PERIYAR UNIVERSITY

Periyarpalkalai Nagar, Salem-636011
(Reaccredited with 'A' grade by the NAAC

DEPARTMENT OF BIOCHEMISTRY

M.Sc. DEGREE

[Choice based credit system(CBCS)]

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2018-2019 and thereafter)

1. Preamble

The Department of Biochemistry was established in the year 2005. The department comprises of two Assistant Professors and two Associate Professors. The main objective of the department is to inculcate the basic concepts and applications of Biochemistry and thrive in the field of research and development. The department is known for its commitment to the self development of students into well-molded individuals who can take on leadership role in Industry, Academic or Government organization. The Department aims in developing human resources in Biochemistry and to expand and transfer knowledge in particular to the rural community residing in and around Salem district of Tamil Nadu, India. There is a greater demand globally, for trained manpower in the areas of Biochemistry for Research and Development in multinational companies, public sectors, quality control labs, biopharmaceutical companies, food industries as well as in universities. The Department is inbuilt and established with numerous research facilities such as high speed ultra centrifuges, spectrophotometers, semi autoanalyser, colorimeter, deep freezers, Cold room, sonicator, Gel documentation system, orbital shakers, PCR machines, CO2 incubators, ELISA Reader, centrifuges, incubators, laminar flow, electronic balance, etc.

2. General Graduate Attributes

The graduate attributes reflect both disciplinary knowledge and understanding, skills, competencies, that students should acquire/attain and demonstrate while studying Biochemistry program. Some of the characteristic attributes that a graduate should demonstrate are as follows:

1. **Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of Biochemistry
2. **Communication Skills:** express thoughts and ideas effectively in writing and orally
3. **Critical thinking:** Capability of analyzing, interpreting, discussion by following scientific approach to knowledge enrichment.
4. **Problem solving:** apply one's learning to real life situations.
5. **Analytical reasoning**: ability to analyze and solve problems quickly and effectively
6. **Research-related skills:** Ability to define problems, analyse, interpret and draw conclusions from data and report the results of an experiment or investigation.
7. **Cooperation/Team work**: Ability to work effectively as a member of a team rather than individually.

8. **Scientific reasoning:** Ability to evaluate ideas and evidence of a particular problem and reason them based on scientific approach.
9. **Reflective thinking:** ability to learn from experience
10. **Information/digital literacy:** Capability to use ICT in a variety of learning situations.
11. **Self-directed learning:** Ability to work independently with efficiency based on the knowledge acquired while learning.
12. **Moral and ethical awareness/reasoning:** Ability to follow moral/ethical values in all aspects of work.
13. **Leadership readiness/qualities:** Capability to guide people to the right destination, in a smooth and efficient way.
14. **Lifelong learning:** Ability to acquire knowledge and skills through self-directed learning aimed at personal development

3. Program specific qualification Attributes

The cognitive domain involves knowledge and the development of intellectual skills (Bloom, 1956). This includes concepts that serve in the development of intellectual abilities and skills. There are six major categories of cognitive processes, starting from the simplest to the most complex

- Knowledge and understanding level (K1 and K2)
- Application level (K3)
- Analytical level (K4)
- Evaluation capability level (K5)
- Scientific or synthesis level (K6)

4. Vision

To achieve academic excellence in Biochemistry by imparting in-depth knowledge to the students and producing quality students trained in the various facets of Biochemistry, facilitating research activities and cater to the academic, industrial & societal demands. To make university a centre of excellence in the discipline of Biochemistry.

5. Program objectives and outcomes

5.1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The career perspectives of the Master's program in Biochemistry are

PEO 1: To prepare students for the future careers in the concerned/various relevant fields in which a core understanding of the chemistry of life is important.

PEO 2: To enable the graduates to exhibit leadership, make life long learners with professional and social ethics and make them communicate effectively.

PEO 3: To add highly skilled scientific workforce in the area of biomedical research sectors, academic, industry as well as for research laboratories across the country and the globe by following best practices for improving the professionalization and employability of students.

PEO 4: The practical and technical skills with laboratory-based work and the final year research project prepare the students for a research or technical position by defining specific and transferable skills.

PEO 5: To sensitize and train the students towards research with typical employers include pharmaceutical, biotechnology, food, water and agricultural companies and specialist services, such as toxicological studies.

PEO 6: To train the students in generic and competency skills so as to be able to work in potential places including scientific and medical publishers and the Intellectual Property Office

5.2. PROGRAMME SPECIFIC OBJECTIVES (PSOs)

The Overall objective of the Program is to promote education and research in biochemistry and provide academic and professional excellence for immediate productivity in industrial, or clinical settings for an ultimate benefit of society and environment.

PSO1:	To acquire necessary knowledge and skills in core themes, principles and components of basic Biochemistry
PSO2:	To demonstrate the knowledge of biochemical processes from the cellular and molecular aspects
PSO3:	To Integrate and apply the techniques studied and to compare and contrast the depth of scientific knowledge in the broad range of fields
PSO4:	to be able to understand, analyze and apply the studied basic and concepts in wide variety of applications including diagnostics, biochemical pathway regulation and drug development and use this knowledge and apply the same for multitude of laboratory applications.
PSO5:	To provide students with the knowledge and skill base that would enable them to go for self-employment and entrepreneurship

5.3. PROGRAMME OBJECTIVES (POs)

PO1: To demonstrate comprehensive knowledge on various areas of Biochemistry.

PO2: To acquire skills in areas related to the current and emerging developments.

PO3: To communicate the concepts, constructs and techniques of the subject learnt in a clear, concise and lucid manner.

PO4: To plan and execute the experiments to the relevant theories of Biochemistry.

PO5: To apply critical thinking, scientific reasoning and mathematical skills in studied areas of Biochemistry.

PO6: To train the students to acquire various relevant generic and competency skills in various aspects of biochemistry so as to be able to work independently in a group or individually

PO7: To make a student life long learner with moral and ethical values

5.4. PROGRAMME OUTCOME (PO'S):-

M.Sc programme in Biochemistry will provide students with the necessary knowledge and skills to undertake a career in research, either in industry or in an academic setting. The training provided will give students the breadth and depth of scientific knowledge in Biochemistry. On completion of the programme, students will be qualified to apply for a PhD or to gain employment in the pharmaceutical or biotechnology industries, which are among the strongest growth sectors. The programme will be based on a combination of taught modules, independent learning and an extended research project to be carried out either in the University departments or industry or in association with industry at the University. The programme incorporates a substantial element of hands-on research experience, with enhanced experimental skills being gained alongside experienced research workers.

It is intended that, on successful completion of the M.Sc degree programme, students will :

1. **be capable of demonstrating comprehensive knowledge** and have a fundamental/systematic or coherent understanding of major concepts, theoretical principles and experimental findings in biochemistry.
2. **acquire skills in areas related to the current and emerging developments** in the field of Biochemistry.
3. **be identifying and applying appropriate biochemical principles** and methodologies to solve a wide range of problems associated with Biochemistry.
4. **communicate the results of studies undertaken** in Biochemistry accurately in a range of different contexts using the main concepts, constructs and techniques of the subject learnt in a clear and concise manner in writing and oral skills.

5. **Plan and execute the experiments**, investigate, analyze and interpret data collected using appropriate experimental methods, and report the findings of the experiment and relate the interpretations and conclusions to relevant theories of Biochemistry.
6. They will have the **ability to employ critical thinking, scientific reasoning and efficient problem** solving skills in the basic areas of biochemistry.
7. Be able to **demonstrate relevant generic skills and competencies** such as (i) problem solving skills, (ii) investigative skills, (iii) communication skills (iv) analytical skills, (v) ICT skills, (vi) skills such as the ability to work both independently and in a group.
8. **demonstrate professional behaviour** such as (i) unbiased and truthful in all aspects of work (ii) follow moral and ethical practices (iii) Life long learners aimed at personal development and for improving knowledge/skill development (iv) focusing on issues related to social cause.

6. Candidate eligibility for admission

Graduates in Biochemistry, Chemistry, Pharmacy, Bachelors of medical lab technology, Microbiology and Life Sciences as principle subject or Biochemistry as subsidiary subject are eligible for admission to the course.

7. Duration of the course: Two year degree programme

8. CBCS structure comprises of two parts

Course component	**Number of courses**	**Hours of learning**	**Marks**	**Credits**
PART A (Credit courses)				
Core courses	11	4	1100	44
Practicals	4	4	400	16
Elective courses	3	4	300	12
Supportive courses	2	3	200	06
Human rights	1	2	100	02
Research Project and viva-voce	1	12	100	12
TOTAL	**21**		**2200**	**92**
PART B (Self learning Credit courses)				
Online courses Swayam Course	2	4	200	08
TOTAL	**2**		**200**	**08**

9. Curriculum structure for each semester

Semester	Paper Code	Title of the Paper	Hrs/week	Exam Duration	Credits
I	18BCHC01	Core I – Biomolecules	5	3	4
	18BCHC02	Core II - Analytical Techniques	5	3	4
	18BCHC03	Core III - Advanced Enzymology	5	3	4
	18BCHC04	Core IV - Cell Biology and Physiology	5	3	4
	18BCHE01	Elective I	5	3	4
	18BCHP01	Core Practical I (Biochemical Techniques and Enzymology)	5	6	4
II	18BCHC05	Core V - Intermediary Metabolism	5	3	4
	18BCHC06	Core VI - Plant Biochemistry	5	3	4
	18BCHC07	Core VII - Molecular Biology	5	3	4
	18BCHP02	Core Practical II (Molecular and Microbial Techniques)	5	6	4
	18BCHE02	Elective II	5	3	4
	18BCHS01	Supportive I	3	3	3
	18PHR01	Human Rights	2	3	
		Internship (4 weeks)			
III	18BCHC08	Core VIII - Genetic Engineering	5	3	4
	18BCHC09	Core IX - Advanced Clinical Biochemistry	5	3	4
	18BCHC10	Core X – Immunology	5	3	4
	18BCHE03	Elective III	5	3	4
	18BCHP03	Core Practical III (Clinical Biochemistry and Genetic Engineering)	5	6	4
	18BCHS02	Supportive II	3	3	3
		Library Hour	2		
IV	18BCHC11	Core XI - Drug Biochemistry and Clinical Toxicology	5	3	4
	18BCHP04	Core Practical IV (Clinical Biochemistry and Immunology)	5	6	4
	18BCHPR01	Project and Viva-voce	20	-	12
		TOTAL			**90**

Semester	Swayam Course	Marks	Credit
I	MOOC-I	100	4
III	MOOC-2	100	4

ELECTIVE COURSES

18BCHE 01 - Molecular Endocrinology
18BCHE 02 - Cancer Biology
18BCHE 03 - Biostatistics
18BCHE 04 - Microbiology
18BCHE 05 - Nutritional Biochemistry
18BCHE 06 - Biotechnology

SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

18BCHS 01 - Tools and Techniques in Bioscience
18BCHS 02 - Medical Lab Technology
18BCHS 03 - Clinical diagnosis in health and diseases
18BCHS 04 - Introduction to Biochemistry

10. Credit calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/demonstration	1	1
Practical/Internship/ Self-Learning	2	1

11. CBCS – scheme of examinations semester wise structure

Semester	Paper Code	Title of the Paper	Hrs /week	Marks			Exam Duration	Credits
				CIA	**EA**	**Total**		
I	18BCHC01	Core I – Biomolecules	5	25	75	100	3	4
	18BCHC02	Core II - Analytical Techniques	5	25	75	100	3	4
	18BCHC03	Core III - Advanced Enzymology	5	25	75	100	3	4
	18BCHC04	Core IV - Cell Biology and Physiology	5	25	75	100	3	4
	18BCHE01	Elective I	5	25	75	100	3	4
	18BCHP01	Core Practical I (Biochemical Techniques and Enzymology)	5	40	60	100	6	4
II	18BCHC05	Core V - Intermediary Metabolism	5	25	75	100	3	4
	18BCHC06	Core VI - Plant Biochemistry	5	25	75	100	3	4
	18BCHC07	Core VII - Molecular Biology	5	25	75	100	3	4
	18BCHP02	Core Practical II (Molecular and Microbial Techniques)	5	40	60	100	6	4
	18BCHE02	Elective II	5	25	75	100	3	4
	18BCHS01	Supportive I	3	25	75	100	3	3
	18PHR01	Human Rights	2	25	75	100	3	
		Internship (4 weeks)						
III	18BCHC08	Core VIII - Genetic Engineering	5	25	75	100	3	4
	18BCHC09	Core IX - Advanced Clinical Biochemistry	5	25	75	100	3	4
	18BCHC10	Core X – Immunology	5	25	75	100	3	4
	18BCHE03	Elective III	5	40	60	100	3	4
	18BCHP03	Core Practical III (Clinical Biochemistry and Genetic Engineering)	5	25	75	100	6	4
	18BCHS02	Supportive II	3	25	75	100	3	3
		Library Hour	2					
IV	18BCHC11	Core XI - Drug Biochemistry and Clinical Toxicology	5	25	75	100	3	4
	18BCHP04	Core Practical IV (Clinical Biochemistry and Immunology)	5	40	60	100	6	4
	18BCHPR01	Project and Viva-voce	20	40	60	100	-	12
		TOTAL				**2200**		**90**

Semester	Swayam Course	Marks	Credit
I	MOOC-I	100	4
III	MOOC-2	100	4

Teaching methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power point presentations. The lecture would be such that the students should participate actively in the discussion, students seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instructions will be given for the experiments followed by demonstration and finally the students have to do the experiments individually. Periodic tests will be conducted for the students. Slow learners will be given special attention

12. Examinations

There shall be four semester examinations. Two in the first year and two in the second year. Candidates failing in any subject will be permitted to appear for such failed subjects at subsequent examination. The syllabus has been divided into 4 semesters. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May. The Practical examination will be conducted at the end of each semesters. Candidates failing in any of the practical examination will be permitted to appear for such failed practical examination at subsequent practical examination.

13. Scheme for evaluation and Attainment Rubrics

Theory

External : 75 Marks
Internal : 25 Marks

Three test : 10 Marks
Seminar : 5 Marks
Assignment : 5 Marks
Attendance : 5 Marks

Practical External : 60 Marks
Internal : 40 Marks

Practical test: 30 Marks
Record : 5 Marks
Attendance : 5 Marks

SCHEME FOR PRACTICAL EXAM

Time – 6 hours Max. Marks = 60

I Major
Experiment - I 25
Experiment - II 25
II Viva 5
III Record 5

Procedure 5
Table 4
Graph 4
Calculation 6
Result 6

QUESTION PAPER PATTERN (THEORY)

Part A : Answer All questions (MCQ) 20 x 1 = 20 marks
Part B : Answer any three questions (Analytical reasoning) 3 x 5 = 15 marks
Part C : Answer All questions (either or type) 5 x 8 = 40 marks

Duration of the examination - 3 hours Maximum marks – 75

FOR RESEARCH

S.No.	Particulars	Marks	Examiners
1	Dissertation	30%	Internal Examiner
		30%	External Examiner
2	Viva-voce	20%	Internal Examiner
		20%	External examiner

14. Grading system

Evaluation of performance of students is based on ten-point scale grading system as given below

Ten Point Scale			
Grade of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	Absent

BIOMOLECULES

COURSE CODE : **18BCHC01**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : To understand the basis of biomolecules which will enable to demonstrate foundational knowledge about important biomolecules in cells and living organism, essential to life processes.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Understand and demonstrate how the structure of carbohydrates determines their chemical properties and reactivity. Various functional groups involved in bond formation / linkage and also encourages the student to draw and recognize key structures of carbohydrates.
CO2	Understand the structure, functional groups, draw and recognize key structures of amino acids and function of amino acids, their interactions, various structural aspects of proteins involved in biology.
CO3	Understand the structure and function of important biological macro molecules like lipids, its types , composition, its role in biological function. Various functional groups bond formation / linkage.
CO4	Have knowledge of the structure/conformational freedom of DNA/RNA various functional groups in bond formation / linkage, functional difference help students to draw and recognize key structures of nucleic acids, know their functions in biology.
CO5	Know about the structure, types of minerals and vitamins in biological reactions, and its relationship with disease.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Carbohydrates	Classification of Carbohydrate - structure, occurrence, properties and biological functions. Homoglycans - structure and biological functions. Heteroglycans and complex carbohydrates : Structure, and biological function. Mucopolysaccharides – bacterial cell wall polysaccharides and sialic acid. Lectins – characteristics and uses, Blood group antigens, Major classes of glycoproteins: O-linked and N-linked oligosaccharides.	K1,K2,K3	12
II	Proteins	Amino acid 1 and 3 letter abbreviation, classification, biologically important peptides.	K1,K2,K3	14

		peptide bond, peptides. Physical interactions that determine the properties of proteins – shot range repulsions, electrostatic forces, van der waals interaction, hydrogen bond and hydrophobic interactions. Primary structure and its determination. The Ramachandran plot and cross links. Secondary structure :The α-helix, β-sheets and Corey model for fibrous proteins, super secondary structures - Zinc motifs, Leucine zipper motif. Tertiary structure - Collagen and quaternary structure - Hemoglobin .		
III	Lipids	Classification of lipids. Saturated and unsaturated fatty acids. Derived lipids: Phospholipids, glycolipids, structure and function. Eicosanoids- structure and biological actions of prostaglandins, prosracyclins, thromboxanes, leukotrienes and lipoxins. Lipoproteins- Classification and composition. Amphipathic lipids – membranes, micelles, emulsions and liposomes.	K1, K2, K3	12
IV	Nucleic Acids	Structure of nucleic acids, Structure of dsDNA – Watson and Crick model of DNA, properties of dsDNA, DNA sequencing procedures- Maxam Gilbert method and Sanger's dideoxy methods. Properties of DNA – denaturation, renaturation, Cot curves, Crucifrom DNA, Triple stranded DNA. Triplex and duplex RNA , Major and Minor classes of RNA- mRNA, t RNA, rRNA, hn RNA.	K1, K2, K3	14
V	Vitamins and Porphyrins	Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, structure, biochemical functions, deficiency diseases, daily requirements. Fat soluble - vitamin A, vitamin D2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements and hypervitaminosis. Porphyrins the porphyrin ring system.	K3, K4	13

Program specific attributes

Knowledge and understanding level (K1 and K2)

Application level (K3)

Analytical level (K4)

Evaluation capability level (K5)

Scientific or synthesis level (K6)

Text Books

1. Nelson,D.L. and Cox,M.M. 2013**.** Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.
2. Berg,J.M. *et al.*, 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.
3. Voet,D. *et al.*, 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

Reference Books

1. Zubay,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.
2. Sinden,S.R. DNA structure and function, First Edition**,** Academic Press, 1994.
3. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing, 1999.
4. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	L	L	M	M	L
CO2	H	M	L	L	L	M	M	L
CO3	H	M	L	L	L	M	M	L
CO4	H	L	L	L	L	M	M	L
CO5	H	M	M	L	L	M	M	L

H-High; M-Medium; L-Low

ANALYTICAL TECHNIQUES

COURSE CODE : **18BCHC02**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES **:** The objective of this course is to understand the working principles, instrumentation and applications of the instruments in various disciplines of biological sciences

COURSE OUTCOMES (CO)

After completion of the course, the students will be able,

CO1	to explore the basic concepts of pH, buffers and the types of various electrochemical cells and its application. The students will also be able to identify and understand the principle components of a light and electron microscope with biological applications.
CO2	to explain the principles of the liquid and gas chromatography as well as electro-migration techniques and evaluate strengths and limitations of the most important chromatographic separation and detection methods. Be able to define radioactivity and use them for various biological applications including handling of biohazards.
CO3	to understand how *electrophoresis* facilitates the separation of molecules based on various principles of electrophoresis? and be familiar with the types of *electrophoretic* gels and their uses.
CO4	to understand the principles of spectroscopy and to analyse and interpret spectroscopic data collected by the methods discussed in the course. Will be able to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data
CO5	to assimilate the principles and applications of centrifuge. Employ the knowledge for the separation of biomolecules/cells/organelles by selecting appropriate centrifugation techniques.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Electrochemical techniques and Microscopy	Principles, electrochemical cells - pH, Henderson - Hasselbalch equation, buffer capacity, pH measurement, glass electrode, oxygen electrode - principle and application. Biosensors. Microscopy - bright field, darkfield, fluorescence and	K1,K2, K3	13

		phase contrast microscope. Scanning and transmission electron microscopy.		
II	Chromatography & Radioisotope techniques	Principle, Instrumentation and applications- Paper, Thin layer, Ion Exchange, gel filtration, Affinity chromatography, HPLC, RF-HPLC, HPTLC, FPLC, Chromatofocusing, capillary electrochromatography Measurement of radioactivity – solid and liquid scintillation counting, scintillation cocktails and sample preparation, Autoradiography, applications of radioisotopes in biology, radiation hazards and safe disposal of radioactivity waste.	K1,K2, K3	12
III	Electrophoresis	Principle, Instrumentation and applications - General principle, migration of charged particle in an electric field, factors affecting mobility, Electrophoresis of proteins - native-PAGE, SDS-PAGE, 2D-PAGE, gradient gels, isoelectric focusing gels, detection, estimation & recovery of proteins in gels; electrophoresis of nucleic acids - agarose gel electrophoresis, pulse field electrophoresis, capillary electrophoresis, Zymography.	K1, K2, K3	13
IV	Spectroscopy	Principle, Instrumentation and applications - Atomic absorption spectroscopy and Atomic emission spectroscopy , UV -Visible, Spectrofluorimetry, Nephlometry, Turbidometry, Luminometry, Infra Red, Electron Spin Resonance, Nuclear Magnetic Resonance, Mass Spectrophotometry,	K1, K2, K3	12
V	Centrifugation	Basic principles of sedimentation; types of centrifuge; types of rotor; preparative and analytical centrifugation - types and its applications, CsCl density gradient and sucrose gradient centrifugation – principle, applications, determination of relative molecular mass – sedimentation velocity and sedimentation equilibrium	K1, K2, K3	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)

Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Wilson,K. and Walker,J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition , Cambridge University. Press.

2. Upadhyay,A. Upadhyay,K. and Nath,N. 2016. Biophysical Chemistry: Principles and Techniques, 4th Edition, Himalaya Publishing. 11th Edition

3. Sharma,B.K. 2014. Instrumental Methods of Chemical analysis, Krishna Prakashan Ltd.

Reference Books

1. Skoog.D, Holler F and Crouch S. 2016. Principles of Instrumental Analysis, 7th Edition, Cengage Learning custom publishing.

2. Boyer,R. 2009. Modern Experimental Biochemistry, 3rd Edition, Pearson India.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	L	L	L	M	L
CO2	H	L	M	L	L	M	M	L
CO3	H	M	M	L	M	L	M	L
CO4	H	L	M	L	M	M	M	L
CO5	H	L	M	L	L	L	M	L

H-High; M-Medium; L-Low

ADVANCED ENZYMOLOGY

COURSE CODE : **18BCHC03**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : To understand the classification, kinetics, mechanism of action, regulation and applications of enzymes.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to,

CO1	Characterize the enzymes in each enzymatic class, examples of such enzymes and their isolation and purification procedures in practice. Role of coenzymes in the activity of enzymes will be thoroughly understood by the students. Students will be able to differentiate non-protein and protein enzymes and understand the mechanism of multienzyme systems in detail.
CO2	Understand the concepts of active site of enzyme and their elucidation along with the basic mechanism of enzyme catalysis with specific examples
CO3	Assess the relationship between properties and structure of the enzymes, kinetics of enzymatic reactions and their inhibition with specific examples
CO4	Relate the regulatory mechanisms of enzyme activity which involve in the maintenance of body's homeostasis
CO5	Choose the correct enzymes for application in various industries by realizing their current and future potential

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Classification, Coenzymes and Purification	Enzyme – Nomenclature and classification of enzymes. General properties of enzymes: effect of pH, substrate and temperature on enzyme catalysed reactions. Coenzymic action of NAD, FAD, TPP, PLP, Biotin, CoA, folic acid and lipoic acid. Purification of enzymes - Methods to isolate and purify enzymes, activity units, Specific activity. Multienzyme complex : Mechanism of action and regulation of pyruvate dehydrogenase	K1,K2	13

		& fatty acid synthase complexes, Non protein enzymes – Ribozyme, Abzymes, DNA enzymes.		
II	Enzyme catalysis	Active site - Concept of active site, investigations of active site structure, use of substrate analogues, modification using chemical procedures, site-directed mutagenesis. Types of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis and metal ion catalysis. Mechanism of reaction catalyzed by enzymes - lysozyme. Metal activated enzymes and mettalloenzymes. Role of metal ions in mechanism – carbonic anhydrase	K1,K2	12
III	Enzyme Kinetics and Enzyme inhibition	Kinetics : Pre-steady state and steady state kinetics, Michaelis Menten kinetics, importance of Vmax, Km, Linear transformation - Lineweaver-Burk plot, Eadie - Hoffstee plot and Hanes plot. Bisubstrate reactions : ordered, random, sequential, Ping-Pong reactions. Enzyme inhibition – Reversible - competitive, non-competitive, uncompetitive and mixed inhibition, irreversible inhibition.	K1, K2, K3	13
IV	Enzyme regulation	General mechanisms of enzyme regulation, Allosteric control, Symmetric and sequential modes for action of allosteric enzymes, Reversible covalent modification, proteolytic activation. Feedback inhibition, feed forward stimulation, sequential feedback, concerted feed back, cumulative feedback and enzyme multiplicity, Enzyme induction and repression.	K1, K2, K3	12
V	Industrial and Clinical applications of enzymes	Industrial application of carbohydrases, proteolytic enzyme, lignocellulose degrading enzyme, pectin and pectic enzyme. Applications of enzymes in food and allied industries : leather, textile, detergent, paper industries. Immobilisation of enzymes - methods and applications. Clinical Enzymology: Enzyme and isoenzymes in diagnosis – Phosphatases, transaminases, LD, CK,	K3, K4	15

		amylase and cholinesterase. Enzymes as thrombolytic agents, anti-inflammatory agents, debriding agents, digestive aids, therapeutic enzymes.		

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Palmer,T. 1995.Understanding enzymes, 4th Edition, Prentise Hall.
2. Allan Svendsen. 2016. Understanding Enzymes: Function, Design, Engineering and Analysis. Pan Standford.
3. Price,N.C. and Stevens,L. 1999. Fundamentals of Enzymology, 3rd Edition, Oxford University Press.
4. Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Reference Books

1. Walsh,G. 2014. Protein Biochemistry and Biotechnology, 2nd Edition, John Wiley and Sons Ltd.
2. Chapline,M.F. and Buke,C. 1990. Enzyme technology, 1st Edition, Cambridge University Press.
3. Burtis,C. and Bruns,D. 2014. Teitz Fundamentals of Clinical Chemistry, 7th Edition, Elsevier.
4. Nelson,D.L. and Cox,M.M. 2017**.** Lehninger Principles of Biochemistry, 7th Edition, W.H. Freeman & Co.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	L	L	L	M	L
CO2	H	L	L	L	L	M	M	L
CO3	H	L	M	L	M	L	M	L
CO4	H	L	M	L	M	M	M	L
CO5	H	L	M	L	L	L	M	L

H-High; M-Medium; L-Low

CELL BIOLOGY AND PHYSIOLOGY

COURSE CODE : **18BCHC04**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : At the end of the course learners will be able to understand the structure of membrane, transport mechanism, cell junctions and adhesion molecules.

COURSE OUTCOMES (CO)

CO1	Understand the structure of membrane. Understand how small and large molecules transported across a membrane by transport system. Understand the primary mechanisms by which cells import and export macromolecules.
CO2	Understand the role of cell junctions, cell adhesion molecules and extracellular matrix components.
CO3	Learn the general characteristics and functions of blood. Acquire the knowledge of heart and its functions.
CO4	Learn the composition, functions and functions of digestive system. Describe the structure of organs of excretory system. Learn the role of kidneys and hormones in their maintenance.
CO5	Learn the structure and functions of nervous system. Study the composition and metabolic adaptation of brain. Describe the structure of muscles and muscle contraction. Analyse the organization amd processes of muscular system.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Membrane structure and transport	Overview of membrane protein – peripheral, integral and fluid mosaic model. Membrane transport: Types, Diffusion - passive and facilitated. General classes of transport systems – Uniport, symport, antiport. Active transport – Primary and secondary, the P-type ATPase (Na^+ K^+ - ATPase), F-type ATPases (ATP synthases), ABC transporters, ionophores, aquaporins, ion channels (ligand-gated and voltage-gated).	K1,K2	12
II	Cell junctions, cell adhesion	Major classes of cell junctions – anchoring, tight and gap junctions. Major classes of cell	K1,K2	12

	and ECM	adhesion molecules (CAMs) – cadherins, integrins. The extracellular matrix of epithelial and nonepithelial tissues. ECM components – collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans and tubulins.		
III	Blood and circulation	Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, E.C.G vasomotor circulation, coronary circulation, blood pressure, spleen, lymph, normal composition and function of lymph - role of different lymph cells.	K1, K2	14
IV	Digestive and Excretory system	Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance	K1, K2	13
V	Neuromuscular function	Structure and function of nerves, neurons, resting and action potential, transmission of nerve impulses, synaptic transmission, compounds affecting synaptic trans mission, neuromuscular junction, composition and functions of cerebrospinal fluid, brain - chemical composition and metabolic adaptation, neurotransmitters and cAMP, biochemical aspects of learning and memory, enkephalins and endorphins. Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction.	K1, K2	14

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Alberts,B. *et al*., 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.

2. Guyton,A.C. and Hall,J.E. 1996. Human Physiology and Mechanisms of Disease, 6th Edition, Saunders.

Reference Books

1. Lodish *et al*. 2016. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.

2. Cooper,G.M. and Hausman,R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.

3. Chatterjee,C.C. 1985. Human Physiology, 11th Edition. Medical Allied Agency

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	L	M	L
CO2	H	L	M	M	L	M	M	L
CO3	H	L	M	M	L	L	M	L
CO4	H	L	M	M	L	M	M	L
CO5	H	L	M	M	L	L	M	L

H-High; M-Medium; L-Low

CORE PRACTICAL I
BIOCHEMICAL TECHNIQUES AND ENZYMOLOGY

COURSE CODE : **18BCHP01**

MARKS : 100

Hours	L	T	P	C
	-	-	5	4

COURSE OBJECTIVES : At the end of the course learners will be able to qualitatively and quantitatively identify the biomolecules present in the given sample

1. Preparation of normal, molar and percentage solution
2. Estimation of fructose in fruits
3. Estimation of calcium in milk
4. Isolation and estimation of starch from potato
5. Isolation and estimation of ascorbic acid from citrus fruit
6. Estimation of β-carotene from carrot
7. Estimation of total free amino acids in plant tissues
8. Estimation of reducing sugars
9. Estimation of protein
10. Estimation of iron
11. Thermal denaturation of DNA.
12. Isolation, purification and characterization of peroxidase or amylase
13. Separation of amino acids by circular and ascending paper chromatography
14. Mitosis and meiosis

OUTCOMES

The students will be acquainted with hands-on knowledge in the qualitative and quantitative analysis of biomolecules in the given samples.

INTERMEDIARY METABOLISM

COURSE CODE : **18BCHC05**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : To understand the various metabolic pathways operating in living cells with special emphasis on carbohydrate, lipid, amino acid, nucleic acid metabolism and the electron transport chain.

COURSE OUTCOMES (CO)

After completion of the course, the students will be able,

CO1	To demonstrate an understanding of the metabolic pathways - the energy-yielding and energy requiring reactions in life
CO2	To demonstrate an understanding of the diversity of metabolic regulation.
CO3	To emphasis the unique role in metabolism for life existence
CO4	To provide conceptual theoretical knowledge
CO5	To relate various metabolic connectivity and its control

SYLLABUS

Unit	Unit title	Intended learning chapters	Knowledge domain	Hours of instruction
I.	Bioenergetics and Biological Oxidation	Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain - organization and role in electron capture. Oxidative phosphorylation - Electron transfer reactions in mitochondria. F1F0 ATPase - Structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores. Regulation of oxidative phosphorylation. Mitochondrial transport systems - ATP/ADP exchange, malate / glycerophosphae shuttle, creatine - phosphate shuttle.	K1 & K2	18

II.	Carbohydrate metabolism	Glycolysis and gluconeogenesis - regulation. The citric acid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose. The glyoxylate cycle. Cori cycle. Futile cycles, anaplerotic reactions	K1 & K2	16
III.	Lipid Metabolism	Biosynthesis of fatty acids - fatty acid synthase complex, regulation of lipogenesis. Oxidation of fatty acids – role of carnitine in fatty acid transport, α, β and ω oxidation. Metabolism of triglycerides, phospholipids and sphingolipids. Cholesterol - Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Eicosanoid metabolism	K1 & K2	16
IV.	Amino Acid, Purine and Pyrimidine metabolism	Overview of biosynthesis of 20 amino acids found in proteins - Amino acids from Ser family (gly), pyruvate family (leu), aspartate family (lys), glutamate family (gln), aromatic amino acid family (trp) and histidine family (his). Catabolism of amino acid nitrogen- transamination, deamination, ammonia formation and the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to special products. Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines.	K4& K6	15
V.	Porphyrins, Minerals and metabolic integration	Biosynthesis and degradation of porphyrins and heme. Minerals : sources, absorption, metabolism, biological roles and clinical significance of calcium, phosphate and magnesium. Trace elements: absorption, metabolism, storage and transport of iron, copper, zinc, selenium. Manganese, cobalt and fluoride. Integration of metabolism	K1 & K2	15

REFERENCE:

Text Books

1. Murray *et al.*, 2012. Harper's Biochemistry, 30th Edition, McGraw Hill Medical Publication.

2. Nelson,D.L. and Cox,M.M. 2013.Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.

3. Berg,J.M. *et al.*, 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Reference Books

1. Voet,D. *et al.*, 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

2. Zubey,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.
3. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	L	M	L
CO2	H	L	M	M	L	M	M	L
CO3	H	L	M	M	L	M	M	L
CO4	H	L	M	M	L	L	M	L
CO5	H	L	M	M	L	L	M	L

H-High; M-Medium; L-Low

PLANT BIOCHEMISTRY

COURSE CODE : **18BCHC06**

Hours	L	T	P	C
	3	1	0	4

MARKS : 100

COURSE OBJECTIVES : To understand the plant cell wall structure, biochemical processes that take place in plant such as plant metabolic processes, photosynthetic reactions, plant hormones, and plant secondary metabolites

COURSE OUTCOMES (CO)

After completion of the course, the students will be able,

CO1	To explain the plant cell wall structure and to understand the plant nuclear, plastid genome organization and explain the biogenesis of organells
CO2	To explain the basic concepts in photosynthesis and its regulation
CO3	to understand different biogeocyles and its impact on earth. The basic knowledge on mineral nutrition in plant health and deficiencies will also be understood.
CO4	To evaluate the impact of hormones in plant growth, flowering and maintenance.
CO5	To imbibe the mechanism of action of plant defences, antiodixant system in plant defenses and photochemistry of plants.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Plant cell wall and genome organization	Plant cell wall - Structure and function. Water uptake and movement – diffusion, osmosis, aquaporins. Plant genome organization: Plant nuclear and plastid genome organization. Biogenesis of organelles - developlment of chloroplast. Interaction between nuclear and organellar genome	K1,K2, K3	13

II	Photosynthesis and its regulation	Photosynthesis - Structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants. Light receptors - chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump. Photosystems I and II. The Hill reaction, Photophosphorylation and reduction of CO_2, C_3, C_4 and CAM metabolism, light and dark reactions. Light activation of enzymes, regulation of photosynthesis. Photorespiration.	K1,K2, K3	12
III	Mineral nutrition	Mineral Nutrition - Biogeo cycles (Carbon, Nitrogen and Sulphur), Nitrate assimilation: structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Sulphur assimilation in plants. Nutrient absorption and translocation, Nutrient functions in growth and development, Nutrient deficiency symptoms, toxicity problems	K1, K2, K3	13
IV	Phytohormones	Phytohormones : Auxins, cytokinins, Abscisic acid, Gibberellins, ethylene- Structure, physiological function and metabolism. Plant movement, apical dominance. Stomatal movements and morphogenesis. Photoperiodism and vernalization – flower induction, initiation and development.	K1, K2, K3	12
V	Plant defense system and phtochemistry	Biological rhythm in plants, plant defenses, environmental and genetic control, Antioxidative defence system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism. Special features of secondary plant metabolism-phytochemistry of plants. Plant tissue culture and its applications.	K1, K2, K3	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Heldt,H.W. and Piechulla,B. 2016. Plant Biochemistry, 4th Edition, Academic Press.
2. Heldt,H.W. 2004. Plant Biochemistry, 3rd Edition, Academic Press.
3. Buchannan,B. *et al*, 2015. Biochemistry and Molecular Biology of Plants, 2nd revised Edition, Wiley.
4. Verma S.K. and Verma Mohit. 2007. Text book of Plant Physiology, biochemistry and Biotechnology, 6th Edition, S. Chand.
5. Goodwin and Mercer. 2005.Introduction to Plant Biochemistry.2nd Edition, CBS.

Reference Books

1. Dey. 2013. Plant Biochemistry, 1st edition, Elsevier.
2. Dey,P.M. and Harborne,J.B. 1997. Plant Biochemistry, 1st Edition, Academic Press.
3. Lea,P.J. and Leegood,R.C. 1999. Plant Biochemistry and Molecular Biology, 2nd Edition, Wiley.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	L	L	L	M	L
CO2	H	L	L	L	L	M	M	L
CO3	H	L	L	L	L	L	M	L
CO4	H	L	L	M	L	M	M	L
CO5	H	L	L	M	L	L	M	L

H-High; M-Medium; L-Low

MOLECULAR BIOLOGY

COURSE CODE : **18BCHC07**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : To understand the basic structure and functioning of the genetic material, knowledge on the activity of genes and genomes, molecular mechanisms of DNA replication, repair, recombination, transcription, protein synthesis and gene regulation.

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COURSE OUTCOMES (CO)

CO1	Molecular biology gives an in-depth knowledge of biological processes through the investigation of the underlying molecular mechanisms.
CO2	Describe the processes of replication, repair and recombination
CO3	Understanding the underlying process of prokaryotic transcription and regulation
CO4	Explain the mechanism of eukaryotic transcription and regulation
CO5	Provides the basics of genetic code, translation and targeting

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Chromatin and Genome	Central dogma of Molecular biology. Structure of the bacterial nucleoid - The *E.coli* chromosome and DNA-binding proteins. Plasmids- classification and properties. The eukaryotic chromatin- nucleosomes, 30 nm fiber and chromatin loops. Organization of chromatin structure. Genome complexity- genome size, C-value paradox, coding and non coding DNA, typical structure of protein-coding genes in prokaryotes and eukaryotes. Introns and exons and repetitive DNA (SINES, LINES, simple sequence repeats - satellite, minisatellite and microsatellite). gene duplication and pseudogenes .Organelle genomes- mitochondria and chloroplast.	K1,K2	13
II	Replication,	DNA replication in prokaryotes and eukaryotes	K1,K2	12

	Repair and Recombination	(helicases, SSB, topoisomerases, DNA polymerases and DNA ligase), Telomeres, telomerases and end replication. Inhibitors of replication. DNA repair mechanisms - Nucleotide excision repair, base excision repair, mismatch repair, double-strand break repair, recombination repair and SOS response. Recombination – Homologous recombination, site specific recombination. Transposons and mechanism of transposition (elementary details).		
III	Prokaryotic Transcription and Regulation	*E.coli* RNA polymerase, Promoter sequence in *E.coli*, Initiation, elongation and termination. Rho dependent and Rho independent termination. Inhibitors of transcription. Post-transcriptional processing of rRNA and tRNA. Regulation of transcription in prokaryotes – lac operon and trytophan operon.	K1, K2	13
IV	Eukaryotic Transcription and Regulation	RNA polymerases - structure, RNA pol I, II and III, transcriptional factors, Transcription initiation by RNA polymerase I, II and III. Transcriptional regulation in eukaryotes - steroid hormone receptors and phosphorylation. Post transcriptional processing of mRNA, rRNA and tRNA. Alternative splicing, RNA editing, Antisense RNA, Micro RNAs and RNA interference.	K1, K2,	12
V	Genetic Code, Translation and Targeting	Genetic code - salient features. Mitochondrial genetic code. Mutations– point mutations and frame shift mutations. Suppressor mutations – nonsense and missense suppression. Mechanism of protein synthesis in bacteria and eukaryotes- amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Co and post-translational modifications. Protein targeting to membranes, nucleus, mitochondria, lysosomes, signal sequence hypothesis, Protein degradation- the ubiquitin pathway. Protein folding- (elementary details).	K1,k2, K3	15

Program specific attributes
Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Lodish *et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
2. Weaver,R.F. 2011. Molecular Biology, 5th Edition, WCB McGraw Hill, Higher Education.
3. Karp,G. 2009.Cell and Molecular Biology, 6th Edition, John Wiley & Sons, Inc.

Reference Books

1. Alberts,B. *et al.*, 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.
2. Watson,J.D. *et al.*, 2013. Molecular Biology of the Gene, 7th Edition, Pearson Education.
3. Lewin,B. 2007. Genes IX, 9th Edition, Jones and Bartlett Publishers.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	M	L	L	M	L
CO2	H	L	L	M	L	L	M	L
CO3	H	L	L	L	L	L	M	L
CO4	H	L	L	M	L	L	M	L
CO5	H	L	L	L	L	L	M	L

H-High; M-Medium; L-Low

CORE PRACTICAL II

MOLECULAR AND MICROBIAL TECHNIQUES

COURSE CODE : **18BCHP02**
MARKS : 100

Hours	L	T	P	C
	--	-	5	4

COURSE OBJECTIVES : This course is designed to provide hands-on training in molecular and microbial techniques.

1. Isolation and estimation of DNA
2. Isolation and estimation of RNA
3. Estimation of phosphorus
4. Estimation of chlorophyll in leaves
5. Estimation of phenols in plant tissues
6. Estimation of peroxidase in plant tissues
6. Plant tissue culture (Demo)

   Callus induction. Initiation of suspension cultures, Regeneration of shoot and root from callus culture
7. Animal tissue culture (Demo)

   Preparation and sterilization of media, Filter sterilization of media, Primary cell culture – trypsinisation, passaging, staging, cell lines, counting – vital staining, Cytotoxicity and viability assay
8. Isolation of pure culture - Serial dilution, pour plate, spread plate, streak plate
9. Staining techniques - Simple, differential
10. Separation of lipids by TLC
11. Separation of proteins by SDS-PAGE
12. Agarose gel electrophoresis of DNA

OUTCOMES

After the completion of this course the students will be able to understand and gain practical experience in molecular and microbial techniques

GENETIC ENGINEERING

COURSE CODE : **18BCHC08**
MARKS : 100

Hours	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

COURSE OBJECTIVES : To familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications of genetic engineering.

COURSE OUTCOMES (CO)

CO1	The student will have knowledge of tools and strategies used in genetic engineering.
CO2	Understanding the application of genetic engineering techniques in basic and applied research.
CO3	To provide the ethical values and nurturing applicablility of conserved genetic traits
CO4	To impact knowledge latest updation and application of genetic engineering
CO5	To motivate and create interest to uptake genetic engineering for research

SYLLABUS

Unit	Unit title	Intended learning chapters (K1,K2)	Knowledge domain	Hours of instruction
I.	Restriction endonucleases, cloning vectors, and ligation	Basic steps in gene cloning. Type II Restriction endonucleases- nomenclature and types of cleavage. Cloning vectors: plasmids (pBR322 and pUC), phage vectors (λ), cosmids, phagemids, BACs and YACs. Methods of ligation of insert and vector DNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation, linkers and adapters.	K1 & K2	18
II.	Gene transfer methods - cloning & screening strategies	Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, viruses, microinjection. Choice of host organisms for cloning. Construction of genomic and cDNAlibraries . Cloning strategies- genomic cloning, cDNA cloning. Differences between genomic and cDNA libraries. Screening of recombinants: marker inactivation (antibiotic	K2,K3	16

		resistance, blue-white selection), colony hybridization, immunoscreening, screening for protein activity.		
III.	Expression systems	Factors affecting expression of cloned genes. Expression of eukaryotic genes in bacteria-expression vector, promoters, industrial protein production. Fusion proteins, strategies to enhance protein stability, secretion and metabolic load. Expression in eukaryotic cells: Expression in yeast- yeast vectors, GAL system. Baculovirus and Mammalian expression systems (brief account). Tagged proteins and secretion signals. Reporter genes- types and uses.	K1&K2	16
IV.	Gene Manipulation Techniques	Extraction and purification of nucleic acids. Probes: radioactive and nonradioactive. Blotting techniques: Southern, northern, and western. Principle and applications of DNA fingerprinting, DNA footprinting in situ hybridization, PCR, RT-PCR, real-time qPCR. DNA Sequencing: Automated sequencing. Next-generation sequencing. Site-directed mutagenesis (SDM): cassette and oligonucleotide-directed mutagenesis. PCR-based methods. Protein engineering by directed evolution and DNA shuffling. Hazards and safety aspects of genetic engineering.	K1,K3,K4 &K5	16
V.	Gene targeting & Metabolite Engineering	Transformation, co-transformation, selectable markers, reporter genes. Transgenic animals - methods of production gene knock out in transgenic mice. Transgenic animals as models of human disease. Application of transgenic mice, animal bioreactors (Pharm animals).Antisense RNA technique, Harbicide resistance. Methods of gene transfer in plants-*Agrobacterium*-mediated transformation and particle gun method. Transgenic plant technology-development and applications.	K1 & K2	16

REFERENCE:

Text Books

1. Brown,T.A. 2010. Gene cloning and DNA analysis: An introduction, 6 th Edition, Wiley-Blackwell Publishers.

2. Primrose,S.B. and Twyman,R. 2006. Principles of Gene Manipulation and Genomics, 7th Edition, Oxford University Press.

3. Glick,B.R. and Pasternak,J.J. 2009. Molecular Biotechnology - Principles and Applications of Recombinant DNA, 4th Edition, ASM Publishers.

Reference Books

1. Strachan,T. and Read,A.P. 2003. Human Molecular Genetics, 3rd Edition, Garland Science Publishers.

2. Watson,J.D. *et al.*, 2007. Recombinant DNA-Genes and Genomes: A short course, 3rd Edition, Cold Spring Harbor Laboratory Press.

3. Winnacker,E.L. 1987. From Genes to clones, 1st Edition, Wiley-Blackwell Publishers.
4. Nicholl,D.S.T. 2008. An introduction to Genetic Engineering. 3rd Edition, Cambridge University Press

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	M	L	M	L
CO2	H	M	M	M	M	M	M	L
CO3	H	M	M	M	M	L	M	L
CO4	H	M	M	M	M	M	M	L
CO5	H	M	M	M	M	L	M	L

H-High; M-Medium; L-Low

ADVANCED CLINICAL BIOCHEMISTRY

COURSE CODE : **18BCHC09**
MARKS : 100

Hours	**L**	**T**	**P**	**C**
	3	**1**	**0**	**4**

COURSE OBJECTIVES : To impart knowledge about the biochemical basis of various diseases and disorders, and to study various diagnostic and therapeutic methodologies available for diseases and disorders.

COURSE OUTCOMES (CO)

CO1	To have a basic knowledge on collection of samples, role of preservatives, time of its additions, need of its addition, and also various procedures involved in collection of clinical samples like blood, urine, stool, CSF, amniotic fluid as well as purpose of collection, biochemical test that could be carried out in the samples.
CO2	To have a critical understanding on In born errors of metabolism. And its causative factors like genetic defect in specific key metabolic enzymes induced specific diseases of carbohydrate, lipid, protein, purine and pyrimidine metabolism.
CO3	Enzymatic assay protocols that could help one to diagnose the specific illness like hepatobiliary diseases by comparing with their normal values and by knowing cusative factors .
CO4	Understand the test available for gastric, liver, pancreas function in order to assess the laboratory results obtained as well as to interpret them.
CO5	To have a better in-depth knowledge on diagnosis using biochemical parameters, complications, management of diseases like Diabetes mellitus, Atherosclerosis, cancer.

SYLLABUS

Unit	Unit title	Intended learning chapters (K1,K2)	Knowledge domain	Hours of instruction
I.	Specimen collection and processing	Collection of blood by various methods, anticoagulants. Collection of urine - Timed urine specimens, urine preservatives. Stool – chemical examination and clinical significance. CSF – composition and collection, chemical examination and infections and spinal cord infections.Amniotic fluid : Origin, collection, composition and analysis of amniotic fluid Automation in the clinical biochemistry: Precision, reliability, reproducibility and other factors in quality control.	K1,K2,K3	15
II.	Inborn	Disorders of carbohydrate metabolism –	K1,K2,K3	15

	errors of metabolism	glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. Disorders of lipid metabolism - Lipid storage diseases, fatty liver and lipoproteinemias. Disorders of amino acid metabolism – Aminoaciduria, phenylketonuria, Hartnup disease, alkaptonuria, albinism, cystinuria, cystinosis, homocystinuria and maple syrup urine disease. Disorders of purine, pyrimidine and porphyrin metabolism- Hyperuricemia, Hyporuricemia and gout, orotic aciduria, porphyrias – Erythropoietic and hepatic.		
III.	Clinical enzymology	Serum enzyme activities in diseases - Principle and assay of transaminases, phosphatases, isocitrate dehydrogenase, 5' nucleotidase, ά-hydroxybutyrate dehydrogenase, ceruloplasmin, γ-glutamyl transpeptidase, creatine kinase. lactate dehydrogenase, amylase, lipase, choline esterase. Enzyme patterns in disease – hepatobiliary disease, myocardial infarction	K1, K2, K3	11
IV.	Hepatic, pancreatic and renal functional tests	Normal structure and functions of liver, diseases of the liver, hepatitis types, cirrhosis, liver function tests, disorders of bilirubin metabolism. Pancreatic and gastric function tests – peptic ulcer Renal function tests - Biochemical findings in glomerulonephritis, acute and chronic renal failure, nephritic syndrome, nephrolithiasis. Normal and abnormal constituents of urine.	K1, K2, K3	12
V.	Diabetes, Atherosclerosis and Cancer	Blood glucose homeostasis-Role of tissues and hormones. Diabetes mellitus–classification, metabolic abnormalities, diagnosis and management, acute and long-term complications. Atherosclerosis – risk factors, biochemical findings and management. Cancer – Benign and malignant tumour, tumour markers	K3, K4, K5	12

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Burtis,C. and Bruns,D. 20. Teitz Fundamentals of Clinical Chemistry, 7th Edition, W.B. Saunders Company.
2. Devlin,T.M. 2010. Text book of Biochemistry with Clinical Correlation, 7th Edition, John Wiley and Sons.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.

Reference Books

1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2015. Text Book of Medical Physiology, 13th Edition, Saunders

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	H	H	M	L
CO2	H	M	M	M	M	H	M	L
CO3	H	M	M	M	H	H	M	L
CO4	H	M	M	M	H	H	M	L
CO5	H	M	M	M	M	H	M	L

H-High; M-Medium; L-Low

IMMUNOLOGY

COURSE CODE : **18BCHC10**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : The candidate will gain knowledge about the molecular and cellular interactions and principles of the immune system, B & T cells maturation and specific response.

COURSE OUTCOMES (CO)

CO1	To provide students with knowledge on how the immune system works. A description of cells involved in the immune response either innate or acquired. Understand the contributions of the organs. Provide basic knowledge of the organization and function of the immune system.
CO2	Understand the antibodies and immunoglobulins, Be able to distinguish and characterize antibody isotypes and functions.
CO3	Understand the significance of MHC molecules in terms of immune response. Be able to describe lymphocyte development and their expression of receptors, Compare and contrast the origin, maturation process.
CO4	Comprehend the over reaction by our immune system leading to hypersensitive conditions and its consequence.
CO5	Gain knowledge about immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation. Understand the properties of tumour antigens, immune response to tumours.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Innate and adaptive immunity, comparative immunity cells	Immune cells, structure and function. Erythropoiesis, growth factors, regulation of hematopoiesis, cells. clinical uses of stem cells, Null cells, granulocytes, adhesion molecules Organs of the immune system; primary and secondary organs Lymphoid cells: Lymphoblast's, CD antigens, B cell receptors. T cell membrane molecules.	K1,K2	13
II	Antigens	B cell epitopes, T cell epitopes, Haptens- viral and bacterial antigens, factor-influencing immunogenicity, adjuvant technology. Immunoglobulins: domains, allotypes, Isotypes and Idiotypes, antigenic determinants on	K1,K2	12

		Immunoglobulins. Immunoglobulins superfamily. Monoclonal antibodies: Formation and selection of hybrid cells, production, clinical uses, Abzymes.		
III	MHC	Organization, MHC molecules and genes, cellular distribution, regulation of MHC and immune responsiveness, MHC and susceptible deficiency diseases. Antigen processing and presentation. T-cell: Receptor complex structure, T-cell maturation, activation and differentiation. Cell death and T-cell population. B-cell: Receptor complex structure, T-cell maturation, activation and differentiation. Complement activation: Pathways, regulation of complement system, Biological consequences of complement activation, complement deficiencies. Antigens - Antibody interaction: *In vivo* - cross reactivity, *In vitro*: precipitants, agglutinants.	K1, K2	13
IV	Cytokines	Structure and function of IL, IFN, TNF, CSF, cytokines receptors, cytokine antagonists, and cytokines related diseases. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity, delayed type hypersensitivity Leukocyte mediated immune response: Cell adhesion molecule, Lymphocyte and neutrophils, extravasation, mediators of inflammation, inflammatory process. Hypersensitivity reactions: Type I, II, III and IV. Hypersensitivity diseases. Immunity to infectious diseases: viral - influenza, bacteria – tuberculosis, parasite – *Plasmodium falciparum.*	K1, K2,	12
V	Transplantation immunology	Types, Genetics of transplantation, Graft versus host reaction, tissue matching and immunosuppressive agents, clinical manifestation, therapy and bone-marrow transplants, organ-transplants. Immunodeficiency diseases: B-cell, T-cell, SCID, Pathogenesis, diagnosis and treatments of AIDS. Vaccines: Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccine, multivalent sub-unit vaccines.	K1,k2, K3	15

Program specific attributes
Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Owen,J.A. *et al.*, 2013. Kuby Immunology, 7th Edition, W.H. Freeman and Company.
2. Delves,P. *et al.*, 2011. Roitt's Essential Immunology, 12th Edition, Wiley-Blackwell Publishers.

Reference Books

1. Abbas,A.K. *et al.*, 2012. Cellular and Molecular Immunology, Fourth Edition, Elsevier Saunders Company.

2. Ananthanarayan,R. 2009. Ananthanarayan and Paniker's Textbook of Microbiology 8th Edition, Universities Press Publishers

3. Virella,G. 2007. Introduction to Medical Immunology, 6th Edition, CRC Press.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	L	M	L	M	M	L
CO2	H	M	L	M	L	M	M	L
CO3	H	M	L	M	L	M	M	L
CO4	H	M	L	M	L	M	M	L
CO5	H	M	L	M	L	M	M	L

H-High; M-Medium; L-Low

CORE PRACTICAL III

CLINICAL BIOCHEMISTRY AND GENETIC ENGINEERING

COURSE CODE : **18BCHP04**
MARKS : 100

Hours	L	T	P	C
	--	-	5	4

COURSE OBJECTIVES : This course is designed to provide hands-on training in clinical Biochemistry and recombinant DNA techniques.

1. Estimation of blood glucose
2. Estimation of blood Urea
3. Estimation of serum uric acid
4. Estimation of serum creatinine
5. Estimation of serum calcium
6. Estimation of serum phosphorus
7. Estimation of serum Bilirubin – TB, DB
8. Estimation of serum protein, albumin, AG ratio
9. Assay of Alkaline phosphatase
10. Assay of Aspartate amino transferase
11. Isolation of genomic DNA from liver/plant/ bacterial source
12. Isolation of plasmid DNA from bacteria
13. Restriction digestion of DNA
14. Transformation in *E.coli*
15. PCR demonstration

OUTCOMES

The students will be able to understand and apply the hands-on knowledge gained in clinical biochemistry and genetic engineering in their future research activites as well as while establishing clinical laboratories

DRUG BIOCHEMISTRY AND CLINICAL TOXICOLOGY

COURSE CODE : **18BCHC11**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : This course is designed to provide detailed understanding of the pharmacological and toxicological aspects of therapeutics and their diverse modes of drug action.

COURSE OUTCOMES (CO)

CO1	To know the theories and principles of drug action, drug metabolism and pharmacodynamics.
CO2	To know effects of toxicants on organ system and drug disposition.
CO3	To provide the dynamic effects various drugs
CO4	To distinguish therapeutic and deleterious effects of drug use invivo
CO5	To exactly provide distinct picture of xenobiotics living system.

SYLLABUS

Unit	Unit title	Intended learning chapters	Knowledge domain	Hours of instruction
I.	General Principles	Basic principles of drug action- Pharmacokinetics : Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacogenetics. Origin of Drug from plants and animals.	K1 & K2	19
II.	Drug metabolism	General pathways of drug metabolism (different types of reaction in phase I and phase II with examples), metabolism and excretion of drugs. Mechanism of drug action, combined effect of drugs. Factors modifying drug action, tolerance and dependence	K1, K2	15
III.	Pharmacodynamics	receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions	K1, K2	17
IV.	Principles of therapeutics	Chemotherapy of microbial diseases, Chemotherapy of fungal infections, Chemotherapy of parasitic infections, rational	K1, K2	17

		use of antibiotics. Application for New Drug Discovery (NDD) according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki's declaration.		
V.	Toxicology	Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD_{50} and ED_{50}. Acute, subacute and chronic toxicity studies. Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule, High throughput screening (*in vitro* and *in vivo*) for pre-clinical pharmacokinetic and pharmacodynamic studies.	K1 & K2	12

REFERENCE:

Text Books

1. Satoskar,R.S*et al*., 2013. Pharmacology and Pharmacotherapeutics, 23 rd Edition, Popular Prakasham, Bombay.
2. Williams,D.A. et al., 2008. Foye's Principles of Medicinal Chemistry, 6 th Edition, Lippincott Williams & Wilkins.
3. Ghosh,M.N. 1984. Fundamentals of Experimental Pharmacology, 2nd Edition, Scientific Book Agency, Kolkatta.

Reference Books

1. Shargel,L.*et al*., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6th Edition, McGraw-Hill Medical,
2. Foreman,J.C. and Johansen,T.J. 1996. Text Book of Receptor Pharmacology, 2nd Edition, CRC Press.
3. Goodman,L.S. *et al*., Goodman and Gillman's the pharmacological basis of therapeutics, 6th Edition,, McGraw Hill, 1996.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	M	L	M	L	L
CO2	H	L	L	M	L	L	L	L
CO3	H	L	L	M	L	M	L	L
CO4	H	L	L	M	L	L	L	L
CO5	H	L	L	M	L	M	L	L

H-High; M-Medium; L-Low

CORE PRACTICAL IV

CLINICAL BIOCHEMISTRY AND IMMUNOLOGY

COURSE CODE : **18BCHP04**
MARKS : 100

Hours	L	T	P	C
	--	-	5	4

COURSE OBJECTIVES : This course is designed to provide hands-on training in clinical Biochemistry and immunochemical techniques.

1. Estimation of Glutathione peroxidase
2. Estimation of reduced Glutathione
3. Estimation of Vitamin C
4. Estimation of Lipid peroxidation
5. Estimation of triglycerides
6. Estimation phospholipids
7. Estimation total cholesterol
8. Estimation of HDL and LDL cholesterol
9. Immuno diffusion – Single radial and double diffusion
10. Immunoelectrophoresis
11. Rocket immunoelectrophoresis
12. Agglutination tests
13. Serial dilution of ASO titre,VDRL titre

OUTCOMES

The students will have a clear understanding and hands-on experience on the most practical aspect of clinical biochemistry and immunology

ELECTIVES

MOLECLAR ENDOCRINOLOGY

COURSE CODE : **18BCHE01**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : To obtain sound knowledge in Hormonal Biochemistry.

COURSE OUTCOMES (CO)

CO1	To provide core principle and concepts of molecular endocrinology to unable to students understand and acquire knowledge.
CO2	To provide clear under standing and critical interpretations of clinical manifestation.
CO3	To impact the basis theoretical knowledge in molecular endocrine
CO4	Educating and familiarizing the terms and concepts of molecular endocrinenology
CO5	To impact complete idea and knowledge in hormones.

SYLLABUS

Unit	Unit title	Intended learning chapters (K1,K2)	Knowledge domain	Hours of instruction
I.	Introduction	Historical and anatomy aspects of mammalian endocrine system . Classification of hormones and mechanism of action. Hypothalamic and pituitary hormones. Hypothalamic releasing factors. Anterior pituitary hormones: biological actions, regulation and disorders of growth hormone, ACTH, gonadotropins and prolactin. Leptin. Posterior pituitary hormones- biological actions of vasopressin.Diabetesinsipidus and syndrome of inappropriate ADH secretion (SIADH) Oxytocin. Hypopituitarism. Classification, biological action regulation and disorders of Anterior pituitary hormones (growth hormone, ACTH, gonadotropins and prolactin) , Posterior pituitary hormones (vasopressin, ADH, Oxytocin).	K1 & K2	19
II.	Thyroid and Parathyroid hormones	Thyroid hormones- synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroidagents.Thyroid function tests. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate	K1, K2& K4	15

		metabolism.Secretion and biological actions of PTH, calcitonin and calcitriol. Hypercalcemia and hypocalcemia. Rickets and osteomalacia.		
III.	Adrenal hormones	Adrenal cortical hormones.Synthesis, regulation, transport, metabolism and biological effects of glucocorticoids and mineralocorticoids. Hypo and hyper function- Cushing's syndrome, aldosteronism, CAH, aderenal cortical insufficiency, Addison's disease. Adrenal medullary hormones- synthesis, secretion, metabolism, regulation and biological effects of catecholamines.Phaeochromocytoma.	K1, K2&K5	15
IV.	Gastrointestinal , Pancreatic and Gonadal hormones	Gonadal hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia.Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. The menstrual cycle. Pancreatic hormones- synthesis, regulation, biological effects and mechanism of action of glucagon, somatostatin and insulin. Insulin receptor. Brief account of gastrointestinal hormones.	K1, K2& K5	15
V.	Signal transduction and Neuro transmitter	Fundamental concepts and general features of cell signalling. Endocrine, paracrine, autocrinesignaling and juxtacrine signalling. Types of receptors. Nuclear and cytosolic receptors. G-protein-coupled receptors. Second messengers: c-AMP, cGMP, inositol triphosphate and Ca^{2+}. Receptor tyrosine kinases- insulin signalling, ras-raf-MAP kinase and JAK-STAT pathways. Neurotransmitter receptor- Cholingeric and adrenergic.	K1 & K2	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCE:

Text Books

1. Hadely,M. and Levine,J.E. 2006. Endocrinology, 6 th Edition, Benjamin Cummings.
2. Smith,E. *et al*., 1983. Principles of Biochemistry, 7th Edition, McGraw Hill International Book Co.

Reference Books

1. Guyton,A.C. and Hall,J.E. 2010. Text book of Medical Physiology, 12th Edition, Saunders Publishers.

S. Melmed et al., 2015. Williams Text Book of Endocrinology, 13th Edition, Saun

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	M	M	L	M	L	L
CO2	H	L	M	M	L	M	L	L
CO3	H	M	M	M	L	M	L	L
CO4	H	L	M	M	L	M	L	L
CO5	H	L	M	M	L	L	L	L

H-High; M-Medium; L-Low

CANCER BIOLOGY

COURSE CODE : **18BCHE02**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : To understand the epidemiology of cancer, mechanism of oncogenesis and apoptosis, and currently available therapeutic treatments.

COURSE OUTCOMES (CO)

CO1	To have an understanding , basic knowledge on various cancer growth and morphology of cancer , terminologies used , types and prevalence of cancer, to have a further in depth knowledge in the continuing units
CO2	Develop an understanding of how a cancer cell develops into a malignant tumor, the mechanisms of DNA damage through various agents and how this process is linked to cellular transformation and cancer risk.
CO3	Understand the common cellular and molecular mechanisms that are deregulated in cancer cells and the reason for their deregulation. And also the relationship between diet and cancer, free radicals and antioxidants balance/ role in cancer development.
CO4	To have a better understanding on the impact of apoptosis, its types on oncogenesis, cancer diagnosis via several different methods, cytotoxicity assays, which will enable the student to be aware on current diagnostic tools and the principles behind it.
CO5	Having basic knowledge on novel therapeutic approaches available for cancer and its assessment/ identification by different cancer markers.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Introduction	Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ.	K1,K2	11
II	Epidemiology of cancer	Endocrinology of cancer. Agents causing cancer-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion,	K1,K2	11

		Progression. Paraneoplastic syndromes.		
III	Molecular mechanism	proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Free radicals and antioxidants in cancer. Diet and cancer. Cell cycle and cancer: Control of the cell cycle-cyclins and CDKs	K1, K2,K4	11
IV	Apoptosis and cancer	Intrinsic and extrinsic pathways-. Mechanism of apoptosis, signaling pathways. Types and their impact on apoptosis and oncogenesis. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests.	K1,K2,K3,K4	11
V	Cancer therapy	Different forms of therapy, chemotherapy, radiation therapy, gene therapy, immune therapy, surgical therapy and biologic therapy. Principles of cancer biomarkers and their applications.	K1, K2,K3,K4	10

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
2. Vincent,T. *et al*., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins.
3. Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.
4. Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.

Reference Books

1. McKinnell, R.G. *et al*., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2. Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	M	L	M	L	L
CO2	H	L	M	M	L	M	L	L
CO3	H	L	M	M	L	M	L	L
CO4	H	L	M	M	L	M	L	L
CO5	H	L	L	M	L	M	L	L

H-High; M-Medium; L-Low

BIOSTATISTICS

COURSE CODE : **18BCHE03**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

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 for the design of basic research and analysis of research data.

COURSE OUTCOMES (CO)

CO1	This course covers the basic tools for the collection, analysis and presentation of data in all areas of research.
CO2	To measure the central tendency, variation and correlation analysis
CO3	To compare and emphasis on probability and theoretical distributions
CO4	To analyze sampling distribution, sampling of variables and test of significance
CO5	To study the Analysis of variation and design of experiment

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Introduction	Organizing a statistical survey, Planning and executing the survey. Source of data - Primary and secondary data, collection, observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic and graphic presentation of data.	K1.K2. K3	13
II	Measures of central tendency and correlation analysis	Measures of central tendency - arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of variation. Correlation analysis - Scatter diagram, Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis.	K1.K2. K3, K4	14
III	Probability and theoretical distributions	Probability- Definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical distributions – Binomial,	K1.K2. K3.K4	14

		Poisson and normal distribution-Simple problems.		
IV	Sampling distribution and test of significance	Sampling distribution and test of significance – Concepts of sampling, Testing of hypothesis, errors in hypothesis testing, standard error and sampling distribution, sampling of variables (large samples and small samples.). Student's "t" distribution and its applications. Chi-square test and goodness of fit.	K1.K2. K3, K4	16
V	Analysis of variance	Analysis of variance - one way and two way classification. Duncan's Multiple Range test. Mann Whittneys test-significance. Design of experiment-Completely randomised block design, Randomised block design.	K1.K2. K3, K4	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Gupta,S.P. 2011. Statistical Methods, 4 th Edition, Sultan Chand & Son Publishers.
2. Zar,J.H. 2010. Biostatistical Analysis, 5th Edition, Pearson Education..

Reference Books

1. Daniel,W.W. 2008. Biostatistics - A Foundation for Analysis in Health Sciences, 9 th Edition, John Wiley and Sons, Inc., 1999.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	L	L	L	M	L	L	L
CO2	H	L	M	L	M	L	L	L
CO3	H	L	M	L	M	M	L	L
CO4	H	L	M	L	M	M	L	L
CO5	H	L	M	L	M	L	L	L

H-High; M-Medium; L-Low

MICROBIOLOGY

COURSE CODE : **18BCHE04**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : Understand the basic information about microbiology, virology, medical, food and industrial microbiology

COURSE OUTCOMES (CO)

CO1	It provides the basic concepts of morphology, cytology and classification of microbes.
CO2	It helps to understand the molecula mechanism behind viral infections.
CO3	Understanding of pathogenesis of microbial diseases affecting humans.
CO4	To educate the beneficiary role of microorganism.
CO5	To understand and appreciate the different industrial applications of microbes.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Morphology, cytology and classification microbes	Bacterial nomenclature and classification; prokaryotic organism on overview, morphology and ultra structure of bacteria, shapes and arrangement of bacteria, morphology types; archeabacteria, gram positive and gram negative and subacteria structure and function of flagella, cilia and endospore. Structure and classification of algae and reproduction. Structure and classification of fungal cell, hypae, spores, Protozoa. Light microscopy- bright field, dark field, phase contrast, fluorescent and polarization microscope, electron microscopy, TEM & SEM.	K1.K2. K3	13
II	Virology	Nomenclature – classification and taxonomy of viruses; host, nucleic acids and structure. Bacterial viruses; ØX 174; T4; M13A, life cycle (Lysogenic and Lytic). RNA phages plant viruses; effects of viruses on plants, RNA viruses, TMV, satellite viruses, bromo mosaic virus. Animal viruses; classification and structure of animal and human viruses. RNA viruses; Herpes virus, RNA tumor virus-retro virus, DNA virus – vaccinia	K1.K2. K3	14

		virus, SV40 adeno viruses. Viroids.		
III	Medical microbiology	Normal microbial flora of human body – (respiratory tract, skin, GIT, Infection – sources) mode of transmission (exogenous and endogenous).Mechanism of bacterial pathogenesis. Medically significant bacteria Staphylococcus aureus, Streptococci, pathogenic, enterobacteriaceae, Vibrio, Corny bacterium, pseudomonas, Mycobacterium tuberculosis, Helicobacter pylori. Pathogenesis of parasitic disease, blood and tissue protozoa, nematodes, arthropods, influenza viruses, measles, chicken pox, hepatitis , dengue fever, Mechanism of fungal pathogenesis, superficial and cutaneous mycoses, systemic mycoses, opportunistic mycoses.	K1.K2. K3	14
IV	Food microbiology and diary microbiology	Food as substrate for the microorganisms. General principles and types of microbes in spoilage of foods, different methods of preservation. Microbes in food: mold, yeast, bacteria. Food borne diseases: Staphylococcus, Clostridium, *E.Coli*, *Salmonella*, mycotoxin, Protozoan. Viral food borne disease. Microflora of milk- sources of contamination-intoxication-pasteurization-sterilization-fermented diary products-yogurt, kafir, kumiss, cheese production. Food hygiene and control-food sanitation in food manufacture.	K1.K2. K3	16
V	Industrial Microbiology	Industrial microbiology; an introduction to fermentation process- components parts of fermentation process. Industrially important organisms- upstream processing, media for industrial fermentation, formulation and sterilization. Aerobiology – droplet nucleus – aerosols – transmission of microbes –assessments of air quality and diseases. Soil Microbiology : Soil microbes, Soil Pollution – Micro flora of various soils – Biofertilizers Geomicrobiology – Biochemical cycles of Carbon, Nitrogen, Phosphorus, Sulphur and Iron cycles. Biobleaching & Biomining – Petroleum degradation- Xenobiodegradation.	K1.K2. K3	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)

Evaluation capability level (K5)
Scientific or synthesis level (K6)

Text Books

1. Prescott, M.L., Harley, P.J. and Klein, A.D. 2004. Microbiology, 6th Edition, McGraw-Hill Science.
2. Pelczar, J.M. *et al.*, 2001. Microbiology, 5th Edition, Tata-McGraw Hill Publications.
3. Ananthanarayanan R and Jayaram Paniker, C.K. 2009. Textbook of Microbiology, 8th Edition, Universities Press.

REFERENCES

Reference Books

1. Medical Microbiology. Jawetz, Melinickand Adelberg's, Twenty Second Edition,
   McGraw Hill Medical Publication division, 2001.
2. Pommerville, J.C. Alcamo, I.E. . 2012. Alcamo's Fundamentals of Microbiology, Jones & Bartlett Publishers.
3. Cruegar,W. and Cruegar. A., Biotechnology : A Textbook of Industrial Microbiology Second Edition, Panima Publishing Corporation, Bangalore, 2004.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	L	L	L	L	M	L
CO2	M	M	L	L	L	L	M	L
CO3	M	M	L	L	L	L	M	L
CO4	M	M	L	L	L	L	M	L
CO5	M	M	L	L	L	L	M	L

H-High; M-Medium; L-Low

NUTRITIONAL BIOCHEMISTRY

COURSE CODE : **18BCHE05**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : To provide an understanding of biochemistry and explores the biochemical activity in the human body of nutrients and food constituents.

COURSE OUTCOMES (CO)

CO1	The students will gain theoretical information on energy metabolism and carbohydrates
CO2	To study the basics of protein and lipid biomolecules
CO3	To understand the importance of electrolytes, minerals and vitamins in human body
CO4	To study and analyze the importance of nutraceuticals and its importance in phytotherapeutics
CO5	To study the clinical relevance of nutritional biochemistry.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Introduction to energy metabolism and carbohydrates	Basic concepts : Composition of human body. Energy metabolism - Energy content of foods- direct and indirect methods. BMR and SDA - methods of measurement of energy expenditure. Thermogenic effects of foods. Recommended dietary allowances, Food Pyramid. Carbohydrates : Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of unavailable carbohydrates (dietary fiber).	K1.K2. K3	13
II	Proteins and Lipids	Proteins : protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality. Cereal proteins	K1.K2. K3	14

		and their limiting amino acids. Protein requirement at different stages of development. Protein deficiency disorders. Lipids : Major classes of dietary lipids. Properties and composition of plasma lipo - proteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.		
III	Electrolytes, minerals and vitamins	Electrolytes and water balance : Electrolyte concentration of body fluids. Acids base regulation by the human body. Concepts of metabolic and respiratory acidosis and alkalosis. Minerals : Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper**.** Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water – soluble vitamins. Hypervitaminosis symptoms of fat – soluble vitamins.	K1.K2. K3	14
IV	Nutraceuticals and phytotherapeutics	Nutraceuticals: significance in human health . Antioxidants : antioxidant enzymes- mode of action, non-enzymic antioxidants- mechanism of action, Phytotherapeutics: phenolic compounds, flavonoids, lycopene, carotenoids, anthocyanins. Vitamin A,E,B and C. Dietary metabolism and health Over view and risks of dietary supplements. Nutrition for infants, children, teenagers, pregnancy and lactation and ageing.	K1.K2. K3,K4	16
V	Applied nutrition	Eating disorders- Obesity, anorexia nervosa and bulimia nervosa, total parenteral nutrition (TPN), sports nutrition, poverty and nutrition, Food allergies - immune reactions. Applied nutrition**:** Diet- nutrition, and lifestyle-related chronic non-communicable diseases (NCDS) - cardiovascular diseases, diabetes mellitus, cancer, diseases of kidney, nutrition and HIV/AIDS, food and nutrition security in developing countries.	K1.K2. K3,K4	15

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Bamji,M.S.*et al.*, 2009. Text book of Human Nutrition, 3 rd Edition, Oxford and IBH Publishers.
2. Insel, P. *et al*. 2013. Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers.
3. Swaminthan, M.S. 1986. 2007. Handbook of Food and Nutrition, 5 th Edition. The Bangalore Printing and Publishing Company.

Reference Books

1. Srilakshmi,B. 2006. Nutrition Science, 2nd Edition, New Age International Publishers.
2. Weighley, E.S. 1997. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	L	L	M	L	M	L	L
CO2	M	L	L	M	L	M	L	L
CO3	M	L	L	M	L	M	L	L
CO4	M	L	L	M	L	M	L	L
CO5	M	L	L	M	L	M	L	L

H-High; M-Medium; L-Low

BIOTECHNOLOGY

COURSE CODE : **18BCHE06**
MARKS : 100

Hours	L	T	P	C
	3	1	0	4

COURSE OBJECTIVES : The objective of this course is to have a basic foundation on bioprocess, industrial, animal, medical and environmental Biotechnology.

COURSE OUTCOMES (CO)

CO1	Understand the basic principles involved in bioprocess technology including fermentation, its types, downstream processing, sterilization of culture media will form a good foundation for advanced learning.
CO2	Understand the basics in microbiology including isolation of a strain as well as identification, production of microbial metabolites, antibiotics through microbial methods, the need for genetic improvements and the process of carrying it out, Single cell protein and its significance.
CO3	Understand the basics in histopathology performance, culture media used for animal cell culture systems – primary, secondary cell culture, its characterization, cytotoxicity assays, gene cloning will help the students to have a wider knowledge in the latest technology.
CO4	Have a basic knowledge on the use of DNA in diagnosing infections via DNA finger printing, pharmaceutical products developed by RDNA technology for certain specific diseases, Vaccine production from plants , studying its types etc will give a strong basic foundation to attain their focused specialization .
CO5	Having basic knowledge in the pollution monitoring, pollutant degradation via biotechnological methods – bioremediation available for solid waste management , soil pollution reduction will help the students to maintain an eco friendly environment which will protect the future generations on the whole as well as reduced global warming.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Bioprocess technology	Bioreactors: types, operation of conventional bioreactor, solid substrate fermentation, *Media for industrial fermentation, sterilization of culture media and gases.Batch culture, Fedbatch culture, and continuous culture Downstream processing:	K1,K2.K3	11

		solid-liquid separation, release of intracellular products, concentration, purification and formulation		
II	Industrial Biotechnology	Isolation of microorganism, microbial metabolic products - primary and secondary metabolites, genetic improvement of strains. Metabolite production : Organic solvent – alcohol, organic acids – citric acid and lactic acid, antibiotics – penicillin and streptomycin, vitamins – riboflavin and ascorbic acid.Single cell protein	K1,K2,K3	11
III	Animal Biotechnology	Animal cell culture: fundamentals and applications. Organ and tissue slice techniques. Culture media for animal cells, cultured cells – Biology and characterization, primary culture and cell lines, cell viability and cytotoxicity, cell transformation and cell cloning	K1, K2,K3	11
IV	Medical Biotechnology	DNA in disease diagnosis : DNA probes, DNA in diagnosis of infectious diseases, genetic diseases, DNA fingerprinting. Pharmaceutical products of DNA technology : Human protein replacement, therapeutic agents for human diseases. Recombinant vaccines : subunit vaccines, DNA vaccines, attenuated recombinant vaccines, plants as edible subunit vaccines.	K1,K2,K3	11
V	Environmental Biotechnology	Environmental pollution : Types of pollution, pollution monitoring, biotechnological methods for management of pollution. Biodegradation : xenobiotic compounds. Bioremediation: Types of bioremediation, types of reactions in bioremediation, genetic engineering for efficient bioremediation, bioremediation of contaminated soil and waste land.	K1, K2,K3	10

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES:

Text Books

1. Satyanarayana,U. 2005.. Biotechnology, 1st Edition, Books & Allied Ltd.
2. Clark,D.P.and Pazdernik,N.J. 2009. Biotechnology: Applying the genetic revolution, Elsevier.

3. Singh,B. and Gautam,S.K. 2013. Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI.

Reference Books

1. Cruger,W. and Cruger,A. 2000. Biotechnology: A text book of Industrial Microbiology, 2nd Edition, Sinauer Associates Inc.
2. Stanbury,P. and Whitaker,A. 1984. Principles of Fermentation Technology, 1st Edition, Pergamon Press.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	L	M	M	L	M	L	L
CO2	M	L	M	M	L	M	L	L
CO3	M	L	M	M	L	M	L	L
CO4	M	L	M	M	L	M	L	L
CO5	M	L	M	M	L	M	L	L

H-High; M-Medium; L-Low

SUPPORTIVE COURSES FOR OTHER DEPARTMENTS

TOOLS AND TECHNIQUES IN BIOSCIENCE

COURSE CODE : **18BCHS01**
MARKS : 100

Hours	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES : To understand the principles, instrumentation and applications of major analytical techniques used in biosciences.

COURSE OUTCOMES (CO)

CO1	To understand the techniques in cell fractionation. To understand the techniques and applications of radioisotopes in biology.
CO2	To understand the principles and applications of centrifugation and microscopy
CO3	To understand the principles and applications of chromatography.
CO4	To understand the principles and applications of electrophoretic techniques.
CO5	To understand the principles and applications of spectroscopy.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Cell-fractionation technique, Radioisotopes in Biology	Cell lysis, homogenization extraction, salting in, salting out, dialysis and ultra-filtration. Concepts of half-life, decay constant, detection and quantitation- GM counter and solid and liquid scintillation counter. Specific activity, autoradiography and their applications. Application of radioactivity.	K1,K2,K3	13
II	Centrifugation, Microscopy	Svedberg's constant, sedimentation velocity and sedimentation equilibrium. Differential and density gradient centrifugation, centrifugal elutriation, construction of preparative and analytical ultracentrifuge. Principles and applications of light phase contrast, fluorescence, scanning and transmission electron microscopy	K1,K2,K3	13
III	Chromatographic techniques	Principles and applications of paper, TLC, adsorption, ion exchange, gel filtration, affinity, GLC, chromate focusing, HPLC and	K1, K2, K3	13

		FPLC.		
IV	Electrophoretic techniques	Polyacrylamide gel electrophoresis, SDS-PAGE, 2D- electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulsed field electrophoresis, high voltage electrophoresis, capillary electrophoresis, isotachophoresis.	K1, K2, K3	13
V	Spectroscopic techniques	Principles of colorimeter, spectrophotometer, fluorimeter. Beer-Lambert's Law and its limitation. Extinction coefficient, Atomic absorption spectroscopy UV-Visible, Spectrofluorometry, Flame photometry, Nephlometry, Turbidometry.	K1, K2,K3	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition , Cambridge University. Press .
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition

Reference Books

1. Sharma,B.K. 1981. Instrumental Methods of Chemical analysis, 5th Edition Goel Publications.
2. Homie,D.J. and Peck,H. Analytical Biochemistry, Third Edition, Longman

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

MEDICAL LAB TECHNOLOGY

COURSE CODE : **18BCHS01**
MARKS : 100
COURSE OBJECTIVES : This syllabus has been formulated to impart basic knowledge of biochemistry, analytical techniques and to perform clinical laboratory tests accurately and efficiently.

Hours	L	T	P	C
	3	0	0	3

COURSE OUTCOMES (CO)

CO1	To gain knowledge in the general laboratory instruments and equipment and to know about the specimen processing for biochemical analysis.
CO2	To understand the principles and applications in the analytical techniques.
CO3	To understand the principles and applications of biochemical tests.
CO4	To understand the principles and applications of automation of the analytical processes in clinical laboratory.
CO5	To understand the laboratory information systems.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	General approach to medical laboratory sciences	Safety in the laboratory. General laboratory instruments and equipments . Basic Chemistry and laboratory calculations . Specimen processing for Biochemical analyses - Blood, urine, cerebrospinal fluid, synovial fluid.	K1,K2,K3	13
II	Principles of Analytical techniques	Basic concepts in analytical chemistry, Colorimetry, Spectrophotometry, titrimetry, flame photometry, chromatography, electrophoresis. Immunochemistry - ELISA, RIA, CLIA, PCR techniques, flow cytometry and biochips.	K1,K2,K3	12
III	Clinical Chemistry	Biochemical tests - glucose, protein, albumin, urea, creatinine, uric acid, bilirubin and cholesterol. Enzymes - SGOT, SGPT, ALP, ACP, LDH, creatinine kinase, lipase, amylase, choline esterase. Hormones - Insulin, T3, T4, TSH, cortisol, FSH, progesterone and estrogen. Electrolytes and blood gases Biochemical profile test: Liver function test, renal function test, gastric function test, pancreatic function test and endocrine function test.	K1,K2,K3 ,K4	15
IV	Automation in Clinical laboratory	Basic concepts, Automation of the analytical processes, Steps of automation in biochemical analysis, Computers in the clinical laboratory, Types of automated analysers, Commonly used analysers of biochemical laboratories. Statistical procedures –	K1,K2,K3	13

		Arithmetic mean, Median, standard deviation, coefficient of correlation, t test and ANOVA.		
V	Laboratory management	Clinical laboratory informatics - Computer systems, Laboratory information systems, Laboratory Management – Basic concepts, financial management . Quality management – Fundamentals, Total quality management of clinical laboratory.	K1,K2,K3 ,K4	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Mukherjee,K.L. 1988. Medical Laboratory Technology – A procedure manual for routine diagnostic tests, Vol I , II, III. Tata McGraw Hill Publishing Company Limited.
2. Burtis,C.A. and Ashwood,E.R. 2007. Teitz Textbook Clinical Chemistry., Third Edition, W.B.Saunders Company.
3. Varley,S. 1988. Practical Clinical Biochemistry, Gowenlock *et al*., Sixth Edition, CBS Publishers & Distributors. 1988

Reference Books

1. Henry,J.B. 1988. Clinical Diagnosis and Management by Laboratory Methods., 17th Edition, W.B.Saunders Company.
2. Chatterjee,M.N. and Shinde,R. Text book of Medical Biochemistry, 5th Edition, Jaypee Brothers Medical Publishers, 2002.
3. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

CLINICAL DIAGNOSIS IN HEALTH AND DISEASES

COURSE CODE : **18BCHS03**
MARKS : 100

Hours	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES : The aim of the course is to understand the diagnostic procedures adopted in various disease conditions and its management.

COURSE OUTCOMES (CO)

CO1	To know about general health, syndrome and common diseases that affects mankind
CO2	To understand the importance of liver and kidney function test
CO3	To understand the basics and importance of heart, lung and brain test
CO4	To know the basic mechanisms of communicable diseases
CO5	To imbibe and understand the mechanism of non- communicable diseases and their clinical significance

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Introduction	General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebrospinal fluid and tissues and histology. General check up: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells).	K1,K2,K3	13
II	Liver and kidney function test	Detection of metabolites and its importance. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance.	K1,K2,K3	12
III	Heart, lung and brain test	Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting	K1,K2,K3	15

		time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.		
IV	Infections	Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikun gunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, Koch postulations – Microscopic examination of body fluids, ELISA and PCR tests.	K1,K2,K3	13
V	Non communicable diseases	Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation. Cancer markers: ELISA.	K1,K2,K3	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical chemistry Chemistry, 3rd Edition W.B.Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.

Reference Books

1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12th Edition, Saunders.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low

INTRODUCTION TO BIOCHEMISTRY

COURSE CODE : **18BCHS04**
MARKS : 100

Hours	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES : This course is an introduction to biochemistry and covers the structure and functions of biological molecules.

COURSE OUTCOMES (CO)

CO1	Understand the basics involved in the structure of carbohydrates like anomerism,stereoisomerism, epimer formation and their types, chemical properties, and functions.
CO2	Understand the basics in the structure of lipids, classifications like simple and complex lipid including lipopotein and lipo polysaccharides and teir biological functions.
CO3	Understand the basic structure- types, classification, properties-coagulation, denaturation, function of protein, amino acids and its sequencing.
CO4	Have a basic knowledge on the structure of DNA, experiments that proved it as a genetic material, as well as to know their properties, functions in biology.
CO5	Know about the structure, types of vitamins in biological reactions, and its relationship with disease, daily requirement.

SYLLABUS

Unit	Unit title	Intended Learning chapters	Knowledge domain	Hours of Instruction
I	Carbohydrates	Classification-monosaccharides, disaccharides, polysaccharides basic chemical structure, aldoses and ketoses, cyclic structure of mo nosaccharides, steroisomerism, anomers and epimers. Sugar derivatives, deoxy sugars, amino sugars, and sugar acids. General reaction and properties. Structure and biological functions of homo- and heteropolysaccharides.	K1,K2,K3	13
II	Lipids	Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.	K1,K2,K3	12
III	Proteins	Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation and structure of proteins - primary, secondary, tertiary and quaternary	K1,K2,K3	15

		structure, coagulation and denaturation of proteins.		
IV	Nucleic acids	Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiments, action spectrum, etc. Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA.	K1,K2,K3	13
V	Vitamins	Structure, biochemical functions, deficiency diseases, daily requirements of water soluble and fat soluble vitamins and their coenzyme activity.	K1,K2,K3	13

Program specific attributes

Knowledge and understanding level (K1 and K2)
Application level (K3)
Analytical level (K4)
Evaluation capability level (K5)
Scientific or synthesis level (K6)

REFERENCES

Text Books

1. Nelson,D.L and Cox,M.M.2013. Lehninger Principles of Biochemistry, 6 th Edition, W.H. Freeman
2. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing

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1. Berg,J.M. *et al.* 2012. Biochemistry, 7th Edition, W. H. Freeman & Company, 2012.
2. Voet,D. *et al.,* 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

MAPPING

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	M	M	M	L	L	M	L
CO2	H	M	M	M	L	L	M	L
CO3	H	M	M	M	L	L	M	L
CO4	H	M	M	M	L	L	M	L
CO5	H	M	M	M	L	L	M	L

H-High; M-Medium; L-Low