UNIVERSITY OF KERALA

COURSE STRUCTURE AND SYLLABUS

FOR

B.Sc. PROGRAMME IN BIOCHEMISTRY

UNDER

CHOICE BASED CREDIT & SEMESTER SYSTEM

(w.e.f. 2010 admissions)

Revised syllabus - 2013

OBJECTIVES OF THE PROGRAMME

- To impart knowledge of Science as the basic objective of education.
- To develop scientific attitude is the major objective to make the students open minded, critical, curious.
- To develop skill in practical work, experiments and laboratory material and equipments along with the collection and interpretation of scientific data to contribute the science.
- To understand scientific terms, concepts, facts, phenomenon and their relationships.
- To provide practical experience to the students as a part of course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.
- To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.
- To enrich the students with the latest development in the field of biochemistry, biotechnology and other related field of research and development.
- To keep the scientific temper which the students acquire from school level and to develop research culture.
- To encourage students to describe and analyze scientific data.

Syllabus for B.Sc. Programme in Biochemistry under Choice Based Credit & Semester System

Semester	Course Title	L	T	P	C	TC
First semester	**EN 1111**-Lang. Course I (English I)	5	-	-	4	17
	1111 - Language Course II (Addl. Lang. I)	4	-	-	3	
	1121 - Foundation Course I	4	-	-	2	
	BC 1141: Perspectives, Methodology & Introduction to Biochemistry (Core-I)	**2**	**1**	**-**	**4**	
	BC 1141: Practical for BC 1141 - P_1	**-**	**-**	**2**	**-**	
	1131 - First complementary course- 1	2	-	2	2	
	1131 - Second complementary course- 1	2	-	2	2	
Second semester	**EN 1211**-Lang. Course III(English II)	5	-	-	4	17
	1212 - Lang. Course IV(English III)	4	-	-	3	
	1211 - Lang. Course V (Addl. Lang. II)	4	-	-	3	
	BC 1221:Foundation Course II : General Informatics& Bioinformatics	**2**	**1**	**-**	**3**	
	BC 1221: Practical for BC1224 - P_2	**-**	**-**	**2**	**-**	
	1231 - First complementary course- II	2	-	2	2	
	1231 - Second complementary course- II	2	-	2	2	
Third semester	**EN 1311** - Lang. Course VI (English IV)	5	-	-	4	17
	1311 -Lang. Course VII (Addl. Lang. III)	5	-	-	4	
	BC 1341:Cellular Biochemistry (Core-II)	**3**	**1**	**-**	**3**	
	BC 1341: Practical for BC1342 - P_3	**-**	**-**	**2**	**-**	
	1331 - First complementary course- III	3	-	2	3	
	1331 - Second complementary course- III	3	-	2	3	
Fourth semester	**EN 1411** - Lang. Course VIII (English V)	5	-	-	4	27
	1411 -Lang. Course IX (Addl. Lang. IV)	5	-	-	4	
	BC 1441 : Techniques in Biochemistry (Core-III)	**3**	**1**	**-**	**3**	
	BC 1442: Practical (Core-IV) - P_4	**-**	**-**	**2**	**2**	
	1431 - First complementary course- IV	3	-	-	3	
	1432 - First complementary practical-IV	-	-	2	4	
	1431 - Second complementary course- IV	3	-	-	3	
	1432 - Second complementary practical-IV	-	-	2	4	
Fifth semester	**BC 1541: Physiology & Immunology (Core-V)**	**4**	**1**	**-**	**4**	20
	BC 1542: Bioenergetics & Carbohydrate Metabolism-I (Core-VI)	**3**	**1**	**-**	**3**	
	BC 1543: Analytical Biochemistry(Core-VII)	**3**	**1**	**-**	**3**	
	BC 1544: Classical & Molecular Genetics (Core-VIII)	**4**	**1**	**-**	**4**	
	BC 1545: Practical – V (Core-IX) - P_5	**-**	**-**	**6**	**4**	
	Choice based Open Course *	3	-	-	2	
	Project Work	-	1	2	-	
Sixth semester	**BC 1641: Clinical Biochemistry (Core-X)**	**4**	**1**	**-**	**4**	22
	BC 1642: Metabolism –II (Core- XI)	**4**	**1**	**-**	**4**	
	BC 1643: Practical – VI (Core-XII) P_6	**-**	**-**	**6**	**4**	
	BC 1644: Practical – VII (Core-XIII) P_7	**-**	**-**	**5**	**4**	
	Elective (Molecular Biotechnology)**	**3**	**1**	**-**	**2**	
	BC 1646: Project Work	**-**	**-**	**3**	**4**	

Total credits: 120

L-Lecture, T- Tutorial, P- Practical, C- Credit, TC-Total Credit (Tutorial hours are outside the regular working hours)

***Choice based Open Course offered to students of other Departments (5th Semester)**

1. **BC 15 51.1: Clinical Diagnosis of Common Diseases** 2 credits.
2. **BC 1551.2 : Life style Diseases** 2 credits

**** Elective Course offered to students of Biochemistry Department (6th Semester)**

1. **BC 1661.1: Molecular Biotechnology** 2 credits

2. **BC 1661.2 : Immunology & Immunological Technique** 2 credits

Core – 13 (9 – theory, 4 –practicals)

	Credits
Open –	**2**
Elective -	**2**
	4

Total credits - 32 (theory)
- 14 (practical)
46

Total credits – 500

(* Tutorial hours are outside the regular hours of teaching)

Scheme of Examination, Evaluation and Grading:

- Each theory examinations are of 3 hours (for core, elective and open).
- Practical examination is of six hours duration.
- Evaluation and grading are in accordance with the general guidelines given by the university.
- Evaluation of each course shall be done in percentage score and shall involve Continuous Evaluation (CE) with a weightage of 25 percent and End Semester Evaluation with a weightage of 75 %.

Continuous Evaluation (CE) -25%

1. Attendance (Type the percentage)
2. Assignment – 2 (or) seminar-1(preferably / assignment and / seminar or viva voce).
3. Test-2 (better of the two tests can be taken).

Scheme for practical examination

For CE

Attendance:

Upto 75%	-	E grade
75% - 80%	-	D grade
81% - 85%	-	C grade
86% upto 90%	-	B grade
Above 90%	-	A grade

Laboratory record:

Test - Better of the two can be taken for grading.

Viva voce.

For ESE

Procedure
Qualitative analysis
Quantitative estimation
Spot test

For each practical examination (ESE) the laboratory record has to be submitted.

Scheme for the Evaluation of Practical Examination

Weightage may be assigned for various components as follows

For Qualitative Analysis
Step 1. Result & Conclusion
Step 2. Confirmatory test 1
Step 3. Confirmatory test 2
Step 4. Neatly written scheme of experiments used for arriving at the final conclusion

Grading scheme

For step 1 only	- Grade D
For step 1 & 2	- Grade C
For step 2 & 3	- Grade C
For step 1, 2 & 3	- Grade B
For step 2, 3 & 4	- Grade B
For all steps	- Grade A

For Quantitative Experiments
Step 1. Result of the reported value (minimum error)
Step 2. Calculation, presentation of the result (Graph)
Step 3. Procedure
Step 4. Skill

For step 1 only	- Grade D
For step 1 & 2	- Grade C
For step 2 & 3	- Grade C
For step 1, 2 & 3	- Grade B
For step 2, 3 & 4	- Grade B
For all steps	- Grade A

PROJECT

Components required: - (a) Institutional visit (compulsory) + report
(b) Project work (lab work)
(c) Report of the project work done
(d) Viva voce of the work

Grade:-

A- Visit + visit report + project work + work report + viva (satisfactory).
B- Project work + work report + viva alone (with out visit)
C- Project work + work report (with out visit + satisfactory viva)
D- If none of the above is satisfactory

Suggested topics for the conduct of the project

The project work can be done either in the college or in any other institutes / lab. For the institutional visit and study tour, a maximum of 7-10 days can be availed.

1. Food analysis – Carbohydrate content
   Protein content
   Lipid content
   Analysis of Vitamin C (In fruits – comparison)
   Ca^{2+} content (milk, potato, cabbage etc.)
   Fe^{2+} content (bitter gourd, moringa etc)

2. Electrophoretic analysis – Any source
   Separation and characterization of proteins (molecular weight determination)
3. Organ function tests – Liver and renal function tests.
4. Marker enzymes of any disease (analysis) – comparison with normal
5. Isolation of secondary metabolites of medicinal plants
6. Water analysis.

   Or
   Any other similar experiments

Scheme for the Evaluation of Project

Weightage may be assigned for various components as follows

1. Rationale of the study
   General background of the study
   Relevance of the study

2. Objective & scope of the study
3. Methodology-Appropriateness & Accuracy
4. Results & Discussion
   Presentation (figures, graphs, legends etc)
   Analysis
   Relevance/ importance
5. References/literature up to latest reports & documentation
6. Conclusions
7. General presentation
   Free of typographic errors
   Free of redundant material

SEMESTER-I

BC1141: Core Course I
Course Title – Perspectives, Methodology and Introduction to Biochemistry

No. of Credits: 4 **No. of Contact Hours: 36**
Hours/week: 2 **(L, T, P, C – 2, 1, 2, 4)**

Objectives of the course: To familiarize the students about the fundamental characteristics of science as a human enterprise and enable them to understand how science works and to impart a general introduction to Biochemistry

Course Outline

Module I (6 hrs)

Methods and Tools in Science (Brief study)**:** Types of knowledge: Practical, Theoretical and Scientific Knowledge. Information: What is Science; what is not science, laws of science, basis of scientific laws and factual truths. Science disciplines. Revolutions in Science – with respect to biochemistry. Hypotheses: Theories and laws in science-observations, evidences and proof. Posing a question; formulation of hypothesis; hypothetico-deductive model, inductive model

Core text:

- The Truth of Science: RG Newton, Viva Books, New Delhi, 2nd edition

Module II (6 hrs)

Experimentation and data handling in science with respect to biochemistry (Brief study)**:** Design of an experiment; experimentation; observation, data collection; interpretation and deduction. Necessity of units and dimensions; repeatability and replication. Scientific instruments: choice and selection of instruments, sensitivity of instruments, accuracy, precision and errors, Types of instrumentation, historical development and evolution of scientific instruments. Examples of great experiments in science to illustrate how various tools were applied to answer a question [Mendel's studies of genetic traits in pea plants, Thomas Hunt Morgan's work with fruit flies, Griffith's Experiment about Genetics-DNA as genetic material, Meselson-Stahl experiment etc- outline only]

Core text:

- Worldviews: An Introduction to the History and Philosophy of Science by Richard DeWitt (2004) Publisher: Wiley-Blackwell ISBN-10: 140511620X, ISBN-13: 978-1405116206
- The Truth of Science: RG Newton, Viva Books, New Delhi, 2nd edition

Module III (6 hrs)

Methods in Biochemistry: Molecularization of Biology-Evolution of Biochemistry-Historical resume (mention works of Helmont, Scheele, Lavoisier, Berzelius, Wohler, Emil Fischer, Miescher, Buchner, Harden and Young, Meyerhof etc – outline only). Basic aspects of Biochemistry as

molecular logic of living organisms. Approaches to study biochemical processes- whole animal, isolated perfused organ, tissue slice, whole cells, homogenate, isolated cell organells, subfractionation of organelles, purified metabolites and enzymes, radiolabelling studies-tracer techniques, isolated genes etc. Classical examples illustrating the application of various tools and approaches (e.g. DNA as genetic material). Terms in biochemistry- anabolism, catabolism, metabolism etc.

Core text:

- Worldviews: An Introduction to the History and Philosophy of Science by Richard DeWitt (2004) Publisher: Wiley-Blackwell ISBN-10: 140511620X, ISBN-13: 978-1405116206
- The Truth of Science: RG Newton, Viva Books, New Delhi, 2nd edition

Module IV (6 hrs)

Physical aspects of biochemistry**:** Dissociation of water, ionic product of water, concepts of pH, pOH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation of weak acids and electrolytes. Bronsted theory of acids and bases, titration curves, Ka and pKa values, Buffers: buffer action, buffers in biological system, Henderson-Hasselbach equation – derivation

Normality, molarity, molality, percentage solutions, mole fractions (simple numerical problems relating to them). Fundamentals of diffusion, osmosis, osmotic pressure, types of solutions (isotonic, hypotonic and hypertonic). Biological significance of osmosis. Relationship of osmotic pressure to gas laws. General equations for dilute solutions, influence of ionization and molecular size on osmotic pressure

True solution, colloids, coarse suspension, distinction between lyophilic and lyophobic colloids, fundamentals of Donnan-membrane equilibrium-biological applications, properties of colloids, applications, emulsions and emulsifying agents.

Core text:

- Introduction to Biophysics by Pranab Kumar Banerjee (2008) Publishers: S. Chand & Company ltd ISBN: 81-219-3016-2 page no-21, 32, and 74.
- Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002) Publishers: McGraw-Hill ISBN 0-07-135657-6 p 241

Module V (6 hrs)

Introduction to Biomolecules: Carbohydrates- Classification, ketoses and aldoses (C3 to C6) series exemplified by one for each group (structure only), monosaccharides: structure, configuration, stereoisomers and optical isomers. Chemical reactions of carbohydrates, ring formation, mutarotatiom, Haworth projection formula, derived monosaccharides, sugar acids, sugar alcohols, amino sugars, deoxy sugars, esters, oligosaccharides, maltose, lactose, sucrose, isomaltose, cellobiose (Haworth structure, occurrence and function), polysaccharides: classification as homo and heteropolysaccharides, Homopolysaccharides: storage polysaccharides (starch, dextrin, glycogen- structure, reaction, properties), structural polysaccharides (cellulose, chitin-structure, properties), Heteropolysaccharides: glycoproteins, proteoglycans, lipopolysaccharides (Brief study)

Core text:

- Lehninger Principles of Biochemistry, 4th edition by David L Nelson. Publisher: WH Freeman (April 23, 2004) ISBN-10:0716743396

Module VI (6 hrs)

Lipids: Classification and functions of lipids, fatty acids, classification, nomenclature, structure and properties of unsaturated fatty acids. Essential fatty acids, reactions of fatty acids, simple lipids: nomenclature, physical properties, chemical properties, characterization of fat hydrolysis, saponification number, acid number, iodine number, Reichert-Meissel number, rancidity of fat, reactions of glycerol, biological significance of fats, complex lipids: glycerophospholipids, shingophospholipids, glycolipid, lipoproteins and proteolipids (structure, properties and function), Derived lipids – (structure, properties and function) : prostaglandins, thromboxanes, leukotriens, isoprenoids (carotenoids and terpenoids), steroids and sterols (cholesterol, ergosterol, stigmasterol, sitosterol)

Core text:

- Lehninger Principles of Biochemistry, 4th edition by David L Nelson. Publisher: WH Freeman (April 23, 2004) ISBN-10:0716743396

Suggested Reading

- Philosophy of Science: A Very Short Introduction by Samir Okasha (2002) Publisher: Oxford University Press, USA; ISBN-10: 0192802836, ISBN-13: 978-0192802835.
- Philosophy of Science by David Boersema (2008) Publisher: Longman; ISBN-10: 032143711X, ISBN-13: 978-0321437112.
- Conceptual Integrated science: PG Hewitt JA Suchocki.
- The Truth of Science: RG Newton, Viva Books, New Delhi, 2nd edition
- The Golem: What Everyone Should Know About Science: H collins and T Pinch, Cambridge Univ Press, 1993.
- E-book on Scientific Methods by Richard D. Jarrard, 2001,
- Lehninger Principles of Biochemistry, 4th edition by David L Nelson. Publisher: WH Freeman (April 23, 2004) ISBN-10:0716743396
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-hill Book Company– Koga ISBN: 0697142752 ISBN-13: 9780697142757, 978-0697142757.

BC 1141: Practical for BC 1141 -P_1

Hours/week: 2 **No. of Contact Hours: 36**

Aim of the course: To resolve quantitative problems concerning the preparation of solutions, buffers, reagents and analysis of biomolecules etc.

1. **Introduction to laboratory and lab equipments**

    - Use of balances-common, analytical and electronic balances.
    - Preparation of solutions:
    - Percentage, molar, normal, dilution of stock solutions, standard solution
    - Standardization of pH meter.
    - Determination of pH of unknown solution using pH meter.
    - Preparation of Buffer. (application of Henderson-Haselbach equation)
    - Preparation of colloidal solutions
        a) preparation of colloidal ferric hydroxide by hydrolysis
        b) preparation of emulsoid solutions
    - Precipitation of colloids by salts

2. **General reactions of Carbohydrates and Lipids**

    - Carbohydrates- Molisch's test, Anthrone test, Fehling's test, Benedict's test, Picric acid test, Barfoed's test, Bial's test, Seliwanoff's test, Foulger's test, Phloroglucinol test, Mucic acid test, Iodine test, Hydrolysis of Sucrose and Starch, Ozazone test.
    - Lipids- Solubility, Translucent spot tests, Test for Unsaturation, Salkowski reaction, Liebermann-Burchard reaction

References

- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).Tata McGRAW Hill Publishing Company LTD, New Delhi.
- ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Despande(ed). I.K International Pvt. LTD, NewDelhi. ISBN 81-88237-41-8.

Model Question Paper
BC 1141: Core Course I
Course Title: Perspectives, Methodology and Introduction to Biochemistry

Section A

Objective questions, Answer **all 16** questions

I. 1. Two stereoisomers of a given sugar that differs only in the configuration about the Carbonyl carbon atoms are known as
a) Asymmetric carbon atom b) Anomers
c) Enantiomers d) Cis-trans isomers

2. Shingosine is the backbone of all the following except
a) Cerebroside b) Ceramide c) Sphingomyelin d)Lecithin

3. The vitalistic theory became untenable by the works of
a) Wohler b) Lavoisier c) Scheele d) Helmont

4. Which among the following is a non-essential fatty acid?
a) Oleic acid b) Linoleic acid c) Arachidonic acid d) Linolenic acid.

II. 5. Which amoung the following is not a polymer of glucose?
a) Cellulose b) Inulin c) Glycogen d) Dextrin

6. An idea which is still under the process of active testing, which may or may not be corrrect is called a
a) Hypothesis b) Law c) Theory d)Model

7. Mucic acid is produced by the oxidation of
a) Glucose b) Galactose c) Fructose d) Mannose

8. A glycosaminoglycan which serves as a lubricant
a) Hyaluronic acid b) Chondroitin Sulphate c) Keratan Sulphate d) Heparin

III 9. Esterification of cholesterol occurs at carbon position
a) 1 b) 2 c) 3 d) 4

10. Precision is
a) Correctnus of a result b) Reproducibility of a result
c) Both a) & b) d) None

11. Which among the following is a Trisaccharide?
a). Lactose b) Cellulose c) Gentibiose d) Melezitose

12. Which among the following gives the same ozazone?
a) Glucose, Galactose, Xylose b) Glucose, Galactose, Maltose
c) Glucose, Fructose, Mannose d). Glucose, Sucrose, Lactose

IV 13. The common precursor for prostaglandins, thromboxanes and leukotrienes is
a) Stearate b) Palmitate c) Arachidonate d) Oleate

14. The linkage region between glycosaminoglycan and protein consists of
a) Glu-Gal-Gal b) Xyl-Gal-Gal c) Asp-Glu-Gal d) Gal-Xyl-Gal

15. Calculate the pH of 10^{-5} N HCl
a) 3 b) 5 c) 2.5 d) 1.5

16. Iodine value of fat/oil indicates:
a) Proportion of unsaturated acid radical b) estimate of non-fatty impurities
c) Amount of free fatty acid present d) none of the above

Section-B (Short Answer Questions)

Answer any **eight** questions

17. Define acids and bases according to Bronsted theory?
18. Explain mutarotation.
19. Define molality and molarity.
20. What happens when a cell is placed in a) hypertonic b) isotonic solution?
21. What is acid value and its significance?
22. Give the structure of lactose and sucrose?
23. Distinguish between lyophilic and lyophobic colloids
24. Differentiate between theory and hypothesis.
25. What are phospholipids and their biological functions?
26. What are essential fatty acids?
27. State Vant-Hoff's law of osmotic pressure.
28. How are sugar acids formed?

Section-C (Short Essay)

Answer any **five** questions

29. Write short note on types of knowledge?
30. Explain hypothetico-deductive model.
31. Explain Donnan-membrane equilibrium and its biological significance.
32. Write a short essay on lipoproteins?
33. What are the requirements for planning an experiment?
34. Describe the chemistry and functions of cholesterol.
35. Distinguish between starch and glycogen.
36. Write a short note on prostaglandins?

Section-D (Long Essay)

Answer any **two** questions

37. Elaborate on the various experimental approaches to study biochemical process?
38. Give an account of the classification and biological functions of lipids?
39. Describe the chemistry and functions of glycosaminoglycans

SEMESTER II

BC 1221: Foundation Course-II
Course Title: GENERAL INFORMATICS AND BIOINFORMATICS

Credits: 3 **No. of Contact Hours: 36**
Hours/Week: 2 **(L, T, P, C - 2, 1, 2, 3)**

Objectives: To provide a basic idea about the application of biological data bases and general informatics.

Course Outline

Module I (5 hrs)

Overview of information technology: Features of modern personal computer and peripherals - computer networks and Internet - purchase of technology - Overview of operating system and major applications of software.

Core Text:

- Alexis and Mathews Leon, Fundamentals and Information and Technology. Leon Vikas ISBN 08125907890.

Module II (6 hrs)

Data information and knowledge - Knowledge management - internet as knowledge repository - academic search techniques – Basic concepts of IPR, copy right and patents, plagiarism - Introduction to use of IT in teaching and learning - Case study of educational software, INFLIBNET, NICNET,.BRNET- academic services.

Core Text:

- Alexis and Mathews Leon, Fundamentals and Information and Technology. Leon Vikas ISBN 08125907890.

Module III (6 hrs)

Data handling in Science and Biostatistics: significance of statistical methods in biological investigations, sampling techniques, probability theory, random variables, distribution function point, interval estimation, multiple linear regression and correlation. student's t-test, Data presentation - graphics, tables, histograms and pi diagrams- scientific information. (Basic theoretical aspects only).

Core Text:

- An Introduction to Biostatistics: A Manual for Students in Health Sciences by P. Sundar Rao, J. Richard publishers: Prentice-Hall Pvt. Ltd. ISBN 81-203-1008-X.

Biomolecules in Bio Informatics

Module IV (7 hrs)

Chemistry of Amino acids and Proteins**:** Amino acids- classification, structure and important reactions. Zwitter ion, isoelectric point. Essential and non essential amino acids. Peptides, solid phase synthesis. Proteins- classification. Structure of proteins – primary, secondary, tertiary and quaternary structure, forces stabilizing the structure of proteins , determination of primary structure- N-terminal, C-terminal residues (One method each). Chemical reactions, purification, precipitation reactions - salt effect, heavy metal precipitation, colour reactions and denaturation of proteins. Hemoglobin and plasma proteins (out line only)

Core Text:

- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6

Module V (6 hrs)

Nucleic acid – Nature of genetic material, structure of purines and pyrimidines, nucleosides, nucleotides. Structure of nucleic acids – Watson – Crick DNA double helix, introduction to circular DNA, supercoiling, helix to random coil transition – denaturation of nucleic acids, hyper chromic effect, Tm-values , cot curves and their significance. Types of RNA and DNA, unusual bases in nucleic acids.

Core Text:

- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6

Module VI (6 hrs)

Bioinformatics: 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 and structural bioinformatics.

Core Text:

- Bioinformatics: A Beginner's Guide. By Jean-Michel Claverie and Cedric Notredame; Wiley Publishing, Inc.2003.

Suggested Readings:

- Alexis and Mathews Leon, Fundamentals and Information and Technology. Leon Vikas ISBN 08125907890.

- Lehninger Principles of Biochemistry, Fourth Edition by David L. NelsonPublisher: W. H. Freeman; Fourth Edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with CDrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Bioinformatics: A Beginner's Guide. By Jean-Michel Claverie and Cedric Notredame; Wiley Publishing, Inc.2003.
- Bioinformatics: A Practical approach. K.Mani and N.Vijayaraj, Aparnaa Publication, 2004.
- Introduction to Bioinformatics T.K. Atwood and D.J. Parry – Smith publisher Pearson Education Pvt. Ltd ISBN 81-7808-507. 2002.

BC 1221: Practical for BC 1221 -P_2

No. of Contact Hours: 36

Hours/week: 2

1. **Bioinformatics:**
   - Internet basics
   - Introduction to NCBI Web sites
   - Introduction to Data bases

2. **General reactions of Amino acids & Proteins**

   - **Amino acids**-Tests- Solubility, Ninhydrin reaction, Xanthoproteic reaction, Millons test, Morners test, Glyoxalic acid test, Ehrlich's test, Nitroprusside test, Lead acetate, Test for Methionine, Aldehyde test, Sakaguchi reaction, Isatin test.

   - **Proteins**-Tests-Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's, Lowry, Heat denaturation, TCA precipitation, Metal precipitation, Alcohol precipitation.

References

- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.
- ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.
- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Despande(ed). I.K International Pvt. LTD, NewDelhi. ISBN 81-88237-41-8.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.

Model Question Paper
BC 1221: Foundation Course-II (Core related)
Course Title: General Informatics and Bioinformatics

Section A

Objective questions, Answer **all 16** questions

I.

1. The commonly used tool for searching sequence data base is
   a) FASTA b) SCOP c) Genebank d) BLAST

2. What is a PROSITE?
   a) Data base of protein structure b) Data base of interacting structures
   c) Database of protein motifs d) a search tool

3. Two main features of any phylogenetic trees are
   a) Clades and notes b) topology and branch length c) clades and root d) all of the above

4. Which protocol is used by browsers to communicate between two machines?
   a) Fttp b) ssl c) tcp d) http

II

5. The following is a non-protein amino acid
   a) Ornithine b) Homocysteine
   c) Histamine d) all of the above

6. Which of the following is a nucleoprotein?
   a) Hemoglobin b) Histones c) Rhodopsin d) Ferritin

7. The three dimensional arrangement of all atoms in a protein constitute
   a) Primary b) Secondary c) Tertiary d) Quaternary

8. Sanger's reagent is
   a) Chloro benzene b) 2, 4-DNFB c) Dansyl chloride d) none of the above

III

9. Adenosine is a
   a) Base b) Nucleoside c) Nucleotide d) Nucleic acid

10. Left handed helical DNA is
    a) A-form b) B-form c) Z-form d) cDNA

11. The amino acid which is optically inactive
    a)Valine b) Glycine c) Arginine d) Leucine

12. The imino acid found in protein structure is
    a) Arginine b) Proline c) Histidine d) Lysine

IV

13. Which of the following is a dipeptide?
    a) Glutathione b) Oxytocin c) Homocysteine d) Anserine

14. Which among the following is an oligomeric protein?
    a) Myoglobin b) Hemoglobin c)Albumin d)Urease

15. The only amino acid having buffering capacity at physiological pH is
    a. Alanine b. Glutamate c. Histidine d. Tryptophan

16. The alphabet 'Q' stands for which amino acid?
    a. Glutamate b. Asparagine c. Tryptophan d. Glutamine

Section-B (Short Answer Questions)

Answer any **eight** questions

17. How are peptide bonds formed? Illustrate with an example.
18. Give the structure of GTP.
19. What is the significance of Tm value?
20. Name four unusual bases?
21. What are conjugated proteins? Give two examples?
22. What is IPR?
23. What is plagiarism?
24. What are zwitterions? Illustrate the zwitter ion form of any two amino acids.
24. What is meant by DNA supercoiling?
25. What is Swissprot?
23. What is correlation coefficient and its significance?
24. What are nucleosomes?
25. State Chargaffs rule of base equivalence.
26. What is hyperchromic effect?
27. What are essential amino acids? Give examples?
28. Give the structural details of tRNA?

Section-C (Short Essay)

Answer any **five** questions

29. Write short note on academic search engines?
30. What are cot curves and their significance?
31. Write short note on nucleic acid databases?
32. Give a brief account of organism specific databases?
33. Explain the features of Watson Crick model of DNA.
34. Write short note on plasma proteins?
35. Write a short essay on educational softwares?
30. Give an account of the different types of RNA?
31. Explain Edmans method of N-terminal aminoacid sequencing.
32. Give an outline of amino acid classification?.
33. Give an account of the different precipitation reactions of proteins?
34. Explain the forces stabilizing protein structure.

35. Give a brief account of operating systems?
36. Write a short note on Hemoglobin?

Section-D (Long Essay)

Answer any **two** questions

37. Explain the different modes of representation of statistical data.
38. Give a detailed account of the different types of databases?
39. Discuss on the different levels of strucutral organization of proteins..

SEMESTER-III

BC1341: Core Course II
Course Title: Cellular Biochemistry

No. of Credits: 3 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C – 3, 1, 2, 3)**

Objectives: To prepare the students for understanding biological systems at cellular level by imparting necessary knowledge that underpins various concepts in Cell Biology and to describe the structural characteristics, functional properties and regulation of enzymes.

Course Outline

Module I (12 hrs)

Fundamentals of cells **:**Discovery of cell and Cell Theory; Comparison between plant, animal and microbial cells, Prokaryotic and Eukaryotic cell, Subcellular fractionation, Structure and functions of animal cell- Nucleus, Mitochondria, Ribosomes, Endoplasmic Reticulum, Golgi Complex, Lysosomes.

Core Text:

- Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York ISBN 978 0470-16961-2, 5th Edition.
- Biochemistry by Lubert Stryer, W.H Freeman and Company ISBN 0-7167-2009-4, 4th Edition.

Module II (9 hrs)

Plasma membrane**:**, Structure and Function-models of membrane structure, Membrane fluidity, Transport across membranes, cell wall, Exocytosis, Endocytosis, Simple diffusion, Facilitated diffusion, Symport, Uniport and Antiport, Active transport- primary and secondary active transport, ion channels.

Core Text:

- Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York ISBN 978 0470-16961-2, 5th Edition.
- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module III (7 hrs)

Cell division: Major cell cycle events**,** different phases of cell division- mitosis and meiosis, outline study of apoptotic pathways, basic properties of cancer cell.

Core Text:

- Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York ISBN 978 0470-16961-2, 5th Edition.
- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.

Module IV (4 hrs)

Interaction between cells and their environment: Extracellular space- ECM, interaction of cells with extracellular materials, interaction of cells with other cells, cell adhesion: desmosomes, tight junction, gap junction, plasmodesmata, cell wall (brief description only).

Core Text:

- Cellular and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York ISBN 978 0470-16961-2, 5th Edition.

Module V (10 hrs)

Enzymes: Classification of enzymes, holoenzyme, apoenzyme, prosthetic group, enzyme specificity, active site, activation energy, , enzyme units-definition of IU, Katal, enzyme turnover number, specific activity, ribozymes, abzymes, coenzymes and their functions, one reaction involving NAD, NADP, FAD, FMN, Lipoic acid, TPP, PLP and Biotin.

Core Text:

- Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7.
- Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher: Harwood Publishing Limited ISBN: 1904275273 ISBN-13: 9781904275275, 978-1904275275.

Module VI (12 hrs)

Enzyme Kinetics**:** Order of reaction, factors affecting velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators, derivation of Michaelis- Menten equation, Km and Vmax, Lineweaver- Burk plot (for single enzyme catalyzed reaction). Enzyme inhibition- competitive and noncompetitive inhibition., allosteric regulation. Zymogens, Isozymes.

Core Text:

- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.
- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Note on course work: The course will permit the student to understand the world of Cellular Biochemistry.

BC 1341: Practical for BC 1341 - P_3

No. of Contact Hours: 36

Hours/week: 2

1. **Qualitative analysis of Carbohydrates.**
   Carbohydrates-Glucose, Fructose, Galactose, Xylose, Sucrose, Maltose, Lactose, Starch & Dextrin
   Tests- Molisch's test, Anthrone test, Fehling's test, Benedict's test, Picric acid test, Barfoed's test, Bial's test, Seliwanoff's test, Foulger's test, Phloroglucinol test, Mucic acid test, Iodine test, Hydrolysis of Sucrose and Starch, Osazone test.

2. **Qualitative analysis of Lipids**

   - **Fatty acids**: Stearic acid, Oleic acid.
     Tests- Solubility, Translucent spot tests, Test for Unsaturation
   - **Glycerol**
     Tests- Acrolein, Solubility.
   - **Triglycerides**
     Tests-Solubility, Saponification, Translucent spot test
   - **Cholesterol**
     Tests- Solubility, Salkowski reaction, Liebermann-Burchard reaction.

3. **Enzyme Assays**

   - Urease/Trypsin
   - Progress curve of Urease /Trypsin

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.
- ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.

Model Question Paper
BC 1341: Core Course II
Course Title: Cellular Biochemistry

Section A

Objective questions, Answer **all 16** questions

I.

1. Which of these organelles is involved in hydrolyzing activity?
   a. Peroxisome b. Lysosomes c. Glyoxisomes d. Ribosome

2. Common feature of prokaryotes and eukaryotes include
   a. mitochondria b. chloroplast c. ER d. Genetic material

3. The protein involved in vesicle transport
   a. Dyneins b. Tubulin c. Actin d. kinesins

4. Plasma membrane has the following feature except
   a. it has a lipid bilayer b. it is involved in transport of ions
   c. it is symmetric in nature d. it consists of protein

II. 5. Membrane fluidity is increased by
   a. increase in long chain fatty acids b. increase in cholesterol
   c. increase in unsaturated fatty acids d. Decrease in unsaturated fatty acids

6. The following has ATPase activity except is
   a. Myosin b. Dyneins c. Kinesins d. Subfibre B

7. Defect in which of the following components of ECM results in Ehler Danlor syndrome (Estrogen imperfecta)
   a. Fibronectin b. Collagen c. Laminin d. Proteoglycan

8. Non-fibrous gel matrix in cell wall consists of the following except
   a. Protein b. Cellulose c. Hemicellulose d. Pectin

III. 9. One of the following is an antiapoptotic member
   a. Bax b. Bcl-2 c. Bcl-x_L d. Bcl W

10. Which of the following is a reductional division?
   a. Mitosis b. Meiosis c. Cytokinesis d. Prophase

11. Binding of insulin to its receptor initiates a signal transduction pathway resulting in all of the following except
   a. Glucose uptake b. glycogen synthesis c. glycogen breakdown d. gluconeogenesis

12. cAMP activates
   a. protein kinase A b. protein kinase B c. protein kinase C d. protein kinase D

IV.

13. Ribozymes are
a Proteins b Ribonucleoprotein c Catalytic Antibody d Ribosomes

14. Class of enzymes involved in transfer of electrons
a. Hydrolases b. Oxidoreductases c. Ligases d. Transferases

15. Enzyme activity
a. Increases with pH
b. Decreases with pH
c. Remain unchanged with change in pH
d. Effect of pH varies among enzymes.

16. Competitive inhibitors
a. Increases V_{max} and K_m
b. Decreases V_{max} and K_m
c. Increase V_{max}
d. Increase K_m

Section-B (Short Answer Questions)
Answer any **eight** questions

17. Give any 2 difference between prokaryotes and eukaryotes.
18. How do SER and RER differ from each other structurally?
19. Mention the action of Colchicine and Taxol.
20. Give 2 functions of plasma membrane.
21. What is tight junction? Mention its significance.
22. What are the compositional transformations during synthesis of cell wall?
23. What is apoptosis? Give an example for a pro apoptotic protein
24. Differentiate between benign and malignant tumor.
25. Give any two receptors involved in signal transduction.
26. Differentiate between Holoenzyme and Apoenzyme
27. Name two enzymes in which TPP acts as coenzyme
28. What is the significance of Q_{10} ?

Section-C (Short Essay)
Answer any **five** questions

29. Give the diagram of mitochondria and chloroplast/ what are their functions
30. Differentiate between SER and RER.
31. Write the role of cilia and flagella in movement
32. Write the role of extra cellular matrix
33. What are the different phases of mitosis? Describe
34. Why is p53 called the guardian of the genome?
35. Comment on the Isozymes of LDH in muscle and heart with respect to Km for pyruvate.
36. Write note on competitive, non-competitive and un-competitive inhibitors.

Section-D (Long Essay)
Answer any **two** questions

37. Describe the various modes of transport across the membrane
38. Explain with diagram the phases of meiosis
39. Write an essay on signaling pathways involving protein kinases A, B and C?

SEMESTER-IV

BC 1441: CORE COURSE III
Course Title: Techniques in Biochemistry

No. of Credits: 3 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C – 3, 1, 2, 3)**

Objective: To familiarize the students with the principle, functioning and applications of biological equipments and to introduce them to the basics of research methodology.

Course Outline

Module I (12 hrs)

Microscopy: Simple, compound, electron microscope, phase contrast microscope (Principle, instrumentation & applications) Colorimetry and Spectrophotometry: Beer- Lambert's law, Absorption and transmission of light, absorption spectra**, c**olorimeter and spectrophotometer- instrumentation & applications), fluorimetry, flame photometer (principle, instrumentation, applications)

Core Text:

- *Principles and Techniques of Practical Biochemistry* by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X.

Module II (6 hrs)

Methods of tissue homogenization, salt and organic solvent extraction and fractionation, dialysis, reverse dialysis, ultra filtration, lyophilization.

Core Text:

- *Principles and Techniques of Practical Biochemistry* by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X.

Module III (10 hrs)

Chromatograph**y:** Principle, procedure and application of partition chromatography, adsorption chromatography, ion exchange chromatography,TLC, Paper chromatography gel filtration chromatography, affinity chromatography, gas liquid chromatography, High performance liquid chromatography.

Core Text:

- *Principles and Techniques of Practical Biochemistry* by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X Pg no. 462-527.

Module IV (7 hrs)

Electrophoresis**:** Principle, procedure and application of electrophoresis (paper, gel, PAGE, SDS-PAGE), isoelectric focusing,

Core Text:

- *Principles and Techniques of Practical Biochemistry* by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X.

Module V (7 hrs)

Centrifugation: Principle, procedure and application of sedimentation technique, Rotors (swinging bucket and fixed angle), different types of centrifugation: differential density gradient and ultra centrifuge.

Core Text:

- *Principles and Techniques of Practical Biochemistry* by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X.

Module VI (12 hrs)

Radioactivity and isotopes: Basic concepts of radioisotopes, types of radioisotopes used in biochemistry, unit of radioactivity measurements, disintegration constant, half life, techniques used in radioactivity (scintillation and Geiger Muller counter), isotopes used in tracer studies, biological hazards of radiation, safety measures in handling radioisotopes (brief study), biological applications of radioisotopes.

Core Text:

- Principles and Techniques of Practical Biochemistry by Keith M. Wilson, John M. Walker, 4th edition. Cambridge University Press, ISBN 052149849-X.

Suggested Reading:

- A Biologist's Guide to Principles and Techniques of Practical Biochemistry by BryanL.Williams, Keith Wilson Hodder Education, ISBN 071312461X (0-7131-2461-X)
- Principles and Techniques of Practical Biochemistry by Keith M. Wilson, John M. Walker Cambridge University Press, ISBN 0521428092 (0-521-42809-2)
- The Tools of Biochemistry by Cooper, T. G. 1977. Publisher: John Wiley & Sons
- Biophysical Chemistry Principles & Techniques Handbook (2003) by Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath Publisher: Himalaya Publishing House ISBN: 8178665883 ISBN-13: 9788178665887, 978-8178665887
- Physical Biochemistry by David Freifelder Publisher: W.H.Freeman & Co Ltd (September 1976) ISBN-10: 0716705591 ISBN-13: 978-0716705598
- Research Methodology For Biological Sciences (2006) by Gurumani N Publisher: MJP Publishers ISBN: 8180940160 ISBN-13: 9788180940163, 978-8180940163
- Instrumental Methods Of Chemical Analysis (2006) by M.S. Yadav Publisher: Campus Books International ISBN: 8187815620 ISBN-13: 9788187815624, 978-8187815624

NOTE ON COURSE WORK: The Course will enable the students to have a practical understanding of methodology involved in Biochemistry.

Model Question Paper
BC 1441: Core Course III
Course Title: Techniques in Biochemistry

Section A

Objective questions, Answer **all 16** questions

I.

1) The size of the colloidal particles can be determined by
(a) Dialysis (b) Centrifugation (c) Ultrafiltration (d) Chromatography

2) The technique used for understanding cellular function and metabolism by studying sub cellular organelles
(a) Microscopy (b) Lyophilization (c) Homogenization (d) Centrifugation.

3) In gel filtration chromatography, particles are separated based on
(a) Size and Shape (b) Charge (c) Number (d) density

4) A technique which uses high pressure for the separation of molecule is
(a) TLC (b) GLC (c) HPLC (d) Paper chromatography

II. 5) UV rays fall in the range of
(a)180-400 nm (b)400-800 nm (c) > 800 nm (d) < 180 nm

6) Spectrophotometer is used for measuring
(a) Colourless substance (b) Coloured substance (c) Both A and B (d) None

7) In flame photometry air with propanol mixture is used for the separation of
(a) K (b) Ca (c) Mg (d) Fe

8) Equation for disintegration constant
(a) $\lambda=2.303 \log (N/No)/t$ (b) $\lambda=2.303 \log(No/N)/t$
(c)$\lambda= t/2.303 \log N0/N$ (d) $\lambda= t/2.303 \log N/No$

III. 9) Commonly used radioactive isotope for the diagnosis of hyper and hypothyroidism
(a) ^{24}Na (b) ^{131}I (c) ^{34}P (d) ^{42}K

10) The phenomenon of radioactivity was discovered by
(a) Rutherford (b) Henry Becquerel (c) Curie (d) Roentgen

11) Radiocarbon dating is done with the help of
(a)^{14}C (b)^{238}U (c)^{15}N (d)^{3}H

12) Equation for half-life period
(a) $t_{1/2}= 0.693/ \lambda$ (b) $t_{1/2}= \lambda/0.693$ (c) $t_{1/2}= 6.93/ \lambda$ (d) $t_{1/2}= 69.3/ \lambda$

IV.13) In Isopycnic centrifugation molecules are separated based on
(a) Charge (b) Size (c) Density (d) Shape

14) An agent which denature protein in SDS-PAGE
(a) SDS (b) Amidoblack (c) Sephadex (d) Dowex 50

15) Ionizing radiations when absorbed by a tissue increases the temperature, this effect is
(a)Photoelectric effect (b) Photographic effect
(c) Calorigenic effect (d) Chemical effect

16) Radioactive isotope used for knowing the formation of antibody in the Recticuloendothelial system
(a) ^{34}P (b) ^{24}Na (c) ^{42}K (d) ^{59}Fe

Section-B (Short Answer Questions)

Answer any **eight** questions

17) Name any two detectors used in spectrophotometer.
18) Define quanta efficiency
19) List the factors affecting electrophoretic mobility in electrophoresis
20) What is the difference between stacking gel and separating gel in PAGE.
21) What are the applications of Ultracentrifugation?
22) What is isoelectric focusing?
23) Define sedimentation co-efficient.
24) What is the basic principle of flame photometer?
25) What are the biological applications of radioisotopes?
26) State Beer-Lamberts law.
27) Define half-life of radioactive isotopes with two examples
28) What is the principle behind chromatographic techniques?

Section-C (Short Essay)

Answer any **five** questions

29) Write notes on fluorimetry.
30) Outline the principle of paper chromatography. Explain its applications.
31) Briefly explain electron microscopy.
32) Explain the methods used in tissue homogenization.
33) Explain the working of confocal microscope.
34) Differentiate Scintillation counter from GM Counter.
35) Write short note on affinity chromatography?
36) Give an account of two-dimensional electrophoresis?

Section-D (Long Essay)

Answer any **two** questions

37) Discuss in detail about the principle, procedure and applications of Zone electrophoresis.
38) Explain:-
a) Calorimeter. b) Differential Centrifugation
b) Isotopes used in tracer study d)Determination of molecular mass by gel filtration
39) What are the biological hazards of radiations and explain the safety measures in handling the radioisotopes.

Core Course-IV

BC 1442: Practical IV - P_4

No. of Credits: 2 **No. of Contact Hours: 36**
Hours/week: 2

1. Qualitative analysis of Amino acids and Proteins

Amino acids- (Tyrosine, Tryptophan, Histidine, Arginine, Cysteine, Cystine, Proline, Methionine) (single components only need be given)

Tests- Solubility, Ninhydrin reaction, Xanthoproteic reaction, Millons test, Morners test, Glyoxalic acid test, Ehrlich's test, Nitroprusside test, Lead acetate, Test for Methionine, Aldehyde test, Sakaguchi reaction, Isatin test

Proteins-Ovalbumin and Casein

Tests-Solubility, Ninhydrin reaction, Xanthoproteic reaction, Folin's test, Lowry's test, Biuret test, Heat denaturation, TCA precipitation, Metal precipitation, Alcohol precipitation.

2. Chromatographic Techniques

- Demonstration of different types of paper chromatography.
- Separation and identification of aminoacid mixture by Paper chromatography
- Thin Layer Chromatography
- Extraction and quantification of total lipids.
- Separation of lipids by TLC.

References

- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.
- ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.

SEMESTER-V

BC 1541: Core Course V
Course Title: Physiology & Immunology

No. of Credits: 4 **No. of Contact Hours: 72**
Hours/week: 4 **(L, T, P, C – 4, 1, 0, 4)**

Objective: This course aims at providing an idea regarding the physiological functions of the biological system and to discuss the basics of immunology and immunological techniques.

Course Outline

Module I **(15 hrs)**

Blood, Plasma, blood cells. Plasma proteins and their functions. Hemoglobin - structure, functions, degradation (bile pigment formation) & abnormal hemoglobins. Fe metabolism- absorption,transport & hemostasis, Blood coagulation: intrinsic and extrinsic coagulation, Anticlotting systems, Anticlotting drugs, Bleeding time, coagulation time. Hemopoiesis: blood forming organs, erythropoeisis, leukopoiesis. Blood group classification.

Core Text:

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

Module II **(15 hrs)**

Partial pressure of gas, chemical and physiological events affecting the diffusion of O2 and CO2. Exchange of Gases in Alveoli and Tissues, Transport of Oxygen in Blood, Effect of PO_2 on Hemoglobin Saturation, Effects of Blood PCO_2, H^+ Concentration, Temperature, and DPG concentration on Hemoglobin Saturation, Transport of Carbon Dioxide in Blood. O_2 dissociation curve. Hill plot, carbonic anhydrase reaction. Acid base balance: Body water balance, buffers in blood, Respiratory acidosis and alkalosis, metabolic acidosis and alkalosis

Core Text:

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.

Module III **(10 hrs)**

Muscle : Structure of muscle, muscle proteins, energy sources for muscle contraction, sliding filament theory. Rigor mortis Muscle contraction in skeletal muscles. Structure of neuron, Glial cells, Graded potential and action potential, Ionic basis of action potential, Threshold and all or none response, Refractory period, Excitatory and inhibitory chemical synapses, Neurotransmitters and neuromodulators. Bone: composition, role of Ca, P and Vitamin D in bone formation.

Core Text:

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.

Module IV **(8 hrs)**

Hormones secreted by thyroid, pituitary, adrenal and pancreas. Site of biosynthesis. Chemical structure of the following hormone: Thyroxine, Cortisone, Cortisol, Epinephrine, Norepinephrine, Deoxycorticosterone, aldosterone, Testosterone and Estradiol.

Core Text:

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.

Module V **(12 hrs)**

Basics of immunology: Basic concepts of immunity: Types of Immunity-innate immunity, mechanical protection and chemical protection, phagocytosis, inflammation. Adaptive immunity-humoral and cell mediated immunity. Organs and cells of adaptive immune system, antigen, Antigen presenting cells, clonal selection of lymphocytes, antibody- formation of antibody. Immunoglobulins- structure, classification and function, haptens. Primary and Secondary Immune responses.

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module VI **(12 hrs)**

Antigen - antibody interactions: Precipitation reactions, Agglutination reaction. Immunological techniques: ELISA, RIA, Immunodiffusion and Immunofluorescence – (Principle, methodology and application expected), Production of monoclonal antibodies (Hybridoma technology) - use in diagnosis and therapy.

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Suggested Readings:

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.
- Textbook of Medical Physiology, 11/e with Student Consult Access (2005) by Arthur C Guyton, John E Hall Publisher**:** Else ISBN: 8181479203 ISBN-13: 9788181479204**,** 978-8181479204.
- Human Physiology (2001) by Bipin Kumar Publisher: Campus Books International ISBN: 8187815604 ISBN-13: 9788187815600, 978-8187815600
- Human Physiology (2001) by KC Sawant Publisher: Dominant Publishers & Distributors ISBN: 8178880202 ISBN-13: 9788178880204, 978-8178880204
- Human Physiology (2001) by Andrew Davies, Asa Gh Blakeley, Cecil Kidd Publisher**:** Churchill Livingstone ISBN**:**0443046549, ISBN-13**:** 9780443046544, 978-0443046544

- Principles Of Biochemistry, 6e (1959) by Abraham White, Philip Handler Publisher: Tata McGraw-hill Publishing Company Limited ISBN:0070590494 ISBN-13: 9780070590496, 978-0070590496
- Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning (Thompson) ISBN: 8131500039, ISBN-13: 9788131500033, 978-8131500033
- Immunology and Immunotechnology by Chakravarty (2006) Publisher: Oxford University Press N Delhi ISBN: 0195676882, ISBN-13: 9780195676884**,** 978-0195676884
- Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8131711587 ISBN-13: 9788131711583**,** 978-8131711583
- Immunology by K.R. Joshi **(**2007) Publisher: Agrobios (India) ISBN**:** 8177541749, ISBN-13: 9788177541748**,** 978-8177541748
- Immunology by Roitt Publisher: Mosby ISBN: 0702025496 ISBN-13: 9780702025495**,** 978-0702025495

NOTE ON COURSE WORK: The course will enable the students to understand the various physiological aspects of our body.

Model Question Paper
BC1541: Core Course-V
Course Title: Physiology & Immunology

Section A

Objective questions, Answer **all 16** questions

1) 1. A small molecule which can act as an epitope but id incapable of itself eliciting an immune response is called
(a) Haptens (b) Kinins (c) Interferons (d) Perforins

2. The most important diffusible ion in the establishment of the membrane potential is
a K^+. b. Na^+. c. Ca^{2+}. d. Cl^-.

3. The movement of water across a plasma membrane occurs by
a active transport. b. facilitated diffusion. c. simple diffusion (osmosis). d. all of these.

4. Depolarization of an axon is produced by
a. inward diffusion of Na^+. b. active extrusion of K^+.
c. outward diffusion of K^+ . d. inward active transport of Na^+.

II.

5. A drug that inactivates acetyl cholinesterase
a. inhibits the release of ACh from presynaptic endings.
b. inhibits the attachment of ACh to its receptor protein.
c. increases the ability of ACh to stimulate muscle contraction.
d. does all of the these.

6. The hormone primarily responsible for setting the basal metabolic rate and for promoting the maturation of the brain is
a. Cortisol. b. ACTH. c. TSH. d. thyroxine.

7. Human Chorionic Gonadotropin (hCG) is secreted by
a. the anterior pituitary b. the posterior pituitary c. the placenta d. the thymus

8. The energy for muscle contraction is most directly obtained from
a. phosphocreatine. b. ATP. c. anaerobic respiration. d. aerobic respiration.

III.

9. When a muscle is stimulated to contract, Ca^{2+} binds to
a. myosin. b. tropomyosin. c. actin. d. troponin.

10. Which Ig is involved in allergic reactions?
(a)Ig M (b) Ig E (c)Ig A (d)Ig D

11. The maximum amount of air that can be expired after a maximum inspiration is
a. the tidal volume. b. the forced expiratory volume.
c. the vital capacity. d. the maximum expiratory flow rate.

12. Erythropoietin is produced by

a. the kidneys. b. the liver. c. the lungs. d. the bone marrow.

IV. 13. Which of these would be most affected by a decrease in the affinity of hemoglobin for oxygen?
a. arterial pO_2 b. arterial percent oxy hemoglobin saturation
c. venous oxy hemoglobin saturation d. arterial pCO_2

14. Antidiuretic hormone promotes the retention of water by stimulating
a. the active transport of water. b. the active transport of chloride.
c. the active transport of sodium. d. the permeability of the collecting duct to water.

15. Immunogen is a chemical substance which has
(a) Immunogenicity only (b) Reactivity only (c) Both (d) None

16. A substance that non-specifically enhance the immune response to an antigen is called
a) Haptens (b) Adjuvant (c) Carrier (d) Allergen.

Section-B (Short Answer Questions)

Answer any **eight** questions

17. List the differences between graded potentials and action potentials.
18. Discuss the relationship between dopamine, norepinephrine, and epinephrine.
19. What are the three general chemical classes of hormones?
20. Compare antibody mediated and cell mediated immune response?
21. What are primary lymphoid organs?
22. Which respiration steps occur by diffusion and which by bulk flow?
23. What do you understand by primary and secondary immune response?
24. Writes notes on inflammation.
25. What is the relationship between body sodium and extracellular-fluid volume?
26. Describe the formation and action of 1, 25-(OH)2D3.
27. How does parathyroid hormone influence the production of this hormone?
28. What are the different classes of immunoglobulins?

Section-C (Short Essay)

Answer any **five** questions

29. Explain the role of calcium and phosphorous in bone formation?
30. Explain ELISA technique.
31. Describe the effects of increased *P*CO2, H+ concentration, and temperature on the oxygen hemoglobin dissociation curve. How are these effects adaptive for oxygen unloading in the tissues?
32. List all six well-established anterior pituitary hormones and their functions.
33. Describe the four steps of one cross-bridge cycle.
34. Describe the role and source of calcium ions in initiating contraction in skeletal muscle.
35. How are monoclonal antibodies produced?
36. Describe the various organs of immune system.

Section-D (Long Essay)

Answer any **two** questions

37. Describe the sequence of events that cause air to move into the lungs during inspiration and out of the lungs during expiration. Diagram the changes in intrapleural pressure and alveolar pressure.
38. Describe the salient features of the different types of Immunoglobulins giving details of heavy and light chains.
39. Illustrate the sequence of events when peptide and steroid hormones bind to their receptors.

SEMESTER-V

BC 1542 : Core Course VI
Course Title: Bioenergetics and Carbohydrate Metabolism

No. of Credits: 3 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C – 3, 1, 0, 3)**

Objective: The course aims at providing an overview of bioenergetics and energy production by explaining the general principles of cellular energy metabolism and schematizing the oxidative pathways of carbohydrates

Course Outline

Module I (8 hrs)

Bioenergetics: Concept of free energy, standard free energy change and actual free energy change, energy rich compounds, types of energy rich compounds, reason for negative value of ΔG of hydrolysis, Biological oxidation- reduction reactions, relation between standard reduction potential, free energy change.

Core Text:

- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.
- Textbook of Biochemistry by Thomas M Devlin, John Wiley & Son, Inc. New York ISBN 13 978-0-471-67808-3/2 6th Edition.

Module II (6 hrs)

Intermediary Metabolism**:** Catabolism and anabolism, metabolic pathways, experimental approaches in metabolism.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module III (14 hrs)

Carbohydrate metabolism (Structures, energetics and regulation of pathways) : Glycolysis (aerobic and anaerobic), entry of other sugars into glycolytic pathway, oxidative decarboxylation, TCA cycle, HMP shunt, gluconeogenesis, galactose & fructose metabolism, anaplerotic reaction, glyoxalate cycle, errors in carbohydrate metabolism-galactosemia, fructosuria, fructose intolerance, lactose intolerance.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module IV (8 hrs)

Glycogen Metabolism**:** Glycogenesis, glycogenolysis, Cori cycle (structures & regulation), Glycogen storage diseases: Von Gierke, Pompes, Cori's or Forbe's, Anderson, Her's, McArdle, Tarui's, Type IX and Fanconi- Bickel).

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module V (8 hrs)

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), sites of ATP synthesis, inhibitors of electron transport chain.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module VI (10 hrs)

Oxidative phosphorylation: Sites of ATP production, hypothesis of mitochondrial oxidative phosphorylation (basic concept), P/O ratio, inhibitors and uncouplers, transport of reducing potentials into mitochondria.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6..

Suggested Readings:

- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6..
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with CDrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757.
- Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365

- Biochemistry 6th Edition (2007) by Jeremy M.Berg John L.Tymoczko Lubert Stryer Publisher: B.I.Publications Pvt. Ltd ISBN:071676766X ISBN-13: 9780716767664, 978-716767664
- Biochemistry (2008) by Rastogi Publisher: McGraw Hill ISBN:0070527954 ISBN-13: 9780070527959, 978-0070527959

Note on Course Work: The course will provide a broad idea regarding bioenergetics and cellular respiration.

Model Question Paper

BC 1542: Core Course VI
Course Title: Bioenergetics and Carbohydrate Metabolism

Section A

Objective questions, Answer **all 16** questions

I

1. Following are high energy compounds except
   a) ATP b) PEP c) Glucose-6-phosphate d) Creatinine phosphate

2. A reaction is spontaneous when
   a) ΔG is −ve b) ΔG is +ve c) ΔG is 0 d) not dependent on ΔG

3. In eukaryotes Glycolyis occurs in
   a) Endoplasmic Reticulum b) Cytosol c) Mitochondria c) Golgibodies

4. Rate limiting enzyme in glycolysis is
   a) Hexokinase b) Glucokinase c) Phosphofructokinase d) Pyruvate Kinase

II

5. Gluconeogenesis involve the following enzymes except
   a) Glucose-6- phosphatase b) PEP carboxykinase
   c) Fructose-1, 6- bis phosphatase d) Glyceraldehyde-3-phosphatase

6. Glyoxalate cycle occurs in
   a) Peroxisome b) Glyoxisomes c) Lysosomes d) Microsomes

7. Which of the following disease is not a glycogen storage disease?
   a) Her's disease b) McArdle's disease c) Addison's disease d) Pompe's disease

8. The coenzyme for Transketolase is
   a) PLP b) CoA c) TPP d) Lipoic acid

III

9. Complex in Electron transport chain that has Copper
   a) Complex I b) Complex II c) Complex III d) Complex IV

10. Complexes of Electron Transport Chain are situated in
    a) Outer mitochondrial membrane b) Inner mitochondrial membrane
    c) Matrix d) Inter membrane space

11. Disease occurring due to mitochondrial dysfunction
    a) Alkaptonuria b) LHON c) Beri beri d) Scurvy

12. ATP yield by the complete oxidation of glucose to CO_2 is
    a) 30 b) 25 c) 20 d) 15

IV

13. Dehydrogenases involved in HMP shunt are specific for
    a) $NADP^+$ b) NAD^+ c) FMN d)FAD

14. Which of the following glycolytic enzyme is inhibited by fluoride?
    a) Pyruvate kinase b) Enolase c) Aldolase d) Hexokinase

15. McArdle's disease is due to the deficiency of
    a) Branching enzyme b) Muscle Phosphorylase c) Glu-6-phosphatase d) Acid maltase

16. In normal resting humans, majority of blood glucose is used as fuel by
    a) Liver b) Brain c) Kidney d) Muscles

Section-B (Short Answer Questions)

Answer any **eight** questions

17. Differentiate standard free energy change and actual free energy change
18. Why is ATP considered a high energy compound?
19. Write down the equation for any one of the irreversible reactions of glycolysis?
20. Comment on the Hexokinase and Glucokinase with reference to their Km for Glucose.
21. Schematically represent Cori's cycle.
22. Comment on Anapleurotic reaction.
23. Differentiate between oxidative and substrate level phosphorylation.
24. Schematically indicate the site of action of any two inhibitors of Electron transport chain.
25. Calculate the energy yield in anaerobic breakdown of Glucose
26. Which metabolic defect causes galactosemia?
27. What is the role of Ca^{2+} in glycogen metabolism?
28. Write done the steps involved in NADPH synthesis in HMP shunt pathway?

Section-C (Short Essay)

Answer any **five** questions

29. How are reducing equivalents generated during glycolysis shuttled from cytosol to mitosol?
30. How does fructose-2, 6- bis phosphate act as a regulator of glycolysis?
31. Give the steps involved in synthesis of glucose from fructose.
32. Explain the action of glucagon on glycogenesis and glycogenolysis.
33. Which are the complexes involved in Electron transport chain?
34. Make a schematic representation of Glyoxalate cycle.
35. Comment on the metabolic fate of pyruvate
36. Explain Chemiosmotic hypothesis.

Section-D (Long Essay)

Answer any **two** questions

37. Write note on Glycogen metabolism.
38. Desribe with reaction the steps involved in TCA cycle.
39. What are high energy compounds? Explain.

SEMESTER-V

BC 1543: Core Course VII
Course Title: Analytical Biochemistry

No. of Credits: 3 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C – 3, 1, 0, 3)**

Objective: It aims at enabling the students to understand the fundamentals of Analytical Biochemistry. A sound knowledge of analytical biochemistry will help in understanding the assessment of nutrients, food preservation and food additives.

Course Outline

Module I (8 hrs)

Digestion and absorption: Digestion and absorption of carbohydrates, proteins, and fat. Enzymes involved in digestion and their action, composition and functions of bile, enterohepatic circulation. Vitamins-Fat and water soluble vitamins- Functions and deficiency diseases.

Core Text:

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.

Module II (8 hrs)

Nutrition: Calorific value. Calorie requirement, food energy BMR - Carbohydrates, fats and protein, minerals. Ca, P, Mg, Na, K, Cl, Iodine, Cu, Zn, Mn and Fe.

Core Text:

- Arthur Vander, James Sherman, and Dorothy Luciano Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition © The McGraw-Hill Companies.

Module III (10 hrs)

FOODS: Chemical composition: Outline study of materials- cereals, pulses, tubers, diary products, egg, fish, meat, fruits and fruit products, alcoholic beverages and soft drinks- coffee, tea and coconut. Edible oils and fats. Spices, molasses, jaggery, honey. Analysis for moisture content, total solid ash protein, total carbohydrates, reducing and non-reducing sugar, fat.

Core Text:

- Foods: Facts and principles, N. Sakunthala Manay and M. Shadaksharaswamy. 3rd edition, ISBN: 978-81-224-2215-3.

Module IV (10 hrs)

Food additives: Permitted colours, permitted food preservatives, emulsifying agents, flavouring agents, artificial sweeteners (saccharine). Preservation of foods: Anaerobic conditions. High temperature, low temperature drying with added preservatives. Food adulteration: elementary study-- detection of adulteration of edible oils and detection of saccharine.

Core Text:

- Foods: Facts and principles, N. Sakunthala Manay and M. Shadaksharaswamy. 3rd edition, ISBN: 978-81-224-2215-3.

Module V (10 hrs)

Microorganisms: microorganisms important in water: absorbed oxygen, BOD and COD in sample of water to test for pollution. Food microbiology: Microbiology of foods: fermentation: - milks, cheese, bread, production of alcohols, beverages, wine.

Core Text:

- Microbiology by Lansing M. Prescott, 5th edition ISBN: 0- 07-282905-2.

Module VI (8 hrs)

Toxicology: outline study of action and detection of alcohol in beverage, copper, lead, mercury, arsenic, cyanide and carbon monoxide.

Core Text:

- Parikh's Text book of Medical Jurisprudence and Toxicology, 5th edition, Dr. C. K. Parikh. ISBN: 81-239-0149-6.

Suggested Readings

- Advanced Text Book on Food and Nutrition, Vol I and II, Dr. M Swaminathan.2nd edition. The Bangalore Printing and Publishing Co Ltd.
- The essentials of Forensic Medicine and Toxicology, Dr. K. S. Narayan Reddy, 18th Edition
- Industrial Microbioloy, L. E. Casida J R ISBN: 0- 85226- 101- 2.
- Food processing and preservation: B. Sivasankar; ISBN: 81- 203- 2086- 7.
- Food Science and Technology, Bhupendra Singh Khatkar; ISBN: 81- 7035- 422- 6.
- Industrial Microbiology A H Patel; SBN: 033908422.
- Microbiology, Michael J Pelczar, E C S Chan, Noel R Krieg ISBN: 0- 07- 049234-4.
- Microbiology: AN introduction' Tortora, FUNKE, CASE
- Food Science, B. Sreelakshmi, 3rd edition, New Age International Pvt. Ltd, ISBN-8122420222
- Text Book of Microbiology, R C Dubey AND DK Maheswary, ISBN-8121926203.

Model Question Paper
BC1543: Core Course VII
Course Title: Analytical Biochemistry

Section A

Objective questions, Answer **all 16** questions

I. 1. Major portion of the digestion occurs in
a. the mouth. b. the stomach. c. the small intestine. d. the large intestine.

2. Saccharine is
a potassium meta benzene nitroxide. b. sodium orthobenzene sulphonamide. c. sodium dinitro benzene. d. sodium orthobenzene sulphoxide.

3. Eggs are excellent source of
a Vit A. b. Vit K. c.Vit C. d. Vit E.

4. Name the selenium containing enzyme
a. hexokinase b. superoxide dismutase c. glutathione peroxidase d. enolase

II.

5. Canning is a process of food
a. preservation. b. adulteration. c. grading. d. concentration.

6. Salivary amylase becomes inactive in stomach primarily due to
a. inactivation by low pH. b. degradation by gastric pepsin. c. inhibition by Cl^{--}. d. inhibition by peptides.

7. The most potent inhibitor of electron transport chain is
a. nitric acid. b. cyanide. c. ethyl alcohol. d. nitrous oxide

8. CO combines with hemoglobin to form
a. methemoglobin b.carboxy hemoglobin c.myoglobin d. haptoglobin

III.

9. Which one of the following is a preservative?
a. calcium sulphate. b. benzoic acid. c. calcium crbonate. d. sodium epoxide.

10. Iron in the mucosal cells binds with the protein.
a. transferring. b. ferritin. c. cereloplasmin. d. hemosiderin.

11. Which of the following micxroorganisms is used for the acid production in mesophilic milk fermentation process?
a. *Lactococcus lactis* b. *Clostridium botulinum* c. *Escheria coli* d. *Bacillus cereus*

12. A nutritional disorder due to protein energy malnutrition is
a. scurvy. b. kwashiorkor. c. tetany. d. beriberi.

IV. 13. Which one of the following is a micronutrient?

a. phosphorous b. calcium c. chromium d. sodium

14. Which of the following is most important essential fatty acid in the diet
a. linoleic acid b. palmitic acid. c. stearic acid. d. oleic acid

15. BMR is increased in
a. hyperthyroidism. b. hypothyroidism. c. marasmus. d. Bloom syndrome.

16. The essential amino acid limiting in rice
a. methionine b. tryptophan c. lysine d. histidine

Section-B (Short Answer Questions)

Answer any **eight** questions

17. Which are the major ingradients of soft drinks?
18. What is pasteurization?
19. Explain chemical oxygen demand?
20. What is the physiological effect of barbiturate?
21. Give two examples for food preservation.
22. Give the mode of action of lead and mercury as a poison?
23. What are artifical sweetners? Give two examples.
24. How is arsenic detected?
25. Write a note on BMR?
26. Write any one function of copper and zinc?
27. Write brief notes on enterohepatic circulation?
28. Describe the process of fat emulsification.

Section-C (Short Essay)

Answer any **five** questions

29. Write a note on food flavours?
30. Identify the enzymes involved in carbohydrate digestion and the mechanism of carbohydrate absorption in the small intestine.
31. Write the composition of (a) Bengal gram (b) Green gram?
32. What is the mode of organophosphorous insecticide? How are they detected?
33. Write a brief account of water pollution?
34. Write a note on CO poisoning/.
35. Indicate different diary products and their chemical nature?
36. Write the composition of bile?

Section-D (Long Essay)

Answer any **two** questions

37. Write the importance of microorganisms in water and food microbiology?
38. Explain the different methods used in preservation of food?
39. Discuss the importance of trace elements in human nutrition?

SEMESTER-V

BC 1544: Core Course VIII

Course Title: Classical and Molecular Genetics

No. of Credits: 4 **No. of Contact Hours: 72**
Hours/week: 4 **(L, T, P, C – 4, 1, 0, 4)**

Objective: To create awareness about the molecular details of the biological system and to describe the events encompassing the central dogma of molecular biology

Course Outline

Module I (15 hrs)

Role of genetics in Biology**:** Model genetic organisms. Basic principles of heredity- monohybrid, dihybrid and test cross (pea plant). Dominance, co-dominance and incomplete dominance. Extensions of Mendelian principles- Gene interactions(complementary, supplementary, duplicate factor), epistasis, penetrance, expressivity, genetic anticipation and genomic imprinting(definition with examples). Sex linked characteristics (Drosophila). Maternal inheritance (paramecium, shell coiling in snail, male sterility in maize) and maternal effect. Pedigree analysis and applications (autosomal dominance, autosomal recessive, X-linked recessive)

Core Text:

- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.

Module II (15 hrs)

Bacterial and viral genetic systems- transformation, transduction and conjugation. Transposons and antibiotic resistance (brief outline). Chromosome variation- aneuploidy, polyploidy, duplication, deletion, inversion and translocation (Brief outline).

Core Text:

- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.

Module III (14 hrs)

Genome organization- chromatin, centromere, and telomere. Repetitive DNA and single copy DNA. DNA replication in prokaryotes. Enzymes involved in replication. Various types of mutation. Physical and chemical mutagens. Repair- Direct, substitution, excision, mismatch, recombination and SOS.

Core Text:

- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module IV (10 hrs)

Transcription in prokaryotes. Enzymes involved in transcription and its inhibitors. Promoter sequences of transcription in prokaryotes and eukaryotes. Post transcriptional modification in prokaryotes and eukaryotes. Translation in prokaryotes. Various translation inhibitors.

Core Text:

- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.
- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module V (10 hrs)

Gene regulation in prokaryotes (negative and positive control (inducible and repressible system) Lac and Trp operon.

Core Text:

- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son, Inc., ISBN 0-471-44180-5, 3rd Edition.
- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.

Module VI (8 hrs)

Recombinant DNA technology- different vectors (plasmids, phage, cosmids, YAC). Use of restriction enzymes. Genomic and cDNA library. PCR, in situ hybridization, DNA fingerprinting. Applications in Biotechnology.

Core Text:

- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Suggested Readings:

- Molecular Biotechnology: Principles and applications of recombinant DNA: Bernard R. Glick and jack J. Pasternak.
- Genes IX by Benjamin Lewin (2008) Publisher: J&b ISBN:0763752223 ISBN-13: 9780763752224, 978-0763752224
- Molecular Biology Of The Gene 5/e (s) by James D Watson, Tania A Baker, Stephen P Bell (2008) Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8177581813 ISBN-13: 9788177581812, 978-8177581812
- Cell and Molecular Biology, 3e (2003) by Karp Publisher: Jw ISBN: 0471268909 ISBN-13: 9780471268901, 978-0471268901

- Molecular Cell Biology (2002) by H.S. Bhamrah Publisher: Anmol Publications ISBN: 8126111429 ISBN-13: 9788126111428, 978-8126111428.

Model Question Paper
BC 1544: Core Course VIII
Course Title: Classical and Molecular Genetics

Section A

Objective questions, Answer **all 16** questions

I 1. A man who is affected with phenylketonuria marries a woman who is heterozygous at that locus. What is the probability that their first child will have phenylketonuria?
a) 1/4 b) 1/8 c) 1/2 d) 0

2. The genetic disorder sickle-cell anaemia is an example of
a) Penetrance b) Epistasis c) Heterozygous dominance d) Homozygous dominance

3. F2 ratio of Mendelian dihybrid cross is
a) 9:3:3:2 b) 3:3:3:1 c) 9:1:3:3 d) 9:3:3:1

4. Down Syndrome results from
a) Polyploidy b) Aneuploidy c) Triploidy d) Diploidy

II 5. During the transcription of a certain protein, an extra cytosine was placed into a gene region, throwing off the correct amino acid sequence. What type of mutation occurred?
a) Frame shift b) Transition c) Transversion c) Nonsense

6. Histones are functionally involved in
a) Chromosome packing b) Replication c) Transcription d) Translation

7. Genetic recombination in bacteria mediated by bacteriophage is called
a) Transformation b) Transposition c) Transduction d) Transportation

8. Jumping genes are called
a) Replicons b) transposons c) Replisons d) Jumposons

III 9. Which of the following is a transcription inhibitor?
a) Puromycin b) Rifampicin c) Streptomycin d) Tetracycline

10. Replacement of a purine by a pyrimidine is called
a) Transition b) Transversion c) Transformation d) Transposition

11. DNA replication is
a) Conservative b) Semi conservative c) Dispersive d) Distributive

12. Topological crisis during replication of DNA is overcome by
a) Primase b) Gyrase c) SSB protein d) Helicase

IV

13. Transcription and translation in prokaryotes are
    a) Coupled by space and time b) Coupled by time
    c) Coupled by space d) Not coupled

14. Which of the following do not undergo post transcriptional modification in prokaryotes?
    a) mRNA b) tRNA c) rRNA d) nil

15. Tryptophan in Tryptophan operon is
    a) Co repressor b) Repressor c) Inducer d) Activator

16. Which tool of recombinant DNA technology is incorrectly paired with its use?
    a) Restriction enzyme: production of RFLPs (restriction fragment length polymorphism)
    b) DNA ligase: enzymes that cut DNA, creating sticky ends
    c) DNA polymerase: used in PCR to amplify sections of DNA
    d) Reverse transcriptase: production of cDNA from mRNA

Section-B (Short Answer Questions)

Answer any **eight** questions

17. Differentiate co-dominance and incomplete dominance
18. What is Law of Independent assortment?
19. Give two examples for condition resulting from chromosomal aberration.
20. What is conjugation?
21. Define mutation. Give an example for a mutagen.
22. What is the function of H1?
23. Which are the promoters involved in prokaryotic transcription?
24. What is siRNA?
25. Differentiate between missense and nonsense mutation.
26. What is light dependent repair?
27. What is the significance of telomere?
28. Give a diagrammatical representation of chromosomal organization in prokaryotes.

Section-C (Short Essay)

Answer any **five** questions

29. Explain with example gene interaction.
30. How is sex determined in drosophila and human?
31. How are transposons involved in multiple drug resistance?
32. Describe the rearrangements of chromosome structure with diagram.
33. What is Cot curve? Explain.
34. Make a schematic representation of Excision repair.
35. What are the post transcriptional modifications in eukaryotes?
36. What is attenuation? Explain.

Section-D (Long Essay)

Answer any **two** questions

37. Write an essay on rDNA technology.

38. Give the steps involved in translation in prokaryotes.
39. Write note on *lac* operon.

Semester-V

Core Course - IX
BC 1545: Practical V – P_5

No. of Credits: 4 **No. of Contact Hours: 108**
Hours/week: 6

1. **Quantitative Analysis of carbohydrates**
   - Estimation of glucose by Nelson-Somogyi method
   - Estimation of reducing sugar by anthrone method.
   - Estimation of reducing sugar phenol-sulphuric acid.
   - Estimation of pentose by Orcinol method.
   - Estimation of ketose by Roe-Papedopaulose method.
   - Estimation of reducing sugar by O-toludine method.

2. **Quantitative Analysis of Lipids**

   - Estimation of Cholesterol by Carr-Drecktor method.
   - Estimation of Cholesterol by Zak's method.
   - Determination of Acid Value.
   - Determination of Saponification value.

3. **Quantitative Analysis of Aminoacids and Proteins**

   - Estimation of Tyrosine by Folin-Lowry method.
   - Estimation of Protein by Biuret method.
   - Estimation of Protein by Folin-Lowry method.
   - Estimation of Protein by Bradford's method.

4. **Quantitative Analysis of Nucleic Acids**

   - Estimation of DNA by diphenylamine method.
   - Estimation of RNA by Orcinol method

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (Ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Hawks Physiological Chemistry, Bernard L.Oser (ed).TATA McGRAW Hill Publishing Company LTD, New Delhi.

- ES West, WR Todd, HS Mason and JT van Bruggen. A text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974.

SEMESTER-VI

BC 1641: CORE COURSE- X
Course Title: Clinical Biochemistry

No. of Credits: 4 **No. of Contact Hours: 72**
Hours/week: 4 **(L, T, P, C- 4, 1, 0, 4)**

Objective: To introduce the students to the clinical applications of biochemistry and to provide them basic information about microbiology and pharmacology.

Course outline

Module I (14 hrs)

Laboratory safety: Management of hazards in the Laboratory (Chemical, Biological, Electrical, fire and Radioactive) with special reference to safety equipments and safety inspections, Management of errors in laboratory- Pre analytical, analytical, Post analytical errors (basic aspects only), Quality control – External and internal quality control, accuracy, precision, specificity, sensitivity.(basic aspects only)

Specimen collection and preservation: Collection and preservation of blood, plasma, serum, CSF, urine.

Core Text:

- Tietz Text book of Clinical chemistry and Molecular Diagnostics. Carl A. Burtis, Edward R. Ashwood, David E. Bruns (Eds), Elsevier (Saunders) 2006.

Module II (14 hrs)

Analysis of blood: Principles of estimation, normal values and clinical significance of glucose {enzymatic method},Lipid profile- Cholesterol, Triglycerides, LDL, HDL, Serum electrolytes-Na^+, K^+, Cl^-. Cardiac marker- creatine kinase– MB, acid phosphatase, GTT-Significance, preparation of patient, interpretation of results with special reference to normal, impaired glucose tolerance and diabetes mellitus

Core Text:

- Text Book of Medical Laboratory Technology, Praful B Godkar, Darshan P. Godkar. Bhalani Publishing House, Mumbai. (2003).

Module III (14 hrs)

Organ function tests: Liver function tests- Principle of estimation, normal value and clinical significance of Serum Bilirubin- Total and conjugated bilirubin(test for excretory function), AST, ALT, alkaline phosphatase (marker enzymes of liver injury), Total protein, albumin, globulin, albumin/globulin ratio(test for synthetic function)Thyroid function test-Assay of T3, T4, TSH

normal value and clinical significance. Renal function tests- Principle of estimation and clearance tests of urea & creatinine- normal value and clinical significance

Core Text:

- Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks, Allan D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & Wilkins; illustrated edition ISBN-10: 068305595X ISBN-13: 978-0683055955.

Module IV (12 hrs)

Analysis of urine: clinical significance of physical characteristics– colour, volume, pH, specific gravity and chemical characteristics-normal and abnormal constituents.

CSF- normal composition, routine analysis (protein, glucose and chloride) and clinical significance.

Automation in clinical laboratory (Basic concepts of): Sample identification by bar coding , automation in analysis (cite any two types) automation in measurement method-Reflectance, Luminescence, Turbidometric, Nephlometric, Ion selective method (just explain the terms).

Core Text:

- Tietz Text book of Clinical chemistry and Molecular Diagnostics. Carl A. Burtis, Edward R. Ashwood, David E. Bruns (6^{TH} Eds), Elsevier (Saunders) 2006 ISBN: 8131213749, ISBN-13: 9788131212742, 978-8131213742.

Module V (8 hrs)

Clinical Microbiology: classification of microorganisms, sterilization, types of media, culturing of bacteria, isolation of pure culture (any two methods), staining techniques - gram staining and acid fast staining. Identification of bacteria- culture, antibiotic resistance& metabolism.

Core Text:

- Methods of Microbiology. Pelczar MJ, Chan ECS. Tokyo: Kogakusha-McGraw Hill, 1981.

Module VI (10 hrs)

Pharmacology: pharmacology, drugs, dosage forms (definitions only), sources of drugs, routes of administration, absorption, distribution. Mechanism of action-mention the target site, types of receptors and their mode of action. General mode of action of Antibiotics- penicillin, streptomycin, tetracycline, chloramphenicol (outline only)

Core Text:

- Basic & Clinical Pharmacology **by** Bertram G. Katzung (2006) **Publisher:** Mcgraw-hill Medical Publishing **ISBN:** 0071451536 **ISBN-13:** 9780071451536, 978-0071451536

Suggested Readings:

- Notes on Clinical Biochemistry by John K. Candlish (1992) Publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
- Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephen K. Bangert, Elizabeth S.M. Ed. SM. Ed. Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861

- Biochemistry **by** John K. Joseph (2006) **Publisher:** Campus Books International **ISBN:** 8180301109 **ISBN-13:** 9788180301100, 978-8180301100
- Basic Medical Biochemistry: A Clinical Approach by Dawn B., PH.D. Marks, Allan D. Marks Colleen M. Smith (1996) Publisher: Lippincott Williams & Wilkins; illustrated edition ISBN-10: 068305595X ISBN-13: 978-0683055955
- Clinical Chemistry, 6/e IE by William J Marshall, Stephen K Bangert (2008) Publisher: Else ISBN: 0723434603, ISBN-13: 9780723434603, 978-0723434603
- Tietz Fundamentals of Clinical Chemistry, 6/e by Carl A Burtis, Edward R Ashwood (2008) Publisher: Else ISBN: 8131213749, ISBN-13: 9788131213742, 978-8131213742.
- Basic & Clinical Pharmacology **by** Bertram G. Katzung (2006) **Publisher:** Mcgraw-hill Medical Publishing **ISBN:** 0071451536 **ISBN-13:** 9780071451536, 978-0071451536
- Handbook Of Experimental Pharmacology **by** Kulkarni SK (2007) **Publisher:** Vallabh Publications / Prakashan **ISBN:** 8185731128, **ISBN-13:** 9788185731124, 978-8185731124

Model Question Paper
BC 1641: Core Course-X
Course Title: Clinical Biochemistry

Section A

Objective questions, Answer **all 16** questions

I.

1. Which one is the most preferred anti-coagulant for blood glucose determination?
   a) EDTA b) Heparin c) Sodium Citrate d) Fluoride Oxalate mixture

2. Ehrlich's reagent is used to detect the following in urine
   a) Bile pigment b) Bile salt c) Urobilinogen d) Acetone

3. Benzidine reaction is used to detect
   a) Ketone bodies b) Bile pigment c) Occult blood d) Urea

4. Which one is not a Liver Function Test.?
   a) Total protein b) Alkaline phosphatase c) Acid phosphatase d) Transaminase

II

5. The normal value of cholesterol in blood is
   a) 150-250 mg/dl b) >200 mg/dl c) 80-120 g/dl d) <200mg/dl

6. Which of the following antibiotic inhibit cell wall synthesis?
   a) Penicillin b) Streptomycin c) Tetracycline d) Chloramphenicol

7. Which one is a gram positive bacterium?

a) E. Coli b) Pseudomonas c) P. Vulgaris d) S. Aureus

8. Urinometer is used for the determination of the following property of urine

a) pH b) Colour c) Sp.gravity d) Volume

III

9. Direct bilirubin is

a) Conjugated bilirubin b) Unconjugated bilirubin c) Total bilirubin d) α- bilirubin

10. Jafee's reaction is used to determine

a) Urea b) Creatinine c) Glucose d) Ketone bodies

11. An abnormal constituent of urine is

a) Ketone bodies b) Creatinine c) Urea d) Uric acid

12. Normal value of sodium is

a) 135-145mEq /L b) 135-145 mg% c) 100-125mEq /L d) 100-125 mg%

I13. M. Tuberculosis is identified by

a) Gram staining b) Acid fast staining c) Albert staining d) Leishmann staining

14. Sterilization by dry heat is used in

a) Autoclave b) Pasteurization c) Steamer d) Hot air oven

15. GOD/POD is the method for the estimation of

a) Glucose b) Urea c) Creatinine d) Bilirubin

16. Normal value of blood glucose

a) 80-120 mg/dl b) 50-100 mg/dl c) 100-160 mg/dl d) 20-80 mg/dl

Section-B (Short Answer Questions)

Answer any **eight** questions

17. What is external quality control?
18. Differentiate between plasma and serum
19. What are anticoagulants?
20. Differentiate between accuracy and precision
21. What is A/G ratio? Write its clinical significance
22. What is urea clearance?
23. What is Haematuria? Write its clinical significance
24. Name two gram negative microorganisms
25. What is a differential media? Give one example
26. Write the role of agar in culture media
27. Write the general mode of action of penicillin
28. What is pasteurization?

Section C **Section-C (Short Essay)**

Answer any **five** questions

29. Describe the method of sterilization by autoclaving
30. Discuss the various types of hazards encountered in a clinical laboratory
31. Discuss the routine examination of CSF
32. Describe the principle of determination, clinical significance and normal values of CPK and acid phosphatase
33. Discuss Thyroid function tests
34. Discuss the role of cytochrome p450 monooxygenase in drug metabolism and varied drug responses in persons
35. Describe the principle of determination, clinical significance and normal values of total and conjugated bilirubin
36. Discuss on the management of different types of errors in a clinical laboratory

Section-D (Long Essay)

Answer any **two** questions

37. Explain the principle, procedure and clinical significance of Glucose tolerance test.
38. Describe the principle, clinical significance and normal values of Liver Function Tests.
39. Discuss the different characteristics used for the identification of bacteria

SEMESTER VI

BC 1642: Core Course XI
Course Title: Metabolism-II

No. of Credits: 4 **No. of Contact Hours: 72**
Hours/week: 4 **(L, T, P, C – 4, 1, 0, 4)**

Objective: To detail the metabolic events occurring in the biological system by explaining the different pathways which are aimed at energy production and biosynthesis and to discuss about the diseases caused by inborn errors in metabolism.

Course Outline

Module I (15 hrs)

Lipid metabolism: Sources of body fat, hydrolysis of tri acyl glycerol, transport of fatty acid into mitochondria: α, β, ω oxidation of saturated fatty acid, sources of acetyl Co A, Biosynthesis of saturated and unsaturated fatty acid, metabolism of Ketone bodies, ketonuria, oxidation of unsaturated and odd chain fatty acid, Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol, regulation of cholesterol metabolism, degradation of cholesterol to bile acids and formation of steroid hormones, disorders of lipid metabolism: Zellweger syndrome, Refsum's disease.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module II (15 hrs)

Nucleic acid metabolism**:** Sources of atoms of purines and pyrimidines, Biosynthesis and degradation of purines and pyrimidines- *de novo* and salvage pathways with regulation, Biosynthesis of adenylic acid, ATP and Uridylic acid (Outline pathway), gout, excretory products. Disorders of purine or pyrimidine metabolism (Lesch-Nyhan syndrome).

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module III (8 hrs)

Nitrogen fixation**:** conversion of nitrate to ammonia by plants, biological nitrogen fixation - nitrogen fixing organisms, legume - Rhizobium
symbiosis;. Nitrogen metabolism: Nitrogen cycle, Biological nitrogen fixation (symbiotic, non – symbiotic- only outline).

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module IV (15 hrs)

Amino acid metabolism**:** Nitrogen balance (positive, negative), general reactions of amino acid metabolism: transamination, transdeamination, oxidative deamination and decarboxylation, Urea cycle and regulation, glucogenic and ketogenic amino acids, biosynthesis and degradation of glycine, phenyl alanine. Disorders of amino acid metabolism (Alkaptonuria, phenylketonuria, maple syrup urine disease, Hartnup disease, Tyrosinosis, Albinism). Heme metabolism - synthesis and breakdown, porphyria. Criggler Najjar syndrome.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4th Edition.
- Principles of biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module V (15 hrs)

Photosynthesis: Photosynthetic machinery, light reaction, cyclic and noncyclic photophoshorylation, chlorophyll (structure only), dark reaction, fixation of CO_2 and formation of carbohydrate (brief treatment only), C3 and C4 plants, photorespiration.

Core Text:

- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York ISBN 0-7167-2009-4, 4^{th} Edition.
- Principles of Biochemistry, by Albert Lehninger, David L Nelson, Michael M Cox, CBS Publishers & Distributors Delhi ISBN 81-239-0295-6.

Module VI (4 hrs)

Xenobiotics metabolism:Formation of toxic compounds in the body, Detoxification process in the liver-phase I reactions - oxidation, ,hydrolysis, reduction & phaseII reactions - conjugation Illusrate with one example each(brief study), role of Cytochrome P_{450} in detoxification.

Core Text:

- Textbook of Medical Biochemistry for Medical Students by DM Vasudevan and Sreekumari S. 5^{th} edition,Japee Brothers, Medical Publishers,ISBN 81-8448-124-1:9788184481242.

Suggested Readings:

- Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson-Fourth-Publisher: W. H. Freeman; Fourth Edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
- E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, A Text Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974
- Biochemistry [with CDrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
- Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: McGraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
- Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
- Biochemistry (2008) by Rastogi Publisher: McGraw Hill ISBN**:** 0070527954 ISBN-13**:** 9780070527959**,** 978-0070527959.

Note on Course Work: The course will enlighten the students' with knowledge regarding metabolic pathways and inborn errors of metabolism.

Model Question Paper
BC 1642: Core Course - XI
Course Title: METABOLISM - II

Section A

Objective questions, Answer **all 16** questions

I.

1. β-oxidation of odd chain fatty acid produces
   a) Succinyl CoA b) Propionyl CoA c) Acetyl CoA d) all the above.

2. Carnitine is synthesized from
   a) Lysine b) Serine c) Arginine d) Choline

3. Photosynthetic pigments found in chloroplast occur in
   a) Thylakoid membrane b) Plastoglobules c) matrix d) chloroplast envelope

4. The key enzyme regulating fatty acid synthesis is
   a) Acetyl CoA carboxylase b) fatty acid synthase
   c) HMG CoA synthase d) acyl CoA dehydrogenase

II.

5. The rate limiting step in cholesterol biosynthesis is
   a) HMG CoA reductase b) HMG CoA synthase c) Mevalonate kinase d) none

6. Which among the following is the biological precursor of glycine?
   a) alanine b) serine c) glutamate d) aspartate

7. Which of the following aminoacid produces vasodilator on decarboxylation?
   a) Histidine b) Glutamate c) Ornithine d) Cysteine

8. Where is the acyl CoA formed in the cytosol transported for oxidation?
   a) mitochondrial matrix b) microsomes c) ER d) remains in the cytosol

III.

9. The product that accumulates in Refsum's disease is
   a) cholesterol b) linoleic acid c) phytanic acid d) palmitic acid

10. The first major common intermediate formed during biosynthesis of purines is
    a) inosinic acid b) adenylosuccinate c) xanthylate d) None

11. Which of the following is not a source of carbon atoms of the purine ring?
    a) glycine b) aspartate c) carbon dioxide d) acetyl CoA

12. The first cyclic metabolic pathway to be discovered is
    a) Krebs's cycle b) glyoxylate pathway c) urea cycle d) None

IV.

13. The ΔG^0 for ATP hydrolysis is _____kcal/mol.
    a) +7.3 b) -7.3 c) 0 d) None

14. Phenylketonuria is due to the deficiency of
    a) Phenylalanine hydroxylase b) Transaminase c) Isomerase d) Decarboxylase.

15. In humans the principle breakdown product is
    a) Ammonia b) Urea c) Uric acid d) Allantoin

16. Nicotinamide is detoxicated by
    a) Active sulphate b) methylation c) acetylation d) Glucuronic acid.

Section-B (Short Answer Questions)

Answer any **eight** questions

17. What is salvage pathway? Give its significance.
18. Name any four inborn disorders of metabolism.
19. Which are the steps involved in the β-oxidation of fatty acids?
20. Define transamination. Give Examples?
21. What is the role of high energy phosphates in energy transfer?
22. Point out two differences between oxidative phosphorylation and photophoshorylation.
23. Which is the committed step in the biosynthesis of cholesterol?
24. Write the reaction catalyzed by Rubisco?
26. Outline the sources of carbon and nitrogen atoms of purine ring
27. What is gout?
28. What is Alkaptonuria and Phenylketonuria?

Section-C (Short Essay)

Answer any **five** questions

29. Explain the role of P_{450} in detoxification?
30. Explain the biosynthetic pathway of pyrimidine nucleotides.
31. Briefly discuss how ATP is generated during electron transport.
32. What are Ketone bodies? Explain their significance.
33. Differentiate between C3 and C4 plants.
34. Explain Urea cycle?
35. Give the β-oxidation pathway of saturated fatty acids?
36. Outline the pathway for the catabolism of purines

Section-D (Long Essay)

Answer any **two** questions

37. Explain the cytoplasmic system of Fatty acid biosynthesis.
38. Discuss in detail the catabolism of phenylalanine. Indicate the inborn errors involved in the pathway.
39. Explain cholesterol biosynthesis.

Semester-VI

Core Course-XII

BC 1643: Practical VI -P_6

No. of Credits: 4 **No. of Contact Hours: 108**
Hours/week: 6

1. **Preparation of Blood Serum & Plasma**

2. **Quantitative estimation in Blood/ Serum:**
   - Glucose by Nelson – Somogyi Method
   - Cholesterol by Zak & Henly's Method
   - Urea by Diacetylmonoxime Method
   - Iron by ά ά dipyridyl method
   - Total Protein by Biuret Method
   - Albumin: Globulin ratio
   - Uric acid using Phosphotungstic acid reagent
   - Bilirubin by van den Bergh reaction
   - Hemoglobin content by Cyanmethaemoglobin method
   - Creatinine By Jaffè's method
   - Phosphorus

3. **Hematology**

   ESR, PCV, TC/DC count, Blood Grouping, Hemoglobin.

4. **Clinical Enzymology:**

   - Assay of serum alkaline phosphatase
   - Assay of Serum alanine amino transferases (ALT/SGPT)
   - Assay of serum aspartate amino transferases (AST/SGOT)
   - Assay of serum Lactate dehydrogenases

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8.
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9.

- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5.
- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.

Semester-VI Core Course-XIII

BC 1644: Practical VII –P_7

No. of Credits: 4 **No. of Contact Hours: 90**
Hours/week: 5

1. **Food Analysis**
   Isolation of protein from milk.
   Estimation of cholesterol in egg.
   Estimation of reducing sugar in honey.
   Estimation of glycogen from liver.
   Estimation of Sucrose in jaggery.
   Estimation of ascorbic acid in Orange juice.
   Estimation of pentose in grapes.
   Estimation of starch from potato

2. **Urine Analysis**
   Qualitative tests of urine: Abnormal constituents
   Proteins (Coagulation test, sulfosalicylic acid test, test for Bence-Jones proteins)
   Sugars (Benedicts test)
   Hemoglobin (Benzidine test)
   Ketone bodies (Rothera test, Gerhardt's test)
   Bile pigments (Fouchet's test, Gmelin's test)
   Bile salts (Hay's test)
   Quantitative estimation in urine:
   - Sugar by Nelson – Somogyi Method
   - Chloride
   - Urea by Diacetylmonoxime Method
   - Uric acid using Phosphotungstic acid reagent
   - Creatinine by Jaffe's reaction
   - Bilirubin by van den Bergh reaction

References

- Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 191 -241
- Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 15 – 109
- Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 49- 181, p 269- 285

- Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi, p327 – 348.
- Hawks Physiological Chemistry, Bernard L. Ser (ed.), TATA McGraw Hill Publishing Company, New Delhi.

SEMESTER VI

BC 1661.1: Elective Course
Course Title: Molecular Biotechnology

No. of Credits: 2 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C - 3, 1, 0, 2)**

Objective: It aims at enabling the students to understand the fundamentals of molecular Biotechnology.

Course Outline

Module I **(10 hrs)**
DNA isolation and purification. Restriction enzymes. Radioactive labeling of nucleic acid. Chemical tagging with biotin. General properties and useful traits of cloning vectors. Constructing and screening the library of genes.

Core Text:
- Basic Methods in Molecular biology by Davis LG, Kuehl WM, and Battey JF. 2nd edition, Norwalk, CT: Appleton & Lange 1994.

Module II **(10 hrs)**
In vitro DNA synthesis. PCR, RT PCR. Antisense RNA. siRNA, miRNA. DNA sequencing-Maxam Gilbert method, Sangers method, Pyrosequencing.

Core Text:
- Molecular Biology by Robert F. Weaver - Fifth Edition ISBN-13: 978-0073525327

Module III **(10 hrs)**
Southern blotting, Northern blotting, Western blotting. 2D gel electrophoresis.

Core Text:
- Molecular Biology by Robert F. Weaver - Fifth Edition ISBN-13: 978-0073525327

Module IV **(10 hrs)**
DNA finger printing and foot printing, Gel mobility shift assay, Chloramphenicol acetyl transferase (CAT) assay, site directed mutagenesis, Filter binding assay.

Core Text:
- Molecular Biology by Robert F. Weaver - Fifth Edition ISBN-13: 978-0073525327

Module V **(8 hrs)**

Role of Ti plasmids in transgenic plants, Detection of inserted DNA in transgenic plants, Transgenic plants with insecticide resistance, Transgenic and knockout mice.

Core Text:

- Biotechnology- Applying the Genetic Revolution by David P. Clark & Nanette J. Pazdernik ISBN- 978-0-12-175552-2

Module VI **(6 hrs)**

Gene therapy, Severe combined immune deficiency syndrome (SCID), Liposomes in gene therapy, role of aptamers.

Core Text:

- Biotechnology- Applying the Genetic Revolution by David P. Clark & Nanette J. Pazdernik ISBN- 978-0-12-175552-2

Suggested Readings:

- Recombinant DNA by Watson JD, Gilman M, Witkowski J and Zoller M, 2nd edition. WH Freeman New York.
- Biotechnology: applying the genetic revolution: David P. Clark and Nanette J. Pazdernik
- Molecular Biotechnology: Principles and applications of recombinant DNA: Bernard R. Glick and Jack J. Pasternak.
- Basic Methods in Molecular biology by Davis LG, Kuehl WM, and Battey JF. 2nd edition, Norwalk, CT: Appleton & Lange 1994.
- PCR Technology: Principles and Applications of DNA Amplification by Erlich HA (Ed.),New York: Stockton Press.
- Principles of Gene Manipulation: An Introduction to Genetic Engineering by Old RW and Primrose SB, 5th edition, Blackwell Scientific Publications, Oxford.

Model Question Paper
BC 1661.1: Elective Course
Course Title: Molecular Biotechnology

Section A

Objective questions, Answer **all 16** questions

I.

6. Which of the following holds the largest pieces of DNA?
   a) Plasmid b) λ phage c) Cosmids d) YAC

7. Why are genomic libraries constructed?
a) Find new genes b) sequence the genomes
c) Compare genes to other organisms d) all of the above

8. Which of the following enzyme is used to radiolabel the 5'end of RNA and DNA?
a) DNA gyrase b) DNA helicase c) SSBP d) polynucleotide kinase

9. Which of the following components terminates the chain in a sequencing reaction?
a) ddNTP b) DNA polymerase I c) DNA polymerase II d) DNA primers

II

10. Which of the following is used detect the expression of genes?
a) Western blotting b) Northern blotting
c) Southern blotting d) all of the above

6. Which of the following RNA is used to regulate gene at translational level?
a) rRNA b) siRNA c) miRNA d) snoRNA

7. Which of the following plasmid is used to introduce a transgene to generate a transgenic plant?
a) F-plasmid b) Ti-plasmid c) Col-plasmid d) R-plasmid

8. Which of the following techniques is combined in 2D gel electrophoresis?
a) Isoelectric focusing and PAGE b) Isoelectric focusing and SDS-PAGE c) PAGE and SDS-PAGE d) Pulsed field gel electrophoresis and PAGE

III

9. CAT assay is used to detect
a) Efficiency of enhancers b) Efficiency of silencers c) Efficiency of promoters d) Efficiency of insulators

10. What process is used to create transgenic animals?
a) Particle bombardment b) nuclear microinjection c) nuclear fusion d) all of the above

11. Which of the following techniques is used to detect the function of an amino acid residue in the active site of an enzyme?
a) Filter binding assay b) Site directed mutagenesis
c) Foot printing d) CAT assay

12. Which of the following is an approach to delivering gene therapy?
a) plasmid b) phagemid c) liposomes d) YAC

IV

13. Which of the following enzyme is defective in SCID?
a) Adenosine deaminase b) Cytosine deaminase c)Guanine deaminase d) Thymine deaminase

14. Which of the following is a rapid DNA sequencing method?
a) Maxam Gilbert b) Sangers c) Edman d) Pyrosequencing

15. Which of the following is not used in the identification of a DNA at crime scenes?
a) PCR b) western blot c) sequencing d) hybridization

16. Aptamers are
    a) RNA b) DNA c) Proteins d) Carbohydrates

Section-B (Short Answer Questions)
Answer any **eight** questions

17. What is the use of ligase enzyme in recombinant technology?
18. What are the features of cloning vectors?
19. What is a ribozyme?
20. What is siRNA?
21. What is miRNA?
22. Comment on cDNA library.
23. Give two examples of transgenic animals?
24. Name two methods of DNA sequencing.
25. Give two use of DNA fingerprinting.
26. What is the use of liposomes in gene therapy?
27. What is Ti plasmid?
28. What is aptamers?

Section-C (Short Essay)
Answer any **five** questions

29. How DNA isolates and purified from an organism?
30. What are the uses of chemical tagging with biotin?
31. Explain chain termination method of sequencing.
32. Explain DNA foot printing.
33. What are the uses of antisense RNA in gene regulation?
34. Explain DNA microarray with an example.
35. Explain gel mobility shift assay.
36. Explain the principle and procedure of southern blotting.

Section-D (Long Essay)
Answer any **two** questions

37. Explain the production of transgenic plants.
38. Explain the engineering and applications of ribozymes and riboswitches.
39. Explain PCR and RT-PCR.

SEMESTER-VI

BC 1661.2: Elective Course
Course Title: Immunology and Immunological Techniques

No. of Credits: 2 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C - 3, 1, 0, 2)**

Objective: It aims at enabling the students to understand the fundamentals of Immunology and Immunological techniques. A proper understanding of life processes requires familiarity with the discipline of immunology. A sound knowledge of immunology and techniques will help in understanding assessment of functions, disordered functions, diagnosis and treatment of diseases

Course Outline

Module I (10 hrs)

Introduction to General Immunology**:** Organs of Immune system, Primary and Secondary lymphoid organs-bone marrow, spleen, lymph nodes, thymus and MALT. Cells of Immune system, Hemopoietic stem cells, B and T lymphocytes, NK cells, mononuclear phagocytes and Granulocytic cells.

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module II (10 hrs)

Immunity: Types of Immunity-innate immunity - mechanical protection and chemical protection, phagocytosis, inflammation. Adaptive immunity-humoral and cell mediated immunity. Cells of adaptive immune system, Antigen presenting cells, clonal selection of lymphocytes, Cellular interaction for generation of humoral and cell mediated responses (Brief outline only)

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module III (10 hrs)

Antigens**:** Chemical nature of antigens, antigenic determinants, haptens, Immunoglobulins-class, structure and functions of Immunoglobulins. Complement system (out line only).

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module IV (6 hrs)

Molecular basis of Immune function: T-cell and B-cell receptor, activation and proliferation of T and B-cells. (Brief outline only). MHC antigens, functions of cytokines, lymphokines and interleukins (Brief outline only).

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module V (6 hrs)

Disease related to immune function**:** Allergy and Hypersensitivity-immediate and delayed type hypersensitivity, Autoimmunity, autoimmune diseases. Immunodeficiency disorders, AIDS, Vaccines and Immunization (brief study).

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Module VI (12 hrs)

Antigen antibody interactions: Precipitation reactions, Agglutination. ELISA, RIA, Immunodiffusion, Immunofluorescence, Production of monoclonal antibodies (Hybridoma technology), Monoclonal antibodies in diagnosis and therapy (Brief outline).

Core Text:

- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903

Suggested Readings

- Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning (Thompson) ISBN: 8131500039, ISBN-13: 9788131500033, 978-8131500033
- Immunology and Immunotechnology by Chakravarty (2006) Publisher: Oxford University Press N Delhi ISBN: 0195676882, ISBN-13: 9780195676884**,** 978-0195676884
- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co ISBN: 0716785900, ISBN-13: 9780716785903, 978-0716785903
- Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt Ltd ISBN: 8131711587 ISBN-13: 9788131711583**,** 978-8131711583
- Immunology by K.R. Joshi **(**2007) Publisher: Agrobios (India) ISBN**:** 8177541749, ISBN-13: 9788177541748**,** 978-8177541748
- Basic Immunology, 3ed by: Abbas Publisher: Elser ISBN: 8131217477, ISBN-13: 9788131217474**,** 978-8131217474
- Immunology by P.R. Yadav **(**2004) Publisher: Discovery Publishing House ISBN: 8171418570, ISBN-13: 9788171418572**,** 978-8171418572
- Immunology by David A. Marcus, Richard A. Goldsby, Barbara A. Osborne **(**2003) Publisher: WH. Freeman & Company ISBN: 0716749475 ISBN-13: 9780716749479**,** 978-0716749479.

Model Question Paper
BC 1661.2: Elective Course
Course Title: Immunology and Immunological Techniques

Section A

Objective questions, Answer **all 16** questions

I.

2) Plasma cells are

(a)Memory cells (b) Phagocytic cells(c) Antibody secreting cells (d) Antigen Presenting cells.

3) A small molecule which can act as an epitope but is incapable of itself eliciting an immune response is called
(a) Haptens (b) Kinins (c) Interferons (d) Perforins

3) Which Immunoglobulin passes through the placenta?
(a) IgA (b) IgD (c)IgG (d) IgE

4) Thymus is a
(a)Endocrine gland (b) Exocrine gland(c) A Lymphoid organ (d) none

II.

5) What is an epitope?
(a) Antigen binding site (b) Antibody binding site (c) Receptor (d) Ligand

6) SLE is a
(a) Immunodeficiency disease (b) Autoimmune disease
(c) A type of allergy (d) A metabolic disorder

7) Lymphocytes originates from
(a) Liver (b) Thymus (c) Bone marrow (d) Spleen

8) CD 8 is expressed on
(a) Helper T-cell (b) Cytotoxic T-Cell (c) NK-Cell (d) Suppressor T- Cell

III.

9) Which Ig is involved in allergic reactions?
(a)IgM (b) IgE (c)IgA (d)IgD

10) Humoral Immunity is
(a) Innate immunity (b) Cell Mediated immunity
(c) Antibody mediated immunity (d) none of these.

11) Immunogen is a chemical substance which has
(a) Immunogenicity only (b) Reactivity only (c) Both (d) None

12) The most abundant phagocytic cell in the body is
(a) Neutrophil (b) Dendritic cell (c) Basophils (d) Macrophages

IV.

13) Cytokines are
(a) An antiviral protein (b) An antibacterial protein
(c) Soluble molecule which communicates between cells (d) T-cell suppressive drug.

14) What is allergy?
(a)A failure to make an immune response (b) An altered immune response
(c) A hypersensitive reaction (d) A heightened immune response.

15) A substance that non-specifically enhance the immune response to an antigen is called
a) Haptens (b) Adjuvant (c) Carrier (d) Allergen.

16) Anaphylotoxin is a
(a) Complement peptide (b) An antibiotic (c) Signaling molecule (d) Lymphokines

Section-B (Short Answer Questions)
Answer any **eight** questions

17) What are NK cells?
18) Give any two functions of spleen?
19) Compare antibody mediated and cell mediated immune response?
20) What is immunological memory?
21) Write short note on immunoprecipitation?
22) What are haptens and immunogens?
23) What is auto-immunity? Give two examples.
24) What do you understand by primary and secondary immune response?
25) What are APC?
26) What are cytokines?
27) What are vaccines?
28) What are primary lymphoid organs?

Section-C (Short Essay)
Answer any **five** questions

29) Describe the structure of T-cell receptor?
30) Explain ELISA technique.
31) Define inflammation. Describe the principal symptoms associated with inflammation.
32) Write short note on immunodeficiency disorders?
33) Differentiate between MHC I and MHC II.
34) How are monoclonal antibodies produced?
35) Write short note on autoimmune diseases?
36) Give a concise account of the nature of different types of vaccines.

Section-D (Long Essay)
Answer any **two** questions

37) Describe the salient features of the different types of Immunoglobulins giving details of heavy and light chains.
38) What is hypersensitivity? Give an account on immediate and delayed type hypersensitivity.
39) Write short notes on:-
A) RIA. B) Immunodiffusion C) Immunofluorescence.

Semester-V

BC 1551.1: Open Course
Course Title: Clinical Diagnosis of Common Diseases

No. of Credits: 2 **No. of Contact Hours: 54**

Hours/week: 3 **(L, T, P, C -3, 1, 0, 2)**

Open courses are offered to students of various other diciplines like arts, humanities and languages. Hence the approach to open course should be made only at a peripheral level. Indepth approach is not expected in this course.

Objective: To provide the fundamental basis for the interpretation of various biochemical tests of diseased conditions.

Course Outline

Module I (10 hrs)

Hematological parameters : Components of blood, function, routine hematological tests –(normal values, brief outline of procedure and clinical significance).
TC/DC count, ESR, PCV, hemoglobin concentration, platelet count, bleeding time, clotting time

Core Text:

Medical Laboratory Technology Volume I, Kanai. L. Mukharjee, Page No. 215-218; 228-307.

Module II (10 hrs)

Blood Analysis: (normal values, brief outline of procedure and clinical significance).

Glucose- fasting blood sugar, random blood sugar, post prandial blood sugar.

Protein- Clinical significance, normal values, total protein, albumin, globulin, A/G ratio

Lipid Profile- Cholesterol, Triglycerides, HDL, LDL

Core Text:

Medical Laboratory Technology Volume III, Kanai. L. Mukharjee, Page No. 985-1029.

Module III (10 hrs)

Enzymes of clinical interest: Function, Clinical significance and location in body
Amylase, Phosphatases (acid and alkaline), Transaminase (AST&ALT), Creatine kinase (CK),Glucose 6 phosphate dehydrogenase (G-6-PD), Lactate dehydrogenase (LDH).
Core Text:

Fundamentals of Biochemistry for Medical Students, Dr. Ambika Shanmugam, Page No. 140-144.

Module IV (6 hrs)

Blood banking: Human blood groups, importance of blood transfusion, collection of blood for blood transfusion, Blood grouping, transfusion reactions, hemolytic disease of the new born (erythroblastosis foetalis)

Core Text:

Medical Laboratory Technology Volume I, Kanai. L. Mukharjee Page No. 398-400; 411-424; 474-477.

Module V (6 hrs)

Clinical pathology: Brief outline of

Urine analysis- routine examination for abnormal constituents (Glucose, Protein, Ketone bodies, Bilirubin, Occult blood),

Body fluid analysis- Normal values and Clinical significance

Cerebrospinal fluid (CSF) appearance, glucose, protein, culture,

Gastric juice- Total acidity

Core Text:

Medical Laboratory Technology Volume II, Kanai. L. Mukharjee, Page No. 801-850.

Module VI (12 hrs)

Various organs, functions, diseases & their diagnosis:

Liver- jaundice, fatty liver, cirrhosis

Kidney- Nephritis

Heart- Atherosclerosis

Pancreas- Pancreatitis

Lungs- Acidosis, alkalosis

Brain- Tumor, hemorrhage

Core Text:

Medical Laboratory Technology Volume III, Kanai. L. Mukharjee, Page No. 905-908.

Suggested Readings:

- Medical Laboratory Technology (Volume, II& III) By Kanai. L. Mukharjee.
- A procedure for routine diagnostic tests, Tata Mc. Graw- Hill Publishing Company Ltd., New Delhi, 12 th reprint, 1988)
- Fundamentals of Biochemistry for Medical students Dr. Mrs. Ambika Shanmugam, Published by 12, III- Cross street, West C.I.T. Nagar, Madras; III Edition, 1977)
- Bauer J.D. Clinical Laboratory Methods, C.V. Mosby, St. Louis 1982.
- Mollison P.L. Blood Transfusion in Clinical Medicine, 6th Ed, Blackwell Scientific Publications, Oxford; 1979.
- Bowley C. C., K.L.G. Goldsmith & Wd'A Maycock, Blood Transfusion: A guide to the formation & operation of a transfusion service, World Health Organisation, 1971.
- Bishop M.L.-J.L. Dlaufer & E.P. Fody, Clinical Chemistry, Lippincott Company, Philadelphia, 1985.

- Lamberg S.L., Laboratory Manual of Haematology and Analysis, AV I publishing Co. Inc., Westport, Connecticut, 1978.

Model Question Paper
BC 1551.1: OPEN COURSE-I

Course Title: Clinical Diagnosis of Common Diseases

Section A

Objective questions, Answer **all 16** questions

I.

1. Serum Glutamate Oxaloacetate Transaminase (SGOT) is present in abundance in

   a. Cardiac muscles b. Kidney c. Erythrocytes d. Liver

2. The condition in which increased serum glucose level is noted.

   a. Hypoglycemia b. Glycosuria c. Hyperglycemia d. Diabetes

3. Albumin is synthesized in the

   a. Liver b. RBC c. Muscles d. Heart

4. Bilirubin originates from the breakdown of

   a. Monocytes b. Platelets c. RBC d. Basophils

II.

5. An increase bilirubin in blood results in a clinical condition known as

   a. Diabetes b. Obesity c. Jaundice d. Atherosclerosis

6. The main constituent of urine is

   a. Urea b. Uric acid c. Albumin d. Water

7. Normal random blood sugar level is

   a. 10-20 mg/dl b. 80-120 mg/dl c. 180-200 mg/dl d. 50-100 mg/dl)

8. Amylase is an enzyme which has the ability to split

   a. Cholesterol b. Starch c. Urea d. Protein

III.

9. Increased amount of albumin in urine is referred to as

   a. Hypoalbuminuria b. Hyperalbumin c. Hypoalbuminuria d. Albuminuria

10. Of the following which is an abnormal constituent of urine

a. Chlorides b. Uric acid c. Blood d. Creatinine

11. Thrombocytes are also known as

a. RBC b. Monocytes c. Neutrophil d. Platelets

12. The metal present in hemoglobin is

a. Mg b. Mn c. Fe d. Se

IV.

13. Westergren's method can be used for the measurement of

a. PCV b. Blood group c. ESR d. WBC count

14. The increased level of WBC is known as

a. Anemia b. Leukemia c. Cytopenia d. Cytosis

15. The concentration of creatinine in blood will increase with decreased --- function.

a. Heart b. Liver c. Kidney d. Muscle

16. The basic ABO blood group system in humans was first discovered by

a. Leeuwenhoek b. Karl Landsteiner c. Robert Hook d. T.H. Morgan

Section-B (Short Answer Questions)

Answer any **eight** questions

17. List any four functions of liver?.

18. What are Transaminases? Give two examples?

19. What is the clinical significance of albuminuria?

20. What do you mean by hemolytic disease of new born?

21. What is Icteric Index and its significance?

22. What is A/G ratio and its significance?

23. What are the tests included under the liver function tests?

24. Write down the difference between bleeding time and clotting time?

25. Name the enzymes which are elevated after acute MI?

26. What due you mean by random and post prandial blood sugar level?

27. What is the significance of CRP?

28. What are the causes of fatty liver?

Section-C (Short Essay)
Answer any **five** questions

29. Write a note on plasma proteins?

30. Describe the components and functions of blood.

31. Elaborate the pathological states of liver and liver function test.

32. Give an account of routine hematological tests.

33. Write a short note on clinical significance of urea and its normal values.

34. Write notes on i) SGPT ii) SGOT iii) LDH iv) CK (CPK)

35. Write a short note on the analysis of Ketone bodies and Bile salts in urine?

36. Write short note on the types of Jaundice?

Section-D (Long Essay)
Answer any **two** questions

37. Comment on the importance of blood transfusion and give an account of various blood transfusion reactions

38. Discuss on the abnormal constituents of urine and the pathological conditions associated with them

39. Give an account of

    i) Urine analysis

    ii) Body fluid analysis

    iii) Clinical significance of Hb concentration and RBC count.

BC 1551.2: Open Course
Course Title: Lifestyle Diseases

No. of Credits: 2 **No. of Contact Hours: 54**
Hours/week: 3 **(L, T, P, C - 3, 1, 0, 2)**

Open courses are offered to students of various other diciplines like arts, humanities and languages. Hence the approach to open course should be made only at a peripheral level. Indepth approach is not expected in this course.

Objectives: To create general awareness among students about the various diseases associated with lifestyle and which could be prevented by controlling the life style.

Course Outline

Module I **(4 hrs)**

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

Core Text:

- Biochemistry – U. Satyanarayana, U. Chakrapani , third edition, ISBN 81-87134-80-1
- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

Module II **(16 hrs)**

Atherosclerosis - characteristics, causes (confirmed & indirect risk factors – brief description only), ischemia, myocardial infarction -definition, Diagnosis (electrocardiography , Exercise ECG – Stress test, Echocardiography , Coronary angiography, Intravascular ultrasound, Magnetic resonance imaging – brief description only), Prevention (lifestyle, diet, drugs), management (drugs, angioplasty, stent, bypass surgery- brief description only)

Hypertension- Characteristics, Causes, Diagnosis, Prevention and Management (brief description only)

Stroke – Characteristics (ischemic and hemorrhagic), Causes, Diagnosis (neurological examination, scanning - brief description only), Management – (drugs, Mechanical thrombectomy, Angioplasty and stenting – brief description only)

Core Text:

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

Module III **(12 hrs)**

Diabetes mellitus: classification – type 1, type 2, gestational (brief description only), Type 2 diabetes: Glucose level, GTT, Glycated haemoglobin (mention only) Characteristics (polyuria, polydypsia, polyphagia), Causes, Diagnosis, Management (diet, exercise, drugs)

Obesity- classification according to BMI (brief description), symptoms, causes, diagnosis, treatment and management.

Core Text:

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

Module IV **(8 hrs)**

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

Core Text:

- Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York ISBN 978 0470-16961-2, 5th Edition.

Module V **(7 hrs)**

Nephritis- Function of kidney (brief outline), Nephritis (mention subtypes), Causes, Symptoms, Diagnosis (Kidney function test- Brief outline of : Significance of GFR, urine creatinine, BUN, blood creatinine, creatinine clearance), Treatment, management (dialysis- peritoneal and hemodialysis).

Module VI **(7hrs)**

Liver disease- Function of liver (brief ouline), Liver disease (viral hepatitis, alcoholic liver disease, cirrhosis), symptoms, causes, diagnosis (Liver function test- Brief outline of serum bilirubin, serum albumin, serum alkaline phosphatase, ALT , AST and LDH), treatment and management.

Core Text:

- Textbook of Medical Physiology, by Arthur C Guyton, John E Hall Prism Saunders 9th Edition ISBN: 81-7286-034-X.

Model Question Paper
BC 1551.2: Open Course
Course Title: Lifestyle Diseases

Section A
Objective questions, Answer all 16 questions (Weightage-1)

I

1. Management of atherosclerosis includes
   a. dietary modifications b. Surgical intervention
   c. Pharmaceutical intervention d. all of these

2. Unhealthy lifestyle includes
   a. alcoholism b. smoking c. both a & b d. none of

3. Insulin is a
   a. virus b. hormone c. carbohydrate d. fat

4. Which one of the following is not a lifestyle disease
   a. Dengue fever b. Atherosclerosis c. Cancer d. Diabetes

II

5. Risk factors for atherosclerosis includes
   a. Obesity b. high blood lipid levels c. hypertension d. All of these

6. Stroke is associated with
   a. Heart b. Brain c. Kidney d. none of these

7. ECG is used to assess the function of
   a. Heart b. liver c. kidney d. none of these

8. Statins are used to
   a. Lower blood cholesterol b. Lower blood glucose
   b. c. both a&b d. none of these

III

9. The disease related to heart
   a. Nephritis b. Diabetes c. Atherosclerosis d. Osteoporosis

10. The presence of glucose in urine is a feature of
    a. Stroke b. Liver disease c. Diabetes d. Atherosclerosis

11. Which of the following parameters in blood is measured to study kidney function?
    a. Glucose b. Cholesterol c. Creatinine d. Triglyceride
    b.

12. Chronic renal failure is also called
    a. Parkinson's disease b. Stroke c. Nephritis d. Atherosclerosis

IV

13. Functional unit of kidney is called
    a. Neuron b. Nephron c. Sarcomere d. None of the above

14. Glucosurea is associated with
    a. Diabetes b. atherosclerosis c. Stroke d. none of these

15. High blood pressure is also called
    a. Hypercholesterolemeia b.Diabetes c. Hypertension d. None of the above

16. The normal level of blood glucose is
    a. 80-120mg/dL b.150-200 mg/dL c. 200-250mg/dL d. 50-70mg/dL

Section B (Short Answer Questions)
Answer any eight questions (Weightage-1)

17. Name a liver disorder
18. What is meant by gestational diabetes?
19. What is normal blood pressure (BP)?
20. What is polyuria?
21. What is the normal blood cholesterol level?
22. What is BMR? What is its significance?
23. What is cancer?
24. What is stroke?
25. What is the defect in diabetes?
26. What do you mean by diagnosis?
27. Define disease.
28. What is atherosclerosis?

Section C (Short Essay)
Answer any five questions (weightage-2)

29. What is kidney function test? Describe briefly.
30. What is meant by benign and malignant condition?
31. What are the preventive measures to control obesity?
32. Write about any four methods employed for the diagnosis of cancer?
33. Write briefly the diagnostic methods of diabetes.
34. What are the causative factors of obesity?
35. Write a short note on nephritis?
36. What is hypertension and what are the different pharmaceutical interventions.

Section D (Long Essay)
Answer any two questions (Weightage-4)

37. Write an essay on the characteristics, causes, diagnosis, prevention and management of cancer.
38. Give an account of the various Liver function tests
39. Write an essay on cardiovascular disease, its causes and methods of prevention.