

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
 Re-accredited by NAAC with 'A' Grade Status – 3.64CGPA (3rd cycle)
 College with Potential for Excellence (UGC), Star College (DBT)
 Coimbatore - 641029, Tamil Nadu, India.

Course Name: B.Sc. Biochemistry
Curriculum and Scheme of Examination under CBCS

(Applicable to Students Admitted for the Academic Year 2016-2017)

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
I	I	15TML101	Language I@	6	25	75	100	3	3
	II	15ENG101	English –I	6	25	75	100	3	3
	III	15UBC101	C.P.1 Chemistry of Biomolecules	7	25	75	100	3	6
		15UBC2CL	C. Pr. I - Biochemistry	2	-	-	-	-	-
		15UZO1A1	Allied A1- Zoology I	5	20	55	75	3	4
		15UZO2A1	A. Pr. 1 Zoology	2	-	-	-	-	-
	IV	15EVS101	Environmental Studies**	2	-	50	50	3	2
II	I	15TML202	Language II@	6	25	75	100	3	3
	II	15ENG202	English –II	6	25	75	100	3	3
	III	16UBC202	C.P.2 Bioanalytical Techniques	7	25	75	100	3	6
		15UBC2CL	C.Pr. 1 Biochemistry	2	40	60	100	3	2
		15UZO2A2	Allied A. 2 Zoology II	5	20	55	75	3	4
		15UZO2AL	A. Pr. 1 Zoology	2	20	30	50	3	2
	IV	15VED201	Value Education- Moral and Ethics**	2	-	50	50	3	2
III	I	15TML303	Language III@	6	25	75	100	3	3
	II	15ENG303	English –III	6	25	75	100	3	3
	III	16UBC303	C. P. 3 – Enzymes and Enzyme Technology	4	25	75	100	3	5
		16UBC4CM	C.Pr. 2 Biochemistry	3	-	-	-	-	-
		15UCH3A2	Allied B. 1. Chemistry I	5	20	55	75	3	4
		15UCH4A1	A.Pr.2 Chemistry	2	-	-	-	-	-
	IV	15UGA3S1	Skill Based Subject 1- General Awareness	2	25	75	100	3	3
IV	I	15TBT301/15TAT301/15UHR3N1	Basic Tamil* Advanced Tamil** (OR) Non-Major Elective- I**	2	75		75	3	2
		15TML404	Language IV@	6	25	75	100	3	3
		15ENG404	English –IV	6	25	75	100	3	3
	III	16UBC404	C. P. 4 Intermediary Metabolism	4	25	75	100	3	4
		16UBC4CM	C. Pr.2. Biochemistry	3	40	60	100	3	2
		15UCH4A2	Allied B.2 Chemistry II	5	20	55	75	3	4
		15UCH4AL	A. Pr.2. Chemistry	2	20	30	50	3	2

APPROVED BY THE ACADEMIC COUNCIL

Date: 20/3/2016 Item No: 13 Page No: 13

S. K. Shri Krishna Kumar
 DEPARTMENT OF BIOCHEMISTRY
 Kongunadu Arts and Science College
 COIMBATORE-641 029

	IV	15UBC4S2	Skill Based Subject 2- Common Human Diseases	2	25	75	100	3	3
		15TBT402/ 15TAT402/ 15UWR4N2	Basic Tamil*/ Advanced Tamil** (OR) Non-Major Elective- II**	2	75		75	3	2
V	III	16UBC505	C.P.5 Human Physiology	4	25	75	100	3	4
		16UBC506	C.P.6 Cell Biology	4	25	75	100	3	4
		16UBC507	C.P.7 Clinical Biochemistry	4	25	75	100	3	4
		16UBC508	C.P.8 Molecular Biology	4	25	75	100	3	4
	III	15UBC5E1	Major Elective I	4	25	75	100	3	5
	III	16UBC6CN	C.Pr.3. Biochemistry	4	-	-	-	-	-
		16UBC6CO	C.Pr.4. Biochemistry	2	-	-	-	-	-
		16UBC6CP	C.Pr.5. Biochemistry	2	-	-	-	-	-
	IV	16UXBO/ ZO/BT	Extra Departmental course-1 Diagnostic Biochemistry	2	25	75	100	3	3
	-	15UBC5IT	Internship Training	Grade ****					
VI	III	16UBC609	C.P.9 Plant Biochemistry and Therapeutics	4	25	75	100	3	4
		16UBC610	C.P.10 Immunology and Immuno Techniques	4	25	75	100	3	4
		16UBC611	C.P.11 Genetic Technology	4	25	75	100	3	4
	III	16UBC6E2	Major Elective II -	4	25	75	100	3	5
		15UBC6Z1	Project ***	4	20	80	100	-	5
	III	16UBC6CN	C.Pr.3. Biochemistry	4	40	60	100	6	3
		16UBC6CO	C.Pr.4. Biochemistry	2	40	60	100	4	2
		16UBC6CP	C.Pr.5. Biochemistry	2	40	60	100	4	2
	IV	15UBC6S4	Skill Based Subject 4- Techniques in Genomics and Proteomics	2	25	75	100	3	3
	V	15NCC / NSS / YRC / PYE101	Extension Activities*	-	50	-	50	-	1
Total				180			3800		140

@ Hindi/Malayalam/ French/ Sanskrit – 15HIN/15MLM/15FRN/15SAN101 - 404

* - No End-of-Semester Examinations. Only Continuous Internal Assessment (CIA)

** - No Continuous Internal Assessment. Only End-of-Semester Examinations (ESE)

***- Project Report – 60 marks; Viva voce – 20 marks; Internal – 20 marks

****- The students shall undergo an Internship training/field work for minimum period of 2 weeks at the end of the fourth semester during summer vacation and submit the report in the fifth semester. The report will be evaluated for 100 marks along with the internal viva voce by the respective faculty. According to their marks, the grades will be awarded as given below.

Marks%	Grade
85-100	O
70-84	D
60-69	A
50-59	B
40-49	C
<40	U (Reappear)

Major Elective Papers

(2 papers are to be chosen from the following 5 papers)

1. Microbiology
2. Biotechnology
3. Advanced Clinical Biochemistry
4. General Pharmacological Principles
5. Basics of Bioinformatics

Non-Major Elective Papers

1. Human Rights
2. Women's Rights

Tally Table:

S.No.	Part	Subject	Marks	Credits
1.	I	Language – Tamil/Hindi/Malayalam/ French/ Sanskrit	400	12
2.	II	English	400	12
3.	III	Core – Theory/Practical/Project	1700	65
		Allied (4)	400	20
		Major Electives (2)	200	10
4.	IV	Basic Tamil / Advanced Tamil (OR) Non-major electives	150	4
		Skill Based subjects (4)	400	12
		Environmental Studies	50	2
		Value Education	50	2
5.	V	Extension Activities NCC/NSS/YRC/PYE	50	1
		Total	3800	140

Note :

CBCS – Choice Based Credit System

CIA – Continuous Internal Assessment

ESE – End of Semester Examinations

25 % CIA is applicable to all theory subjects except JOC, COP and Diploma Courses, which are considered as extra credit courses.

UBC - 1
SEMESTER - 1
C.P.1 CHEMISTRY OF BIOMOLECULES

16UBC101
Credits 6
Total teaching hours: 105

OBJECTIVES

- To learn the chemistry and structure of different biomolecules.
- To understand the biological significance of different biomolecules.

Unit I (21 hrs)

Carbohydrates: Introduction; definition; functions of carbohydrates; classification of carbohydrates-monosaccharides-configuration; spatial configuration of sugars – stereoisomerism; asymmetry of carbon atom and optical activity; optical isomerism; α and β – anomers and mutarotation; epimers; pyranose and furanose structure; aldose – ketose isomerism.

Reactions of carbohydrates: enediol formation; benedict's reaction; osazone formation; purfural derivatives.

Unit II (21 hrs)

Lipids: Introduction; definition; classification; functions of lipids.

Simple lipids: fats; physical properties of fat; chemical properties of fats – hydrolysis, saponification number, iodine number.

Compound lipids: phospholipids; classification of phospholipids; biological functions.

Derived lipids: - fatty acids; types of fatty acids – saturated and unsaturated fatty acids; essential fatty acids.

Unit III (21 hrs)

Amino acids: Introduction; definition; classification of amino acid; based on structure, side chain metabolism and nutritional requirements.

Properties of amino acids – ampholyte and isoelectric point, optical activity.

General reactions of amino acids: due to carboxylic group – decarboxylation and amide formation; due to amino group – transamination and oxidative deamination; due to side chain – transmethylation and ester formation.

Unit IV (21 hrs)

Proteins: Introduction; general properties; classification. Bonds relating to protein structure – strong bonds (peptide & disulphide bonds) - weak bonds (hydrogen and hydrophobic bonds). Structure of proteins – primary, secondary, tertiary and quaternary structure.

Denaturation and Renaturation.

UBC-2

Unit V (21 hrs)

Nucleic acids: - Introduction; Types of nucleic acids; Structure of purine (A and G) and pyrimidine (C,U,T, dihydrouridine and pseudouridine) bases.

Structure of nucleotide – AMP, dAMP , GMP, dGMP, CMP, dCMP , dTMP , UMP.

Structure of DNA – Watson and Crick model.

Structure of RNA – mRNA, tRNA and rRNA.

Denaturation and Renaturation.

Text Books

1. Ambika Shanmugam (2008), Fundamentals of Biochemistry for Medical Students, 7th ed., Published by the Author, Chennai – 600 035.
2. Deb, A. C. (2011), Fundamentals of Biochemistry, 10th ed., New Central Book Agency Pvt. Ltd., Kolkata 700 009.

Reference Books

1. Voet, D., Voet, J.G. and Pratt, C.W. (2013), Fundamentals of Biochemistry, Life at the Molecular Level, 4thed., John Wiley & Sons, New Delhi, 110002.
2. Vasudevan, DM.,Sreekumari, S. and KannanVaidyanathan (2011), Text Book of Biochemistry for Medical Students, 6th ed., JAYPEE Brothers Medical Publishers Pvt. Ltd., New Delhi, 110002.

UBC – 3
C.Pr.1 BIOCHEMISTRY

16UBC2CL
Credits 2
Total hours: 30

OBJECTIVES

- To acquire skill of analyzing carbohydrates and amino acids.
- To provide practical knowledge about the characterization of lipids.
- To learn the methodology of separation of amino acids by paper chromatography.

Analysis of Biomolecules

I. Qualitative Analysis of Carbohydrates

- a. Monosaccharides - Hexoses: Glucose and fructose
 - Pentose: Arabinose
- b. Disaccharides - Sucrose and Lactose
- c. Polysaccharides - Starch

II. Qualitative Analysis of Amino acids

- a. Arginine
- b. Histidine
- c. Tyrosine
- d. Tryptophan
- e. Cysteine

III. Characterization of Lipids (Group Experiment)

Determination of Iodine number

IV. Separation Technique (Demonstration)

Separation of amino acids by paper chromatography

Reference Books

1. Jayaraman. J. (1992), Laboratory Manual in Biochemistry, 4th reprint, Wiley Eastern Ltd, New Delhi
2. Gupta. R.C and Bhargava. S.(1992), Practical Biochemistry, CBS Publishers and Distributors, New Delhi.
3. David. T. Plummer, (1995), An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company Ltd, New Delhi.

UBC - 4
Part IV – I Semester
ENVIRONMENTAL STUDIES

15EVS101
Credits: 2
Total teaching hours: 30

OBJECTIVES

- To inculcate knowledge and create awareness about ecological and environmental concepts, issues and solutions to environmental problems.
- To shape students into good “ecocitizens”, thereby catering to global environmental needs.

UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENT (6 hours)

1.1 Definition : scope and importance

1.2 **Need for public awareness***

1.3 Natural resources

1.3.1 Types of resources

Forest Resources – Water Resources – Mineral Resources – Food Resources – Energy Resources – Land Resources.

UNIT II ECOSYSTEMS (6 hours)

2.1 Concept of an ecosystem

2.2 Structure and functions of an ecosystem

2.3 Producers, consumers and decomposers

2.4 Energy flow in the ecosystem

2.5 Ecological succession

2.6 Food chains, food web and ecological pyramids

2.7 Structure and function of the following ecosystem*

Forest Ecosystem – Grassland Ecosystem – Desert Ecosystem – Aquatic Ecosystem.

UNIT III BIODIVERSITY AND ITS CONSERVATION (6 hours)

3.1 Introduction – Definition – Genetic – Species and ecosystem diversity

3.2 Biogeographical classification of India

3.3 Value of biodiversity*

3.4 Biodiversity at global, national and local levels

3.5 India as a mega – diversity Nation

3.6 Hot spot of biodiversity

3.7 Threats to biodiversity

3.8 Endangered and endemic species of India

3.9 Conservation of Biodiversity

insitu Conservation of Biodiversity – *exsitu* Conservation of Biodiversity

UNIT IV ENVIRONMENTAL POLLUTION (6 hours)

4.1 Definition

4.2 Causes, effects and control measures of: Air Pollution – Water Pollution – Soil Pollution – Marine Pollution – Noise Pollution – Thermal Pollution – Nuclear Pollution.

4.3 Solid Waste Managements: causes, effects, control measures of urban and industrial wastes.

4.4 Role of individual in prevention of pollution*.

4.5 Pollution case studies – domestic waste water, effluent from paper mill and dyeing, cement pollution.

4.6 Disaster Management – Flood, Drought, Earthquake, Tsunami, Cyclone and Landslide.

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT (6 hours)

5.1 Sustainable Development

5.2 Urban problems related to energy

5.3 Water Conservation : Rain Water Harvesting and Watershed Management

5.4 Resettlement and rehabilitation of people, its problems and concerns, case studies – Narmatha Valley Project.

5.5 Environmental ethics, issues and possible solutions.

5.6 Climatic change, global warming, ozone layer depletion, acid rain, nuclear accidents and holocaust, case studies – Hiroshima and Nagasaki, Chernobyl.

5.7 Consumerism and waste products

5.8 Environmental Protection Act

5.9 Air Pollution Act (Prevention and Control)

5.10 Water Pollution Act (Prevention and Control)

5.11 Wild Life Protection Act

5.12 Forest Conservation Act

5.13 Issues involved in enforcement of environmental legislation

5.14 Public awareness*

5.15 Human population and the environment

5.15.1 Population Growth and Distribution

5.15.2 Population Explosion – Family Welfare Programme*

5.15.3 Environment and Human Health

5.15.4 Human Rights*

5.15.5 Value Education*

5.15.6 HIV / AIDS*

5.15.7 Women and Child Welfare

5.15.8 Role of Information Technology in Environment and Human Health*.

*** Self Study (Questions may be asked from these topics also)**

Text Books:

1. P. Arul, A Text Book of Environmental Studies, Environmental Agency, No 27, Nattar street, Velacherry main road, Velacheery, Chennai – 42, First Edition, Nov. 2004.

Reference Books:

1. Purohit Shammi Agarwal, A text Book of Environmental Sciences, Publisher Mrs. Saraswati Prohit, Student Edition, Behind Naswan Cinema Chopansi Road, Jodhpur.
2. Dr. Suresh and K. Dhameja, Environmental Sciences and Engineering, Publisher S. K. Kataria & Sons, 424/6, Guru Nanak Street, Vaisarak, Delhi – 110 006.
3. J. Glynn Henry and Gary W Heinke, Environmental Science and Engineering, Prentice Hall of India Private Ltd., New Delhi – 110 001.

UBC - 7
SEMESTER-II
C.P.2 BIOANALYTICAL TECHNIQUES

16UBC202

Credits 6

Total teaching hours: 105

OBJECTIVES

- To know the various types of buffer systems in blood and plasma and its significance in the maintenance of blood pH.
- To understand the principle, materials, methods and applications of chromatography, electrophoresis and colorimetry.
- To detect, measure the radioactivity and explore its role in biological and clinical fields.

Unit I (21 hrs)

Acids, bases, pH scale, derivation of Henderson - Hasselbalch equation for acids and bases, buffer solutions, buffer systems of blood and RBC, hemoglobin buffer system. pH indicators. pH meter. Various ways of expressing the concentrations of solutions – normality, molarity and percentage solution.

Unit II (21 hrs)

Chromatography – Principles of separation techniques, materials, methods and applications: paper chromatography, column, ion exchange, molecular sieve and affinity chromatography.

Unit III (21 hrs)

Electrophoresis: Principle, factors affecting, instrumentation and applications of paper electrophoresis, SDS-PAGE, agarose gel, isoelectric focusing and immunoelectrophoresis.

Unit IV (21 hrs)

Colorimetry –Derivation of Beer and Lambert's law, principle, components, instrumentation and working of a single cell photo electric colorimeter and spectrophotometer. Comparison of colorimeter and spectrophotometer. Applications of colorimeter and spectrophotometer.

Unit V (21 hrs)

Tracer technique – Radioactive decay. Units of radioactivity (Curie, Rutherford and Becquerel), detection and measurement of radioactivity by scintillation counter – solid and liquid scintillators, counting efficiency and factors affecting counting efficiency. Advantages and disadvantages of scintillation counting. Autoradiography. Applications of radioisotopes.

Text Books:

1. Asokan,P (2006), Basics of Analytical Biochemical Techniques, Chinna Publications. Melvisharam, Tamil Nadu.
2. Ambika Shanmugam (2008), Fundamentals of Biochemistry for Medical Students, 7thed., Published by the Author, Chennai – 600 035.

Reference Books:

1. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, (2008), Fundamentals of Analytical Chemistry, BarkhaNath Printers, India.
2. Keith Wilson and John Walker (2007), Principles and Techniques of Biochemistry and Molecular Biology, 6thed, Cambridge University Press, New York.

UBC- 9
SEMESTER – II
PART IV VALUE EDUCATION – MORAL AND ETHICS
(2014 – 2015 Batch Onwards)

15VED201

Credits 2

Total teaching hours: 30

Total teaching hours: 105

UNIT I

Introduction to Moral and Ethics; Aim of Education (6 Hours)

UNIT II

Ethics and Culture (6 Hours)

UNIT III

Early Life of Swami Vivekananda (6 Hours)

UNIT IV

The Parliament of Religions (6 Hours)

UNIT V

Teachings of Swami Vivekananda (6 Hours)

Text Book

1. Value Based Education - Kongunadu Arts and Science College, Coimbatore, First Edition, 2014.

Reference book

1. **Moral and Ethics** - Published by Dr.M.Aruchami, Secretary and Director, Kongunadu Arts and Science College, Coimbatore, First Edition, June 2007.
2. **“Vivekananda A Biography”** - Swami Nikilananda, 29th Reprint, January 2013, Published by Swami Bodhasarananda, Adhyaksha, Advaita Ashrama, Mayavati, Champawat, Uttarakhand, Himalayas.

UBC - 10
SEMESTER-III
C.P.3 ENZYMES AND ENZYME TECHNOLOGY

16UBC303
Credits 5
Total teaching hours: 60

OBJECTIVES

- To perceive knowledge about enzymes and their kinetics.
- To study about the coenzymes and their roles in the biological system.
- To know about the recent enzyme technologies and their applications for diagnostic purpose.

Unit I (12 hrs)

Enzymes: Introduction, International classification of enzymes.

Enzyme activity and factors affecting rate of enzyme activity – effect of temperature, pH, enzyme concentration and substrate concentration.

Unit II (12 hrs)

Enzyme kinetics, single substrate: Michaelis-Menten equation derivation. Transformation of MM equation –Line weaver Burk plot. Enzyme inhibition: competitive, non-competitive and uncompetitive enzyme inhibition.

Unit III (12 hrs)

Coenzymes: Definition; structure and functions of thiamine pyrophosphate, nicotinamide adenine dinucleotide, nicotinamide adenine dinucleotide phosphate, flavin mono nucleotide, flavin adenine dinucleotide, coenzyme A, lipoic acid, biotin and folate coenzymes.

Unit IV (12 hrs)

Enzyme technology: Immobilized enzymes: sources and techniques of immobilization – adsorption, entrapment, microencapsulation, covalent binding and cross linking. Choice of immobilization techniques. Industrial, analytical and medicinal applications of immobilized enzymes.

Unit V (12hrs)

Uses of enzymes in analysis: Enzymes of diagnostic importance, Isoenzymes - LDH. Principle, types and components of Biosensors: Calorimetric, potentiometric, optical and immunosensors. Artificial enzymes: abzymes, synzymes and ribozymes.

Text Books

1. Chaplin, M.F and Buck, C (1990), Enzyme Technology, 1sted, Cambridge University Press, New York.
2. Dr. U. Sathyanarayana (2013), Biotechnology, Books and allied (P) Ltd, Kolkata.
3. Dr. U. Sathyanarayana(2013) Biochemistry 4th ed., Elsevier Health Sciences.

Reference Books

1. P. K. Gupta, Elements of biotechnology (2008), 1sted, Educational Publishers, Meerut.
2. D. Balasubramanyam, CFA. Bryce, K. Dharmalingham, J. Green, Kunthala Jayaraman, (2002), Concepts in Biotechnology, Universities Press (India) Pvt Ltd, Hyderabad.
3. Talwar. G.P (1989), Text book of biochemistry and Human Biology, 2nded, Prentice Hall of India Private Ltd, New Delhi.
4. EE. Conn and PK. Stumpf, G. Bruening and RY. Doi (2010), Outlines of biochemistry, 5thed, John Wiley and Sons, New York, USA.
5. David L Nelson, Micheal M Cox (2008), Lehninger's Principles of Biochemistry, Replika press (P) Ltd, India.
6. Palmer & Bonner (2007). Enzymes, 2nd Ed, Biochemistry, Biotechnology, Clinical Chemistry.

UBC - 12
C.Pr.2 BIOCHEMISTRY

16UBC4CM
Credits 2
Teaching hours: 30

OBJECTIVES

- To make the students to learn the method of estimation of unknown concentration of the solutions by colorimetric and to learn the effect of factors on enzyme activity.
- To determine the pH of buffer solutions using pH meter.

I. COLORIMETRY

1. Estimation of glucose - Ortho-toludine method.
2. Estimation of Phosphorus - Fiske & Subbarow method.
3. Estimation of urea – DAM – TSC method.
4. Estimation of protein - Lowry's method.
5. Estimation of creatinine – Alkaline picrate method.

II. PREPARATION OF BUFFER SOLUTIONS [Group experiment]

1. Preparation of buffer solutions
 - a. Acetate buffer - pH range- 3.6 - 5.6.
 - b. Phosphate buffer - pH range- 5.8 - 8.0.
2. Determination of pH using pH meter.

III. ENZYMOLOGY

- a. Effect of pH on the activity of **acid phosphatase**
- b. Effect of temperature on the activity of **acid phosphatase**
- c. Effect of enzyme concentration on the activity of **acid phosphatase**.
- d. Effect of substrate concentration on the activity of **acid phosphatase**
- e. Determination of **acid phosphatase** activity

IV. TECHNIQUE (Demonstration Experiments)

- 1) Determination of absorption maximum (λ_{max}) of any two biochemical substances using UV-VISIBLE Spectrophotometer.
- 2) Identification of any two nucleic acid bases using UV -VISIBLE Spectrophotometer.

Reference Books

1. Jayaraman. J. (1992), Laboratory Manual in Biochemistry, 4th reprint, Wiley Eastern Ltd, New Delhi
2. Gupta.R.C and Bharghava.S (1992), Practical Biochemistry, CBS Publishers and Distributors, New Delhi.
3. David. T. Plummer (1995), An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company Ltd, New Delhi.

OBJECTIVES

- To acquire knowledge in relation to various competitive examinations.
- To create awareness about an online examination which is being followed in competitive examinations

UNIT I (6 hours)

1. Tamil and other Literatures

Tamil, English, Christian and Muslim Literatures – Ancient Literature – Bakthi Literature – Epics – Medieval Literature – Modern Literature (Novel, Dramas, Short Stories, Modern Poetry).

2. Economics and Commerce

Basic Economics – Auditing – Management – Capital Market – Foreign Trade – Companies – Banking.

3. Social studies

Indian History – Inventions – Indian Poetry – Constitution - Judiciary – Languages – Literacy – Indian Geography – Lithosphere – Climate – Soil – Agriculture – Population.

UNIT II (6 hours)

4. Numerical Aptitude

Objective Arithmetic : Number systems – probability – HCF and LCM of numbers - decimal fractions – simplification – squareroots and cuberoots – average – percentage – profit and loss – ratio and proportion – time and work – simple interest – area, volume and surface area.

5. Verbal Aptitude

Spot the odd one out – correct form of verb – preposition – find out the rightly spelt word – choose the correct meaning of idioms – synonyms and antonyms.

6. Abstract Reasoning

Logic Reasoning: Logic – statement – arguments – statement assumptions – Statement course of action – theme detection – deriving conclusion from passages.

Non – verbal Reasoning: Series – analogy – classification – analytical reasoning – mirror images – water images – paper folding – paper cutting – rule detection – grouping of identical figures.

UNIT III (6 hours)

7. General Science and Technology

SCIENCE - Basic principles and concepts in Physics, Chemistry, Botany and Zoology.

TECHNOLOGY - Metallurgy, instrumentation, discoveries and inventions of techniques.

8. Computer Science

Historical evolution of computers – Computer applications – Data processing concepts – Computer codes and arithmetic – Hardware components – Data Structures.

9. Education

Development process of the learner – Principles of development (physical, social, emotional and intellectual) – Learning process – Teaching and teacher behaviour – Interaction analysis – Microteaching – Teacher as a leader – Motivation – Personality dimension – concept of mental health – Counselling.

UNIT IV (6 hours)

10. Library and Information Science

Library and Information Science – Basics, Computer, Library Network and others like Research, Reprography etc.

11. Sports and Games

Athletics – Track Events – Field Events – Games – Indoor Games – Outdoor Games – General knowledge – Sport and Olympics – First Aid.

12. Current Affairs

State, Central and International affairs: Budgets – Politics – Sports – Education – Commerce and Industry – Inventions – Science and Technology – Currency – Agriculture – Movies – Guinness records – Awards – IT Industry – Space Research – Defence etc.

UNIT V (6 hours)

13. National Cadet Corps (NCC)

Introduction to the Armed Forces (Army, Navy, Air Force) – Drill – Weapon Training – Map Reading – Civil Defence.

14. National Service Scheme (NSS)

History of NSS – History of Motto, Symbol, Badge – Aims and Objectives – Duties and Total Hours – Organisational and Administrative setup – History of voluntary organization – Regular activities – Special camp activities – Special programmes – awards – Important days.

15. Youth Red Cross (YRC)

History of International Red Cross – History of Indian Red Cross – History of Youth Red Cross – Main objectives of YRC – Emblem – Fundamental principles of Red Cross – Organizational Setup – Activities of Youth Red Cross – Role of different functionaries – Training programmes for YRC Program Officers – Training programme for YRC Volunteers – YRC Song – Working Hours – General orientation – Special orientation – Program skill learning.

Text Book

1. General Awareness, Question Bank, Kongunadu Arts and Science College, Coimbatore, First Edition 2014.

Part IV – III Semester
Non- Major Elective - I “Human Rights”

15UHR3N1

Credits 2

Teaching hours: 30

OBJECTIVES

- To impart knowledge of human values, ethics and human rights to the students.
- To reinforce positive personality traits and enhance physical, mental, social ethical and spiritual well-being of the students.

UNIT – I: Concept of Human Values, Value Education towards Personal Development (6 hours)

Aim of education and value education; Evolution of value-oriented education; Concept of human values; types of values; Components of value education.

Personal Development:

Self-analysis and introspection; sensitization towards gender equality, physically-challenged, intellectually-challenged. Respect to - age, experience, maturity, family members, neighbours, co-workers.

Character Formation towards Positive Personality:

Truthfulness, Constructivity, Sacrifice, Sincerity, Self-Control, Altruism, Tolerance, Scientific vision.

UNIT – II: Value Education towards National and Global Development

National and International Values: (6 hours)

Constitutional or national values - Democracy, socialism, secularism, equality, justice, liberty, freedom and fraternity.

Social Values - Pity and probity, self-control, universal brotherhood.

Professional Values - Knowledge thirst, sincerity in profession, regularity, punctuality and faith.

Religious Values - Tolerance, wisdom, character*.

Aesthetic Values - Love and appreciation of literature and fine arts and respect for the same.

National Integration and international understanding.

UNIT – III: Impact of Global Development on Ethics and Values (6 hours)

Conflict of cross-cultural influences, mass media, cross-border education, materialistic values, professional challenges and compromise.

Modern challenges of adolescent emotions and behaviour; sex and spirituality: comparison and competition; positive and negative thoughts.

Adolescent emotions, arrogance, anger, sexual instability, selfishness, defiance.

UNIT- IV: Therapeutic Measures (6 hours)

Control of the mind through

UBC - 17

- a. Simplified physical exercise
- b. Meditation – objectives, types, effect on body, mind and soul
- c. Yoga – objectives, types, Asanas

d. Activities:*

- (i) Moralisation of Desires
- (ii) Neutralisation of Anger
- (iii) Eradication of Worries
- (iv) Benefits of Blessings

UNIT- V: Human Rights (6 hours)

- 1. Concept of Human Rights – Indian and International Perspectives
 - a. Evolution of Human Rights
 - b. Definitions under Indian and International documents
- 2. Broad classification of Human Rights and Relevant Constitutional Provisions.
 - a. Right to Life, Liberty and Dignity
 - b. Right to Equality
 - c. Right against Exploitation
 - d. Cultural and Educational Rights
 - e. Economic Rights
 - f. Political Rights
 - g. Social Rights
 - h. Rights to Information
- 3. Human Rights of Women and Children
 - a. Social Practice and Constitutional Safeguards
 - (i) Female Foeticide and Infanticide
 - (ii) Physical assault and harassment
 - (iii) Domestic violence
 - (iv) Conditions of working women
- 4. Institutions for Implementation
 - a. Human Rights Commission
 - b. Judiciary
- 5. Violations and Redressal
 - a. Violation by State
 - b. Violation by Individuals
 - c. Nuclear weapons and terrorism
 - d. Safeguards

*** Self-study(Questions may be asked from these topics also)**

Prescribed Book: Human Rights, Compiled by Bharathiar University, Coimbatore – 46.

UBC - 18
Part IV – IV Semester
Non- Major Elective - II “Women’s Rights”

15UWR4N2
Credits 2
Teaching hours: 30

OBJECTIVES

- To impart specific and up-to-date information about national and international laws related to the welfare of women.
- To create awareness about crimes against women, legal rights of women in the country and access to justice.

UNIT I (6 hours)

Laws, Legal Systems and Change

Definition - Constitutional law, CEDAW and International Human Rights – Laws and Norms – Laws and Social Context – Constitutional and Legal Framework.

UNIT II (6 hours)

Politics of land and gender in India

Introduction – Faces of Poverty – Land as Productive Resources – Locating Identities – Women’s Claims to Land – Right to Property - Case Studies.

UNIT III (6 hours)

Women’s Rights: Access to Justice

Introduction – Criminal Law – Crime Against Women – Domestic Violence – **Dowry Related Harassment* and Dowry Deaths*** – Molestation – Sexual Abuse and Rape – Loopholes in Practice – Law Enforcement Agency.

UNIT IV (6 hours)

Women’s Rights

Violence Against Women – Domestic Violence - The Protection of Women from Domestic Violence Act, 2005 - The Marriage Validation Act, 1982 - The Hindu Widow Re-marriage Act, 1856 - The Dowry Prohibition Act, 1961.

UNIT V (6 hours)

Special Women Welfare Laws - Sexual Harassment at Work Places – Rape and Indecent Representation – The Indecent Representation (Prohibition) Act, 1986 - Immoral Trafficking – The Immoral Traffic (Prevention)

UBC – 19

Act, 1956 - Acts Enacted for Women Development and Empowerment - Role of Rape Crisis Centers.

*** Self-study (Questions may be asked from these topics also)**

Prescribed Book:

1. Women's Rights Compiled by Kongunadu Arts and Science College, Coimbatore-29.

References:

1. Nitya Rao "Good Women do not Inherit Land" Social Science Press and Orient Blackswan 2008
2. International Solidarity Network "Knowing Our Rights" An imprint of Kali for Women 2006
3. P.D. Kaushik "Women Rights" Bookwell Publication 2007
4. Aruna Goal "Violence Protective Measures for Women Development and Empowerment" Deep and Deep Publications Pvt. 2004
5. Monica Chawla "Gender Justice" Deep and Deep Publications Pvt. Ltd. 2006
6. Preeti Mishra "Domestic Violence Against Women" Deep and Deep Publications Pvt. 2007
7. Clair M. Renzetti, Jeffrey L. Edleson, Raquel Kennedy Bergen, Source Book on "Violence Against Women" Sage Publications 2001.

UBC - 20
SEMESTER IV
C.P.4 INTERMEDIARY METABOLISM

16UBC404
Credits 4
Total teaching hours: 60

OBJECTIVES

- To learn the fate of dietary carbohydrates and lipids.
- To study the various catabolic and biosynthetic pathways of biomolecules and their significance.
- To understand the interrelationship between carbohydrate, protein and fat metabolism.

Unit I (12 hrs)

Overview of metabolism: Definition; types of metabolic pathways; phases of metabolism. Fate of absorbed carbohydrates.

Glycolysis: definition; significance; pathway; energy yield from glycolysis; regulation of glycolysis. Cori's cycle. Metabolic fate of pyruvate.

TCA Cycle: - reactions of the cycle; bioenergetics; amphibolic pathway; anapleurotic role of TCA cycle.

Pathway of Glycogenesis and glycogenolysis; Gluconeogenesis: Definition; significance; pathway; substrates for gluconeogenesis; regulation of gluconeogenesis.

Unit II (12 hrs)

Biological oxidation; redox potentials; electron transport chain: overview; mitochondrial organization; structural organization of respiratory chain; oxidative phosphorylation; mechanism of oxidative phosphorylation – chemiosmotic hypothesis. Uncouplers of oxidative phosphorylation.

UNIT III (12hrs)

Blood lipids and fate of dietary lipids. Oxidation of fatty acids: Carnitine cycle;

Beta – oxidation, alpha oxidation and omega oxidation.

Biosynthesis of saturated fatty acids: Extra mitochondrial and microsomal system for synthesis of fatty acids. Interconversion of fatty acids.

Biosynthesis and degradation: Lecithin, cephalin, phosphatidyl inositol and phosphatidyl serine.

Plasma lipo proteins (Composition).

Biosynthesis of glycolipids.

UBC - 21

Unit IV (12 hrs)

Amino acid pool, overview of amino acid metabolism – deamination (oxidative and non-oxidative), transamination, decarboxylation. Urea cycle. Metabolism of individual amino acids – glycine, phenyl alanine and tyrosine.

Unit V (12 hrs)

Interrelationship between carbohydrate, fat and protein metabolism.

Metabolism of purines: *de novo* synthesis, salvage pathway and catabolism.

Metabolism of pyrimidines: *de novo* synthesis, salvage pathway and catabolism.

Text Books

1. Deb, A.C. (2011), Fundamentals of Biochemistry, 10th ed., New Central Book Agency Pvt. Ltd., Kolkata 700 009.
2. Satyanarayana, U. and Chakrapani, U. (2010) Biochemistry, 3rd ed., Books and Allied Pvt. Ltd, Kolkata, 700 010.

Reference Books

1. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell(2008), 27thed., Harper's Illustrated Biochemistry. McGraw Hill Companies, Inc. New Delhi.
2. Vasudevan D.M., Sreekumari S.and Kannan Vaidyanathan (2011), Text Book of Biochemistry for Medical Students, 6th ed., JAYPEE Brothers Medical Publishers Pvt. Ltd., New Delhi, 110002.

UBC - 22
SKILL BASED SUBJECT 2
COMMON HUMAN DISEASES

16UBC4S2
Credits 3
Total teaching hours: 30

OBJECTIVES

- To provides a broad overview of the most common and important human diseases
- To provide sufficient knowledge about the pathogenesis of common human diseases.
- To addresses the aspects of diseases, diagnosis, and treatments that are essential to maintain human health.

UNIT I (6 hrs)

Diseases of Circulatory System -Hypertension:- Definition of normo, hypo and hypertension, types, causes, pathogenesis, symptoms and treatments.

UNIT II (6 hrs)

Diseases of Endocrine System - Diabetes mellitus: Definition, normal range of fasting, random and postprandial blood sugar levels, different types of DM, causes of DM, and GTT.

UNIT III (6 hrs)

Diseases of Hepatic System - Formation and fate of bilirubin, normal value of plasma bilirubin, test for bilirubin – van den Bergh test. Jaundice – definition, classification of jaundice – hemolytic jaundice, hepatic jaundice and obstructive jaundice.

UNIT IV (6 hrs)

Diseases of Obstructive Pulmonary System –Normal structure and functions of lungs. Asthma – Definition, types – extrinsic (allergic and atopic), intrinsic (idiosyncratic and non – atopic) and mixed type. Common features of asthma, contrasting features of extrinsic and intrinsic asthma.

UNIT V (6 hrs)

Diseases of Kidney – Clinical features and treatment of acute glomerulo nephritis and nephrotic syndrome. Urinary and renal calculi.

Text Books:

1. AmbikaShanmugam (2008), Fundamentals of Biochemistry for Medical Students, 7th ed., Published by the Author, Chennai – 600 035.
2. Deb, A.C. (2011), Fundamentals of Biochemistry, 10th ed., New Central Book Agency Pvt. Ltd., Kolkata 700 009.

Reference Books:

1. Harish Mohan (2010), Text Book of Pathology, 6th ed., JAYPEE Brothers Medical Publishers P Ltd, New Delhi, 110 002.
2. Robbins and Cotran, (2010), Pathological Basis of Diseases, 8th ed., Elsevier, New Delhi, 110 019.

UBC - 24
SEMESTER- V
C.P.5 HUMAN PHYSIOLOGY

16UBC505
Credits 4
Total teaching hours: 60

OBJECTIVES

- To understand the basic principles and mechanisms involved during the functioning of various organs of the physiological system.
- To learn the role of hormones under normal conditions.

Unit I (12 hrs)

Skeletal Muscle

Structure of the skeletal muscle; myosin, actin and regulatory proteins; mechanism of muscle fibre contraction; chemical changes during muscle contraction; sources of energy for muscle contraction.

Blood and body fluids

Blood - Composition of blood, blood coagulation, blood grouping, ionic composition of ECF and ICF. Formation, composition and functions of lymph.

Unit II (12 hrs)

Digestive System

Secretion of digestive juices. Digestion and absorption of carbohydrates, proteins and fats.

Respiratory System

Diffusion of gases in lungs. Transport of oxygen from lungs to tissues through blood and factors influencing the transport of oxygen. Transport of CO₂ from tissues to lungs through blood and factors influencing the transport of CO₂.

Unit III (12 hrs)

Excretory System

Structure of nephron. Mechanism of formation of urine, micturition and renal regulation of acid-base balance. Physical properties and composition of urine.

UBC - 25

Nervous system

Structure of neuron, resting potential and action potential, and propagation of nerve impulse. Structure of synapses and synaptic transmission (electrical and chemical theory). Structure of neuromuscular junction and mechanism of neuro muscular transmission.

Unit IV (12 hrs)

Endocrine System

Classification of hormones. Mechanism of action of hormones – intracellular receptor mechanism and second messenger mechanism (cAMP only). Functions and pathophysiology of hormones of pituitary, thyroid and adrenal glands. Functions and pathophysiology of pancreatic hormones (insulin and glucagon).

Unit V (12 hrs)

Male Reproductive System

Structure of male reproductive system and spermatogenesis. Hormones of testes – functions only.

Female Reproductive System

Structure of female reproductive system. Ovarian cycle, menstrual cycle, menopause, pregnancy and lactation. Hormones of ovary and placenta- functions only.

Text Books

1. Chatterjee. M.N. and Rana Shinde (2005). A Text book of Medical Biochemistry. Jaypee Brothers Medical Publishers Pvt. Ltd, Delhi.
2. Saradha Subramaniam, Madavankutty K. and Singh H. D. (2012). Textbook of Human Physiology. 6th edition., S. Chand and company LTD. New Delhi.

Reference Books

1. Chatterjee. C.C. (2004). Human Physiology (Vol I & II) 11th ed., Medical Allied Agencies, Kolkata.
2. Robert K. Murray., Granner D.K., Mayes P.A. and Rodwell V.W., (2008). Harpers Illustrated Biochemistry, 27th ed., Appleton and Lange Stanford, Connecticut, USA.
3. Talwar G.P. (1980). A Text book of Biochemistry and Human Biology. Printice Hall of India Pvt Ltd. New Delhi.

UBC - 26
C.P.6 CELL BIOLOGY

16UBC506
Credits 4
Total teaching hours: 60

OBJECTIVES

To enable the students pursuing biochemistry discipline to acquire knowledge in

- The structure of animal cell membrane and its function
- Protein sorting and transport
- Nucleus and its function
- Modes of cell signaling
- Cell cycle; and cancer & properties of cancer cells.

UNIT I (12 hrs)

Cell membrane

Membrane bilayer models; Biochemical composition and functions of Fluid Mosaic Model. Membrane transport: Passive transport – Simple diffusion and facilitated diffusion, Active transport – Simple active transport and group translocation, Bulk transport- Phagocytosis and endocytosis.

UNIT II (12hrs):

Protein Sorting and Transport: The endoplasmic reticulum: Protein secretion, Targeting proteins to ER, Insertion of proteins, Protein folding and processing, The smooth ER and lipid synthesis- synthesis of phospholipids; Export of proteins and lipids.

The golgi apparatus: Organization, glycosylation and transportation of proteins.

The Lysosomes: Acid hydrolases, endocytosis and lysosome formation. Autophagy and phagocytosis.

UNIT III (12hrs)

Cytoskeleton: Chemistry, Organisation and function of Microtubules, Microfilaments and Intermediate filaments. Microtubule movement: cilia and flagella.

The nucleus: Structure of nuclear envelope; Nucleolus: rRNA genes –transcription and processing of rRNA. Ribosome assembly. Nucleus during mitosis: Dissolution of nuclear envelope, chromosome condensation and reformation of interphase nucleus.

UNIT IV (12 hrs)

Cell signalling: Modes of cell – cell signalling, steroid hormones and nuclear receptor super family, nitric oxide, neurotransmitters, peptide hormones and growth factors. Functions of surface receptors: G protein - coupled receptors. Pathways of intracellular signal transduction: The cAMP, cGMP, phospholipids and calcium ion pathways.

UNIT V (12hrs)

Cell cycle: Overview of cell cycle and its control. Cell cycle control in mammalian cells, checkpoints in cell cycle regulation.

Apoptosis-pathways, regulators and effectors in apoptosis.

Cancer: Types, properties, causes and development. Tumor viruses - DNA and RNA viruses.

Tumor suppressor genes and functions of their products. Carcinogenic effect of chemicals and radiation.

Text Books

1. Goeffrey. M. Cooper (2009), 5th ed., The Cell: A Molecular Approach, Boston university, ARM press, Washington D.C.,USA
2. P.S. Verma and V.K. Agarwal (2010), Cell Biology, Genetics, Molecular biology, evolution and ecology, S. Chand and Company, New Delhi.

Reference Books

1. Harvey Lodish, Baltimore David, Arnold Berket *al.*, (2007), 6st ed., Molecular Cell Biology, Scientific American Books, USA.
2. Garrette R.H and Grisham, C. M, Principles of Biochemistry, Saunders college publishers. 5th ed, 2012.

UBC - 28
C.P.7 CLINICAL BIOCHEMISTRY

16UBC507

Credits 4

Total teaching hours: 60

OBJECTIVES

- To explore the disorders of carbohydrate metabolism
- To understand the disorders of lipid metabolism
- To understand the disorders of protein and amino acids
- To assess the gastric, intestinal, liver and kidney functions.

Unit I (12 hrs)

Disorders of carbohydrate metabolism:

Normal glucose level in blood, renal threshold value.

Hypoglycemia: Definition and causes of hypoglycemia.

Hyperglycemia: Definition and causes of hyperglycemia.

Diabetes mellitus: Introduction, types of diabetes mellitus; clinical pathology and diagnosis.

Glycosylated haemoglobin.

Unit II (12 hrs)

Disorders of lipid metabolism:

Plasma lipids and lipo proteins – Introduction; hyper lipoproteinemia. Type I, II, III, IV and V and alpha lipoproteinemia.

Hypolipoproteinemia: a-beta – lipoproteinemia, hypobetalipoproteinemia, Tangier's disease and lecithin – cholesterol acyl-transferase deficiency.

Unit III (12 hrs)

Plasma protein abnormalities.

Disorders of amino acid metabolism: Cystinuria, phenylketoneuria and maple syrup diseases.

Definition and causes of hypo and hyper uremia. Definition and causes of hypo and hyper uricemia.

Unit IV (12 hrs)

Gastric and Intestinal functional tests:

Gastric functional tests – Introduction, tests of gastric function – The insulin stimulation test and tubeless gastric analysis.

UBC - 29

Intestinal functional tests – Introduction, tests used in the diagnosis of malabsorption – determination of total faecal fat (fat balance test), test of monosaccharide absorption (xylose excretion test) and determination of total protein (Lowry's method). Pancreatic function test.

Unit V (12 hrs)

Liver and Kidney function tests.

Liver function tests, estimation of conjugated and total bilirubin in serum (diazotization method), detection of bilirubin and bile salts in urine (Fouchet's test and Hay's sulphur test) and marker enzymes: SGOT, SGPT, γ -glutamyl transferase.

Kidney function test: Urea clearance test and EGFR.

Text Books

1. AmbikaShanmugam (2008), Fundamentals of Biochemistry for Medical Students, 7th ed., Published by the Author, Chennai – 600 035.
2. Deb, A.C. (2011), Fundamentals of Biochemistry, 10th ed., New Central Book Agency Pvt. Ltd., Kolkata 700 009.

Reference Books

1. Carl A. Burtis, Edward R. Ashwood, Norbert W. Tietz. (1999). Tietz Textbook of Clinical Chemistry. 3rd ed. W.B. Saunders.
2. Vasudevan D.M, Sreekumari S and Kannan Vaidyanathan, (2011), Text Book of Biochemistry for Medical Students, 6th ed., JAYPEE Brothers Medical Publishers Pvt. Ltd., New Delhi, 110002.

UBC - 30
C.P.8 MOLECULAR BIOLOGY

16UBC508
Credits 4
Total teaching hours: 60

OBJECTIVE

- To provide knowledge about the enzymology of DNA replication.
- To acquire knowledge about prokaryotic transcription.
- To know about genetic code and translation.

UNIT I (12 hrs)

DNA as genetic material

Central Dogma, DNA carries genetic information, Transformation, Transduction, Conjugation, Griffith's Experiment, Avery's Experiment and Hershey – Chase experiment.

UNIT II (12 hrs)

DNA Replication

DNA Replication, semi conservative mechanism, The Meselson – Stahl experiment, enzymology of DNA replication, initiation, elongation and termination. Replication of DNA in eukaryotes, Error and repair of DNA.

UNIT III (12 hrs)

Transcription

Synthesis of RNA, DNA dependent RNA Polymerase, association of RNA polymerase with DNA, initiation, elongation, termination of transcription, post transcriptional modification of RNA, reverse transcription, RNA directed RNA polymerase.

UNIT IV (12 hrs)

Translation:

Genetic Code: Features of genetic code, chemical composition of eukaryotic and prokaryotic ribosomes, activation of amino acids, initiation, elongation and termination of protein synthesis in prokaryotes, post translational modification of proteins and inhibitors of protein synthesis.

UNIT-V (12 hrs)

Gene Regulation:

Regulation of gene expression in prokaryotes: Types of operon: lactose, arabinose and tryptophan (negative and positive control).

Text Books

1. Ajay Paul (2007), Text Book of Cell and Molecular Biology, Books and allied Pvt. Ltd. Kolkata.
2. G.P. Jayanthi (2009), Molecular Biology, MJP publishers, Chennai.

Reference Books

1. Robert .H. Tamarin (2003), 7th ed., Principles of Genetics, Tata McGraw Hill Publishing Company Ltd, Kolkata.
2. Gardner and Simmons Snustad (2006), 4th ed., Principles of genetics, John Wiley & Sons Inc. USA.
3. Robert F. Weaver (1996), Molecular Biology, McGraw Hill Publishing Company Ltd. Kolkata.
4. David L. Nelson, Micheal M. Cox (2008), Lehninger's Principles of Biochemistry, Replika press (P) Ltd, India.

UBC – 32
C.Pr.3 BIOCHEMISTRY

16UBC6CN
Credits 3
Teaching hours: 120

I. Quantitative estimation of the following in urine

1. Glucose - Benedicts method
2. Calcium - Permanganate method.

II. Quantitative estimation of the following in the blood

1. Glucose - Glucose oxidase method.
2. Urea - DAM – TSC method.
3. Cholesterol - Zak's method
4. Phosphorus - Fiske and Subbarow method
5. Uric acid - Caraway Method
6. Iron and Haemoglobin - Wongs method
7. Total protein
8. AG ratio

III. Group Experiments (kit method)

1. Bilirubin – Direct and Indirect.
2. SGOT.
3. SGPT.
4. LDH
5. CKMB

Reference Books

1. N. Raghuramalu, K. Madhavan Nair and S. Kalyana Sundaram (2003), A Manual of Laboratory Techniques, 2nd ed., NIH Hyderabad.
2. S.P. Singh (2004), Practical Manual of Biochemistry, 5th ed., CBS Publishers and Distributors, New Delhi.
3. S.K. Shawney, and Randhirsingh, (2002), Introductory Practical Biochemistry, Narosa Publishing House. India.
4. Alan H Growen Lock (1988), Varley's Practical Clinical Biochemistry, 6th ed., CBS Publishers and Distributors. India.

GENETIC TECHNOLOGY

- a. Estimation of DNA by diphenylamine method
- b. Estimation of RNA by orcinol method
- c. Preparation of buccal smear
- d. Separation of DNA by agarose gel electrophoresis (Demo)
- e. Restriction digestion of DNA (Demo)
- f. Isolation of Plasmid DNA from bacteria (Demo)
- g. Isolation of Genomic DNA from liver/plant/bacterial source (Demo)

MICROBIOLOGY

- a. Isolation of pure culture - serial dilution, pour plate, spread plate and streak plate.
- b. Simple staining, Gram staining and Negative staining.
- c. Biochemical tests for identification of Bacteria.
- d. Isolation of microbes from samples – sewage/ water/ soil.
- e. Antibiotic Sensitivity Test – Kirby Bauer Method

PLANT BIOTECHNOLOGY (Demonstration)

- a. Preparation of media and sterilization.
- b. Initiation of callus culture.

CELL BIOLOGY (Demonstration)

- a. Animal cell types
- b. Mitosis in onion root tips

Reference Books

1. Sadhasivam. S. and Manickam. A. (2008). Biochemical Methods, 3rd ed., New Age International Publishers Ltd, New Delhi.
2. Ramniksood (2003), Medical Laboratory Technology, 5th ed., (reprint), Jaypee brothers, Medical Publishers Private Ltd, New Delhi.
3. Kannan. N. (1996), Laboratory Manual in General Microbiology, Palani Paramount Publications, Palani, Tamil Nadu, India.

UBC - 34
C.Pr.5 BIOCHEMISTRY

16UBC6CP
Credits 2
Total hours: 30

PLANT BIOCHEMISTRY

- a. Qualitative Analysis of Secondary Metabolites - Alkaloids, Flavonoids, Saponins and Glycosides
- b. Estimation of chlorophyll.
- c. Estimation of starch.
- d. Estimation of total phenols.

IMMUNOLOGY

- a. RA factor (kit method)
- b. Pregnancy test (kit method)

PHYSIOLOGY (Demonstration)

- a. Identification of blood groups.
- b. Enumeration of RBCs.
- c. Enumeration of total WBCs.
- d. Differential count of WBCs.

Reference Books

1. Sadhasivam. S. and Manickam. A. (2008). Biochemical Methods, 3rd ed., New age International Publishers Ltd, New Delhi.
2. Kannan. N. (1996), Laboratory Manual in General Microbiology, Palani Paramount Publications, Palani, Tamil Nadu, India.

UBC - 35
Extra Departmental Course -1
DIAGNOSTIC BIOCHEMISTRY

16UBC5X1
Credits 3
Total teaching hours: 30

OBJECTIVES

- To make the students to know the principles for routinely conducted tests in diagnostic laboratories.
- To select the appropriate biochemical tests to the diagnosis of the diseases.
- To enable the students to interpret the laboratory data properly.

UNIT I (6 hrs)

Introduction to Diagnostic Biochemistry. Components of blood - cellular and fluid components. Functions of each components. Collection of blood specimens and separation of plasma and serum using anticoagulants (heparin, EDTA and sodium citrate).

UNIT II (6 hrs)

Haematology – Introduction, haemoglobin- normal value and functions of haemoglobin. Estimation of haemoglobin by spectrophotometry (oxy hemoglobin method). Significance of glycosylated hemoglobin. Blood grouping.

UNIT III (6 hrs)

Serology: Introduction, importance and clinical significance of ELISA, Fluorescent antibodies, VDRL test, Widal Test, RA test, Pregnancy test.

UNIT IV (6 hrs)

Enzymology: overview and diagnostic value of enzyme assays. Assay and clinical importance of Serum glutamate oxalo acetate transaminase, serum glutamate pyruvate transaminase, lactate dehydrogenase and creatine kinase.

UNIT V (6 hrs)

Endocrinology: Introduction and clinical importance of hormone assay

Thyroid hormones: T₃, T₄ and TSH

Sex hormones: FSH, testosterone and progesterone.

Text Books:

1. Pal GK and Pravati Pal (2010), Text Book of Practical Physiology, 3rd ed., Universities Press, Hyderabad, 500 029.
2. Alan H Gowenlock; Janet R Mc Murray, Donaly M McLauchlan; Varley's Practical Clinical Biochemistry; (2002); 6th ed., Sathish Kumar Jain for CBS Publishers and Distributors, New Delhi.

Reference Books:

1. Thomas M Devlin; Text book of Biochemistry with Clinical Correlations, (2002); 5thed., Wiley LissA John Wiley and Sons, Inc. Publications. USA.
2. Harish Mohan (2010), Text Book of Pathology, 6th ed., Edition, JAYPEE Brothers Medical Publishers P Ltd, New Delhi, 110 002.

UBC - 37
SEMESTER VI
C.P. 9 PLANT BIOCHEMISTRY AND THERAPEUTICS

16UBC609
Credits 4
Total teaching hours: 60

OBJECTIVES

- To make the students understand the basic structure and function of plant cell
- To acquire the enzymatic processes of photosynthetic process in plants
- To understand nitrogen fixation, nitrogen and mineral nutrition in plants
- To explore the plant hormones and their role in plants
- To know the structures and the roles of secondary metabolites in plants

UNIT I (12 hrs)

Photo synthesis: Overview, Pigments – chlorophylls, carotenoids and phycobillins. Photosynthetic apparatus. Light reactions –Red drop and Emerson’s enhancement effect, Hill’s reaction, Arnons work. Photo system I and II – Mechanism of Photosynthesis- cyclic and non cyclic photophosphorylation. Dark reactions: C3, C4 and CAM pathway.

UNIT II (12hrs)

Role of nitrogen in plants. Nitrate reduction. Nitrogen cycle, Nitrogen fixation: non-biological, biological- symbiotic, non-symbiotic and associative. Biochemistry of nitrogen fixation and factors controlling biological nitrogen fixation.

UNIT III (12hrs)

Plant growth hormones: Chemistry, biosynthesis, physiological effects, applications of auxins, gibberellins, cytokinins, abscisic acid and ethylene.

Mineral nutrition in plants: Major elements: Nitrogen, Phosphorus, Sulphur, Calcium, Magnesium and Potassium-specific roles and deficiency symptoms in plants.

Minor elements: Iron, manganese, copper, zinc, boron, molybdenum, chlorine and nickel-specific roles and deficiency symptoms in plants.

UNIT IV(12hrs)

Photo morphogenesis: Photo periodism. Phytochrome - Function in growth and development of Plant. Biochemistry of seed germination. Biochemistry of fruit ripening.

UNIT V (12 hrs)

Secondary metabolites:

Classification, Biosynthetic pathways (structures not needed) and biological functions of Terpenes, Alkaloids, Cyanogenic glycosides, phenolics, flavonoids (anthocyanins) and Tannins.

Text Books:

1. P. K. Verma (2005) 8th ed., Text Book of Plant Physiology, EMKAY Publications, Bhopal.
2. Dr. V. K. Jain (2013) 17th ed., Fundamentals of Plant physiology, S. Chand and Company Ltd, New Delhi, India.

Reference Books:

1. Lea and Lea wood (1997), Plant Biochemistry and Molecular Biology, John Wiley and sons Publishers, UK.
2. William G. Hopkins, Introduction to Plant Physiology, 2nd ed., John Wiley and sons Publishers, UK.
3. V. Kumaresan (2010), 6th ed., Biotechnology, Saras Publication, Nagercoil, India.

C.P. 10 IMMUNOLOGY AND IMMUNOTECHNIQUES

16UBC610

Credits 4

Total teaching hours: 60

OBJECTIVES

- To learn about the basic principles of immunology, functioning of immune system, immunological techniques of research and clinical laboratories.
- To know about different types of immune mechanisms involving in the various abnormal conditions and diseased conditions.

Unit I (12 hrs)

Immunity- Definition and types. Innate immunity- Definition; Physical, biochemical, cellular and genetic factors, and other factors. Acquired immunity - active and passive .Child Immunization chart. Cells of the immune system. Lymphoid organs – primary and secondary lymphoid organs.

Unit II (12hrs)

Antibody mediated immunity – Definition; Maturation of B – lymphocytes; Activation of B - lymphocytes by antigens and production of antibodies. Primary and secondary immune responses. Cell mediated immunity – Definition; Maturation and types of T-lymphocytes; Activation of T_H cells; Cytokines–functions (any two) of IL-1,IL-2,IL-4,IL-12. Cytotoxic activity of T_c, NK and K cells.

Unit III (12 hrs)

Antigens– Definition, Characteristic features of antigens, cross reactivity, haptens and adjuvants. MHC antigens –Definition, classification and functions (structures not required).

Antibodies – Definition. Structure of Immunoglobulin (with reference to IgG); Classification of immunoglobulins; Properties and biological functions of immunoglobulins (IgG, IgM, IgA, IgD and IgE);

Complement system – Definition and components of complement system; Classical complement pathway, alternate pathway. Phagocytosis and Inflammation.

Unit IV (12 hrs)

Hypersensitivity – Definition, types, clinical manifestation: Type I, II, III and IV and their clinical manifestations. Autoimmune diseases – Definition; Myasthenia gravis and Rheumatoid arthritis.

Transplantation – Definition, Mechanism and complications of allograft rejection.

AIDS –Definition. AIDS viruses - structure.

Unit V (12 hrs)

Antigen antibody interactions –formation of precipitation and agglutination- precipitin curve test.

Immunotechniques – Immunodiffusion: Double diffusion in two dimensions (Ouchterlony procedure). Immuno-electrophoresis, Fluorescent antibody technique, RIA, ELISA, Western blotting technique.

Text Books:

1. Dulsy Fatima and Arumugam.N.(2007).Immunology.1stedition,Saras publication, Nagercoil, Kanyakumari Dt
2. Ananthnarayanan. R and Jayaraman Panikar C.K. (2009). Text book of Microbiology, 8thedition., Orient Longman Ltd, Madras.

Reference Books:

1. David Male, Jonathan Brastoff, Roitt Ivan and David Roth (2012). Immunology, 8thed., Times mirror, International Gower Medical Publishing Ltd, printed by Grajos SA, Arts Sobrepapel, Barcelona, Spain.
2. Judy Owen, Jenni Punt and Sharon Stranford (2012), Kuby Immunology, 7thed., W.H.Freeman Company.
3. Ian R.Tizard (1995).Immunology - An Introduction.Saunders college publishing,Harcourt Brace College Publishers,Philadelphia,Newyork,Tokyo.

UBC - 41
C.P.11 GENETIC TECHNOLOGY

16UBC611
Credits 4
Total teaching hours: 60hrs

OBJECTIVES

- To know the basis of gene cloning and biological tools used in genetic engineering.
- To study the techniques used in genetic engineering.
- To discuss the applications of genetic engineering.

UNIT I (12 hrs)

Gene cloning- basic steps; restriction endonucleases – types, cleavage pattern; DNA ligases- action of DNA ligase, use of linkers and adaptors; Vectors- characteristics of an ideal vector molecule, plasmid vectors – basic features – pBR 322, lambda phage, pUC8 and YAC; bacteriophage vectors.

UNIT II (12 hrs)

Introduction of rDNA into bacterial cells: Transformation of *E. coli* ; selection and screening of recombinants. Genomic library and cDNA library. Southern, northern and western blotting techniques.

UNIT III (12 hrs)

DNA sequencing: Outline of Sanger's method. Genetic finger printing – technique and applications. *In vitro* mutagenesis: Oligonucleotide directed mutagenesis, protein engineering. Basic PCR – Technique and applications;

UNIT IV (12 hrs)

Expression vectors of *E. coli*: Constituents; examples of promoters – expression cassettes – problems caused in expression of eukaryotic genes; fusion proteins. Production of recombinant insulin. Safety aspects and hazards of genetic engineering, HGP: objectives and applications.

UNIT V (12 hrs)

Gene transfer in plants: Ti plasmid vectors; mechanism of T-DNA transfer, virulence genes, electrofusion, biolistics process. Applications of transgenic plants – herbicide resistance, male infertility, virus resistance, pest resistance, antisense RNA.

Text Books:

1. Satyanarayana, U. (2007), Biotechnology, Books and Allied (P) Ltd, Kolkata, 700 010.
2. Dubey, R.C. (2008), Text book of Biotechnology, S. Chand and Company Ltd. New Delhi, 110 005.

Reference Books:

1. T.A. Brown (2006), Gene Cloning and DNA analysis, 5th ed., Blackwell publishing Ltd, UK.
2. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and KunthalaJayaraman (2007), Concepts in Biotechnology, University Press (India) Private Limited, Hyderabad, India.

UBC - 43
SKILLBASED SUBJECT 4
TECHNIQUES IN GENOMICS AND PROTEOMICS

16UBC6S4

Credits 3

Total teaching hours: 30

OBJECTIVES

- To learn the basics of Genomics and Proteomics
- To learn the basic techniques of Genomics and Proteomics

Unit I (6 hrs)

Organization of nuclear DNA in Eukaryotes. Telomere, Centromere and Transposons. RFLP and RAPD. BAC libraries and cDNA libraries. Mapping genome- physical maps, cytogenetic map and markers.

Unit II (6 hrs)

Highthroughput sequencing and shotgun sequencing. PCR and RT-PCR. Complementary DNA (cDNA). Human Genome Project (HGP). Positional cloning. Identifying disease genes and Gene therapy.

Unit III (6 hrs)

Comparative genomics. Ortholog and Paralog. Comparative genomics of model organisms- bacteria, *C.elegans* and *Drosophilla*.

Unit IV (6 hrs)

Transcriptomics - mRNA in the cell. Northern blot. Expression profiling and analysis of microarray data. Pharmacogenomics.

Unit V (6 hrs)

Proteomics - Definition. Protein sequencing. MALDI-ToF Mass Spectrometry (MS). PFGE (Pulse Field Gel Electrophoresis). Protein microarray. Peptide fingerprinting. 2D-gel electrophoresis.

Text books:

1. Brown T.A. (2006). Gene Cloning and DNA analysis, 5th edition., Blackwell publishing Ltd, UK.
2. Primrose SB and Twyman (2006). Principles of Gene Manipulation and Genomics. Seventh Edition, Blackwell Publishing.

Reference Books:

1. Tom Stracham and Andrew P Read (2004). Principles of Human molecular genetics. 3rd edition. Garland Science Publication, New York.
2. David P. Clark & Nanette J Pazdernik (2009). Biotechnology applying the Genetic revolution Elsevier Academic Press.

UBC - 44
MAJOR ELECTIVE PAPERS
MICROBIOLOGY

Credits 5
Total teaching hours: 60

OBJECTIVES

- To learn about the different techniques used in microbiology.
- To study the properties of bacteria and viruses.
- To be familiar with the relationship between microbes and human beings and infectious diseases.

Unit I (12 hrs)

Introduction to microbiology, Microscopy – Bright field microscopy, fluorescent microscopy, electron microscopy- transmission electron microscopy, scanning electron microscopy.

Culture techniques for isolation of bacteria- streak plate technique, pour plate technique.

Staining – Simple staining, flagella staining, gram staining, acid-fast staining.

Unit II (12 hrs)

Prokaryotes: Morphology of bacteria, component parts, cell wall structure, growth curve, microbial nutrition.

Eukaryotes: Morphology, characteristics and importance of algae and fungi.

Unit III (12 hrs)

Viruses: Cultivation of viruses, structure of viruses, plaque assay.

Bacteriophages – T₄ phage, stages in life cycle; Lambda phage-life cycle; switch between lysogeny and lytic cycle.

Oncogenic viruses – Mechanism of oncogenesis.

Unit IV (12 hrs)

Microbial diseases: Normal human micro flora, host parasitic interaction, exo and endotoxins.

Water borne diseases – Aetiology, pathogenesis and symptoms of cholera and dysentery.

Air-borne diseases – Aetiology, causes, symptoms and prevention of TB and diptheria.

Direct contact disease – Aetiology and symptoms of rabies.

Unit V (12 hrs)

Water microbiology: Microbes in water; bacteriological examination of water; purification of drinking water. Soil microbiology: Rhizosphere and mycorrhiza.

Microbiology of food borne diseases: Botulism, staphylococcal poisoning, salmonellosis and perfringens poisoning.

Text Books:

1. Micheal J. Pelczar, E.C.S. Chan and Noel R. Krieg (2008), Microbiology 5thed., Tata McGraw - Hill Publishing Company Ltd, New Delhi.
2. R.C. Dubey and D.K. Maheshwari (2005), Text Book of Microbiology, S Chand and Company Ltd. New Delhi.

Reference Books:

1. Ronald M. Atlas (1995), Principles of Microbiology, Mosby – Year Books, Inc. Missouri.
2. GeethaSumbali and R.S. Mehrotta (2009), Principles of Microbiology, Tata McGraw – Hill Education private limited, New Delhi.

UBC - 46
MAJOR ELECTIVE
BIOTECHNOLOGY

Credits 5
Total number of hours: 60

OBJECTIVES

- To provide knowledge about plant tissue culture and animal tissue culture.
- To acquire knowledge about various methods of genetic engineering of animal cells.
- To provide knowledge about gene therapy and *in vitro* fertilization.
- To know about the different fermentation technologies.

UNIT I (12 hrs)

Plant Biotechnology

Plant tissue culture: Media composition, types – Callus culture, organ culture, cell culture, embryo culture, protoplast culture. Somatic hybridization, Cybrids, Micropropagation. Applications of plant tissue culture.

UNIT II (12 hrs)

Animal Biotechnology

Animal Cell culture: Facilities, applications, natural and artificial culture media, merits, demerits and development of serum free media. Characterization and features of cultured cells: cell adhesion, cell proliferation, cell differentiation, initiation of cell culture, evolution and development of cell lines. Primary culture techniques and cell lines, subculture, stem cell cultures. Cell transformation and cell cloning. Artificial insemination and embryo transfer; *in vitro* fertilization (IVF); Transgenic mice.

UNIT III (12 hrs)

Medical biotechnology

Gene therapy: *ex vivo* and *in vivo*. Antisense therapy for cancer and AIDS. Recombinant vaccines. Aptamers as therapeutic agents. DNA in disease diagnosis – tuberculosis, AIDS, cancer, cystic fibrosis, sickle cell anaemia.

UNIT IV (12 hrs)

Bioprocess technology

Bioreactors: types, operation of conventional bioreactor, solid substrate fermentation, media for

industrial fermentation, sterilization of culture media and gases, types of culture, stages of fermentation. Stages of Downstream processing. Production of Single cell protein, antibiotic (penicillin) and citric acid.

UNIT V (12 hrs)

Environmental Biotechnology

Biodegradation: Introduction, Biodegradation of pesticides, herbicides and hydrocarbons.

Bioremediation: Types and reactions of bioremediation, GEMs in bioremediation, bioremediation of soil and waste lands. Biohazards and safety aspects.

Text Books:

1. Dr. U. Sathyanarayana (2005), Biotechnology, Books and allied (P) Ltd, Kolkata.
2. V. Kumerasan (2010), 6th ed., Biotechnology, Saras Publication, Nagerkoil.
3. Biotol series, *In vitro* Cultivation of Animal Cells (2004), 1sted, Butlerworth Heineman, UK.

Reference Books:

1. R. Ian Freshney (2005), Animal cell culture; IRL press, UK.
2. Benjamin Lewin (2008), Genes IX , Jones and Barlet Publishers, USA.
3. Singh B.D (2012), 5th ed., Biotechnology, Kalyan Publishers, New Delhi.

ADVANCED CLINICAL BIOCHEMISTRY

Credits 5

Total teaching hours: 60

OBJECTIVES

- To make the students learn more about the latest techniques in clinical laboratories for diagnosis of different types of diseases.
- To understanding the abnormal levels of various biochemical parameters in diseased conditions.

Unit I (12hrs)

Collection of blood specimens-vein puncture, vein occlusion, collection using syringe, evacuated tube, capillary blood, venous blood and arterial blood. Changes in blood on keeping. C-reactive protein, ESR protein precipitants and anticoagulants.

Unit II (12hrs)

Collection of urine specimens-urine preservatives, normal composition and minerals in urine. Changes on keeping. Automated instruments in analysis. Test and clinical significance of abnormal constituents in urine(sugar, protein, ketone bodies blood bile salts and bile pigments).

Unit III (12hrs)

Hb occurrence in cells, plasma and urine. Normal Hb. Abnormal Hb- Haemoglobinemia and hemoglobinuria. Sick cell anemia and hemophilia. Separation and identification of abnormal Hb.

Unit IV (12hrs)

Principles of diagnostic enzymes, factors affecting the enzyme levels in blood. Principle, assay and clinical significance of transaminases, phosphatases, lactate dehydrogenases and creatine kinase. Enzyme pattern in diseases-myocardial infarction and hepatobiliary diseases.

Unit V (12hrs)

Liver function tests. Cirrhosis, jaundice, hepatitis and fatty livers. Renal function tests and related disorders. Stones-gall stones, renal stones and its examination.

Text Books:

1. Thomas M. Devlin (2002), Text book of Biochemistry with Clinical Correlations, 5thed., A John Wiley and Sons, Inc Publications.

2. M. N Chatterjee and RanaShinda (2005), Text book of Medical Biochemistry, Jaypee Brothers, Medical Publishers Private Ltd. New Delhi.

Reference Books:

1. Harold Varley (2005), Practical Clinical Biochemistry, 4thed., CBS Publishers and Distributors, New Delhi.
2. AmbikaShanmugam (1999), Fundamentals of Biochemistry for Medical Students
3. Authur, III Cross street, West C.I.T. Nagar, Chennai – 600 035.
4. A.C. Deb (2008), 9th ed., Fundamentals of Biochemistry, New Central Book agency (P) Ltd India.
5. J.L.Jain, Sanjay Jain, Nitin Jain (2007), Fundamentals of Biochemistry, S Chand and Company, India.
6. Carl A Burtis, Edward R Ashwood (1998), Tietz Text book of Clinical Biochemistry, 2nded., W. B Saunders Company.
7. Philip D Mayne (1994), 6thed., Clinical Chemistry in Diagnosis and Treatment. ELBS Publications.
8. Carl A. Burtis (Author), Edward R. Ashwood (Author), David E. Bruns (2005). 5th Ed. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics.

UBC - 50
MAJOR ELECTIVE
GENERAL PHARMACOLOGICAL PRINCIPLES

Credits 5
Total teaching hours : 60

OBJECTIVES

- To make the students to understand the basic principles of pharmacology.
- To learn the concepts regarding the pharmacokinetics, pharmacodynamics and pharmacotherapy.

UNIT I (12 hrs)

Introduction, definition – Pharmacodynamics, pharmacokinetics. Drug, Pharmacotherapeutics, clinical pharmacology, chemotherapy, pharmacy and toxicology.

Routes of drug administration. Local routes and systematic routes.

UNIT II(12 hrs)

Pharmacokinetics: Biological membrane, membrane transport – Passive diffusion, filtration. Specialized transport – carrier transport.

Absorption – Oral, subcutaneous and intramuscular and topical sites.

Bioavailability, distribution, redistribution penetration into brain and CSF, plasma protein binding.

UNIT III (12hrs)

Pharmacokinetics: Biotransformation – nonsynthetic reactions, oxidation, reduction, hydrolysis, cyclization and de - cyclization.

Synthetic reduction – Glucuronide conjugation, acetylation, methylation, sulfate conjugation, glycine conjugation, glutathione conjugation, microsomal enzyme induction.

Excretion – renal excretion.

UNIT IV (12hrs)

Pharmacodynamics: Principles of drug action, mechanism of drug action – enzymes, ion channels, transporters, receptors transducer mechanisms – G – protein coupled receptors, receptors with intrinsic ion channel, enzyme – linked receptors, receptors regulating gene expression.

UNIT V (12 hrs)

Aspects of pharmacotherapy: Drug dosage, factors affecting drug action rational use of medicines.

Text Books:

1. Tripathi K.D. (2010), 6th ed., Essentials of Medical Pharmacology, Jaypee Brothers, Medical Publishers Private Ltd, New Delhi.
2. William Foye (1986) 3rded., Principles of Medicinal Chemistry, Lippincott Williams and Wilkins, Philadelphia , USA.
3. R.S. Satoskar, Nirmala N. Rege and S.D. Bhandarkar.(2011). Pharmacology and Pharmacotherapeutics, 22nded., Popular prakashan private limited, Mumbai.

Reference Books:

1. George M. Brenner, Craig W. Stevens. (2010). Pharmacology, 3rd Ed., Rajkamala electric press, Haryana.
2. Dr. V. N. Sharma. (2009). Essentials of pharmacology, 3rd Ed., CBS publishers and distributors, New Delhi, India.
3. H.L. Sharma. (2009). Principles of pharmacology, Paras Medical publishers, Hyderabad, India.
4. Partrick L. Graham (1995). An Introduction to Medicinal Chemistry.Oxford University press, New York.
5. Grahame, D.G. Smith and Aronson, J.K Oxford Text Book of Clinical Pharmacology and Drug Therapy, Oxford University Press, New York.
6. S.N. Khosla(2008). 1st ed. Essentials of Medicine CBS publishers, New Delhi.
7. K.Ilango, P.Valentina (2007).1st ed., Text Book of Medicinal Chemistry.Vol I,Keerthi publishers, New Delhi.

UBC - 52
MAJOR ELECTIVE
BASICS OF BIOINFORMATICS

Credits5
Total teaching hours: 60

OBJECTIVES

- To know about various tools for database search.
- To acquire knowledge about different biological databases.
- To provide knowledge about Gene prediction and drug designing.

Unit I (12hrs)

Bioinformatics -Overview and application. Bioinformatics resources on web. PubMed .Nucleic acid databases GENBANK, DDBJ and EMBL. Sequence submission and file formats. Protein sequence data bank SWISSPROT, UNIPROT. Data mining of biological database with ENTREZ.

Unit II (12hrs)

Data base similarity searching –Local and Global alignment. BLAST and FASTA. Similarity searching algorithms and program, dot plot, scoring matrices and substitution matrices-PAM and BLOSUM.

Unit III (12hrs)

Genome annotation- analysis of regulatory regions in genome- promoters, splice site, termination signals. ORF prediction. Algorithms for gene prediction.

Unit IV (12hrs)

Protein structure-levels, basic physio chemical properties, Mol weight, amino acids, transmembrane region and tools in ExPASy. Protein structure databases: CATH and SCOP. Secondary structure prediction: Chou–Fasman and GOR methods. Tertiary structure prediction.3D structure prediction-homology modeling, Threading, Fold recognition and Abinitio protein structure prediction method.

Unit V (12hrs)

Molecular visualization tools Ras Mol and Chime. Structure based drug design, target-identification, validation; ligands, docking.

Text books:

1. Rastogi.S.C, Namita – Mendiratta and ParagRastogi, (2004) BioInformatics – Concepts, Skills and applications, Rastogi Publications, Meerut, India.
2. Ignatchimuthu, S, (2009), Basic Bioinformatics, Narosa Publishing House Pvt Ltd, New Delhi.

Reference books:

1. Attwood.T.K. Parry D.J. and Smith (2001). Introduction to BioInformatics, Prentice Hall Publishers, Pearson Education, India.
2. Mani.K and Vijayaraja (2005), BioInformatics – A practical Approach, Aparna Publications, Coimbatore.
3. Dr. P. Shanmughavel, (2006), Trends in Bioinformatics, Pointer Publishers, Jaipur, India.

UBC - 54
ALLIED BIOCHEMISTRY I
(For B.Sc Zoology)

15UBC3A3
Credits 4
Total teaching hours: 75

OBJECTIVES

- To make the students understand the basic principles of biochemistry.
- To learn about the mechanism of action of enzymes in the biological system.

UNIT I (15 hrs)

Carbohydrates: Definition and classification. Monosaccharides – Structural aspects-asymmetric carbon atom, D and L isomers, anomers, optical activity and mutarotation. Epimers: pyranose and furanose forms, aldo and keto forms.

Monosaccharides- Classification, definition, structure and biological importance.

Hexoses: glucose, fructose, galactose and mannose. Pentoses: Ribose and deoxyribose.

Disaccharides: Maltose, sucrose and lactose.

Polysaccharides: Homopolysaccharides: Starch, glycogen, cellulose, inulin and chitin, Heteropolysaccharides: Heparin, hyaluronic acid, chondroitin sulphates. Reactions of monosaccharides- Oxidation of glucose (aldonic acid, aldaric acid and uronic acid).

Action of alkalies with sugars, Reducing action of sugars in alkaline solution and reaction with phenyl hydrazine.

UNIT II(15 hrs)

Lipids: Classification and properties of lipids. Types of fatty acids: Saturated, unsaturated and essential fatty acids. Classification and significance of phospholipids: Phosphatidyl choline, phosphatidyl ethanolamine, phosphatidyl serine, phosphatidyl inositol and sphingomyelin.

Classification and significance of glycolipids: Cerebrosides and gangliosides. Classification and functions of lipoproteins. Structure and biological functions of cholesterol.

UNIT III (15 hrs)

Amino acids: Classification of amino acids (chemical nature), essential and non-essential amino acids, reactions of amino group with benzoic acid, ninhydrin, fluorodinitrobenzene (FDNB) and carbon dioxide. Reactions of carboxyl group – decarboxylation and amide formation.

Proteins: Definition, classification (chemical nature) and functions of proteins. Structure of proteins. Denaturation and renaturation of proteins. Ampholytes and isoelectric pH.

UNIT IV(15 hrs)

Enzymes: Definition, classification of enzymes with examples. Enzyme kinetics- Derivation of Michealis- Menton Equation (single substrate). Factors affecting enzyme activity – Effect of pH, temperature, substrate concentration and enzyme concentration. Types of inhibition of enzyme action – Competitive, non – competitive and uncompetitive inhibition.

UNIT V(15 hrs)

Nucleic acids: Structure of purine bases: Adenine and guanine. Structure of pyrimidine bases: Cytosine, uracil and thymine. Components of nucleoside and nucleotide. Double helical structure of DNA. Structure and types of RNA: mRNA, tRNA and rRNA.

Text Books:

1. A.C. Deb (2008), Fundamentals of Biochemistry, 9thed., New Central Book Agency Pvt.Ltd. Kolkata.
2. AmbikaShanmugam (1998), Fundamentals of Biochemistry for medical students. 7th Edition Authur, III Cross Street, West C.I.T. Nagar, Chennai – 600 035.

Reference Books:

1. M.N. Chatterjee and RanaShinda (2005), Text book of medical biochemistry, Jaypee brother medical publishers Pvt Ltd. New Delhi.
2. J.L. Jain, Sanjay Jain and Nitin Jain (2007), Elementary Biochemistry, 3rd ed, S Chand and company Ltd, New Delhi.
3. David L. Nelson, Micheal M. Cox (2008), Lehninger's Principles of Biochemistry, Replika press (P) Ltd, India.
4. Robert K. Murray, Daryl K. Garner and Victor W. Rodwell (2008), 27thed, Harper's Illustrated biochemistry, Appleton and Lange Stanford, Connecticut, USA.

UBC - 56
ALLIED BIOCHEMISTRY II
(For B.Sc Zoology)

15UBC4A4
Credits 4
Total teaching hours: 75

OBJECTIVES

- To learn about the various biochemical techniques applicable in both research and clinical laboratories.
- To provide knowledge on metabolic reactions involved in biological systems.

UNIT I (15 hrs)

Buffers: Definition. Concept of pH and derivation of Henderson-Hasselbalch equation, Acid-base indicators. Components and working of pH meter. Buffer systems of blood and body fluids; mechanism of action of bicarbonate buffer system.

UNIT II (15 hours)

Colorimetry – Beer and Lambert's law. Instrumentation and working of photoelectric colorimeter (single cell) and spectrophotometer. Comparison of colorimeter and spectrophotometer. Chromatography-Definition. Principle and technique of paper chromatography with reference to separation of aminoacids.

Electrophoresis-Definition. Principle and technique of SDS PAGE electrophoresis with reference to separation of serum proteins.

UNIT III (15 hrs)

Radioactivity – Isotopes-definition and different types. Definition of radioactivity. Types of radioactive decay (alpha and beta particle, gamma rays emission). Units of radioactivity and measurement of radioactivity - Geiger-Muller counter. Applications of radioisotopes in biological sciences (any five) and medical sciences (any five).

UNIT IV (15 hrs)

Metabolic pathways: Carbohydrate metabolism: Glycolysis, TCA cycle, HMP shunt, Glycogenesis and glycogenolysis.

Lipid metabolism: Beta-oxidation, biosynthesis of saturated fatty acids- Palmitic acid.

Protein metabolism: General pathway of amino acid metabolism – deamination, transamination and decarboxylation. Urea cycle.

UNIT V (15 hrs)

Inter-relationship of carbohydrate, fat and protein metabolism (Flow chart only-structures not required).

Bioenergetics: Definition. Entropy, enthalpy and free energy; high-energy phosphates. Biological oxidation– Definition and redox potential.

Respiratory chain (Electron Transport Chain)- Components of ETC ; Transport of electrons in respiratory chain .

Oxidative phosphorylation- Definition. Sites of oxidative phosphorylation in ETC; Mechanism – Chemiosmotic hypothesis.

Text Books:

1. P. Asokan, (2006), Basics of Analytical Biochemical Techniques, Chinna Publications, Tamilnadu.
2. A.C. Deb (2008), 9thed., Fundamentals of Biochemistry, New Central Book Agency Pvt.Ltd. Kolkata.

Reference Books:

1. Keith Wilson and John walker (2007), Principles and Techniques of Biochemistry and Molecular Biology. 6thed., Cambridge University Press, New York.
2. Robert K. Murray, Daryl K. Garner and Victor W. Rodwell (2008), 27thed, Harper's Illustrated Biochemistry, Appleton and Lange Stanford, Connecticut, USA.
3. Ambika Shanmugam, (1998), Fundamentals of Biochemistry for Medical Students'. 7th Edition Authur, III Cross Street, West C.I.T. Nagar, Chennai – 600 035.

UBC - 58
A.Pr.2 BIOCHEMISTRY

15UBC4AL
Credits 2
Total hours: 30

OBJECTIVES

- To acquire the skill of analysing carbohydrates and amino acids.
- To provide practical knowledge about the characterisation of lipids.
- To learn the methodology of separation of amino acid by paper chromatography.

I. QUALITATIVE ANALYSIS

1. Analysis of carbohydrates:

- a. Monosaccharides- Pentose- Arabinose.
Hexoses- Glucose and fructose
- b. Disaccharides- Sucrose, maltose and lactose
- c. Polysaccharide-Starch.

2. Analysis of Amino acids:

- a. Histidine b. Tyrosine. c. Tryptophan d. Arginine e. Cysteine

II. CHARACTERISATION OF LIPIDS [Group experiments]

- Determination of acid number.
- Determination of iodine number.

III. SEPARATION TECHNIQUE [Demonstration]

Separation of amino acids by paper chromatography

Reference Books:

1. Sadhasivsam. S and Manickam. A. (2005), Biochemical Methods, revised 2nded, New age International Publishers, India.
2. Jeyaraman. J. (1992), Laboratory Manual in Biochemistry, 4th Reprint Wiley Eastern Ltd, New Delhi.
3. Gupta R.C. and Burghava S. (1992), Practical Biochemistry, CBS Publishers and Distributors, New Delhi.
4. David T Plummer. (1995), An Introduction to Practical Biochemistry, Tata McGraw Hill publishing Co Ltd, New Delhi.

UBC - 59
KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE-29
CHOICE-BASED CREDIT SYSTEM
QUESTION PAPER PATTERN FOR PART III B.Sc BIOCHEMISTRY
FOR ALL SIX SEMESTERS

Time: 3 hours

Max. Marks: 75

Section A (10x1= 10 marks)

Q. No: 1-10

Multiple-choice questions with four choices to be taken from all units in the prescribed syllabus

Section B (5x 5 =25 marks)

Q.No:11-15

Five paragraph questions (either – or type in about 150 words each) to be taken from all the units in the prescribed syllabus.

Section C (5x 8= 40 marks)

Q.No: 16-20

Five essay type questions (either – or type in about 500 words each) to be taken from all the units in the prescribed syllabus.

UBC - 60

15UBC3A3 & 15UBC4A4

**KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE-29
CHOICE-BASED CREDIT SYSTEM.
QUESTION PAPER PATTERN FOR PART III Allied.B.2 BIOCHEMISTRY
FOR THIRD AND FOURTH SEMESTER**

Time: 3 hours

Max. Marks: 55

Section A (10x1= 10 marks)

Q. No: 1-10

Multiple-choice questions with four choices to be taken from all units in the prescribed syllabus

Section B (5x 3 = 15marks)

Q.No:11-15

Five paragraph questions (either – or type in about 150 words each) to be taken from all the units in the prescribed syllabus.

Section C (5x 6= 30 marks)

Q.No;16-20

Five essay type questions (either – or type in about 500 words each) to be taken from all the units in the prescribed syllabus.

UBC – 61
Part IV – I Semester
ENVIRONMENTAL STUDIES

15EVS101

Question Paper Pattern

(External only)

Duration: 3 hours

Total Marks : 50

Answer all Questions (5 x 10 = 50 Marks)

Essay type, either or type questions from each unit.

UBC – 62
Part IV – II Semester
Value Education – Moral and Ethics

15VED201

Question Paper Pattern

(External only)

Duration: 3 hours

Total Marks: 50

Answer all Questions (5 x 10 = 50 Marks)

Essay type, either or type questions from each unit.

UBC – 63
Part IV – III Semester

15UGA3S1

Skill Based Subject 1 – GENERAL AWARENESS (ONLINE)

Question Paper Pattern

Max. Marks 100

End of Semester Examination (ESE)- On-Line Examination

75 Marks

1. 150 questions are to be given. Each question carries ½ mark.
2. In each unit, 30 questions are to be given, covering all the 5 units.

Continuous Internal Assessment (CIA) (through On-Line)

25 Marks

- | | |
|-----------------|----------|
| a) Two Exams. | 15 Marks |
| b) Assignment** | 5 Marks |
| c) Attendance | 5 Marks |

** Each student has to submit an assignment in the Current Affairs area.

UBC - 64
PART IV – SEMESTER III and IV
NON – MAJOR ELECTIVES I AND II
(2015 - 2016)

15UHR3N1 & 15UWR4N2

QUESTION PAPER PATTERN

Duration : 3 hours

Max.Marks: 75

Answer ALL Questions

SECTION A (5X5 = 25 marks)

Short answers, either or type, one question from each unit.

SECTION B (5 X 10 = 50 marks)

Essay type questions, either or type, one question from each unit.

UBC - 65
KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE-29
B.Sc DEGREE PRACTICAL EXAMINATION MARCH/ APRIL 2017
PART III CORE AND ALLIED BIOCHEMISTRY PRACTICALS
APPLICABLE TO STUDENTS ADMITTED FROM THE ACADEMIC YEAR
2016-2017

GENERAL GUIDELINES TO EXAMINERS

All matters concerned with practical examination have to treat as strictly confidential.

Both the examiners are jointly responsible in conducting practical examination. Preparing, conducting and valuing are to be done in accordance with the general and specific instruction issued.

PREPARATION FOR EXAMINATION:

Question papers and valuation schemes for various batches of practical examinations as per time- table have to be collected from the principal / chief Superintendent of the center. Preparation of solutions and packing of substances are to be one as per the requirement of the questions and the number of candidates registered in the batch on the previous day/ session in advance after receiving the concerned question paper cover. Prepared solutions and substances should be kept under safe custody. Values of weights and volumes names of substances etc are to be preserved confidentially by the examiners.

CONDUCT OF EXAMINATIONS:

Seats for candidates are to be marked by numbers serially and the required apparatus/ instruments to be provided at the places. Candidates have to be admitted into the laboratory in time after verifying their hall tickets and identity cards. Seats have to be allotted to the candidates in batch by lot system. One main book one additional book if needed a graph sheet, log table and O.D. chart etc shall be kept on the table noted against the sample number.

Marks ten shall be allotted for the write up of principle, brief procedure and indication of calculation of the experiment allotted to the candidate, written within thirty minutes for six hours and 15 minutes for three hours duration practicals in the additional book provided to them, collected immediately and valued by the examiners.

UBC - 66

The examiners shall dictate to the candidates an outline of the procedure to be adopted for volumetric and colorimetric experiment

GENERAL GUIDELINES TO EXAMINERS IN BIOCHEMISTRY

Examiners should supervise the candidates while carrying out the experiments. Reporting of result alone at the end of the practical examination session should not be taken as an indication for having carried out the experiment properly. For qualitative analysis confirmatory tests should be shown to the examiner by the student.

Volumes and colorimetric readings have to be attested by the examiners as and when reported to them by the candidates before completing the final calculations.

VALUATION OF RECORD NOTE BOOKS

Every candidate should submit a certified bonafide record of practical experiments at the time of his/her first appearance for the practical examination. In case of arrear/ improvement candidates, whose note books were already submitted and valued, a statement to the effect that they have already submitted the records at a previous examination should be obtained from them in the following proforma and the consolidated statement be sent to the controller of examinations at the closure of the practical examinations.

Signature of the Examiners

10% of the total marks of core practical 2, 3, 4 and 5 of each practical examination is allotted for record notebook. The criteria for awarding marks include neatness, regularity in submission, accuracy of result, number of exercises done etc. Record notebook should be signed by both the examiners and punched after valuation.

GENERAL GUIDELINES TO EXAMINERS IN BIOCHEMISTRY FOR QUALITATIVE ANALYSIS

Two systematic analyses have to be carried out in 3 hrs.

Estimations

For three hours practical one experiment has to be carried out.

For six hours practical two experiments have to be carried out.

UBC - 67

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

COIMBATORE-29

CHOICE-BASED CREDIT SYSTEM.

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY

Core Practical 1 - Biochemistry

15UBC2CL

Time: 3hrs

Max. Marks:60

- Analyse systematically the given unknown sugar solution and write the systematic procedure (20+5 marks).
- Analyse systematically the given unknown aminoacid solution and write the systematic procedure (20+5 marks).
- Record – 10 marks

Valuation of answer scripts:

A. Core Biochemistry Practical 1

For qualitative analysis, the following samples shall be given

I – Carbohydrate

Glucose, Fructose, Arabinose, Sucrose, Lactose and Starch

II – Aminoacid

Arginine, Histidine, Tyrosine, Tryptophan and Cysteine

Qualitative Analysis

	Marks
Analysis I	
Procedure	05
Tests and Results	20
Analysis II	
Procedure	05
Tests and results	20
Record	10
Total	60

CIA	Marks	
Attendance	5	
Observation notebook & Regularity	10	
CIA model practical test	25	
Total		40

Total		100

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY
Core Practical 2 - Biochemistry

15UBC2CM

Time : 3 hours

Max. Marks: 60 marks

- I. a) Estimate the amount of phosphorus present in 100ml of given unknown solution. .

(Odd numbered candidates) **(OR)**

- b) Estimate the amount of uric acid present in 100ml of given unknown solution.

(Even numbered candidates) (40)

- II. Write the procedures assigned to the above experiments. (10)

- III. Record submitted (10)

Colorimetric experiment

No.	Details	Marks
1.	Tabular column	5
2.	Graph	5
3.	Calculation	10
4.	Accuracy of result	20
5.	Procedure	10
6.	Record	10
Total		60

CIA

Attendance	5	
Observation notebook & Regularity	10	
CIA model practical test	25	
Total		40

	Total	100

COMPONENT FOR PROJECT

Maximum marks: 100

CIA/ESE	Particulars	Project out of 100 marks
CIA	Project review	15
	Regularity	5
	Total internal marks	20
ESE*	Project report present	60
	Viva voce	20
	Total external marks	80
Total marks (CIA+ESE)		100

*Project report and viva voce will be evaluated jointly by both the project supervisor (Faculty of department) and an External examiner.

UBC - 70

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY

Core Practical 3 - Biochemistry

15UBC6CN

Time : 6 hours

Max. Marks: 60 marks

I. For odd numbered candidates. Estimate the amount of phosphorus present in 100ml of the urine sample by fiske-subbarow method. **(or)**

For even numbered candidates. Estimate the amount of creatinine present in 100ml of the given urine sample by alkaline picrate method. (20)

II. For odd numbered candidates. Estimate the amount of urea present in 100 ml of the given serum sample by DAM-TSC method. **(or)**

For even numbered candidates. Estimate the amount of uric acid present in 100 ml of the given serum sample by caraway method. (20)

III. Write the procedures assigned to the above experiments. (10)

IV. Record submitted (10)

Core Biochemistry practical - 3

Quantitative analysis

I Urine Analysis

No	Details	Marks

1.	Procedure	5
2.	Tabular column	4
3.	Graph	4
4.	Calculation	4
5.	Accuracy of results	8
	Total	

25

UBC-71

II Blood Analysis

1.	Procedure	5
2.	Tabular column	4
3.	Graph	4
4.	Calculation	4
5.	Accuracy of results	8

Total	25
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Record	10
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Total	60
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CIA

Attendance	5
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Observation notebook & Regularity	10
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CIA model practical test	25
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Total	40
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Total	100
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UBC - 72

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY

Core Practical 4 - Biochemistry

15UBC6CO

Time :4 hours

Max. Marks: 60 marks

I a) Analyse the optimum pH for the activity of the enzyme acid phosphatase from the given buffer solutions. (odd)

(or)

b) Determine the K_m value of the enzyme catalase by michaelis-menton method.(even) **35 marks**

II a) Examine the given urine sample whether it contains HCG hormone. **15 marks**

(or)

b) Analyse the serum sample for RA factor.

III Record : **10 marks**

CORE PRACTICAL – 4 BIOCHEMISTRY

ESC

I. Enzymology

1.Procedure	10
2.Tabular column	05
3.Graph	05
4.Calculation	05
5.Accuracy of results	10

35

II. Immunology

1.Procedure	05
2.Report	10

15

III. Record

10

Total (ESC)

60

CIA

Attendance	5
Observation notebook,Regularity	10
CIA model practical test	25

40

Total marks

100

UBC - 74

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY

Core Practical 5 - Biochemistry

15UBC6CP

Time: 4 hours

Max. Marks: 60 marks

I a) Determine the quantity of starch in 1gm of the given sample. (odd) **35 marks**

(or)

b) Estimate the amount of aminoacids present in the given sample. (even)

II a) Using simple staining method determine the microorganism in the given sample

(odd) **15 marks**

(or)

b) Find the micro organism by the method of negative staining in the given sample.

(even)

III Record

10 marks

UBC - 75

CORE PRACTICAL – 5 BIOCHEMISTRY

ESC

I. Plant biochemistry

1. Procedure	10
2. Tabular column	05
3. Graph	05
4. Calculation	05
5. Accuracy of results	10

35

II. Microbiology

1. Procedure	05
2. Report	10

15

III. Record

10

Total (ESC)

60

CIA

Attendance	5
Observation notebook& Regularity	10
CIA model practical test	20

40

Total marks

100

UBC – 76

QUESTION PAPER PATTERN FOR PART III PRACTICAL BIOCHEMISTRY

Allied Practical 2 - Biochemistry

15UBC4AL

Time : 3 hours

Total: 30 marks

- a. Qualitatively analyse the given unknown sugar sample and give the systematic procedure (8+5 marks).
- b. Analyse systematically the given unknown amino acid solution and write the procedure (7+5 marks).
- c. Record – 5 marks

Allied Practical 2 Biochemistry

For qualitative analysis, the following samples shall be given.

I- Carbohydrate

Pentose, glucose, fructose, sucrose, lactose and starch.

II- Aminoacids

Histidine, Tyrosine, Tryptophan, Arginine and cysteine.

Qualitative Analysis

ESC	Marks	
Analysis I		
Procedure	5	
Tests and Results	8	
		13
Analysis II		
Procedure	5	
Tests and results	7	
		12
Record		05

Total (ESC)		30
 CIA		
Attendance	5	
Observation notebook & Regularity	5	
CIA model practical test	10	
		20

Total marks		50
