERENCE BOOK(S)

1. Rodney F. Boyer - (2010). Biochemistry Laboratory: Modern Theory and Techniques, 2thedition, Pearson Prentice Hall.
2. Undurti N. Das - (2011). Molecular Basis of Health and Disease, 1stedition,Springer.
3. Nanda Maheshwari – (2008). Clinical biochemistry, 1stedition, JAYPEE.
4. MN Chatterjea, Ranashinde – (2012). Textbook of Medical Biochemistry, 8thedition, JAYPEE.

5. By William J. Marshall, S. K. Bangert – (1995). Clinical Biochemistry: Metabolic and Clinical Aspects, 1st edition, Churchillivingstone.

6.Michael Lieberman, Allan D. Marks – (2009). Marks'Basic Medical Biochemistry: A Clinical Approach, 3rd edition,Lippincott Williams &Wilkins.

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SEMESTER IV

CATEGORY	CODE	SUBJECTS	Hrs	Credits
Core 13	BC 401CR	Proposal Writing Research based project Project Dissertation Project Viva-Voce	30	25
		Total credits for Semester IV	**30**	**25**