



UNIVERSITY OF CALICUT

Abstract

BSc Biochemistry – under CUCBCSS UG 2014 – Modified the format - The Scheme updated rectifying the omissions -approved --Corrigendum issued.

G & A - IV - J

U.O.No. 83/2016/Admn

Dated, Calicut University.P.O, 04.01.2016

- Read:-*1. U.O. No. 3797/2013/CU, dated 07.09.2013 (CBCSS UG Modified Regulations)
(File.ref.no. 13752/GA IV J SO/2013/CU).
2. U.O. No. 5180/2014/Admn, dated 29.05.2014 (CBCSS UG Revised Regulations)
(File.ref.no. 13752/GA IV J SO/2013/CU).
3. The minutes of BOS in Biochemistry held on 27.1.14
4. Item No: 6A of the Minutes of the meeting of Faculty of Science held on 3.2.14
5. Item II (i). of the minutes of Academic Council held on 20.3.14
6. U.O.No 6925/2014/Admn dated: 17.07.14
7. U.O.No 11813/2014/Admn dated: 12.12.14
8. Modified Syllabus forwarded by the Chairman
9. Orders of the Vice Chancellor in the file of even no.

ORDER

The Modified Regulations of Choice Based Credit Semester System for UG Curriculum w.e.f 2014 was implemented under the University of Calicut vide paper read as (1). The Revised CUCBCSS UG Regulations has been implemented w.e.f 2014 admission, for all UG programmes under CUCBCSS in the University, vide paper read as (2).

As per the paper read as (3), the Scheme and Syllabus of BSc Biochemistry (LRP) under Choice Based Credit Semester System (UG) was approved by the Board of Studies in Biochemistry. As per paper read as(4) above, the Faculty of Science has approved this minutes and as per paper read as (5) above ,the Academic Council has approved it and orders implementing the syllabus has been issued as per paper read as (6) and corrigendum issued as per paper read as (7)

Since common papers are common for all the UG programme those were not shown in the scheme of previous version of the syllabus. Now, the common courses also included in the scheme and the syllabus has been updated to that effect and the chairperson forwarded the updated syllabus as per paper read as (8).

Since this is a minor correction which effect the format only, the Vice Chancellor has approved the corrections as per the reference cited 9th.

Therefore the Scheme and Syllabus implemented vide paper read as (7) stands corrected to this effect.

Corrigendum is issued accordingly.

The updated syllabus appended. The syllabus is also available in the official website of the Calicut University.

Anuja Balakrishnan
Deputy Registrar

To

1. All Affiliated Colleges/SDE/Dept.s/Institutions under University of Calicut.
2. The Controller of Examinations, University of Calicut.
3. The Director SDE, University of Calicut.

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

**SYLLABUS FOR B.Sc. PROGRAMME IN
BIOCHEMISTRY (LRP/ Alternative pattern)**

And

**SYLLABUS FOR BIOCHEMISTRY AS COMPLEMENTARY
SUBJECT FOR B.Sc. COURSE**

**UNDER CHOICE BASED CREDIT SEMESTER SYSTEM
UG (CBCSS-UG) –MODIFIED REGULATIONS w.e.f.2014**

UNIVERSITY OF CALICUT

**SCHEME FOR B.SC. BIOCHEMISTRY DEGREE (LRP/
ALTERNATIVE PATTERN) UNDER CHOICE BASED CREDIT
SEMESTER SYSTEM UG (CBCSS-UG) –MODIFIED
REGULATIONS W.E.F.2014**

Programme structure

Duration of the programme shall be six semesters distributed in a period of three years. Each semester consists of a minimum of 90 working days, including examination, distributed over 18 weeks each of 5 working days. The Programme leading to B.Sc. Biochemistry shall have the following courses from four types of courses viz. Common Course, General course, Core Course, Complementary Course and Open Course.

There shall be:

06 Common Courses (22 credits)

04 General Courses (16 credits)

14 Core Theory Courses

03 Core Practical Courses,

01 Project

56 credits

01 open course (2 credits)

Two complimentary subjects (08 Courses) 24 credits

Total Credits: 120

Total Marks: 3600

Course	Total credits	Total marks
Common English	14	400
Additional language	8	200
General	16	400
Core	56	1750
Complementary I	12	400
Complementary II	12	400
Open	2	50

Common English courses shall be taught by English teachers and additional languages by teachers of additional languages and the general courses will be taught by the teachers of departments offering core courses

Course Structure for B.Sc. Programme in Biochemistry

Semester I

No	Course	Title	Credits	Marks
1	Common	Common English course I	4	100
2	Common	Common English course II	3	100
3	Common	Additional language course I	4	100
4	Core	Introduction and Physical Aspects of Biochemistry	3	100
5	Complementary I		3	100
6	Complementary II		3	100
		Total	20	600

Semester II

No	Course	Title	Credits	Marks
1	Common	Common English course III	4	100
2	Common	Common English course IV	3	100
3	Common	Additional language course II	4	100
4	Core	Cellular Biochemistry	3	100
5	Complementary I		3	100
6	Complementary II		3	100
		Total	20	600

Semester III

No	Course	Title	Credits	Marks
1	General	Basic Numerical Skills	4	100
2	General	General informatics	4	100
3	Core	Techniques in Biochemistry	3	100
4	Core	Enzymology	3	100
5	Complementary I		3	100
6	Complementary II		3	100
		Total	20	600

Semester IV

No	Course	Title	Credits	Marks
1	General	Entrepreneurship	4	100
2	General	Intellectual Property Rights	4	100
3	Core	Biomolecules and Bioinformatics	4	100
4	Core	Practicals I (Carbohydrates , Lipids, Amino Acids ,Nucleic Acids and Techniques)	3	100
5	Complementary I		3	100
6	Complementary II		3	100
		Total	21	600

Semester V

No	Course	Title	Credits	Marks
1	Core	Intermediary Metabolism I	3	100
2	Core	Intermediary Metabolism II	2	100
3	Core	Plant Biochemistry	3	100
4	Core	Physiological Aspects of Biochemistry	4	100
5	Core	Clinical and Nutritional Aspects of Biochemistry	4	100
6	Core	Immunology	3	100
7	Open		2	50
		Total	21	650

Semester VI

No	Course	Title	Credits	Marks
1	Core	Classical Genetics and Molecular Biology	4	100
2	Core	Recombinant DNA Technology	3	100
3	Core	Molecular Endocrinology	3	100
4	Core	Practicals II (Clinical and Enzymology)	3	100
5	Core	Practicals III(Molecular Biology, Immunology and Nutritional Biochemistry)	3	100
6	Core	Project	2	50
		Total	18	550

BSc Biochemistry Core courses program

Semester	Course Code	Course Title	Hours/week	Credits	Total marks
1	BCH1B01	Introduction and Physical Aspects of Biochemistry	3	3	100
2	BCH2B02	Cellular Biochemistry	3	3	100
3	BCH3B03	Techniques in Biochemistry	3	3	100
3	BCH3B04	Enzymology	3	3	100
4	BCH4B05	Biomolecules and Bioinformatics	4	4	100
4	BCH4B06	Practicals I (Carbohydrates , Lipids, Amino Acids ,Nucleic Acids and Techniques)	6	3	100
5 th semester	BCH5B07	Intermediary Metabolism I	3	3	100
	BCH5B08	Intermediary Metabolism II	2	2	100
	BCH5B09	Plant Biochemistry	3	3	100
	BCH5B10	Physiological Aspects of Biochemistry	4	4	100
	BCH5B11	Clinical and Nutritional Aspects of Biochemistry	4	4	100
	BCH5B12	Immunology	3	3	100
		Open Course	2	2	50
6 th semester	BCH6B13	Classical Genetics and Molecular Biology	4	4	100
	BCH6B14	Recombinant DNA Technology	3	3	100
	BCH6B15	Molecular Endocrinology	3	3	100
	BCH6B16	Practicals II (Clinical and Enzymology)	6	3	100
	BCH6B17	Practicals III(Molecular Biology, Immunology and Nutritional Biochemistry)	6	3	100
	BCH6B18	Project	4	2	50

Open courses (semester 5: Credit: 2 hours/ week 2)

- BCHD01 Elementary Biochemistry
- BCHD02 Life Style Diseases
- BCHD03 Clinical Diagnosis of Common Diseases

Total credits for the core courses 56

Credits for the open course 2

Total marks for the core course 1750

Scheme of Examination, Evaluation and Grading:

- There shall be external university examination of 3 hour duration for each theory course at the end of the each semester (for core, ,complementary and open)
- Practical examinations shall be conducted by the university at the end of even semesters.
- Practical examination, project / dissertation evaluation and *viva voce* shall be conducted by one external examiner and one internal examiner appointed by the university.
- Project evaluation shall be conducted at the end of 6th semester. 20% of marks may be awarded through internal assessment
- Practical examination shall be of six hours duration.
- Evaluation and grading are in accordance with the general guidelines given by the university.
- The questions should be answered only in English

The evaluation scheme for each course (core) shall contain two parts

(1) Internal evaluation (2) External evaluation

20% marks shall be given to the internal evaluation. The remaining 80% of marks shall be for the external evaluation.

Marks for the external evaluation 80

Marks for the internal evaluation 20

Components of and marks for the internal evaluation of theory courses are given below

Attendance	5
Test paper	10
Seminar/viva/assignment	5
Total	20

Scheme for practical examinations

Maximum marks for external evaluation 80

Maximum marks for internal evaluation 20

Components and of marks for the internal evaluation of practical courses are given below

Attendance	5
Records	10
Lab involvement	5
Total	20

For practical examination the question paper will have the following components

- Writing the Procedure

- Qualitative analysis
- Quantitative estimation
- Spotters

For each practical examination the laboratory record has to be compulsorily submitted.

Scheme for the evaluation of practical examination

Marks may be assigned for various components as follows:

For Qualitative Analysis:

- Result & Conclusion
- Confirmatory test 1
- Confirmatory test 2
- Neatly written scheme of experiments used for arriving at the final conclusion

For Quantitative Experiments

- Result of the reported value (minimum error)
- Calculation, presentation of the result (Graph/table/chart etc.)
- Procedure
- Skill

PROJECT

Each student will have to do a research project during the entire course under the guidance of a faculty member of the college. A group of students can collectively undertake the project under the supervision of a member of the faculty. The total member in a group may be restricted to a maximum of 6.

The total marks for the project will be 50

The following components may be taken into consideration for the evaluation of projects

1. Introduction, review of literature etc.
2. Objectives and relevance of the study
3. Methodology
4. Results
5. Discussion and Interpretation
6. Conclusions
7. Involvement of the students
8. Style and neatness of the dissertation
9. References

PROJECT EVALUATION

1. Evaluation of the Project Report shall be done under Mark System.
2. The evaluation of the project will be done at two stages:

- a) Internal Assessment (supervising teachers will assess the project and award internal Marks)
- b) External evaluation (external examiner appointed by the University)
- c) Marks secured for the project will be awarded to candidates, combining the Internal and external Marks
3. The internal to external components is to be taken in the ratio 1.:4. Assessment of different components may be taken as below.

Internal (20% of total)	
Components	% of Marks
Punctuality	20
Use of Data	20
Scheme/Organization of Report	30
Viva-Voce	30

External (80% of total)	
Components	% of marks
Relevance of the Topic, Statement of Objectives, Methodology (Reference/Bibliography)	20
Presentation, Quality of Analysis/Use of Statistical tools, Findings and recommendations	30
Viva-Voce	50

BCH1B01: INTRODUCTION AND PHYSICAL ASPECTS OF BIOCHEMISTRY

Credits: 3. Total hours: 54 hours / week: 3

Unit I. (4h) General Introduction

Brief study of the foundations of biochemistry (cellular, chemical and physical foundations- fundamental study only)

Unit II. (10h) Water, Acids, Bases and Buffer

Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation

of weak acids and electrolytes, Brønsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases. Meaning of K_a and pK_a values, buffers and buffer action. Buffers in biological system, Henderson-Hasselbalch equation with derivation, simple numerical problems involving application of this equation, simple numerical problems on buffer composition. Uses of buffers in biochemistry/experimental biology

Unit III. (10h) Colloids

Meaning of true solution, colloidal solution, coarse suspension, distinction between lyophilic and lyophobic sols. Fundamental study of Donnan equilibrium- applications in biological system. Methods of preparation of colloidal solution, membrane permeability, separation of colloidal solutions, elementary study of charge on colloids. Tyndall effect, applications of colloidal chemistry, emulsion and emulsifying agents.

Unit IV. (6h) Chemical Equilibrium and Catalysis

Introduction to chemical kinetics, equilibrium reactions, law of mass action, equilibrium constant, definition of catalysis, characteristics of catalytic reaction- explanation of positive negative and auto catalysis. Fundamental ideas of promoters and catalytic poisoning, basic principles of thermodynamics, free energy, enthalpy, entropy, reversible and irreversible reactions- examples from biochemistry.

Unit V. (8h) Solutions

Meaning of normality, molarity, molality, percentage solution, mole fractions; simple numerical problems from the above. Fundamental principles of diffusion and osmosis, definition of osmotic pressure, isotonic, hypotonic and hyper tonic solutions. Biological importance of osmosis. Relationship of osmotic pressure to gas laws. General equation for dilute solutions, influence of ionization and molecular size on osmotic pressure.

Unit VI (10h) Isotopes

Isotopes, isobars. Principle and applications of radioactive isotopes as tracers in biochemistry. Important stable radioisotopes used in biochemical research. (P^{32} , I^{125} , I^{131} , Co^{60} . C^{14} etc). Radiation hazards and precautions taken while handling radioisotopes.

Unit VII(6h) Laboratory practices

Laboratory safety requirements and precautions. Safe handling and disposals of chemicals, biological and other samples. Radioactive materials. Management of laboratory accidents and injuries.

Reference

1. Text book of Biochemistry: E.S.West, W.R.Todd, H.S. Mason and J.T. Van Bruggen
2. Lehninger's Principles of Biochemistry: D.L. Nelson and M. M. Cox . Worth Publishers, 41 Madisons Avenue New York, USA ISBN 0-333-94657-X
3. Principles of Physical Chemistry: B. R. Puri , L.R. Sharma and S . P. Madan. Vishal Publishing Company. Gumber Market, Old Railway Road, Jalandhar.
4. Medical Biochemistry: S. Ramakrishnan 3-6-272 Himayat Nagar Hyderabad ISBN 81-250-20713

BCH2B02 CELLULAR BIOCHEMISTRY

Credits: 3. Total hours: 54 hours / week: 3

Unit I. (15h)

Ultra structure of cell: prokaryotic and eukaryotic cell. Subcellular organelles and marker enzymes. Nucleus, chromosomes, mitochondria, chloroplast, ribosomes, endoplasmic reticulum, golgi complex, lysosomes, microfilaments, microtubules and intermediate filaments, glyoxysomes and peroxysomes.

Unit II. (12h)

Plasma membrane- structure and composition; transport across the membranes- definition and examples-simple diffusion- Facilitated transport- Symport, uniport and antiport. Active transport (eg:sodium potassium ATPase). Ion channels, ionophores

Unit III. (12h)

Cell – cell interaction and cell matrix interaction, extracellular matrix, proteoglycans and collagen, Cell – cell adhesion, catherins, desmosomes, gap junction and tight junction.

Unit IV. (15h)

Cell cycle- different phases including cell division - Mitosis and meiosis (fundamental study), Apoptosis-definition, difference between apoptosis and necrosis .Tumor - benign and malignant. Properties of malignant cells.

References

1. The Cell : Geoffrey M.Cooper, Robert E. Hausman, ASM Press Washington DC. Sinauer Associates, Inc. ISBN 0-87893-214-3
2. Molecular Biology of the Cell: B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. , Garland Publishing Inc., New York. ISBN 0-8153-3218-1
3. Cellular and Molecular Biology: J. Darnell, H. Lodish and D. Baltimore. Scientific American Books, W.H. Freeman and Company, New York.
4. Cell and Molecular Biology: E.D.P. Robertis and De Robertis
5. Molecular Cell Biology: H. Lodish, J. Parnell and C. A. Kaiser, WH. Freeman and company New York and London.

BCH3B03 TECHNIQUES IN BIOCHEMISTRY

Credits: 3 Total hours: 54 Hours per week: 3

Unit I. (5h)

Methods of tissue homogenization. Salt and organic solvent extraction and fractionation. Dialysis, Reverse dialysis, ultra filtration, lyophilization.

Unit II.(10h)

Chromatography:- principle, procedure and application of partition chromatography , adsorption chromatography, ion exchange chromatography, gel chromatography, affinity chromatography, Paper , TLC, HPLC, GLC and HPLC.

Unit III.(10h)

Electrophoresis:- Principle, procedure and application of free flow, zone electrophoresis (Paper electrophoresis, membrane electrophoresis Gel electrophoresis, PAGE, SDS-PAGE and *disc* PAGE). Isoelectric focussing, highvoltage electrophoresis, pulse field electrophoresis, immunoelectrophoresis. 2D electrophoresis

Unit IV.(10h)

Centrifugation:- Principle of sedimentation technique. Relationship with rpm and radius of rotation. RCF and centrifugal force (xg). Different types of centrifuge and rotors. Principle, procedure and application of differential centrifugation, density gradient centrifugation, ultra centrifugation, rate zonal centrifugation, isopycnic centrifugation

Unit V(10h).

Colorimetry and spectrophotometry:- Laws of light absorption -Beer - Lambert law. UV and visible absorption spectra, molar extinction coefficient and quantitation. Principle and instrumentation of colorimetry and spectrophotometry. Principle of nephelometry, fluorometry, atomic absorption and emission spectrophotometer.

Unit VI.(9h)

Principle and application of RIA. Measurement of radioactivity by GM counter and Scintillation counter. Autoradiography

References

1. Physical Biochemistry- Application to Biochemistry and Molecular Biology:
Friefelder D. WH Freeman and Company
1. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K.
Wilson and J. Walker, Cambridge University Press.
2. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
3. Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K
and Nath N., Himalaya publishing house.
4. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L , W.H. Freeman
and Company.
5. Research Methodology for Biological Sciences: Gurumani.N , M.J.P. Publishers.,
Chennai, India.
6. Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S.,
Himalaya Publishing House, Mumbai, India.
7. A Biologist's Guide to Principles and Techniques of Practical Biochemistry:
Williams. B.L. and Wilson. K. (ed.) Edward Arnold Ltd. London

BCH3B04 ENZYMOLOGY

Credits: 3 Total hours: 54 Hours per week: 3

Unit I (3h)

Introduction to enzymes: Historical development of enzymology as a discipline. Proteins as enzymes. (Briefly mention about ribozymes and abzymes). Definition, examples of holoenzyme, apoenzyme.

Unit II(4h)

Coenzymes and cofactors:Definition: examples of a) metal ions b) coenzymes c) prosthetic group.. Coenzymes and their functions - NAD, NADP+,FAD, FMN, lipoic acid, TPP, pyridoxal phosphate and biotin.(structure and one reaction each)

Unit III (4h)

Classification of enzymes,

Need and rationale for classification of enzymes. IUPAC system of classification and nomenclature of enzymes: (Give one example each from each major class and its sub class).

Unit IV (8h)

Enzyme catalysis and Mechanism of enzyme action-:

Idea of enzyme specificity; Concept of active site and the 'lock and key' model of Emil Fischer; Koshland's induced fit theory of enzyme catalysis. Standard free energy change in a reaction. Transition state, energy of activation of non-enzymatic and enzymatic reaction; reaction rate, rate equation, rate constant; binding energy and release of binding energy; specificity of enzymes – absolute, group, linkage, and stereochemical specificity with example.

Unit V(10h)

Enzyme kinetics: Importance of kinetics; order of reactions; study of the factors affecting the velocity of enzyme catalyzed reaction - enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators -Definition and significance of V_o , and V_{MAX} value in enzyme reaction. Derivation of Michaelis-Menten equation and Michaelis-Menten constant (K_M). Determination of K_M by Lineweaver- Burk plot (for single-substrate enzyme catalyzed reaction). Significance and relevance of K_M value of an enzyme. K_{cat} (turnover number) and significance. K_{cat}/K_M ratios for determining catalytic efficiency.

Unit VI (4h)

Measurement of enzyme activity. Enzyme assays: *In vitro* measurements - fixed time and continuous. Methods of measurement of enzyme activity. Quantitative expression of enzyme activity; Units of activity; specific activity - definition and significance. International unit (IU) and Katal.

Unit VII(7h)

Enzyme inhibition: Reversible and irreversible – examples. Reversible- competitive, non-competitive, uncompetitive and mixed type inhibitions. Explanation of double reciprocal plot ($1/v$ versus $1/s$) in the presence of inhibitor. Antibiotic inhibitors of enzymes- penicillin, sulfa drugs, methotrexate etc. Inhibitors as tools in biochemical studies.

Unit VIII (5 hours)

Enzyme regulation– Significance in metabolism. Types of regulations- reversible covalent modification with examples of phosphorylation and adenylation (glycogen phosphorylase and glutamine synthetase); allosteric regulation (aspartate transcarbamoylase); isoenzymes (lactate dehydrogenase and creatine phosphokinase); zymogens (pepsin, trypsin).

Unit IX (5h)

Isolation, purification and characterization of enzyme:

General protocol: Solubilization, and extraction from sample; fractional precipitation (salting out, pH, heat, organic solvents etc). Purification: by chromatography (exclusion, ion exchange, adsorption, affinity); by electrophoresis (PAGE); isoelectric focusing. Criteria of purity: immunological, ultracentrifugation etc.

Unit X (4h)

Immobilization of enzymes:

Different methods of immobilization of enzymes (brief mention only). Industrial and clinical uses of enzymes: detergent enzymes, as food additive, and in other industrial application (give examples: thermo stable alpha amylase, papain, chymotrypsin etc.). Use of enzymes in ELISA.

References

1. Cook, P.F. and Cleland, W.W. Enzyme kinetics and Mechanism. Pub. Garland Science London, New York : 2007
2. Dixon M. and. Webb E. C (1979) Enzymes: Longman Publication, London
3. Laidler, K.J. and Bunting, P.S , The Chemical Kinetics of Enzyme action Oxford University Press London.
4. Nelson, D. L. and Cox, M.M. Lehninger Principles of Biochemistry, 6th Edition, W.H.Freeman and Company, N.Y., USA.
5. Palmer, T. Understanding Enzymes Ellis Horwood Limited, Third Edition (1991).
6. Palmer, T and Bonner, P. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry Publisher: Horwood Publishing Limited.
7. Price, N.C. and Stevens, L. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins Publisher: Oxford University Press, USA.
8. Stryer, L. Biochemistry Pub. W.H. Freeman
9. Voet, D. and Voet, J.G. Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA.
10. Voet, D. and. Voet, J. G, Biochemistry, 4th Edition, John Wiley & sons Inc. New York
11. Walsh, G. Protein Biochemistry and Biotechnology, John Wiley and Sons Ltd. 2002.
12. Walsh, G. and Headon, D. Protein Biotechnology, John Wiley and Sons, 1994.
13. West E.S., W.R. Todd, H.S. Mason and J .T. Van Bruggen Text Book of Biochemistry: Oxford & IBH publishing Co-Pvt. Ltd.

BCH4B05 BIOMOLECULES AND BIOINFORMATICS

Credits: 4 Total hours: 72 Hours per week: 4

Unit I. Carbohydrates (12 h.)

Definition and classification. Isomerism of carbohydrates: optical isomerism and stereoisomerism, 'd' and 'l' D and L forms of compounds. Glyceraldehyde as example. R and S nomenclature of enantiomers. Examples of epimers, mutarotation and its explanation, anomeric forms. Classification of monosaccharides, linear and cyclic structure (glucose, galactose, mannose, ribose and fructose). Reactions and characteristics of aldehyde and keto group, action of acids and alkalis on sugars, reactions of sugars due to hydroxyl group. Disaccharides- structure, occurrence, chemistry and

functions of sucrose, lactose, trehalose, maltose, isomaltose and cellobiose. Homopolysaccharides: occurrence, structure, chemistry and functions of cellulose, starch, glycogen, chitin, dextrin and inulin. Heteropolysaccharides: occurrence, types, composition and function. Sugar derivatives: sugar alcohols, sugar acids, amino sugars, deoxy sugars and their relevance.

Unit II.Lipids (10h.)

Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids, physical and chemical properties of fatty acids- saponification number, acid number and iodine number and their application. Structure of the following fatty acids – stearic acid, oleic acid, linoleic acid. Structure of triacylglycerol. Essential and non essential fatty acids with examples, prostaglandin, eicosanoids.

Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Steroids: Structure of steroid nucleus, cholesterol, ergosterol, stigmasterol, calciferol.

Unit III. Amino acids and Proteins (12 h.)

Amino acids: Definition, stereoisomerism , structure of 20 ‘protein amino acids’ - Three letter and single letter abbreviations of amino acids, and novel amino acids: selenocysteine and pyrrolysine; classification of amino acids based on charge and polarity, general reactions of amino acids- side chain, carboxyl and amino group- essential and non essential amino acids, ionization of amino acids. Zwitter ion, isoelectric point for amino acids.

Unit IV Proteins (8h):

Basic ideas about the classification (including solubility characteristics) and functions of proteins. Peptides: Formation of peptide bond, Ramachandran's plot -structure of glutathione, oxytocin and vasopressin. Elementary study of primary, secondary, tertiary and quaternary structure of proteins, forces stabilizing the proteins- end point determination of primary structure- N-terminal, C-terminal residues (one method each). Chemical reactions, purification, precipitation reactions - salt effect, heavy metal precipitation, denaturation, renaturation and precipitation of proteins. Color reactions for proteins. Sequencing of proteins (basic principles of the methods employed)

Unit V. Nucleic acids (10h)

Structure of common purine and pyrimidine bases, tautomeric forms of bases, structure of nucleosides and nucleotides.-unusual bases in nucleic acids DNA: Double helix (Watson and Crick model) A, B, and Z forms of DNA, physical properties of DNA (conformational variants). Introduction to circular DNA, supercoiling, helix to random coil transition – denaturation of nucleic acids, hyper chromic effect, T_m-values , cot curves and their significance. Types of RNA- (t-RNA, r-RNA, m-RNA). Elementary study of the structures of these RNAs. Sequencing of DNA (basic principles of the methods employed)

Unit VI. Bioinformatics:(12h)

Introduction, history , scope and applications of Bioinformatics , Introduction to Biological databases, Types of databases, Primary and secondary databases, Nucleic acid databases, protein databases, structural databases, bibliographic databases and organism specific data bases. NCBI, gene bank, Expasy, Swissprot, PIR, Prosite, PDB.Basics of sequence alignment-pair wise and multiple sequence alignment- Global and local alignment -.Scoring matrices(PAM and BLOSSUM)- gap penalties - and structural bioinformatics: molecular docking, Homology modelling

Unit VII.Vitamins and Minerals (8h)

Definition, classification- fat soluble and water soluble- , sources, chemical nature (without structure), functions of vitamins. Macro minerals (Ca,P,Mg,Na,K,Cl) and micro minerals/trace elements(Co, I, Fe, Mn, Zn, and F)-their sources, daily requirements, functions and deficiency diseases.

References

1. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in Publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0
2. Harper's Biochemistry: R.K. Murray, D. K. Granner, Peter A Mayer, Victor W Rodwell ISBN 0-07-122939-6
3. Lehninger's Principles of Biochemistry: D. L.Nelson and M.M. Cox , Worth Publishers

4. Biochemistry: Donald. Voet and Judith G. Voet John Wiley & sons Inc. New York
ChichesterBrisbane,Toronto, singapore ISBN 0-471-58651-X
5. Bioinformatics concepts, skills and applications- C S Rastogi, N Mendirattar and Y Rastogi, CBS
Publishers, New Delhi
6. Introduction to Bioinformatics: A theoretical and practical approaches- S A Krawetz,
D. D. Womble, Human Press
7. Fundamental concepts in Bioinformatics Dan .E. Karne Michael L Raymer Pearson education
Inc
8. Instant note Bioinformatics: West Head David R et al Taylor and Francis

BCH4B06 PRACTICALS I (BIOMOLECULES AND TECHNIQUES)

Credits: 3 Total hours: 108 Hours per week: 6

1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2. Standardization of pH meter, preparation of buffers, emulsions.
3. Qualitative analysis: Carbohydrates- general reactions of carbohydrates. Schematic analysis
of biochemical substance (carbohydrate, protein, amino acid, lipids)

Quantitative analyses:

4. Verification of Beer's law
(Use KMnO_4 , K_2CrO_4 or similar coloured solution for this experiment.)
5. Experimental verification of molar extinction coefficient of any known compound.
6. Estimation of sugars (by any two methods only)
7. Amino acid estimation by ninhydrin method
8. Protein estimation by Biuret method.
9. Protein estimation by Lowry *et.al* method.
10. Cholesterol estimation by Zak's method or any other convenient method.
11. Fractional precipitation of protein from crude tissue extracts (Avoid plant tissue with
phenolics in it. May use pulses or animal tissues)
12. Separation of sugars and amino acids by paper chromatography
13. Separation of lipids and amino acids by thin layer chromatography (TLC)
14. Separation of serum protein by agarose gel electrophoresis (Demonstration)
15. Dialysis using dialysis membrane
16. SDS- PAGE (Demonstration)

References:

1. Practical Biochemistry: Plummer
2. Practical Biochemistry: K.E. Van Holde.
3. Physical Biochemistry- Application to Biochemistry and Molecular Biology: Friefelder D. WH Freeman and Company
4. Principles and Techniques of Biochemistry and Molecular Biology: - Ed. K. Wilson and J. Walker, Cambridge Univerity Press.
5. The Tools of Biochemistry: Cooper T.G., John Wiley and Sons Publication.
6. Biophysical chemistry. Principles and Techniques: Upadhayay A, Upadhayay K and Nath N., Himalaya publishing house.
7. Experimental Biochemistry. Cark Jr J. M. and Switzer R.L., W.H. Freeman and Company.
8. Research Methodology for Biological Sciences: Gurumani.N. , M.J.P. Publishers., Chennai, India.
9. Instrumental Methods of Chemical Analysis: Chatwal. G and Anand.S., Himalaya Publishing House, Mumbai, India.
10. A Biologist's Guide to Principles and Techniques of Practical Biochemistry:Williams. B.L. and Wilson. K. (ed.) Edward Arnold Ltd. London

BCH5B07 INTERMEDIARY METABOLISM- I

Credits: 3 Total hours: 54 Hours per week: 3

Unit I. (5h.)

Bioenergetics: Introduction, Biological oxidation, Role of high energy phosphates in energy transfer -redox potential

Unit II(10 h)

Intermediary Metabolism: Catabolism and anabolism, metabolic pathways, experimental approaches in metabolism. Compartmentalization of metabolic pathways in cells and energy conversation. Approaches to study metabolism: using intact animals, bacterial mutants, in vitro, and radioactive isotopes.

Unit III(25h)

Carbohydrate metabolism (Structures, energetics and regulation of pathways) : Glycolysis (aerobic and anaerobic), entry of other sugars into glycolytic pathway, TCA cycle, HMP shunt, gluconeogenesis, galactose and fructose metabolism, anaplerotic reactions, glyoxalate cycle. Carbohydrate synthesis, Synthesis of starch, cellulose and peptidoglycans Glycogen Metabolism: Glycogenesis, glycogenolysis, regulation- Cori cycle (structures & regulation),

Unit V (14 h)

Electron Transport Chain: Structure of mitochondria, sequence of electron carriers: NADH-ubiquinone dehydrogenase, Succinate dehydrogenase, cytochrome reductase and cytochrome oxidase (outline of electron transport chain), Structure of ATP synthase -inhibitors of electron transport chain.Oxidative phosphorylation: Sites of ATP production, Chemiosmotic theory (an outline), P/O ratio, inhibitors and uncouplers, transport of reducing potentials into mitochondria.

References

1. Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
2. Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.
3. Biochemistry: Donald. Voet and Judith G. Voet John Wiley & sons Inc. New York Chischester Brisbane,Toronto, singapore ISBN 0-471-58651-X

BCH5B08 INTERMEDIARY METABOLISM II

Credits: 2 Total hours: 36 Hours per week: 2

Unit I(15h)

Metabolism of lipids: Fatty acid synthase complex, Biosynthesis of fatty acids, Fatty acid elongation. Difference of fatty acid synthesis in plants and animals. β - oxidation of palmitic acid and its energy balance sheet. Ketogenesis; Cholesterol synthesis (structure not needed) and significance. Synthesis of steroid hormones from cholesterol .A brief account of committed steps in steroid metabolic pathway.

Unit II (15h)

Metabolism of amino acids and proteins: Protein turn over, proteolytic enzymes. transamination, oxidative deamination, reductive amination, non-oxidative deamination and decarboxylation of amino acids. Brief outline of metabolism of, glycine phenylalanine, valine and methionine. Metabolic fate of amino acids- glucogenic, ketogenic and gluco-ketogenic. Urea cycle. Details on committed steps in the cycle

Unit III (6h)

Metabolism of nucleotide -Biosynthesis of purine and pyrimidine nucleotides *–de novo* and salvage pathway (structure not required); end products of purine and pyrimidine metabolism. Details on committed steps in the metabolic pathway.

References

1. Biochemistry: L. Stryer. and Hall, J.E., Library of congress cataloguing-in publication Data, Bery, Jeremy mark ISBN -0-7167-4684-0
2. Harper's Biochemistry: R.K. Murray, D. K. Granner, Peter A Mayer, Victor W Rodwell ISBN 0-07-122939-6
3. Lehninger's Principles of Biochemistry: D. L.Nelson and M.M. Cox , Worth Publishers
4. Biochemistry: Donald. Voet and Judith G. Voet John Wiley & sons Inc. New York Chischester Brisbane,Toronto, singapore ISBN 0-471-58651-X

BCH5B09 PLANT BIOCHEMISTRY

Credits: 3: Hours/week:3. Total hours of instruction: 54h.

Unit I (10h)

Structure , chemistry and function

An over view of plant cell and sub cellular components of the plant cell. Brief account of separation of plant sub cellular constituents. Structure and organization of primary cell wall. Structure and chemical composition of plant cell membranes; membranes of nucleus, endoplasmic reticulum, plasmalemma, plastid,vacuole and Golgi body. Structural features of organelles of plant

cell: chloroplast, microbody, vacuole, and plant microtubule. Unique functional roles of the plant organelles. Importance of sucrose as transport form of sugar in plants.

Unit III (12h)

Autotrophy and metabolic pathways in plants:

Photosynthesis: Plant pigments: structure, properties and functions of chlorophylls, xanthophylls and carotenoids and other plant pigments. Phytochromes, cryptochromes and phototropins: general account of structure and chemistry. Functions and mechanism of action of photoreceptor proteins in plants Photosynthesis and pathway of carbon dioxide fixation: Light reactions, cyclic and non cyclic phosphorylation; Calvin cycle, C₄ pathway, Crassulacean acid metabolism; regulation of photosynthesis; photorespiration and the glycolate pathway.

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Unit IV(8 h)

Mineral and other metabolisms

Mineral metabolism: Essentiality and functions- magnesium, iron, manganese, zinc, copper, molybdenum, calcium, potassium, chlorine and boron. potassium,

Sulfate metabolism: Sulfate reduction and assimilation. Pathway of cysteine and methionine synthesis.

Nitrate metabolism: Nitrate reduction- nitrate reductase- physiology and regulation; nitrite metabolism (nitrite reductatase).

Unit V(5 h)

Nitrogen fixation: Nitrogen cycle; symbiotic and non-symbiotic nitrogen fixation. Biochemistry of nitrogen fixation:

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Unit VI (7h)

Plant growth substances

Plant growth regulators :Auxins, cytokinins, abscisic acid and related compounds, gibberellins, and ethylene; chemical nature, physiological roles, distribution in plants, mode of action, .

Unit VII (4h)

Fruit ripening, senescence, seed dormancy and germination:

A brief account of the biochemical aspects associated with the above in relation to plant development and growth.

Unit VIII(8h)

Secondary metabolism in plants

A brief account of the following major chemical classes of secondary metabolites: Alkaloids, terpenoids, flavonoids, phenolics and phenolic acids, steroids, coumarins, quinines, acetylenes, cyanogenic glycosides, amines and non-protein amino acids, gums, mucilages, resins etc.

Importance of secondary metabolites: To the producer plant: protection of the plant from predators and insects (give examples). To man: as biologically active compounds in mammalian metabolism (examples). Also as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses. Allelopathy: detrimental biochemical effects of phytotoxic compounds of producer plant to other plants; inhibition of germination, growth and development. (Give examples for the above). Xenobiotic and plant metabolism (A brief study)

References

1. Anderson, J. W. and Beardall, J. Molecular activities of plant cell: An Introduction to Plant Biochemistry, Blackwell Science.
2. Bell, E.A. and Charlwood, B.V. (Editors). Encyclopedia of Plant Physiology. New Series. Vol. 8. Secondary Plant Products: Springer-Verlag Pub. (1980.)
3. Bonner, J. and Varner, J. E. Plant Biochemistry, Academic Press, New York
4. Buchanan B B and Gruissem W and Jones R L ,Biochemistry and Molecular biology of plants, Society of American Plant Physiologists
5. Conn, E.E. (Editor) The Biochemistry of Plants. A comprehensive Treatise. Vol. 7.
6. Secondary Plant Products.: Academic Press Pub. 1981.
7. Dennis, D. T., Turpin, D. H., Lefebvre. D.andLayzell, D. B. eds, Plant Metabolism, 2nd Edition. Addison Wesley Longman Ltd., 2nd Edition, 1997.
8. Dey, P.M. and Harborne, J.B. (Editors.) Plant Biochemistry: Harcourt Asia PTE Ltd. Academic Press. (Indian Edition, 2000)
9. Hopkins, W. G. and Norman. P.A. Hunger, Introduction to Plant physiology, 3rd edition
10. Kumar, H.D. and Singh, H.N. Plant Metabolism:.. Affiliated East-West Press Pvt. Ltd., New Delhi, Madras, Hyderabad and Bangalore. (1993; 2nd edition).
11. Lea, P. J. and Leegood, R. C. Plant Biochemistry and Molecular Biology 2nd Edition. Wiley, London, 1999.
12. Noggle, G.R. and Fritz,G.J. Introductory Plant Physiology, Prentice Hall of India Pvt Ltd,N. Delhi

13. Pandey, S. N. and. Sinha, B.K. Plant Physiology, Vikas Publishing House Pvt. Ltd, 3rd edition, 1999.
14. Ramawat, K.G. and Merillon, J.M. (Editors.) Biotechnology. Secondary metabolites: Oxford and IBH Publishing Company Pvt. Ltd., New Delhi and Calcutta. (1999).
15. Salisbury, F. B. and Ross, C. W. Plant Physiology, 4th Ed. Wadsworth Publishing Company, California
16. Stumpf, P. K. and Conn, E. E (1980). The Biochemistry of Plants: A Comprehensive Treatise. Academic Press.
17. Taiz, L. and Zeiger E, Plant Physiology, 5th Ed.(2010), Sinauer Associates, Inc Publishers, Massachusetts
18. Verma, V. Plant physiology 7th Revised edition, Emkay Publications 2001.

BCH5B10 PHYSIOLOGICAL ASPECTS OF BIOCHEMISTRY

Credits: 4 Total hours: 72 Hours per week: 4

Unit I (8 h)

Introduction to physiology: functional organization of human body, extracellular and intracellular fluids, constituents and characteristics of extracellular fluid, homoeostasis, overview of coordination between major functional systems of human body, physiological significance of carbohydrates and lipids.

Unit II (8 h)

Digestion and absorption: Functions of different gastro intestinal organs in digestion and absorption, secretion of digestive fluids and enzymes, activation of digestive enzymes, gastro intestinal hormones, epithelial transport of solutes, Digestion and absorption of carbohydrates, proteins, lipids, vitamins and minerals, composition and function of bile, metabolism of bile acids.

Unit III (16 h)

Biochemistry of Blood: Constituents of blood, types of blood cells, components of plasma, plasma proteins- types and functions. Formation of blood cells, differentiation of RBC, red cell antigens and blood groups, Mechanism of blood clotting (intrinsic and extrinsic pathway) Clotting factors and anticoagulants, Structure and function of hemoglobin, types of haemoglobin, formation and destruction of haemoglobin, blood pressure, standard units of blood pressure, clinical methods of measuring systolic and diastolic pressures, vasoconstrictors and vasodilators.

Unit IV (12 h)

Biochemistry of respiration and renal function: Pulmonary volumes, pulmonary capacity, Blood flow through lungs and its distribution, Transport of oxygen and carbon dioxide in blood, role of haemoglobin, carbonic anhydrase, chloride shift, oxygen dissociation curve and Bohr effect, role of 2,3-bisphospho glycerate, respiratory exchange ratio. Oxygen toxicity, free radical formation, anti oxidants. Structure of nephrons, renal excretory mechanism, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. composition of urine, regulation of water and electrolyte balance. Respiratory and renal regulation of pH.

Unit V (12 h)

Biochemistry of Specialized tissues: Muscle- types of muscles, muscle proteins, organization of contractile protein and mechanism of muscle contraction (Sliding filament theory), fuel metabolism in muscle, Maintenance of ATP availability in active muscle, role of creatine and creatine kinase. Neurons- structure, mechanism of nerve impulse transmission, neurotransmitters, acetyl choline, GABA , serotonin, dopamine. Bone- Role of calcium, phosphorus, vitamin D and hormones in bone metabolism. Collagen in bone formation. Biochemistry of vision- Structure of eye, lens and retina, Rod and cone cells, rhodopsin, visual cycle, events in visual excitation, mechanism and regulation of vision, colour vision.

Unit VI (16 h)

Endocrinology: Organization of endocrine system. Hormone secretion, transport and clearance from blood, Classification of hormones and hormone action- type I and type II. Brief study of the site of biosynthesis, major physiological functions, mechanism of action and type of receptors of insulin, glucagon, epinephrine, thyroxine, glucocorticoids, mineralocorticoids, androgen, estrogen, growth hormone, corticotropic hormone, thyroid stimulating hormone, gonadotropic hormone, vasopressin, oxytocin, parathyroid hormone and calcitonin.

References

1. Textbook of medical physiology: A. C. Gyton, and J. E Hall. Saunders Elsevier Publications, A division of Reed Elsevier India Pvt .Ltd. New Delhi ISBN 81-8147-084-2
2. Human physiology: Chatterjee, Medical Allied Agency.
3. Mammalian biochemistry- White, A. Handler, P .and Smith E.L. (Pub)Mc Graw Hill

4. Review of medical physiology – G. William, F., Mc Graw Hill Karan books publications 0-07-1223356-3.
5. Essential Physiological Biochemistry An organ-based approach. Stephen Reed, Wiley-Blackwell Publishers
6. Principles of Anatomy and Physiology Gerard J Tortora, Bryan Derrickson, (Pub) John Wiley and sons Inc. 978-0-47.
7. Textbook of Biochemistry with clinical correlations. Ed.Thomas M. Devlin. Wiley Publishers.
8. Harper's Biochemistry Ed. R.K. Murray, D.K. Granner, P.A. Mayes & V.W.Rodwell.

BCH5B11 CLINICAL AND NUTRITIONAL BIOCHEMISTRY

Credits: 4: Hours/week:4. Total hours of instruction:72.

Unit I (6h)

Good clinical practices: Basics and principles, Requirements for setting up of a clinical laboratory, SI units in clinical laboratory, collection, preparation, preservation and handling of clinical samples, quality control, Safety measures in clinical laboratory, Familiarization of biochemical charts from clinical labs. Automation in clinical laboratory- sample identification by bar coding-automation in analysis.

Unit II (16 h)

Analysis of Blood: Total and differential blood count, Erythrocyte sedimentation rate (ESR), blood groups and Rh factor incompatibility, packed cell volume. Laboratory tests to measure coagulation and thrombolysis, prothrombin time. Lipid profile determination: significance of HDL (high density lipoprotein)-LDL (low density lipoprotein) ratio. Diagnostic Enzymology, Clinical significance of isoenzymes. Use of lactate dehydrogenase, Serum glutamate pyruvate transaminase, Serum glutamate oxaloacetate transaminase, acid and alkaline phosphatases, amylase, blood glucose, cholesterol, albumin, creatinine, Na⁺, K⁺, Cl⁻ and phosphate etc. in diagnosis and monitoring of disorders. Total protein, albumin, globulin, albumin-globulin ratio.

Unit III (15 h)

Organ function tests: Normal functions of liver, liver function tests, diseases of the liver, disorders of bilirubin metabolism, hepatitis types, cirrhosis, alcoholic liver disease, hepatic tumor and biliary tract diseases. Normal functions of kidney, Renal function tests, Glomerular filtration

rate, Renal threshold and clearance values for urea and creatinine, disorders of kidney, renal failure and proteinuria, renal tubular disorders and renal stones. Thyroid function tests- analysis of T3, T4 and TSH.

Unit IV (5 h)

Analysis of urine, cerebrospinal fluid: Urine and CSF- Normal and abnormal constituents, procedures of qualitative analysis, interpretation and their clinical significance. Chemistry, composition and functions of lymph, asciticfluid, pleuralfluid & synovialfluid.

Unit V (13 h)

Inborn errors of metabolism: Brief introduction of inborn errors of metabolism-Diabetes mellitus: Analysis of fasting, post prandial and random sugar , glycated hemoglobin , significance of glucose tolerance test, hyperinsulinism and hypoglycemia, galactosemia, lactose intolerance, glycogen storage diseases, pentosuria, phenyl ketonuria, alkaptonurea, maple syrup urine, hyperlipidemia, atherosclerosis, sphingolipidosis. Disorders of purine and pyrimidine metabolism.

Unit VI (12 h)

Nutrition: Role of diet in health, Concepts of nutrition, nutrients, balanced diet, Caloric values of foods, basal metabolic rate (BMR), factors affecting BMR, determination of BMR, respiratory quotient, nutritional significance of proteins, fats, carbohydrates, fiber, vitamins, minerals and trace elements. Nutritional profile of principal foods- Cereals, pulses, vegetables, fruits, nuts, oil seeds, animal foods, milk and milk products, egg, fish, meat, drinks and spices. Nutritional requirements- concepts, Energy requirements, recommended Dietary Allowances for men, women, pregnant and lactating women, and children of various ages. nitrogen balance, protein energy malnutrition, glycemic index.

Unit VII (5 h)

Food safety and hygiene- Milk, fish, meat, fruits and vegetables, Food additives- colors, preservatives. Food adulteration, Food spoilage, Food borne diseases, Community nutrition programme, Social aspects of nutrition – problems, ecology, social action.

References

1. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Publishers.

2. Tietz Textbook of Clinical Chemistry. Ed. Burtis & Ashwood W.B.Saunders Company.
3. Preventive and social medicine K. Park
4. Clinical Biochemistry – Metabolic and Clinical aspects. William J. Marshall & Stephen K. Angert.
5. Harper's Biochemistry Ed. R.K. Murray, D.K. Granner, P.A. Mayes& V.W.Rodwell.
6. The Metabolic Basis of Inherited Diseases. John Stanbury.
7. Human Nutrition and Dietetics.Davidson and Passmore. Churchill Livingstone; 8th edition (1986)
8. Principles of Nutrition. M.S.Swaminathan
9. Food and Nutrition. Don Ross, Oxford Book Company, Jaipur

BCH5B12 IMMUNOLOGY

Credits: 3 Total hours: 54 Hours per week: 3

Unit I (7 h)

Overview of the Immune system. Immunity: Innate immunity (Nonspecific) - Anatomic barriers, Physical barriers, Phagocytic barrier, inflammatory responses.

Adaptive (Specific) Immunity- Humoral and cell mediated immune responses, Recognition of antigens by B and T lymphocytes. Processing and presentation of antigens. Major Histocompatibility complex (MHC), Clonal selection of lymphocytes. Cellular interaction for generation of humoral and cell mediated response.

Collaboration of Innate and adaptive mechanisms for an effective immune response.

Unit II (6 h)

Cells of the Immune system- Hematopoiesis, lymphoid cells, stem cells, B and T lymphocytes, Null cells, Mononuclear cells, granulocytic cells. Organs of the Immune system: Primary and secondary lymphoid organs. Thymus, Bone marrow, Spleen.

Unit III (7 h)

Antigens: Types of antigens, factors that influence immunogenicity, adjuvants, epitopes, haptens
Major Histocompatibility Complex: Structure, Peptide interaction with MHC, MHC and immune responsiveness

Antibodies (Immunoglobulins)- Structure of immunoglobulins, Classes of immunoglobulins and their functions. Antigenic determinants on Immunoglobulins.

Monoclonal antibody and its production. Abzymes.

Unit IV (8 h)

Antigen-antibody interactions: Precipitation reaction, Immunodiffusion, agglutination, ELISA, RIA, Immunoprecipitation, Immunofluorescence. Western blotting.

T- cell receptors, maturation, activation and differentiation. B- cell receptors, maturation, activation and proliferation.

Cytokines- structure and function, Classification and types of cytokines according to the function, Cytokine related diseases.

Unit V (10 h)

Complement system: The function of complement, the complement components, complement activation, complement pathways. Complement deficiencies.

Immunodeficiency, Immunodeficiency diseases. Phagocytic, humoral and cell mediated deficiencies.

Hyper-sensitivity- Gell and Coombs classification- IgE mediated Type I hypersensitivity, Antibody- mediated cytotoxic (Type II) hypersensitivity, Immune complex mediated (Type III) Hypersensitivity, TDTH(delayed type hypersensitivity T cells) mediated (Type IV) hypersensitivity. Immune dysfunction. Allergy, asthma.

Autoimmunity, autoantibodies and their devastating role. Autoimmune diseases- Definition. Types of immune diseases like HIV, systemic lupus erythematosus, Multiple sclerosis, Rheumatoid arthritis, scleroderma, Myasthenia gravis, Insulin depended diabetic mellitus.

Unit VI. (6 h)

Vaccines: Active and passive immunization, types of vaccines. Vaccines from whole organisms, Polysaccharide vaccines, Toxoids as vaccines, Vaccines from recombination vectors, DNA as vaccines, Vaccines from Synthetic peptides.

References:

1. Immunology – Thomas J. Kindt, Richard A Goldsby, Barbara A. Osborne, and Janis Kuby
W.H. Freeman and Co

2. Essential Immunology –Peter J Delves , Seamus J. martin, Dennis R Burton, Ivan M. Roitt, Blackwell Publishing, Massachussts, USA ISBN 1-4051-6066-7
3. Cellular and Molecular Biology Abul K Abbas, Andrew a Lichtman, Jprdam S. Pober, WB Saunders company, Philadelphia ISBN)-7216-8233-2
4. Immunology, A Text book, CV Rao Narosa Publishing house New Delhi

BCH6B13 CLASSICAL GENETICS AND MOLECULAR BIOLOGY

Credits: 4 Total hours: 72 Hours per week: 4

Unit I. (10h.)

Mendel's laws of inheritance, gene interaction, Dominance relationship-complete, incomplete and co-dominance, multiple alleles, linkage. Chromosomal aberrations: Monosomy, trisomy. Translocations, inversions, duplications, deletions.

Unit II. (10 h.)

Preliminary study of gene mapping in haploid and diploids, recombination mapping, complementation analysis, physical mapping and restriction mapping, gene transfer in bacterial conjugation, transformation and transduction. Sex determination in Drosophila and humans, pedigree analysis.

Unit III (13h.)

History- DNA as a genetic material Chemical nature of gene, central dogma of molecular biology, Genome organization chromatin organization centromere telomere exons and introns C- value paradox, Prokaryotic transposable elements- IS elements, Composite transposons, Tn-3 elements Modes of transposition (brief study)

UnitIV(15h)

DNA replication in prokaryotes. Chemistry of DNA synthesis, general principles - bidirectional replication, rolling circle model, Semiconservative, RNA priming Enzymes involved in DNA replication – DNA polymerases, DNA ligase, Primase, and other accessory proteins. Mutation and its types. Mutagens- Physical and chemical. Ames test DNA damage and repair (Direct repair DNA photolyases -Mismatch repair,-base excision repair- nucleotide excision repair).

Unit V(8h.)

Transcription in prokaryotes (- promoter sequences- sigma factor-RNA polymerase initiation-elongation and termination) inhibitors of transcription -brief mention about post transcriptional processing.

Unit VI(8h)

Genetic code and wobble hypothesis. Translation in prokaryotes, Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis. Brief mention about the opost translational modifications

Unit VII. (8h.)

Regulation of gene expression in prokaryotes. Operon concept, Lac operon, tryptophan operon.

References

1. Genes : Benjamin Lewin, Pearson education Inc. upper Siddle River NJ.
ISBN 0-13- 123826-4
2. Molecular Biology of gene: Watson Hopkins, Benjamin Cummings
3. Cell and Molecular biology: Gerald Karp, John Wiley & Son Inc. New York
ISBN 0-471-38913-7
4. Lehninger's principles of Biochemistry -: D. L. Nelson and M. M. Cox , Worth Publishers, 41 Madisons Avenue New York, USA ISBN 0-333-94657-X

BCH6B14 RECOMBINANT DNA TECHNOLOGY

Credits: 3 Total hours: 54 Hours per week: 3

Unit I (12 h)

Recombinant DNA Technology: Basic principles of recombinant DNA technology, restriction endonuclease, Cloning vectors: plasmid vectors, phage vectors, cosmids, high capacity cloning vectors- bacterial artificial chromosome (BAC), phage P, vector PACs (P1 artificial chromosomes), Yeast artificial chromosome (YAC) and human artificial chromosomes.

Unit II (8h)

Gene transfer methods: electroporation, lipofection, cloning strategies, cDNA and genomic DNA libraries, cDNA cloning and cloning from genomic DNA.

Unit III (10 h)

Applications of recombinant DNA technology: production of therapeutic proteins, genetically modifies organisms (GMO), safety issues, ethical and social issues in recombinant DNA technology.

Unit IV(12 hrs)

Transgenesis in plant technology: plant tissue culture methods, methods of gene transfer to plants, Agrobacterium mediated transformation. Direct DNA transfer, protoplast transformation, plant virus as vectors. Control of transgene expression in plants, Developing plant species for insect resistance, herbicide resistance, stress and senescence tolerance, modification of production traits (starch oil, vitamin etc). Transgenic plants as bioreactors, vaccine and antibody production.

Unit V(12 h)

Animal cell and tissue cultures, cell lines, stem cell, gene transfer methods in animal cells, transgenic animal- transgenic mice, cattle, sheep. Transgenic and knock out animals as models for human disease.

References

1. Biotechnology: U Sathyanarayana. Books and Allied (p) Ltd.
2. Recombinant DNA: A Short Course. James D. Watson, Gilman Michael, Jan Witkowski, Mark Zoller. Freeman, W. H. & Company.
3. Biotechnology: John E Smith. Cambridge University Press
4. Genetic Engineering: Principles and Practice. Sandhya Mitra. Laxmi Publications.
5. Biotechnology: B D Singh. Kalyani Publishers.
6. Biotechnology: A guide to Genetic Engineering. Pamela Peter. William C Brown Pub.
7. Molecular Biotechnology: S B Primrose. Panima Publishing Corporation.

BCH6B15 MOLECULAR ENDOCRINOLOGY

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Unit I (2h)

Introduction, History, endocrine glands, hormones as chemical messengers,

Unit II (10h)

Classification of hormones (peptides, steroid and other chemical entities as hormones) – General characteristics and mechanism of action – stimulus for hormone release, Regulation of hormone secretion: change in homeostasis , target tissue feedback control , sensory stimulus and others. General characteristics of hormones-general mechanism of action -Role of second messengers in hormonal action (cAMP). Role of calcium in hormone secretion-Types of hormone receptors- Signal transduction- role of plasma membrane receptors (eg: G protein coupled receptors), steroid hormone receptors), Assay of hormones ELISA

Unit III (12h)

Hormones of the hypothalamus and pituitary- chemical nature, secretion, release and their biological functions.

Unit-IV(6h)

Hormones of the thyroid & parathyroid- chemical nature, secretion, function & disorders of thyroid & parathyroid hormones.

Unit-V (8h)

Pancreatic & G.I. Tract hormones – chemical nature & functions of Insulin, Glucagon. Secretion, release, chemical nature & functions of Gastrin, Secretin & Cholecystokinin .

Unit-VII (8h)

Hormones of the Adrenal gland – chemical nature & functions of Adrenal medullary (Catecholamines) & Cortex (glucocorticoids and mineralocorticoids) hormones.

Unit-VIII (8h)

Hormones of the testes and ovaries – chemical nature & functions of Androgens , Estrogens , Progesterone.

References

1. Harper's Review of Biochemistry David. W. Martin Peter. M. Mayes Victor. W. Rodwell 18th edition. Lange Medical Publications
2. Fundamentals of Biochemistry, J.L. Jain, S. Chand publications, 2004.
3. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H.Freeman and company.

4. Fundamentals of Biochemistry, Donald Voet , Judith G. Voet , Charlott W. Pratt , upgrade edition John Willey & Sons. Inc,
5. Biochemistry, LubertStryer , 4th edition, W.H. Freeman & Co, 1995.
6. Mammalian Biochemistry – White Handler Smith.
7. Basic & Clinical Endrocrinology – Francis Sreenspan , Gordon J. Strewler Prentice – HallInternational Inc. 5th ed., 1997

BCH6B16 –Practicals II

Clinical Biochemistry and Enzymology Credits: 3 Total hours: 108 Hours per week: 6

1. Preparation of Blood Serum & Plasma
2. Quantitative estimation in Blood/ Serum:
 - a) Glucose by Nelson – Somogyi Method(or any other method)
 - b) Cholesterol by Zak & Henly’s Method
 - c) Urea by Diacetylmonoxime Method
 - d) Iron by ú ú dipyridyl method
 - e) Total Protein by Biuret Method
 - f) Albumin: Globulin ratio
 - g) Uric acid using Phosphotungstic acid reagent
 - h) Bilirubin by van den Bergh reaction
 - i) Hemoglobin content by Cyanmethaemoglobin method
 - j) Creatinine By Jaffe’s method
 - k) Phosphorus
3. Haematology

ESR, PCV, Total and differential count, Blood Grouping, Hemoglobin
4. Enzyme Assays
 - a) Urease/Trypsin
 - b) Progress curve of Urease /Trypsin
5. Clinical Enzymology
 - a) Assay of serum alkaline phosphatase
 - b) Assay of Serum alanine amino transferase (ALT/SGPT)
 - c) Assay of serum aspartate amino transferase (AST/SGOT)
 - d) Assay of serum Lactate dehydrogenases

References

1. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
2. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
3. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
4. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.

BCH6B17 – Practicals III

Molecular biology, Immunology and Nutritional biochemistry

Credits: 3 Total hours: 108 Hours per week: 6

Molecular Biology:

1. Isolation and estimation of nucleic acids, Electrophoretic separation of nucleic acids,
2. Isolation of plasmid DNA from bacterial culture and separation on agarose gel electrophoresis.
3. 3. Isolation of total RNA from animal tissues and separation of RNA by formaldehyde/ agarose gel electrophoresis.
4. Melting temperature of DNA (T_m analysis).
5. Restriction digestion

Immunology:

1. Antigen-antibody reaction- Ouchterlony method, agglutination
2. ELISA
3. Immunoblotting (Demo)
4. Immunostaining (Demo)
5. Immunofluorescent staining. (Demo)

Nutritional Biochemistry:

1. Titrimetric or colorimetric estimation of Vitamin C in food samples
2. Colorimetric determination of calcium in food samples
3. Colorimetric determination of iron in food samples
4. Colorimetric determination of inorganic phosphorus in food samples
5. Estimation of beta carotene by column chromatography

6. Isolation of proteins from milk.
7. Estimation of cholesterol in egg.
8. Estimation of total reducing sugar in honey /jaggery.
9. Estimation of glycogen from liver.
10. Estimation of pentose in grapes.
11. Estimation of inulin from *Kyllinga* rhizome/onion/dahlia tuber/asparagus stem/chicory roots etc.
12. Extraction and estimation of starch from potato

OPEN COURSES

BCH5D01 ELEMENTARY BIOCHEMISTRY

Credits: 2 Total hours: 36 Hours per week: 2

Unit I (2 h)

Origin, nature and scope of biochemistry and the Molecular basis of life.

Unit II (3h)

Properties and significance of water as a solvent of life, pH, Buffer, Physiological buffer systems

Unit III (15h) Biomolecules

Carbohydrates, classification and functions. Isomerism

Amino acids classification, peptide bond, features of peptide bond, classification and characterization of proteins, functions of protein, enzymes, and classification of enzymes. Protein denaturation, factors affecting the activity of an enzyme.

Micronutrients: Vitamins, classification ,and function --- macro and micro minerals of nutritional and functional significance.

Nucleic acids and their components. Phosphodiester bond, Structure of purine and pyrimidine.

Nucleotide, nucleoside, Brief outline of the DNA double Helix

Lipids, classification, lipids and membranes. Properties of lipids

Unit IV (4h) Organization of the cell.

Cell wall, Plasma membranes, Nucleus, Endoplasmic reticulum, mitochondria, transport processes across membranes.

Unit V (8h)

Introduction to metabolism and the concept of free energy. Energy rich compounds. Coupling of reactions. Glycolysis(outline study), ATP generation

Unit VI (4 h)

Application of biochemistry in fields like medicine (diagnosis and treatment), industry, pharmaceuticals, agriculture, food, health and nutrition, environmental studies, enzyme technology, biotechnology, bioengineering, bioinformatics, toxicology, microbiology, and drug designing.

References

1. Lehninger's Principles of Biochemistry - David L. Nelson and Michael M. Cox Worth W.H. Freeman and Co
2. Text book of Biochemistry JL Jain Schand and Co Ltd New Delhi
3. Biochemistry U. Sathyanarayana Books and allied (P) Ltd
4. Outlines of Biochemistry- Eric E Conn, Paul K Stumpf, George Bruening, Roy H John Wiley and sons New York

BCH5D02 LIFESTYLE DISEASES

Credits: 2 Total hours: 36 Hours per week: 2

Unit I (4h)

General awareness

Basic biochemistry (Biomolecules- carbohydrates, lipids, proteins, nucleic acids, vitamins, minerals – brief outline), Life style, food habits, healthy habits, and unhealthy habits (brief description only).

Unit II (8h)

Atherosclerosis

Characteristics, risk factors (modifiable & unmodifiable), ischemia, myocardial infarction - definition, Diagnosis (electrocardiography , Exercise ECG – Stress test, Echocardiography , Coronary angiography, Intravascular ultrasound, Magnetic resonance imaging), Prevention (lifestyle, diet, drugs), Management (drugs, angioplasty, stent, bypass surgery)

Unit III (2h)

Hypertension

Characteristics, Causes, Diagnosis, Prevention and Management

Unit IV (2h)

Stroke

Characteristics (ischemic and hemorrhagic), Causes, Diagnosis (neurological examination, scanning), Management – (Drugs, Mechanical thrombectomy, Angioplasty and stenting)

Unit V (4h)

Diabetes mellitus

Classification – type 1, type 2, gestational, Type 2 diabetes: Glucose level, GTT, Glycatedhaemoglobin, Characteristics (polyuria, polydypsia, polyphagia), Causes, Diagnosis, Management (diet, exercise, drugs)

Unit VI (3h)

Obesity

Classification according to BMI, symptoms, causes, diagnosis, treatment and management.

Unit VII (5h)

Cancer

Introduction, Types-(benign, malignant), Metastasis (definition), Causes, Diagnosis (screening. blood tests, X-rays, CT scans & endoscopy), Prevention- (Dietary, Medication, Vaccination, Screening-Outline only) Management- (Surgery, Chemotherapy, Radiation, Palliative care).

Unit VII (4h)

Nephritis

Function of kidney, Nephritis, Causes, Symptoms, Diagnosis (Kidney function test, Significance of Glomerular filtration rate (GFR) , Urine creatinine, Blood Urea Nitrogen, Blood creatinine, Creatinine clearance), Treatment, management (dialysis- peritoneal and hemodialysis).

Unit VIII (5h)

Liver disease

Function of liver (brief outline), Liver disease (viral hepatitis, alcoholic liver disease, cirrhosis), symptoms, causes, diagnosis (Liver function test- Brief outline of serum bilirubin, serum albumin, serum alkaline phosphatase, Aspartate amino transferase, alanine amino transferase, lactate dehydrogenase, treatment and management.

References

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders.
- Biochemistry – U. Satyanarayana, U. Chakrapani books and Allied (P) Ltd
- Cell and Molecular Biology by Gerald Karp John Wiley & Sons,

Credits: 2: Hours/week:2. Total hours of instruction: 36h.

Unit I(6h)

Diabetes Mellitus: Hypoglycemia, hyperglycemia, basic understanding of type 1 and type 2 diabetes, symptoms- polyuria, polydipsia, weight loss, polyphagia, blurred vision, susceptibility to infections. glycosurea, fasting blood sugar, postprandial blood sugar, random blood sugar, impaired glucose tolerance, oral glucose tolerance test, glucose challenge test, normal values, role of hemoglobin A1c in diagnosis, diagnosis of diabetic ketoacidosis and retinopathy.

Unit II(6h)

Cardiovascular diseases: causes and symptoms of cardio vascular diseases , diagnostic methods: Blood tests- lipid profile, cholesterol and triglycerides, C reactive protein, creatine kinase, lactate dehydrogenase measuring blood pressure, Electrocardiogram (ECG), Echocardiogram, Coronary Angiography, Cardiac catheterization, Heart biopsy, Cardiac computerized tomography (CT) scan, Cardiac magnetic resonance imaging (MRI).

Unit III(6h)

Liver diseases: Hepatitis-types, fatty liver, alcoholic liver disease, cirrhosis, cholestasis. Diagnosis: liver function tests-serum proteins, serum albumin, serum globulin, A/G Ratio, bilirubin, alanine transaminase, aspartate transaminase, gamma glutamyltransferase, alkaline phosphatase,

Unit IV(6h)

Thyroid disorders: functions of thyroid gland, Hypothyroidism, hyperthyroidism, goiter, Grave's disease, thyroiditis. Thyroid function tests: levels of triiodothyronine(T_3), thyroxine (T_4), free thyroxine estimate (FT_4E), reverse T_3 , thyroid hormone binding ratio, thyroglobulin, antithyroid antibodies. Effects of drugs on thyroid function.

Unit V(6h)

Cancer: definition and classification, Tumor markers- cancer antigen 125, prostate-specific antigen (PSA), calcitonin, alpha-fetoprotein (AFP), human chorionic gonadotropin (HCG). Diagnosis; Complete blood count (CBC), Urine cytology, Blood protein testing, Tumor marker tests, x rays, CT scans, MRI scans, PET scans, biopsy, mammography, endoscopy, genetic testing.

Unit VI(6h)

Neurological disorders: definition and classification, Epilepsy, Parkinson's disease, Amyotrophic lateral sclerosis(ALS), Multiple Sclerosis, Peripheral Neuropathy, Migraines, Huntington's disease, Alzheimer's disease. Diagnosis: genetic testing, neurological examination, X-rays, Fluoroscopy, Angiography, Biopsy, Brain scans, Cerebrospinal fluid analysis, Electroencephalography, Magnetic resonance imaging (MRI), Ultrasound imaging.

References

1. Textbook of Medical Physiology. Arthur c. Guyton W.B Saunders Co
2. Tietz Textbook of Clinical Chemistry. Ed. Burtis & Ashwood W.B.Saunders Company.
3. Preventive and social medicine K. Park Banarsidas Bhanot Publishers
4. Clinical Biochemistry – Metabolic and Clinical aspects. William J. Marshall & Stephen K. Angert.
5. Neurodegenerative Disorders A Clinical Guide. Ed. Orla Hardiman & Colin P. Doherty. Springer, New York.

SYLLABUS FOR BIOCHEMISTRY AS A COMPLEMENTARY SUBJECT FOR B.Sc. COURSE

Total credits for the complementary courses 12

Total marks for the complementary course 400

The evaluation scheme for each course (complimentary) shall contain two parts

(1) Internal evaluation (2) External evaluation

20% marks shall be given to the internal evaluation. The remaining 80% of marks shall be for the external evaluation.

Components of and marks for the internal evaluation of theory courses are given below

Attendance 5%

Test paper 10%

Seminar/viva/assignment 5%

Scheme for practical examinations

Maximum marks for external evaluation 20

Maximum marks for internal evaluation 5

Total marks for the practical examination 25

Components and of marks for the internal evaluation of practical courses are given below

Attendance 5%

Records 10%

Lab involvement 5%

For practical examination the question paper will have the following components

- Writing the Procedure

- Qualitative analysis
- Quantitative estimation

For each practical examination the laboratory record has to be compulsorily submitted.

Scheme for the evaluation of practical examination

Marks may be assigned for various components as follows:

For Qualitative Analysis:

- Result & Conclusion
- Confirmatory test 1
- Confirmatory test 2
- Neatly written scheme of experiments used for arriving at the final conclusion

For Quantitative Experiments

- Result of the reported value (minimum error)
- Calculation, presentation of the result (Graph)
- Procedure
- Skill

BCH1C01. BIOCHEMISTRY-I

Credit: 3 Total hours of instruction: 54. Hours/week: 3.

Unit I. (5h) Introduction and Applications of biochemistry.

Nature and Scope of Biochemistry. The roots of Biochemistry in the field of medicine, nutrition, agriculture, fermentation and natural products.

Unit 11. (12h)

Fundamentals of the following: Law of mass action- the equilibrium constant, electrolytes and non-electrolytes. Bronsted's definition of acids and bases. Definitions of normality, molarity, molality, acidity and titrable acidity of solutions.

Dissociation of water. Concept of pH and pOH. Simple numerical problems involving determination of H⁺, OH⁻, pH and pOH. Elementary study of methods to determine the pH (a) theoretical calculations, (b) using indicators, (c) using pH meter.

Dissociation of weak acids- Henderson - Hasselbalch equation, simple numerical problems involving application of this equation. Shapes of titration curves of strong and weak acids and bases.

Meaning of K_a and pK_a values. Buffers and buffer actions. Simple numerical problems on buffer composition.

Unit III.(12h)

Fundamental principles of diffusion and osmosis. Definition of osmotic pressure- relationship of osmotic pressure to gas laws. The general equation for dilute solutions ($p=g/mRT$). Problems involving the general equation- influence of ionization and molecular size on osmotic pressure.

Fundamental study of Donnan equilibrium and dialysis. Meaning of colloidal solutions and coarse suspensions, crystalloids and colloids. Elementary study of charge on colloids and Tyndall effect. Lyophilic and lyophobic colloids. Emulsions and emulsifying agents.

Unit IV.(5h) Classification of isomerism with examples. Basic ideas about hydrogen bonds and weak interactions. An example for the following type of reactions – oxidation, reduction, substitution, addition, elimination, condensation and decarboxylation.

Unit VII. (15h.) Blood and other body fluids

Blood – functions, plasma proteins. Special proteins in blood. Acid base balance and maintenance of pH of blood – biochemistry of blood clotting. Brief account of the function and composition of lymph, interstitial fluid, cerebrospinal fluid, synovial fluid, bile, seminal fluid, saliva, gastric juice, tears, milk, urine, sweat and feces.

Unit VIII.(10h.)Modern techniques in Biochemistry

Principles and applications of: (a) chromatography (paper, thin layer, gas, HPLC, gel filtration), (b) electrophoresis (paper, PAGE, immunoelectrophoresis), (c) absorption photometry (colorimetry and spectrophotometry), (d) centrifugation, (e) radioimmunoassay.

BCH2C02. BIOCHEMISTRY- II

Total hours of instruction: 54. Hours/week: 3. Credit: 3

Unit I. (20h.)Carbohydrates

Isomerism of carbohydrates, relationship- D and L forms of glyceraldehyde – examples of epimers, mutarotation and its explanation by ring structures, anomers, structure (linear and cyclic structures of glucose, galactose, mannose and fructose). Reducing actions. Sugar derivatives. Structure of methyl β - D glucopyranose, 2- deoxy β - D ribofuranose.

Structure of the following disaccharides (Haworth perspective formulas- maltose, isomaltose, sucrose, lactose trehalose and cellobiose (elucidation of the structures of mono, di, and polysaccharides are not included). Structure and important properties of the following polysaccharides– amylose, amylopectin, glycogen, cellulose and chitin. Heteropolysaccharides, functions.

Unit II. (10h.) Lipids

Basic ideas about physiological functions of lipids. Fatty acids – classification, essential and non-essential fatty acids, structure of the following fatty acids – stearic acid, oleic acid, linoleic acid. Structure of triacylglycerol. Saponification.

Structure of phosphatidic acid, lecithin, cephalin, and phosphatidyl serine.Sphingo lipids.Definition of saponification number, acid number and iodine number of fats. Chemical structure and functions of cholesterol and ergosterol.

Unit III. (12h.)Amino acids and Proteins

Basic ideas about physiological functions of proteins – Name (with abbreviation) and structures of the 20 important amino acids occurring in proteins. General chemical reactions of amino acids. Representation of alanine, in the zwitter ionic form. Elementary study of primary, secondary, tertiary and quaternary structure of protein. The general methods of proteolysis. Identification and estimation of amino acids. Sequencing of proteins (only basic principles of the methods employe(d). Denaturation of proteins, precipitation reactions and colour reactions of protein.

Unit IV .(12h.)Nucleic acids

Classification of nucleic acids. Chemical structure of adenine, guanine, cytosine, uracil and thymine. Structure of adenosine, AMP and ATP. Different types of RNAs .Structure of RNA- primary and secondary structures. Structure of DNA – regularities in base compositions. Watson and Crick model of DNA.

BCH3C03 BIOCHEMISTRY III

Credit: 3 Hours of instruction: 54. Hours/week: 3.

Unit I. (22h.)Enzymes

History of Enzymology. Classification of enzymes; six major classes of enzymes with one example each. Apo enzyme, coenzyme, holoenzyme with examples. Elementary study of the following factors affecting velocity of enzyme-catalysed reactions – effect of substrate concentration, enzyme concentration, temperature and pH; Michaelis Menten equation (without derivation), K_m and its significance The Lineweaver- Burk plot.

Definition of enzyme specificity – an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes from the pathways to be studied this year.

Explanation of competitive and non competitive type of inhibition, their destination on the basis of double reciprocal plot, brief study of allosteric inhibition with an example. Brief study of the activation of zymogen form of enzymes. Brief study of allosteric activation with example. Industrial applications of enzymes (preliminary study).

Unit II. (16h.) Anaerobic Metabolism of Carbohydrates

Introduction to metabolism. Digestion of carbohydrates and absorption. Reactions of glycolytic sequences with the names of enzymes and intermediates (without structures). Fate of pyruvate in alcoholic fermentation. Outline study of glycogenesis and glycogenolysis. Role of cyclic AMP and hormones in glycogen metabolism. Gluconeogenesis and pentose phosphate pathway (only outlines without structures of intermediates).

Unit III.(12h.)Aerobic Oxidation of Carbohydrates

Decarboxylation of pyruvate – reactions of citric acid cycle (without structures of intermediates) only outline expected. Calculation of energy yield (as ATP) of aerobic and anaerobic oxidation of carbohydrates. The mitochondria – arrangement of electron carriers in the electron transport chain. Substrate level phosphorylation – site of ATP formation in the chain (Mechanism of ATP formation not expected). High energy compounds with an examples. Phosphate potential, principle of reversible reaction.

Unit IV. (6h.) Photosynthesis

Outline of cyclic and non cyclic photophosphorylation- outline study (without structures) of the path of carbon in the dark reaction (Calvin cycle), glyoxylate cycle, significance.

BCH4C04 BIOCHEMISTRY IV

Credit: 2 Total hours of instruction:36. Hours/week: 2.

Unit I. (10h.)Metabolism of Lipids

Outline study of lipid digestion and absorption. Outline study of β -oxidation scheme (without structures). ATP yield in β -oxidation – outline study (without structures) of the cytoplasmic systems of fatty acid biosynthesis. Physiological functions of phospholipids. Outline study of cholesterol synthesis without structure.

Unit II (10h.)Metabolism of Amino acids and Proteins

Proteolytic enzymes of the gastrointestinal tract and their activation (from zymogen forms). Classification of proteins based on catabolism. Absorption of amino acids from the intestine – an example each indicating decarboxylation, deamination and transamination of aminoacids (without molecular mechanisms).Urea cycle. Metabolism of glycine, phenylalanine, tyrosine, ammonia.

Unit IV (7h.)Vitamins

Classification, source, chemical nature and deficiency disorders of vitamins. Basic physiological functions of vitamin C, B1, B2, pyridoxine and niacinamide (chemical structures not expected). One biochemical reactions involving TPP, FMN, FAD, NAD⁺, NADP⁺, PLP, CoA and biotin from metabolic sequences. Fat soluble vitamins A, D, E ,K. Physiological functions daily requirements, etc.

Unit V (5h) Hormones

Classification, mechanism of action (preliminary study), site of biosynthesis, important physiological functions of thyroxine, insulin, glucagon, epinephrine, glucocorticoids and growth hormones.

Unit VI: (4h.)

Mineral Metabolism (macro and trace minerals) Sodium, potassium, iron, copper, iodine, fluorine, selenium – biological role and nutritional importance.

References

1. E.S. West, W.R. Todd, H.S. Mason and J.T. Van Bruggen. Text book of Biochemistry. Pub. The Macmillan Company, Collier-Macmillan Ltd., London
2. Medical Biochemistry : Ramakrishnan Text Book of Biochemistry : D.M. Vasudevan
3. Text Book of Biochemistry: A.C. Deb New central Book agency (P) Ltd
4. Plant Metabolism: H.D. Kumar and H.N. Singh Pub. Affiliated East-West Press Pvt. Ltd. New Delhi
5. Principles of Biochemistry: Worth Publishers A.L. Lehninger, D.L. Nelson and M.M. Cox.

BCH1C05 BIOCHEMISTRY PRACTICALS

Credits: 1 Total hours: 36 Hours per week: 2

1. Preparation of solutions

(i) Percentage solutions, (ii) molar solutions, (iii) normal solutions

Standardization of pH meter, preparation of buffer, principles of colorimetry and

Verification of Beer-Lambert law.

2. Qualitative analysis:

Carbohydrates- general reactions of carbohydrates (mono, di and polysaccharides) Molisch test, anthrone reaction, phenol -sulphuric acid reaction. Specific reactions of reducing sugars – Benedict's test, Fehling's test, picric acid test, ferricyanide test. Scheme for analysis of biochemical solution containing a single component; carbohydrate(starch, reducing sugar, ketose), protein (Biuret test, ninhydrin, solubility pattern, xanthoproteic test, millons test, glyoxylic acid test, nitroprusside test, precipitation by heavy metal ions and alkaloidal reagents)

3. Quantitative analysis

- a) Glucose estimation by Benedict's method, anthrone or arsenomolybdate methods
- b) Amino acid estimation by Ninhydrin method
- c) Protein estimation by Biuret method. Or Protein estimation by Lowry *et al.* method.
- d) Cholesterol estimation by Zak's method.
- e) DNA estimation by diphenylamine method & RNA estimation by orcinol method

4. Demonstration experiments:

- a) Demonstration of paper chromatography and TLC.
- b) Digestion of starch by salivary amylase.

References:

1. Introduction to Practical Biochemistry Plummer Mu, David T. Plummer. Tata McGraw Hill Publishing Company
2. The Tools of Biochemistry : Cooper, T.G. . John Wiley & Sons, New York.
3. Principles of physical Biochemistry: K.E. Van Holde, Kensal, Pearson Education Inc

Model Question Papers

BCH1B01 INTRODUCTION AND PHYSICAL ASPECTS OF BIOCHEMISTRY

Time: Three hours

Maximum Marks 80

Section -A

Answer all questions. Each question carries 1 mark (16x 1= 16marks)

1. Atoms with the same atomic number and different mass numbers are called
2. The type of hydrogen bond in water is:
(a) Intermolecular (b) intramolecular (c) both of these (d) none of these
3. One litre of a normal solution of NaOH contains _____ grams of NaOH
4. The term pH is defined by the expression.....
5. is a substance that increases the rate of a reaction.
6. Buffers are the mixtures of
7. The first law of thermodynamics deals with:
(a) Energy (b) entropy (c) enthalpy (d) all the three
8. Which of the following is negatively charged?
(a) α - particles (b) β - particles (c) γ - rays (d) ω -rays
9. The size of a colloidal particle ranges from:
(a) 10 Ao - 2000 Ao (b) 10 nm - 2000 nm
(c) 10 pm -2000pm (d) 10 μ - 2000 μ
10. Importance of Henderson –Hasselbalch equation is in:
(a) pH (b) preparation of buffer (c) ionic strength (d) all the three
11. Acid is a proton donor and base is a proton acceptor according to
(a) Bronsted-Lowry theory (b) Arrhenius theory
(c) Lewis concept (d) none of the three
12. One litre of a normal solution of NaOH containsgrams NaOH:
(a) 40 (b) 400 (c) 4 (d) 0.4
13. is an optical property of colloidal systems
14. Of the following is a natural emulsion
(a) starch solution in water (b) alloys (c) shaving foam (d) milk
15. The H⁺ concentration in a solution having pH 10 is:
(a) 10¹⁰ mols/l (b) 10⁻¹⁰ mols/l (c) 10 moles/l (d) 10⁻⁴ mols/l
16. discovered natural radioactivity.

Section-B

Answer any eight questions each question carries 3 marks (8x3 =24 marks)

17. What is meant by natural radioactivity?
18. State the Law of Mass action
19. What is zeta potential?
20. What is osmosis?
21. State Bronsted theory of acids and bases
22. What is a buffer?
23. What is autocatalysis?
24. Write a short note on radioactive disposal.
25. What do you mean by buffer capacity?
26. Define the terms free energy and enthalpy

Section- C

Answer any four questions. Each question carries 4 marks (4x5 = 20 marks)

27. Explain the applications of Donnan membrane equilibrium in biological systems.
28. Explain the different types of isomerisms
29. Distinguish between lyophilic and lyophobic sols.
30. Explain the titration curve of a weak acid with strong base.
31. Explain the mechanism of osmosis.
32. Derive the Henderson-Hasselbalch equation.

Section- D

Answer any two questions each question carries 10 marks (2x 10 = 20 Marks)

33. Explain the determination of pH by different methods
34. Explain the application of radioactive isotopes as tracers in biological studies.
35. (a) Calculate the pH of a 0.2N acetic acid. (K_a of acetic acid is 1.8×10^{-5})
(b) Calculate the osmotic pressure of a 205 solution of sucrose at 27°C
(Gas constant, R is: 0.0821 litre atm. $K^{-1}mol^{-1}$)

BCH2B02 CELLULAR BIOCHEMISTRY

Time: Three hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries one mark. (16x1=16 Marks)

1. The site of dark reaction during photosynthesis is
(a) Chloroplast (b) Stroma (c) Grana (d) Thylakoids
2. Name the protein synthesizing machinery in the cell
3. Energy dependant transport of molecules across membranes is called as
4. Cell drinking is otherwise known as
5. Name the triplet alpha helical structure percent in ECM

6. DNA synthesis take place during phase of cell cycle
7. Fluid mosaic model of plasma membrane was proposed by
8. Name the protein which is abundant in microtubules

9. The site of of rRNA synthesis is
(a) Nucleoplasm (b) Nucleolus (c) Cytosol (d) Mitochondria

10. The DNA containing region with in the cytoplasm in the cytoplasm in prokaryotic cell is
(a) Nucleus (b) Nucleoplasm (c) Nucliod (d) Mitochondria

11. Uncontrolled growth of a cell leads to

12. The cancer cell which grows into a multicellular mass is called.....

13. Programmed cell death is
(a) Apoptosis (b) Necrosis (c) Cell death (d) Cell digestion

14. Glucose transporter is an example for
(a) Active transport (b) facilitated diffusion (c) Diffusion (d) Osmosis

15. The organelle which is associated with programmed cell death
(a) Mitochondria (b) Peroxisomes (c) Ribosome (d) Lysosomes

16. The subunit composition of Eukaryotic Ribosome
(a) 40S&50S (b) 40S&60S (c)50S&30S (d) 30S&60S

Section B

Answer any eight questions. Each question carries 3 marks (8x3=24Marks)

17. Write a note on Glyoxysomes?
18. Differentiate symport and antiport?
19. Name any two marker enzymes of lysosome?
20. What are ion channels?
21. Write a note on gap junction?
22. Differentiate between benign and malignant tumors?
23. Define apoptosis?
24. Define simple diffusion?
25. What are desmosomes
26. Differentiate between benign and malignant tumors.

Section C

Answer any four questions. Each question carries 5 marks (4x5= 20 Marks)

27. Differentiate between prokaryotic and Eukaryotic cells?
28. Write a note on mitochondrial and intermediate filaments?
29. Write a note on facilitated diffusion?
30. Explain different components of ECM?
31. Differentiate cancer cells from normal cells?
32. Explain fluid mosaic model of plasma membrane?

Section C

Answer any two questions. Each question carries 10 marks (2x 10=20 Marks)

33. Explain the mitotic division in detail.
34. a) Explain the plasma membrane structure in detail.
b) Write a short note on proteoglycans
35. Explain the major sub cellular organelles of eukaryotic cell?

BCH3B03 TECHNIQUES IN BIOCHEMISTRY

Time: Three hours

Maximum Marks 80

Section -A

Answer all questions. Each question carries 1 mark (16x 1= 16marks)

1. The major factor which determines the mobility of molecules in electrophoresis is
2. Cross linking agent in PAGE is:
(a) Ammonium persulfate (b) TEMED (c) Bis-acrylamide (d) acrylamide
3. Wall effect is observed in centrifugation when the rotor is of type
4. In isoelectric electric focusing the anode is
5. Column chromatography can work on the principle of
(a) Partition (b) Adsorption (c) Ion exchange (d) All these
6. Rf value of a compound will always be:
(a) Less than one (b) greater than one (c) equal to one (d) zero
7. In gel chromatography the spaces between gel beads represents:volume
8. The commonest adsorbent used in thin layer chromatography is.....
9. In ultracentrifuges the rotors are made up ofalloys:
(a). titanium (b) steel (c) Iron (d) copper
10. Colorimeter works on the principle of:
(a) Beer-Lambert law (b) Beer's law (c) Lambert's law (d) Snell's law
11. Carboxymethyl cellulose is aexchanger
12. In gel chromatographic procedure of the following proteins having 15Kd, 43Kd, 65Kd 100KD which one will be eluted first.
(a) 15KD (b). 43KD (c) 65KD (d) 100KD
13. Purpose of guard column in HPLC is
(a) Separation of components (b) removal of impurities

(c) Concentrating sample (d) Dilution of sample

14. Protein subunit studies can be done by

(a) Native PAGE (b) ion exchange (c) Isoelectric focusing (d) SDS- PAGE

15. Lyophilization is based on the principle of

16.....salt is most commonly used in the salting out of proteins

Section-B

Answer any eight questions each question carries 3 marks (8x3 =24 marks)

17. What are the factors which influence the electrophoretic mobility of a molecule?

18. Define Beer - Lambert Law

19. Write the principle of dialysis

20. What are the different methods used for tissue homogenization?

21. Name four radioactive isotopes used as tracers in biological studies

22. What are the precautionary measures adopted while handling radioisotopes?.

23. What is isoelectric pH.

24. Give two examples of anion and cation exchange resins.

25. Name two ligands used in affinity chromatography,

26. Write a short note on choice of buffer while doing ion exchange chromatography

Section- C

Answer any four questions. Each question carries 4 marks (4x5 = 20 marks)

27. Give a brief account of the steps involved in column chromatographic separation.

28. Describe the principle and application of affinity chromatography.

29. Describe the principle and application of radio immunoassay.

30. Explain the principle and instrumentation of atomic absorption chromatography.

31. Give a short notes on different detectors used in GLC

32. What are the applications of HPLC.

Section D

Answer any two questions. Each question carries 10 marks (2x 10=20 Marks)

33. Explain the principle, procedure and application of PAGE

34. What are the different types of centrifuges? What are the major applications in biology

35. Describe the principle of gel chromatography. Explain how the molecular weight of a protein is determined by gel chromatography?

BCH3B04: ENZYMOLOGY

Time: 3 hours

Maximum Marks: 80

Section-A

Answer all the 16 questions. Each question carries 1 mark (16x1=16 marks)

1. Ribozymes are by nature:
(a) heteropolysaccharides (b) ribosomal proteins
(c) lipoproteins (d) ribonucleic acids
2. Coenzyme involved in carboxylation reaction is:
(a) Thiamine pyrophosphate (b) pyridoxal phosphate (c) Biotin (d) NADP
3. An activator for salivary amylase is:
(a) Mg^{2+} (b) Mn^{2+} (c) Zn^{2+} (d) Cl^-
4. In noncompetitive enzyme inhibition:
(a) K_m decreases; V_{max} increases (b) K_m remains unchanged; V_{max} decrease
(c) K_m and V_{max} decreases (d) K_m decrease; V_{max} remains unchanged
5. Which among these is a competitive inhibitor of succinate dehydrogenase:
(a) Maleic acid (b) Malonic acid (c) Mevalonic acid (d) Mandelic acid.
6. Retenone is an inhibitor of the enzyme.....
7. The 'lock and key' model of enzyme action was proposed by
8. Apoenzyme is the..... part of an enzyme is.
9. The catalytic activity of enolase is inhibited by.....
10. Monoclonal antibodies that catalyze the hydrolysis of ester or carbonates are.....
11. The class of enzyme that removes group from substrates or break bonds by mechanism other than hydrolysis are classified under
12. Who proposed the 'induced fit hypothesis'
13. Which type of enzymes comes under the major class 6 in the classification?
14. Name a graphical method for the determination of K_m value.
15. Which inorganic salt is most commonly used in enzyme purification steps?
16. What is the coenzyme involved in 'acyl' group transfers?

Section- B

Answer any 8 questions. Each question carries 3 marks (8x3=24 marks)

17. What are zymogens? Give an example
18. Define energy of activation and diagrammatically represent.
19. Significance and definition of international unit (IU) of enzyme?
20. What do you understand by 'optimum pH' of an enzyme?
21. Name four uses of immobilized enzymes.
22. What is the significance of K_M value of an enzyme?
23. What is 'turn over number' (K_{cat}) of enzymes. Name two enzymes with high K_{cat} .
24. Define specific activity and its significance in enzyme isolation.
25. What is binding energy 'in enzyme catalysis'?
26. Write down the structure of biotin

Section C

Answer any 4 questions. Each question carries 5 marks (4x5=20)

27. Give a brief account of the various factors which influence the initial velocity of enzyme reaction during *in vitro* measurement of activity.
28. Derive the Michaelis-Menten equation for a single substrate reaction and discuss the importance of the equation.
29. What is 'induced fit hypothesis'? What is its relevance in enzyme studies?
30. Allosteric regulation of enzymes is of great metabolic significance. Substantiate the statement.
31. What is 'ELISA'? What are its uses and applications?
32. Enumerate the different methods of enzyme immobilization. What are the uses of immobilized enzymes?

Section- D

Answer any 2 questions. Each question carries 10 marks (2x10=20)

33. Give a detailed account of the IUPAC classification and nomenclature of enzymes.
34. Starting from a fresh sample of muscle tissue, describe the major steps you would adopt for the extraction and isolation of an enzyme. How will you evaluate the degree of purity of the isolated enzyme?
35. Describe describecompetitive , uncompetitive and noncompetitive inhibitions

BCH4B05 BIOMOLECULES AND BIOINFORMATICS

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16x1=16 marks)

- 1.. The 2nd epimer of D glucose is:
(a) D Ribose (b) D galactose (c)D mannose (d) D fructose
2. D Ribulose is----- isomer of D xylulose?
3. D Fructose is ----- isomer of D glucose?
4. The glycosidic linkage in sucrose is.
(a) α 1-2 (b) β 1-2 (c) α 1-4 (d) α 1-3
5. Lactose is composed of D Glucose and:
(a) β -D galactose (b) D –galactose (c)Fructose (d) ribose
6. Cellobiose is a partial hydrolytic product of.
(a) Cellobiose (b) starch (c) glycogen (d) chitin

7. Heparin is a----- polysaccharide?
8. Sugar present in DNA is.
(a) β D ribose (b) β D deoxy ribose (c) 2 β D deoxy ribofuranose (d) deoxy ribose
9. Linoleic acid is ----- fatty acid.
10. Cholesterol is ----- type of lipid
11. Vitamin D is formed from
(a) Cholesterol (b) Lanosterol (c) fatty acid (d) ergosterol.
12. Gaps inserted into the alignment are called
(a) Indels (b) Gaps (c) Dots. (d) Holes
13. Which one is a 3D structure database?
(a) PDB (b) Swiss-prot (c) Genbank (d) DDBJ
14. The first bioinformatics database was created by
(a) Richard Durbin (b) Dayhoff (c) Michael. J.Dunn (d) Pearson
15. How many double bonds are there between carbon atoms in a saturated fatty acid?
(a) 0 (b) 1. (c) 2 (d) More than 2
16. The hydrolysis of which of the following substances will produce the greatest number of glucose molecules?
(a) Maltose. (b) Sucrose. (c) A disaccharide (d) A polysaccharide.

Section B

Answer any 8 questions. Each question carries 3marks (8×3=24)

17. What are epimers?.
18. Write the structure of 4'' epimer of D glucose?
19. Differentiate D and L form?
20. What do you mean by invert sugar?
21. What are essential fatty acids?
22. Write the structure of cholesterol?
23. Write the structure of AMP?
24. What are unusual bases?
25. What do you mean by global alignment?
26. What is a secondary database?

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

27. Write the structure of sucrose and maltose?
28. Differentiate starch and Cellulose?
29. Write down the classification of lipids?
30. Explain the structure of tRNA?

31. Write note on denaturation of protein?
32. Write notes on scoring matrices

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20)

33. Explain structure of proteins?
34. Describe Watson and Crick model of DNA?
35. Write down the reactions of amino acids?

BCH5B07 INTERMEDIARY METABOLISM I

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16marks)

1. Mitochondrial ATP synthesis requires
 - a. [H⁺] gradient.
 - b. A membrane potential
 - c. An intact inner mitochondrial membrane.
 - d. All the three

2. During glycolysis the following reaction requires NAD⁺:
 - a. Alcohol dehydrogenase
 - b. Glyceraldehyde-3-phosphate dehydrogenase
 - c. Lactate dehydrogenase
 - d. Pyruvate dehydrogenase

3. The synthesis of glucose from lactate, glycerol, or amino acids is called:
 - a. Glycogenolysis
 - b. Glycolysis
 - c. Lipolysis
 - d. Gluconeogenesis

4. Anaerobic metabolism refers to the generation of ATP:
 - a. without the involvement of ADP
 - b. without the use of glycogen
 - c. without the use of oxygen
 - d. in the absence of available oxygen

5. In the electron transport final acceptor of electron is

- a. Cytochrome b
 - b. Cytochrome a
 - c. Oxygen
 - d. CoQ
6. Fructose 1 phosphate is split into glyceraldehydes and dihydroxy acetone phosphate by the enzyme
- a. Enolase
 - b. Aldolase
 - c. Dihydroxylase
 - d. Phospho fructokinase
7. ATP contains
- a. Low energy phosphate bond
 - b. High energy phosphate bonds
 - c. Phosphate bond
 - d. Low barrier high energy bonds
8. The synthesis of glucose from lactate, glycerol, or amino acids is called:
- a. Glycogenolysis
 - b. Glycolysis
 - c. Lipolysis
 - d. Gluconeogenesis
9. The components of electron transport chain are arranged in the following order of redox potential
- a. Increasing
 - b. Decreasing
 - c. Random
 - d. Alternatively increasing and decreasing
10. The site in the cell at which cellular respiration occurs is the _____.
- a. Golgi complex
 - b. ribosome
 - c. nucleus
 - d. mitochondria
11. The conversion of one molecule of glucose to two molecules of pyruvate results in the net formation of:
- a. two molecules of ATP
 - b. three molecules of ATP
 - c. thirty-eight molecules of ATP
 - d. six molecules of water
12. Embedded in the inner membrane of the mitochondrion are:
- a. the enzymes of the tricarboxylic acid cycle (Krebs' cycle)
 - b. the components of the electron transport chain
 - c. glycogen molecules

- d. triacylglycerol molecules
13. The number of high energy bonds in ATP is-----
14. The net production of ATP via substrate-level phosphorylation in glycolysis is:
- 2 from glucose
 - 4 from glucose
 - 3 from glucose
 - 38 from glucose
15. Liver glycogen breakdown is stimulated by:
- insulin
 - glucagon
 - adrenaline
 - both glucagon and adrenalin
16. Name the enzyme which catalyses the following reaction
 Phospho enol Pyruvate—————> Pyruvate

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

- What is the relationship between epinephrine and 3'-5' cyclic AMP
- Name two glycogen storage diseases
- What are uncouplers?
- What are high energy compounds?
- Define anabolism and catabolism
- Define P: O ratio
- Name two inhibitors of electron transport chain and state their site of action
- What is the cause of the lactose intolerance?
- Describe the reaction catalyzed by fructose 1 phosphate
- Briefly describe chemiosmotic hypothesis

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20marks)

- What is the importance of pentose phosphate pathway?
- Describe the glyoxylate cycle
- Draw the structure of mitochondria.
- Describe Cori cycle
- Describe glycogen synthesis
- Write notes on various approaches to study metabolism

Section D

Answer any two questions (2×10= 20 marks)

39. Describe the reactions of glycolysis and mark the irreversible steps in glycolysis
 40. Describe the arrangements of complexes in the electron transport chain and mark the sites of ATP formation in the chain
 41. Describe the citric acid cycle

BCH5B08 INTERMEDIARY METABOLISM II

Time: Three Hours

Maximum Marks 80

Section A

Answer all questions. Each question carries one mark (16x1=16 Marks)

1. Carnitine is
 (a) β -hydroxy- γ trimethylammoniumbutyrate (b) ∞ -hydroxy μ trimethylammoniumbutyrate (c) μ -hydroxy- ∞ trimethylammoniumbutyrate (d) γ -hydroxy- β -trimethylammoniumbutyrate
2. Which of the following is not a ketone body?
 (a) acetone (b) acetoacetate (c) acetic acid (d) β -hydroxybutyrate
3. Which amino acid is not involved in purine biosynthesis?
 (a) glycine (b) aspartate (c) serine (d) glutamine
4. In humans, the end product of purine metabolism is
 (a) Alanine (b) Allantoin (c) Uric acid (d) Lipoic acid
5. The coenzyme involved in transamination reaction a)TPP b)PLP c)FMN d)FADH₂
6. Urea is synthesized in (a) Spleen (b) Kidney (c) Nephron (d) Liver
7. Which of the following is not a multienzyme complex?
 (a) Fatty acid synthase (b) \square - ketoglutarate dehydrogenase
 (c) Pyruvate dehydrogenase (d) isocitrate dehydrogenase
8. Which of the following aminoacid is both ketogenic and glucogenic?
 (a) Alanine (b) histidine (c) cysteine (d) phenylalanine
9. The key cholesterol precursor is
 (a) Succinyl CoA (b) HMG CoA (c) Propionyl CoA (d) Acyl CoA
10. Urea cycle takes place in
 (a) Liver mitochondria (b) liver cytosol (c) both of these (d) none of these
11. Carbamyl phosphate synthase II is involved in
 (a) Pyrimidine biosynthesis (b) purine biosynthesis (c) urea cycle (d) lipid biosynthesis
12. Uricotelic organisms are (a)Birds (b) Man (c) Fishes (d) None of these

13. The amino acid that does not participate in transamination is (a) Lysine (b) Glutamate (c) Isoleucine (d) Tryptophan
14. The end product of purine metabolism in humans is -----
15. Synthesis of purine is regulated by the intracellular concentration of -----
16. Net yield of oxidation of one molecule of palmitate is ----- ATP.

Section B

Answer any eight questions each question carries 3 marks (8x3=24 Marks)

17. What is transamination? Give 2 examples.
18. How is AMP synthesized from IMP?
19. Which are the enzymes constituting fatty acid synthase complex?
20. Draw the structure of cholesterol. Mention the significance of cholesterol.
21. What are the enzymes and reactions involved in the Salvage pathway?
22. What are the enzymes and compounds involved in the transport of long chain fatty acid from cytosol to mitochondria for β -oxidation?
23. Write the rate limiting step in the biosynthesis of cholesterol.
24. Define protein turnover.
25. What do you mean by 'Salvage Pathway' of purine synthesis?
26. What are transaminases?

Section C

Answer any four questions each question carries 5 marks (4x5=20 Marks)

27. Write a note on β -oxidation of fatty acids.
28. Write a short note on ketogenesis
29. Give an account on urea cycle.
30. Enumerate UMP synthesis.
31. Write a short note on fatty acid elongation.
32. Describe how fatty acids in cytosol is transported to mitochondria for β -oxidation

Section D

Answer any two questions each question carries 10 marks (2x 10 = 20 marks)

33. Describe the biosynthesis and degradation of phenylalanine
34. Describe the *denovo* synthesis of purines
35. Write a note on biosynthesis of fatty acids.

BCH5B09: PLANT BIOCHEMISTRY

Time: 3 hours

Maximum Marks: 80

Section-A

Answer all the 16 questions. Each question carries 1 mark (16x1=16 marks)

1. The major site of ATP synthesis within the cell is in :
(a) Mitochondria (b) Nucleus (c) Cytoplasm (d) Lysosomes
2. Nitrogenase is protected in heterocysts because it is sensitive to:
(a) light (b) CO₂ (c) N₂ (d) O₂
3. The organelle which is associated with programmed cell death :
(a) Mitochondria (b) Peroxisomes (c) Ribosome (d) Lysosomes
4. The site of dark reaction during photosynthesis is:
(a) endoplasmic reticulum (b) stroma (c) grana (d) thylakoids
5. Secondary metabolites in plants are mostly sequestered in :
(a) lysosomes (b) chloroplasts (c) golgi bodies (d) vacuoles.
6. Zeitgebers are signals involved in
7. Tropical legumes export nitrogen components as.....
8. Fluid mosaic model of plasma membrane was proposed by
9. Protein which is abundant in microtubule is
10. Malate synthase is associated withmetabolic pathway
11. Fluidity of the cell membrane is controlled by.....
12. How many carbon atoms are present in an isoprene unit?
13. Calvin cycle is also known as.....
14. Chloroplasts that develop in darkness are called as.....
15. Chlorosis in leaves is caused by the deficiency of which element?
16. What chemical is known as fruit ripening hormone?

Section-B

Answer any 8 questions. Each question carries 3 marks (8x3=24 marks)

17. What is the role of dinitrogenase activity in nitrogen fixation?
18. What are the functions of lysosomes?
19. What is meant by accessory plant pigments?
20. Distinguish between apoptosis and necrosis
21. Mention two important physiological roles each of gibberellins and cytokinins
22. Copper and molybdenum are essential micronutrients in plants. Why?
23. What are cryptochromes and phototropins?
24. What is allelopathy? Give two examples.
25. Highlight the structural organization of primary cell wall in plants.
26. What is the importance of selenium in plant nutrition?

Section C

Answer any 4 questions. Each question carries 5 marks (4x5=20)

27. What are glyoxysomes? Describe glyoxylate cycle and its metabolic significance?

28. Give a short account of circadian rhythm in plants
29. How is sucrose synthesized in plants? Add a note on plant invertases.
30. Give a brief account of photorespiration in plants.
31. What are phytochromes? What are their functions in plant growth and development?
32. What is crassulacean acid metabolism and what is its significance?

Section D

Answer any 2 questions. Each question carries 10 marks (2x10=20)

33. With suitable examples, give a detailed account of the various secondary plant products, their functions and uses
34. With the help of detailed structural diagram, describe the cyclic and noncyclic photophosphorylation reactions in chloroplast.
35. Give a detailed account of light and dark reactions in photosynthesis and diagrammatically represent the different steps

BCH5B10 PHYSIOLOGICAL ASPECTS OF BIOCHEMISTRY

Time: 3 Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16x1=16 marks)

1. Blood pressure is measured in
 - a. Paskals
 - b. millimetres of Hg
 - c. Daltons
 - d. Ergs
2. Salivary and pancreatic amylases helps in the digestion of
 - a. Proteins
 - b. Starch
 - c. Lipids
 - d. Vitamins
3. The amount of light entering the eye is controlled by
 - a. Retina
 - b. Iris
 - c. Rods
 - d. Cones
4. Physiological pH is -----
5. ----- is also known Antidiuretic hormone
6. The serum may appear milky after a diet with high amount of
 - a. Milk proteins
 - b. glucose
 - c. galactose
 - d. fat
7. Pepsinogen is secreted by
 - a. Chief cells
 - b. Parietal cells
 - c. Islets of langerhans
 - d. Intestinal mucosa
8. The enzyme that makes ATP available for muscle contraction is
9. Name a tripeptide which functions as an antioxidant.
10. Heparin is a
 - a. Hormone
 - b. vasodilator
 - c. anticoagulant
 - d. clotting factor

11. Increase in the concentration of 2,3-bisphospho glycerate ----- the affinity of haemoglobin to oxygen
12. ----- is an abnormal constituent in urine
a. Urea b. glucose c. sodium d. creatinine
13. The thick filaments in myofibrils are composed almost entirely of
a. Actin b. Myosin c. Troponin d. Tropomyosin
14. Growth hormone is secreted by-----
15. In males ----- stimulates the production and secretion of testosterone from the testes via Leydig cells.
a. Luteinising Hormone b. Follicle Stimulating Hormone c. Testosterone d. Oxytocin
16. ----- is an amino acid which acts as an inhibitory neurotransmitter
a. Glycine b. Alanine c. Trypsin d. Proline

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

17. What are the enzymes involved in protein digestion? How they are activated?
18. Write a note on homeostasis in human body.
19. Write a note on blood grouping.
20. What are vasodilators? Give examples.
21. What is respiratory exchange ratio?
22. Describe the structure of neurons
23. What is meant by visual excitation?
24. Name three steroid hormones and describe their functions.
25. Give an account of excitatory neurotransmitters
26. Define pulmonary volume and pulmonary capacity

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

27. Explain the process of absorption of lipids
28. Describe the composition of bile
29. What are the major events involved in the differentiation of RBCs?
30. Explain Bohr effect. Comment on its physiological significance.
31. Describe the hormonal regulation of ovarian function.

32. Explain the mechanism of transmission of nerve impulses.

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20)

33. Explain the events involved in the coagulation of blood.

34. Elaborate the role of kidneys in maintaining homeostasis.

35. Give an account of the major physiological functions and mechanism of action of the following hormones:

i) Insulin ii) calcitonin iii) growth hormone iv) parathyroid hormone v) oxytocin

BCH5B11 CLINICAL AND NUTRITIONAL BIOCHEMISTRY

Time: 3 Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. Alkaptonurea is due to the deficiency of ----- enzyme
2. The normal serum concentration of urea is
a. a. 20-40 mg/dl b. 2-4 mg/dl c. 120-140 mg/dl d. 0.20-0.40 mg/dl
3. Blood levels of all the following are raised after a myocardial infarction except
Creatine phosphokinase b. Lactate dehydrogenase c. Alkaline phosphatase d. Aspartate amino transferase
4. Night blindness is caused due to the deficiency of -----
5. Gout is due to the accumulation of
urea b. uric acid c. creatinine d. ornithine
6. ----- is a milk protein
Galactose b. casein c. lactose d. dextrin
7. ----- help blood to clot
a. Platelets b. Erythrocytes c. Immunoglobins d. Albumins
8. The heat labile isoenzyme of ALP is produced from
a. Bone b. Liver c. Placenta d. Intestine
9. Monosodium glutamate is

- a. An artificial sweetener b. taste enhancer used in dishes c. chemical used for blood glucose detection d. abnormal constituent of urine
10. Good cholesterol refers to
a. LDL b. VLDL c. HDL d. TAG
11. The blood levels of which among the following best reflects kidney function?
a. Glucose b. Creatinine c. LDL d. HDL
- 13 Which among the following has the highest calorific value per unit mass
12. Carbohydrates b. Fats c. Fiber d. Proteins
13. Renal threshold of glucose is ----- mg/dl
14. Lactose intolerance is due to the deficiency of ----- enzyme
15. ----- is also known as folic acid
a. Vit B9 b. Vit B12 c. Vit B6 d. Vit B3
16. Normal level of plasma cholesterol is -----.

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

17. What are the usually adopted safety measures in a clinical laboratory?
18. How ESR is measured in a clinical laboratory?
19. Write a note on the clinical significance of Lactate Dehydrogenase.
20. What is Albumin-Globulin ratio? What is its clinical significance?
21. Give a brief account of renal function tests.
22. Describe the composition and functions of lymph.
23. Comment on the significance of monitoring fasting and post prandial blood sugar in a diabetic patient.
24. What is BMR? What are the factors affecting BMR?
25. Comment on the significance of glycemic index.
26. Write a note on food adulteration.

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

27. Explain the nutritional significance of different B vitamins.
28. Give an account of protein malnutrition in children.
29. Write a note on atherosclerosis.

30. Explain thyroid function tests.
31. Write a note on the determination of lipid profile.
32. Give an account of the collection, preparation and preservation of serum in a clinical laboratory.

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20)

33. Give an account of the clinical significance, normal values and methods of estimation of any four serum enzymes of clinical interest.
34. What are the major disorders of liver? How liver function tests are used in their diagnosis and management?
35. Give an account of the nutritional significance of minerals and trace elements in humans.

BCH5B12 Immunology

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. Which among the following does not constitute for the primary level of immunity?
 - a. Sweat
 - b. Mucus
 - c. Tears
 - d. B Cell
2. The term “vaccine” is related to
 - a. Dog
 - b. Cow
 - c. Guinea pig
 - d. Mice
3. The main store of red blood cells is
 - a. Liver
 - b. Spleen
 - c. Heart
 - d. Bone marrow
4. Which among the following is not an antigen presenting cell?
 - a. Dendritic Cells
 - b. T Cells
 - c. B Cells
 - d. Macrophages
5. Phagocytosis...
 - a. is carried out by the cells of adaptive immune system
 - b. is restricted to macrophages
 - c. is important in bacterial infections

- d. is a process that does not involve energy
- 6. Immediate hypersensitivity usually involves
 - a. Mast cells
 - b. Antibodies
 - c. Platelets
 - d. IgG
- 7. A substance that non specifically enhances the immune response to an antigen is called _____
- 8. Acquired immune deficiency syndrome is caused by _____
- 9. Myasthenia Gravis is an _____ disease
- 10. The broad and loose category of small proteins that are inevitable for cell signaling are called _____
- 11. IgG coating of pathogen surfaces is called _____
- 12. What is the name given to a monoclonal antibody with catalytic function?
- 13. Name the immunoglobulin which plays a pivotal role in allergic conditions
- 14. Who is often called as the father of Immunology?
- 15. Where does B cells originate?
- 16. What is the full form of ELISA?

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

- 17. What is Innate Immunity?
- 18. What are the organs of the immune system?
- 19. Define autoimmunity with the help of two examples
- 20. What is immuno diffusion? What are its applications?
- 21. What are vaccines?
- 22. What is hypersensitivity?
- 23. How are cytokines classified?
- 24. Define immunodeficiency.
- 25. What is an antigen? What are the different types of antigens?
- 26. What constitute the first layer of defense for the human immune system?

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

- 27. Discuss on the clonal selection of lymphocytes
- 28. Give a brief outline of Western Blotting
- 29. Briefly explain hematopoiesis
- 30. What are monoclonal antibodies? How are they produced?
- 31. Write short note on T lymphocytes
- 32. Explain hypersensitivity. How is it classified?

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20)

- 33. Explain the components and functioning of the complement system
- 34. Describe the maturation, activation and proliferation of B Cell receptors
- 35. What are the different classes of Immunoglobulins? Write on the various functions of different classes of immunoglobulins.

BCH6B13 CLASSICAL GENETICS AND MOLECULAR BIOLOGY

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. How does transcription begin?
 - a. it doesn't, transcription doesn't exist
 - b. when RNA polymerase binds to a sigma to create a holoenzyme and the sigma guides the RNA polymerase to certain locations where transcription should begin
 - c. The non-template strand signals to the binding receptor that a phosphodiester bond is present and ready for action
 - d. The RNA polymerase binds to a coding strand located downstream

2. Nucleotides are linked to one another in mRNA by which of the following bonds
 - a. Phosphate ester bonds
 - b. Glycosidic bonds
 - c. Phosphodiester bonds
 - d. Hydrogen bonds

3. All t RNAs have ---bases at the 3' end
 - a) GGC b) CCA d) AAC d) UUC

4. What is the complementary strand of the following RNA strand: 5' GCACGUUUACCGA 3'?
 - a. 3' AGCCAUUUGCGUA 5'
 - b. 3' AUGCGUUUACCGA 3'
 - c. 3' CGUGCAAUGGCU 5'
 - d. 3' TACGCAAATGGCT 5'

5. Okazaki fragments
 - a. Add nucleotides to the elongating DNA.
 - b. Are synthesized by primase.
 - c. Are formed in the leading strand.
 - d. Are formed in the lagging strand.

6. Hydrogen bonds between cytosine and guanine are
 - a)1 b) 2 c)3 d) 4

7. Transfer RNA molecules are characterized by all the following except

- a. They are one of the largest of the RNAs
- b. Clover shape
- c. Many modified bases
- d. D)Extensive secondary and tertiary structure

8 . What process occurs before the other?

- a. Transcription and then Translation
- b. Translation and then Transcription
- c. Translation and then Polymerization
- d. Translation and then differentiation

9. In vivo synthesis of DNA is

- a. 5' to 3'.
- b. 3' to 5'.
- c. 5' to 2'.
- d. Both A and B.

10 . Gene is:

- a. a piece of clothing that is placed upon the bipedal legs of human.
- b. a chromosome carrier
- c. a section of DNA that codes for a protein or RNA molecule.
- d. a regulatory sequence

11. Pyrimidine dimers are formed on

- a. Exposure to UV light
- b. On exposure to dark
- c. On exposure to X rays
- d. On exposure to IR rays

12. The codon AUG, which codes for the amino acid methionine, also serves as

- a. a lac operon
- b. a start codon
- c. a stop codon
- d. a promoter

13. The codons UAA, UAG, and UGA all code for

- a. arginine
- b. threonine
- c. phenylalanine
- d. stop codons

14. Chromosome pattern in normal human males

- a) 44XX b) 44XY c) 44XO d) 45XY

15. The phenotypic ratio in monohybrid cross is

a) 3:1 b) 1:2:1 c) 9:3:3:1 d) 2:2

16. Polypeptide is assembled on a

- a. DNA molecule
- b. Nuclear membrane
- c. Nuclear pore
- d. Ribosome

Section B

Answer any 8 questions. Each carries 3 marks (8×3=24marks)

- 17. A segment of DNA containing 20 base pairs includes 7 guanine residues. How many cytosine residues are there in the segment?
- 18. Describe Charagaff's rules
- 19. What is the function of Primase in replication?
- 20. Name one inhibitor of transcription and its mode of action
- 21. What is the importance of Shine –Dalgarno sequence?
- 22. What is an Operon
- 23. Differentiate between genotype and phenotype
- 24. What are cosmids?
- 25. What is a repressor
- 26. What is meant by semiconservative replication

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20 marks)

- 27. What are the different types of RNA? Give an account of their function
- 28. Write note on wobble hypothesis
- 29. Describe the charging of t RNA
- 30. What are the functions of DNA polymerase
- 31. Differentiate between induction and repression
- 32. Explain the terms codominance and incomplete dominance with examples.

Section D

Answer any two questions each carries 10 marks (2×10=20 marks)

- 33. Describe the initiation elongation and termination of transcription in prokaryotes
- 34. Briefly explain chromosomal aberrations
- 35. Describe DNA replication in prokaryotes

BCH6B14 RECOMBINANT TECHNOLOGY

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. If a recombinant protein has to be produced, which biomolecule should be recombined?
a) RNA b) DNA c) protein d) glycolipid.
2. Embryonic stem cells is derived from
a) bone marrow b) blastocyst c) brain stem d) none of these
3. Eukaryotic genes may not function properly when cloned into bacteria because of:
a) inability to excise introns
b) destruction by native endonuclease
c) failure of promoter to be recognized by bacterial RNA polymerase
d) all of the above
4. Shotgun approach is used for the construction of;
a) cDNA library b) genomic library c) both d) none of these
5. A mouse in which one particular gene has been replaced by its inactivated form generated in vitro is called:
a) transgenic mouse b) knockout mouse c) nude mouse d) mutant mouse
6. A DNA molecule into which foreign DNA molecule may be inserted and which can be returned to and replicated within a living cell is called a:
a) Complementary DNA or cDNA b) Vector c) Transgene d) Kinetochore
7. Restriction endonucleases have the ability of cutting
a) DNA at random sites
b) DNA at specific sites
c) Both a and b
d) DNA and RNA at random sites
8. Humulin, a genetically engineered insulin was produced for the first time by

- a) Biocon India Limited
- b) Glaxo
- c) Elililly and Company
- d) Cipla

9. Expression vectors are those

- a) produce protein products
- b) used for genomic libraries
- c) used for chromosome synthesis
- d) used for finger printing

10. In restriction endonuclease EcoR1, “E” stands for

- a) extraction
- b) the first letter of the genus in which it is present
- c) endonuclese
- d) endangered

11. Bt cotton is a

- a) a cotton variety obtained by crossing two different cotton plants
- b) a cotton variety brought from South America
- c) an insecticide sprayed on cotton plant
- d) a transgenic cotton variety

12. Recombinant organisms can pose serious threat to the biosphere (True/ False)

13. Plasmids form part of bacterial chromosome (True/ False)

14. Is it possible to produce glycosylated protein in a normal bacterial strain? (Yes/NO)

15. Name a plant pathogen used as a vector

16. Golden rice is a variety that express -----

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

17. What is the basic difference between a cDNA library and a genomic library?

18. What are restriction endonucleases?

19. Write briefly on the use of klenow fragment of DNA Pol in cloning.

20. How does an expression vector differ from a normal cloning vector?

21. What do you understand by a conditional knockout?

22. What cloning strategy will you adopt, in case the vector you are using donot have compatible restriction sites?

23. How can total cellular RNA be isolated? How would you purify mRNA from that?

24. Which vector is usually used for generating genomic library?

25. Briefly explain the advantages of two genetically modified plants.

26. Differentiate between totipotent, multipotent and unipotent stem cells.

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20marks)

27. Write notes on protoplast transformation.
28. How can plants be used for generating vaccines?
29. What is the problem with btCotton?
30. Is it possible to blunt a staggered DNA end? If so How?
31. Write notes on lipofection and calcium phosphate mediated gene transfer.
32. Write notes on phage vectors.

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20marks).

33. Explain in detail the procedure to generate a cDNA library.
34. Detail the various biosafety measures to be considered while generating recombinant protein.
35. What is a knockout mouse? Describe how it is generated.

BCH6B15 MOLECULAR ENDOCRINOLOGY

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. A hormone released by the posterior pituitary gland is
 - a. gastrin.
 - b. glucagon.
 - c. parathyroid hormone (PTH).
 - d. antidiuretic hormone(ADH)

2. Testosterone is produced in the
 - a. epididymis.
 - b. prostate gland.
 - c. interstitial cells.
 - d. seminiferous tubules.

3. The pituitary glands posterior lobe produces two hormones
 - a. Vasopressin and oxytocin
 - b. Cortisone and coticosterone
 - c. Progesterone and estradiol
 - d. Testosterone and aldosterone

4. Which of the following hormones does not act by a second messenger system
 - a. Glucagon
 - b. Epinephrine

- c. Follicle stimulating hormone
 - d. Testosterone
5. Which hormone binds to intracellular receptors
- a. Insulin
 - b. Growth hormone
 - c. Triiodothyronine
 - d. Thyroid stimulating hormone
6. A person with diabetes mellitus does not secrete enough
- a. sugar
 - b. Insulin
 - c. Glucagon
 - d. Epinephrine
7. Thyroxine is important in the control of
- a. diabetes mellitus
 - b. mitochondrial respiration
 - c. calcium uptake
 - d. cellular metabolic rates
8. Which of the following hormone is a modified amino acid
- a. prostaglandin
 - b. epinephrine
 - c. progesterone
 - d. estrogen
9. Diabetes mellitus is related with
- a. Graafian follicles
 - b. Peyer's patches
 - c. Islets of Langerhans
 - d. Glisson's capsules
10. Diabetes insipidus is caused by
- a. Over secretion of oxytocin
 - b. over secretion of ADH
 - c. Under secretion of ADH
 - d. Under secretion of insulin
11. A steroid hormone typically alters the activity of its target cells by
- a. Digesting holes in the plasma membrane
 - b. entering the cell and altering the gene expression
 - c. passing the message to an intracellular messenger
 - d. Digesting holes in the lysosomes

12. Which of the following is not a female sex hormone
- estradiol
 - estriol
 - progesterone
 - testosterone
13. Which hormone regulate glycogenesis
- Glucagon
 - Epinephrin
 - Insulin
 - Cortisol
14. All the hormones of the adrenal cortex are synthesized from
- tyrosine
 - glycoproteins
 - cholesterol
 - fats
15. epinephrine and norepinephrine function as both hormones and
- fuel for respiration
 - neurotransmitters
 - ions to promote action potentials
 - solutes to promote osmotic flow
16. Name a steroid hormone -----

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

- Name the hormones produced by hypothalamus
- Why hormone like insulin cannot be administered by oral route?
- Define signal transduction
- What are protein kinases? What are their functions?
- What is diabetes mellitus?
- What are second messengers?. Give examples
- Draw the structure of cGMP
- How hormones are classified based on structure? .Give examples
- Explain the functions of somatostatin
- What are hormones?

Part C

Answer any 4 questions. Each question carries 5 marks (4×5=20marks)

27. Explain the role of calcium in signal transduction
28. Explain mechanism of action of steroid hormones
29. What is the function of glucagon
30. Differentiate between the terms endocrine and paracrine?
31. What are the functions of catecholamines
32. Explain feedback regulation with an example

Part D

Answer any 2 questions. Each question carries 10 marks (2×10=20marks)

33. Write an essay on hormones of thyroid
34. Describe the molecular mechanism of insulin action
35. Describe the functions of the hormones of testes and ovaries

OPEN COURSES

BCH5D01 Elementary Biochemistry

Time: Two Hours

Maximum Marks 50

Section A

Answer all the questions. Each question carries 1mark (8×1=8 marks)

1. Physiological pH is
 - a. 6.8
 - b. 7.0
 - c. 7.2
 - d. 7.4
2. The term “globulin” is related to
 - a. Carbohydrate
 - b. Protein
 - c. Fatty acids
 - d. Nucleic acids
3. “Phospho di ester bond is seen in
 - a. Carbohydrates
 - b. Proteins
 - c. Fatty acids
 - d. Nucleic acids
4. Which among the following is not an energy rich compound?
 - a. GTP
 - b. ATP
 - c. CTP
 - d. PTP
5. The type of hydrogen bond in water is:
 - a. Intermolecular

- b. Intramolecular
 - c. both of these
 - d. none of these
6. The first law of thermodynamics deals with:
- a. Energy
 - b. Entropy
 - c. Enthalpy
 - d. all the three
7. Maleic acid and fumaric acid are examples of isomers
8. Atoms with the same atomic number and different mass numbers are called

Section B

Answer any 4 questions. Each question carries 3 marks (4×3=12marks)

- 9. What is meant by natural radioactivity?
- 10. What are the features of a peptide bond?
- 11. What is a co factor? Give examples
- 12. What is osmosis?
- 13. State Bronsted theory of acids and bases
- 14. What is a buffer? Give examples

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20marks)

- 15. What are the different types of purine molecules present in DNA? Draw the structure.
- 16. Explain the different types of isomerism in carbohydrates
- 17. What is denaturation? What do you mean by denaturing agents?
- 18. Explain the classification of lipids.
- 19. Explain the classification of vitamins.
- 20. Explain the structure and functions of mitochondria

Section D

Answer any one question. Each question carries 10 marks (1×10=10marks)

- 21. Explain glycolysis by plotting the pathways leading to the formation of pyruvate
- 22. Explain the biochemical organization of the cell.
- 23. Write down the application of Biochemistry in the field of health and nutrition

BCHD02 LIFE STYLE DISEASES

Time: Two Hours

Maximum Marks 50

Section A

Answer all the questions. Each question carries 1 mark (8×1=8 marks)

- 1. Which among the following does not constitute for the category life style disease?
 - a. Diabetes
 - b. Nephritis
 - c. Atherosclerosis
 - d. Jaundice
- 2. The term “BMI” is related to

- a. Obesity
 - b. Hypertension
 - c. Cancer
 - d. Stroke
3. The vitamin which is good for eye is
- a. A
 - b. D
 - c. E
 - d. K
4. Which among the following is not a mode of Cancer treatment?
- a. Chemotherapy
 - b. Surgery
 - c. Radiation
 - d. Physiotherapy
5. GFR is related to
- a. Lungs
 - b. Heart
 - c. Kidney
 - d. Liver
6. "Stent" is related to
- a. Obesity
 - b. Atherosclerosis
 - c. Hepatitis
 - d. Tumor
7. Sedentary life style means lack of _____
8. Coronary angiography is a diagnostic test for _____

Section B

Answer any 4 questions. Each question carries 3 marks (4×3=12marks)

- 9. What are the minerals that should be included in diet?
- 10. Discuss the role of Sodium ions in hypertension?
- 11. Define stroke.
- 12. What is metastasis?
- 13. What are vaccines?
- 14. What are the functions of kidney?

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

- 15. Define myocardial infarction
- 16. Give a brief outline of MRI
- 17. Briefly explain type 2 diabetes
- 18. What are the kidney function tests?
- 19. Write short note on hypertension
- 20. Explain Obesity. How is it classified?

Section D

Answer any one question. Each question carries 10 marks (1×10=10)

21. Explain the various lifestyle disorders that may lead to cancer. Describe the diagnosis and mode of treatment of cancer.
22. Describe the liver function tests. How do we manage liver disorders?
23. What are the characteristic features and consequences of atherosclerosis? Write on the various types of disease management.

BCHD03 CLINICAL DIAGNOSIS OF COMMON DISEASES

Time: 2 Hours

Maximum Marks 50

Section A

Answer all the questions. Each question carries 1mark (8×1=8 marks)

1. Type 2 diabetes mellitus is also known as
 - a. Insulin dependent diabetes mellitus
 - b. Non Insulin dependent diabetes mellitus
 - c. Hypoglycemia
 - d. Diabetes insipidus
2. Normal range of Albumin/Globulin ratio is -----
3. While taking blood for LDH estimation haemolysis should be avoided because
 - a. Haemolysis prevents LDH activity
 - b. Haemolysis leads to blood clotting
 - c. LDH level is more inside the RBC than in plasma
 - d. LDH level is more in plasma than inside the RBC
4. Normal plasma bilirubin level is -----
5. Glucagon is secreted by
 - a. Liver
 - b. pancreas
 - c. pituitary
 - d. hypothalamus
6. Hepatitis affects
 - a. Kidney
 - b. Heart
 - c. Liver
 - d. Brain
7. Normal fasting blood sugar level is -----
8. EEG is used for the diagnosis of
 - a. Cardiac dysfunction
 - b. Cancer
 - c. Liver disorders
 - d. Neurological disorders

Section B

Answer any 4 questions. Each question carries 3 marks (4×3=12 marks)

9. What is hypoglycaemia? How is it diagnosed?

10. Why a diabetic patient more susceptible to infections?
11. Write a note on the diagnostic importance of lactate dehydrogenase.
12. How the blood triglyceride level affects cardiac activity?
13. Comment on the clinical significance of Albumin/Globulin ratio
14. Describe the functions of thyroid gland.

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

15. What is meant by lipid profile analysis? Give the importance of determining lipid profile in cardiovascular diseases.
16. Explain diabetic ketoacidosis. How it is diagnosed?
17. What are the major diagnostic procedures for cardiovascular diseases?
18. Describe polyurea and glycosurea.
19. Write a note on tumor markers.
20. Give an account of the diagnosis and management of epilepsy.

Section D

Answer any one questions. Each question carries 10 marks (1×10=10)

21. Elaborate the role of liver function tests in the diagnosis of clinical conditions.
22. Describe any four clinical conditions of thyroid dysfunction and their diagnosis.
23. Give an account of the two types of diabetes mellitus, associated complications and diagnosis.

COMPLEMENTARY COURSE IN BIOCHEMISTRY

BCH1C0I BIOCHEMISTRY I

Time 3 hrs

Maximum marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. Which among the following is an electrolyte?
 - a. NaOH
 - b. CO₂
 - c. N₂
 - d. O₂
2. The term “pH” is related to

- a. Concentration of salt
 - b. Concentration of hydrogen ion
 - c. Concentration of metal ion
 - d. Concentration of the solution
3. Milk is an example of
 - a. Solution
 - b. Emulsion
 - c. Suspension
 - d. Mixture
 4. A condensation reaction is associated with the formation of
 - a. Ester
 - b. Water
 - c. Salt
 - d. CO₂
 5. The term partition coefficient is related to
 - a. TLC
 - b. Gel filtration
 - c. RIA
 - d. PAGE
 6. "Bile" is stored in
 - a. Spleen
 - b. Gall Bladder
 - c. Duodenum
 - d. Pancreas
 7. The fluid that fills the spinal cord is _____
 8. When blood passes through capillaries, the fluid part oozes out forming _____
 9. The pale yellow color of urine is due to the presence of _____
 10. When the rate of forward reaction equals that of backward reaction, the system is said to be in _____
 11. In decarboxylation reaction, _____ is eliminated.
 12. Name a technique used for alcohol production
 13. What is the name of a carbon atom which is attached to four different atoms or groups?
 14. Name a plasma protein present in blood
 15. What is the full form of PAGE?
 16. What is the law applicable to colorimetry?

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

17. What is diffusion?
18. What is serum?
19. State law of mass action.
20. What is Normality?
21. What is pOH?
22. What is pKa value?
23. What is a colloid?
24. What is a substitution reaction?
25. Explain the term 'lymph node'?
26. What is HPLC?

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20marks)

27. Give an outline on the scope of Biochemistry
28. Write down the Henderson Hasselbalch equation and state its applications.
29. Briefly explain the relationship of osmotic pressure to gas laws
30. What are emulsions? Discuss on emulsifying agents
31. Write short note on Donnan membrane equilibrium.
32. Explain the biochemistry of blood clotting

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20marks)

33. What is isomerism? What are the different types of isomerism exhibited by bio molecules?
Explain with suitable examples
34. Describe the principle of chromatography? Write on any five popular chromatographic techniques
35. What is the composition of blood? Write on the various methods by which the pH of blood is maintained.

BCH2C02 BIOCHEMISTRY II

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. Isomerism is exhibited by
 - a. Proteins
 - b. Carbohydrates
 - c. Fats
 - d. All of the above
2. Cholesterol is a
 - a. lipid
 - b. protein
 - c. carbohydrate
 - d. vitamin
3. Salt of a fatty acid is
 - a. Ester
 - b. Soap
 - c. Detergent
 - d. Perfumes
4. A condensation reaction is associated with the formation of
 - a. Ester
 - b. Water
 - c. Salt
 - d. CO₂
5. Which among the following is a cyclic amino acid
 - a. glycine
 - b. tryptophan

- c. asparagine
 - d. proline
6. Uracil is
 - a. A nucleotide
 - b. A nitrogen base
 - c. DNA
 - d. RNA
 7. The energy currency of living cells is _____
 8. When positive and negative charges are present in the same molecule, it is called a _____
 9. On denaturation, only the _____ structure of protein is retained.
 10. The phospholipid present in lecithin is _____
 11. Cellulose is composed of _____ units.
 12. The change in optical rotation owing to epimerization; name the phenomenon
 13. What is the name of a carbon atom which is attached to four different atoms or groups?
 14. Name the essential fatty acids
 15. What is the other name of phosphatidylethanolamine?
 16. Name a heteropolysaccharide which has got anticoagulant activity

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24marks)

17. What is isomerism?
18. What are epimers?
19. What is a reducing sugar?
20. What is Iodine number?
21. What is saponification number?
22. What is protein sequencing?
23. Give the structure of Serine
24. What is a purine?
25. What is base pairing?
26. Give the structure of thymine

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20)

27. Give a short note on heteropolysaccharides
28. Write down the structure and properties of amylose and amylopectin.
29. Briefly explain the structure and functions of tyrosine and tryptophan
30. Outline the structure of cholesterol and discuss the functions of cholesterol
31. Write short note on denaturation of proteins.
32. Explain the double helical structure of DNA

Section D

Answer any 2 questions. Each question carries 10 marks (2×10=20)

33. What is isomerism? What are the different types of isomerism exhibited by bio molecules?
Explain with suitable examples

34. Describe the classification and basic functions of lipids and fatty acids
35. Describe the structural organization of proteins.

BCH3C03 BIOCHEMISTRY III

Time: Three Hours

Maximum Marks 80

Section A

Answer all the questions. Each question carries 1mark (16×1=16 marks)

1. The enzyme is more efficient in catalysis when K_m value is
 - a. Low
 - b. High
 - c. Zero
 - d. Infinity
2. In the presence of a fixed concentration of a competitive inhibitor, increase in the concentration of the substrate
 - a. Reverses the inhibitory action
 - b. Increases K_m
 - c. Inhibitory effect remains unaffected
 - d. Decreases V_{max}
3. The enzymes catalyzing breakdown without addition of water are called
 - a. Lyases
 - b. Hydrolases
 - c. Ligases
 - d. Oxidoreductases
4. At high temperatures enzymes are
 - a. Killed
 - b. Denatured
 - c. Inactivated
 - d. All of the above
5. The protein part of an enzyme is.-----
 - a. Apoenzyme
 - b. Coenzyme
 - c. Holoenzyme
 - d. Isoenzyme
6. . ----- group of enzymes are involved in joining of two molecules involving energy
 - a. oxidoreductases

- b. ligases
 - c. hydrolases
 - d. lyases
7. Which of the following factors can affect enzyme activity?
- a. Temperature
 - b. pH
 - c. The presence of certain metal ions
 - d. All of the above
8. The initial rate of an enzyme catalysed reaction depends on:
- a. The concentration of the enzyme
 - b. The concentration of the substrate
 - c. the affinity of the enzyme for its substrate
 - d. All of the above
9. Enzyme accelerate reaction by
- a. Increasing E_a
 - b. Decreasing E_a
 - c. Increasing ΔH
 - d. Increasing ΔG
10. During glycolysis the following reaction requires NAD^+ :
- a) Alcohol dehydrogenase
 - b) Glyceraldehyde-3-phosphate dehydrogenase
 - c) Lactate dehydrogenase
 - d) Pyruvate dehydrogenase
11. Mitochondrial ATP synthesis requires
- a) a $[H^+]$ gradient.
 - b) a membrane potential.
 - c) an intact inner mitochondrial membrane.
 - d) All three, a) - c).
12. Which hormone regulate glycogenesis
- (a) Glucagon (b) Epinephrin (c) Insulin (d) Cortisol
13. Gluconeogenesis takes place in
- a. Cytosol
 - b. Mitochondria
 - c. Both cytosol and mitochondria
 - d. Golgi complex
14. Tricarboxylic acid cycle takes place in .-----
15. Calvin cycle is also known as

- a. reductive hexose phosphate cycle
- b. reductive pentose phosphate cycle
- c. oxidative hexose phosphate cycle
- d. oxidative pentose phosphate cycle

16. The enzyme that catalyses carbon di oxide fixation in C4 plants is

- a. Carbonic anhydrase
- b. RuBP carboxylase
- c. Carboxidismutase
- d. PEP carboxylase

Section B

Answer any 8 questions. Each question carries 3 marks (8×3=24 marks)

- 17. Define activation energy
- 18. Define enzyme turnover number
- 19. Give an example for sterio specificity of enzymes
- 20. What is a zymogen? How is it activated
- 21. What is the active site of an enzyme?
- 22. What is competitive inhibition? Give examples
- 23. What are high energy compounds? Give two examples
- 24. What is the action of glycogen synthase
- 25. Differentiate between aerobic and anaerobic oxidation
- 26. Name the most important photosynthetic pigments

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20 marks)

- 27. Write down the lock and key model of the mechanism of enzyme action
- 28. What are the six classes of enzymes? Give examples.
- 29. What is the importance of pentose phosphate pathway?
- 30. Differentiate between substrate level oxidation and oxidative phosphorylation
- 31. Describe the glyoxylate cycle
- 32. Draw the structure of mitochondria.

Section D

Answer any two questions. Each carries 10 marks (2×10=20 marks)

- 33. Draw Lineweaver Burk Plot. Describe its importance in the study of inhibition of enzymes.
- 34. Describe the citric acid cycle
- 35. Describe the arrangements of complexes in the electron transport chain and mark the sites of ATP formation in the chain

BCH4C04 BIOCHEMISTRY IV

Time: Three Hours

Maximum Marks 60

Section A

Answer all the questions. Each question carries 1 mark (12×1=12marks)

- Which of the following is not correctly matched
 - Vitamin A--- fat soluble
 - Vitamin C ----water soluble
 - Vitamin E---- water soluble
 - Vitamin D---- fat soluble
- Rickets is due to the deficiency of.-----
(a) Vitamin C (b) Vitamin D (c) Vitamin E (d)Vitamin A
- ATP yield during the β oxidation of palmitic acid is
(a) 149 (b) 131 (c) 129 (d) 12
- The coenzyme needed for fatty acid oxidation is
(a) NAD (b) NADP (c) TPP (d) Biotin
- Transamination reaction are carried out by.-----
(a) Aminotransferases (b) Aminoacid carboxylase (c) Aminoacid oxidases (d) Dehydrogenase
- Rate limiting enzyme in cholesterol biosynthesis is
(a) HMG CoA reductase (b) HMG CoA synthase (c) Acetyl CoA carboxylase (d) Cholesterol synthase
- The metal ion present in hemoglobin is
(a) Mg^{2+} (b) Fe^{2+} (c) Mn^{2+} (d) Cu^{2+}
- Diabetes mellitus is due to the deficiency of
(a) Insulin (b) Glucagon (c) Epinephrine (d) Inulin
- The coenzyme form of thiamine is
(a) TPP (b) CoA (c) Biotin (d) FAD
- is the codon of methionine
- Name the site of β -oxidation of fatty acids
- enzyme involve in the activation of amino acid during translation

Section B

Answer any 8 questions. Each question carries 3 marks (6×3=18 marks)

13. What is the function of carnitine
14. Explain the term pellagra
15. What are stop codons?
16. Explain the term 'central dogma'
17. What are Okazaki fragments?
18. What do you mean by inborn errors of metabolism
19. What are the major physiological functions of thyroxine
20. Explain the biological role of selenium

Section C

Answer any 4 questions. Each question carries 5 marks (4×5=20 marks)

21. Outline the reactions involved in the beta oxidation of fatty acids
22. Explain physiological function of phospholipids
23. Give an account of genetic code
24. Explain termination of transcription in detail
25. Give a brief account of urea cycle
26. Describe the metabolism of glycine.

Section C

Answer any one question. Each question carries 10 marks (1×10=10 marks)

27. Write an essay on glycolysis
28. Explain the fatty acid biosynthesis.
29. Explain the replication process in prokaryotes