

B.Sc., BIOCHEMISTRY

ELECTIVE

SEMESTER – VI

Theory: BCT-601-Microbiology and Molecular Biology

Unit- I : Microbiology

12 hours

Introduction to brief history of microbiology. Classification of microorganisms- prokaryotic and eukaryotic microorganisms. Isolation and cultivation of bacteria. Selective media and enriched media. Bacterial growth curve and kinetics of growth. Gram's staining- Gram positive and Gram negative bacteria, motility and sporulation.

Structure and composition of viruses. Isolation and cultivation of bacterial plaques. Lytic and lysogenic life cycle of λ phage. Retro viruses- HIV.

Unit II-Applied Biochemistry

12 hours

Fermentation Technology: Batch, continuous culture techniques, principle types of fermentors. Industrial production of chemicals- alcohol, acids (citric acid), solvents (acetone), antibiotics (penicillin),

Enzyme Technology: Immobilization of enzymes and cells, different methods. Industrial applications.

Production of transgenic plants and their applications.

Introduction to Bioinformatics- definitions of proteomics and genomics. Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA.

Unit- III : DNA Replication and Transcription

12 hours

Nature and structure of the gene. DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model. DNA polymerases I, II and III of *E.coli*, helicase, topoisomerases, primase, ligase. Bidirectional replication model. Okazaki fragments, leading and lagging strands of DNA synthesis. Inhibitors of DNA replication.

Transcription - RNA synthesis, RNA polymerases of prokaryotes. Promoters, Initiation- sigma factors and their recognition sites. Elongation- role of core enzyme. Termination- rho dependent and rho independent.

Unit- IV: Protein Synthesis and Regulation of Gene Expression

12 hours

Introduction to protein synthesis- Genetic code, deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.

Protein synthesis- activation of amino acids (aminoacyl t-RNA synthetases). Ribosome structure. Initiation, elongation and termination of protein synthesis. Post- translational modifications- signal hypothesis. Inhibitors of protein synthesis.

Regulation of prokaryotic gene expression- induction and repression. Lac operon.

Unit- V: Recombinant DNA technology

12 hours

Outlines of cloning strategies. DNA sequencing- Maxam Gilbert and Sanger's methods. Tools of r-DNA technology: Enzymes- Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases- S_1 and RNAase H. Restriction mapping. Cloning vectors- Plasmid, Expression vector - Host- *E.coli*.

Construction of c-DNA and genomic libraries. Isolation and sequencing of cloned genes- colony hybridization, nucleic acid hybridization.

Polymerase chain reaction- principle and applications. Outlines of blotting techniques-Southern, Northern and Western.
Applications of gene cloning- production of insulin and human growth hormone, production of Bt cotton and edible vaccines.

Practical: BCP-601: Microbiology and Molecular Biology

**45 hrs
(3 periods/week)**

List of Experiments:

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method. (ii) Serial dilution method.
3. Gram staining.
4. Motility of bacteria by hanging drop method.
5. Antibiotic sensitivity by paper disc method.
6. Isolation of DNA from onion/liver/coconut endosperm.
7. Estimation of DNA by diphenylamine method.
8. Estimation of RNA by orcinol method..
9. Sequence alignments of insulin/BSA with other proteins using BLAST and FASTA.
10. Examination of milk quality by MBRT method.

CLUSTER ELECTIVE – 1

Theory BCT-602: Biochemistry of Cell

60hrs
(5 periods/week)

Unit- I: Biomolecules in their cellular environment

No. of Hours : 12

The cellular basis of life. Cellular structures – prokaryotes and eukaryotes. Chemical principles in biomolecular structure. Major classes of biomolecules. Role of water in design of biomolecules.

Unit –II : Amino acids and Lipids

No. of Hours : 12

Types of amino acids and their chemistry, derivatives of amino acids and their biological role. Introduction to biologically important peptides. Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, cofactors and pigments.

Unit- III: 3 Sugars and Nucleic Acids

No. of Hours : 12

Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides - their distribution and biological role. Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.

Unit- IV : Vitamins, coenzymes and metal ions

No. of Hours : 12

Occurrence and nutritional role of vitamins. Coenzymes and their role in metabolism. Metal ion containing biomolecules - heme, porphyrins and cyanocobalamin; their biological significance.

Unit- V: Signalling molecules

No. of Hours : 12

Second messengers - cAMP, cGMP, IP₃, diacyl glycerol, Ca²⁺, NO. Brief account of their importance and role in signalling and signal transduction.

CLUSTER ELECTIVE – 1
Practical – 602 : Biochemistry of Cell

45 h 60hrs
(3 p (5 periods/week))

1. General safety procedures in a laboratory. Use of auto pipettes. Making solutions and buffer preparation - acetate and tris buffers.
2. Qualitative tests for biomolecules - carbohydrates, lipids, amino acids, proteins, bases and nucleic acids.
3. Separation of amino acids by paper chromatography.
4. Separation of sugars/bases by TLC and their identification.
5. Estimation of ascorbic acid in fruit juices.

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13; 978-1-4641-0962-1 / ISBN:10-146410962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.

CLUSTER ELECTIVE – 2

60hrs
(5 periods/week)

Theory: BCT-603: Biochemical Correlations in Diseases

60 hrs
(5 periods/week)

Unit- I : Inborn errors of metabolism

No. of Hours : 12

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Unit- II: Nutritional Deficiency and Life style diseases

No. of Hours : 12

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease. Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

Unit- III: Hormonal Imbalances and Autoimmune diseases

No. of Hours : 12

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism. Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis; Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I.

Unit- IV : Diseases caused due to misfolded proteins

No. of Hours : 12

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell anaemia, Thalessemia.

Unit- V: Infectious diseases

No. of Hours : 12

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (*Plasmodium* and *Trypanosoma*) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

45 hrs
(3 per/week)

CLUSTER ELECTIVE – 2

Practical BCP- 603: Biochemical Correlations in Diseases

60hrs
(5 periods/week)

1. Glucose tolerance test.
2. Lipid profile: triglycerides and total cholesterol.
3. Obesity parameters.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Bone density measurements (visit to a nearby clinic).
7. T₄/TSH assays.
8. Tridot Test/ Lateral flow test for viral diseases

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Immunology: A Short Course (2009) 6th ed., Coico, R and Sunshine, G., John Wiley & sons, Inc (New Jersey), ISBN: 978-0-470-08158-7
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer, L., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.
4. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Recommended Books for UG Course -Biochemistry

General Biochemistry

1. Lehninger's Principles of Biochemistry – Nelson.D.L. and Cox.M.M., Freeman & Co.
2. Biochemistry – Berg.J.M., Tymoczko.J.L. and Stryer.L., Freeman & Co.
3. Biochemistry – Voet.D and Voet., J.G., John Wiley & Sons
4. Textbook of Biochemistry – West.E.S., Todd.W.R., Mason.H.S. and Bruggen, J.T.V., Oxford & IBH Publishers.
5. Principles of Biochemistry: General Aspects-Smith, E. L., Hill, R.L. Lehman, I. R. Lefkowitz, R.J. Handler, P., and White, A. McGraw-Hill
6. Outlines of Biochemistry – Conn.E.E., Stumpf.P.K., Bruening, G and Doi.R.H., John Wiley & Sons
7. Harper's Illustrated Biochemistry – Murray, R.K., Granner.D.K. & Rodwell,V.W., McGraw-Hill
8. Biochemistry-Lippincott's Illustrated Reviews. Champe, P.C. and Harvey, R. A. Lippincott
9. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
10. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.
11. Biochemistry – Rama Rao. A and Ratna Kumari. D, Kalyani Publishers.
12. Biochemistry- The Molecular Basis of Life – McKee. T and McKee, J. R, McGraw-Hill.

Enzymology

1. Fundamentals of Enzymology – Price.N.C.and Stevens.L., Oxford University Press.
2. Understanding Enzymes – Palmer.T., Ellis Harwood.
3. Enzymes – Biochemistry, Biotechnology, Clinical Chemistry – Palmer.T., Affiliated East-West Press

Biochemical Techniques

1. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.
2. The Tools of Biochemistry- Cooper, T. G. John Wiley & Sons Press.
3. Physical Biochemistry- Friefelder, D. W.H. Freeman Press.
4. Analytical Biochemistry – Holme.D.J. and Peck.H., Longman.
5. Biophysical Chemistry: Principle and techniques- Upadhyay A, Upadhyay K and Nath. N. Himalaya Publishing House.
6. Experimental Biochemistry- Clark Jr. J.M and Switzer, R. L. Freeman & Co..

Physiology, Nutrition and Clinical Biochemistry:

1. Textbook of Biochemistry and Human Biology – Talwar, G.P. and Srivastava. L.M., Printice Hall of India
2. Review of Medical Physiology-Ganong. McGraw-Hill.
3. Human Physiology – Chatterjee.C.C, Medical Allied Agency
4. Textbook of Medical Physiology – Guyton.A.G and Hall.J.E., Saunders
5. William’s Textbook of Endocrinology – Larsen, R. P. Korenberg, H. N. Melmed, S. and Polensky, K. S. Saunders
6. Mammalian Biochemistry- White, A. Handler, P. and Smith, E. L. McGraw-Hill.
7. Textbook of Human Nutrition- Bamji, Pralhad Rao and Reddy V. Oxford & IBH Publishers.
8. Foods: Facts & Principle- Shakuntala and Shadaksharaswamy. Wiley Ester Press.
9. Essentials of Food and Nutrition – Swaminathan.M. Bangalore Press.
10. Human Nutrition and Dietetics. Davidson, S. and Passmore, J. R. ELBS.
11. A Textbook of Biochemistry: Molecular and Clinical Aspects. Nagini, S. Scitech Publishers.
12. *Tietz* Fundamentals of Clinical Chemistry- Burtis, A. A. and Ashwood, E. R. Saunders-imprint Elsevier Pub.
13. Textbook of Biochemistry with Clinical Correlations – Devlin.T.M.,Wiley – Liss
14. Textbook of Medical Biochemistry – Chatterjea.M.N. and Shinde.R, Jaypee Brothers Medical Publishers.
15. Textbook of Medical Biochemistry- Ramakrishnan, S., Prasannan, K. G. and Rajan, R. Orient Longman

Immunology:

1. Immunology. Tizard, I. R. Thomson Press.
2. Kuby Immunology – Kindt.T.J., Goldsby.R.A. and Osborne.B.A., Freeman & Co.
3. Roitt’s Essential Immunology – Roitt.I.M. and Delves.P.J., Blackwell Science.
4. Immune system- Parham. Garland Publishing.

Microbiology:

1. Introduction to Microbiology: A Case History Approach- Ingraham and Ingraham. Thomson Press.
2. Textbook of Microbiology – Ananthanarayan, R and Jayaram Paniker, C.K., Orient Longman.
3. Microbiology – Prescott.L.M.,Harley.J.P. & Klein.D.A, McGraw-Hill.
4. Microbiology: An Introduction- Tortora, G. J. Funke, B. R. and Case, C. L., Pearson-Benjamin-Cummings Co.
5. Microbiology – Pelczar Jr.,M.J., Chan.E.C.S. and Krieg.N.R., Tata McGraw-Hill.

6. Textbook of Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

Molecular Biology and Biotechnology:

1. Protein Biochemistry & Biotechnology- Walsh. John Wiley & Sons Press.
2. Molecular Biology of Cell- Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J. D. Garland Publishing.
3. Recombinant DNA and Biotechnology: A Guide for teachers- Helen and Massey. ASM Press.
4. Genes VIII – Lewin. B, Oxford University Press .
5. Molecular Biology- Freifelder. D. Narosa Pub. House
6. Molecular Biology of the Gene- Watson. J.D., Baker, T.A, Bell, S.P., Gann.A, Levine, M. and Losick.R, Pearson Education.
7. Molecular Biotechnology- Glick, B. R. and Pasternak, J. J. ASM Press
8. Principles of Gene Manipulation: An Introduction to GE- Old, R. V. and Primrose, S. B. Blackwell Sci. Pub.
9. A Textbook of Biotechnology-Dubey, R. C. S. Chand & Co.
10. Gene Biotechnology- Jogdand. Himalaya Pub. House.
11. Introduction to Biotechnology: An Agricultural Revolution-Herren. Thomson Press.
12. Molecular Cell Biology- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C. A., Krieger, M. Scott M. P., Zipursky, S. L. and Darnell, J. Freeman & Co.

Bioinformatics

1. Instant Notes-Bioinformatics- Westhead *et al.*, Viva Books (P), Ltd
2. Introduction to Bioinformatics- Attwood T K and Parry-Smith, D. J. Pearson Education.
3. Introduction to Bioinformatics- Lesk, A.M. Oxford University Press

Practical Biochemistry:

1. Experimental Biochemistry: *A Student companion*- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd. Pub.
2. Modern Experimental Biochemistry- Boyer. R. Pearson Education
3. Biochemical Methods –Sadasivam, S and Manickyam, A.- New Age International publishers
4. An Introduction to Practical Biochemistry- Plummer, D. T. Tata McGraw-Hill.
5. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh- Narosa Publications House
6. Lab Manual in Biochemistry, Immunology and Biotechnology- Arti Nigam and Archana Ayyagari- Tata McGraw-Hill New Delhi
7. Enzyme Assays – A Practical Approach – Eisenthal, R and Dawson, M.J., IRL Press
8. Practical Biochemistry – Rameshwar. A, Kalyani Publisher.
9. Experiments and Techniques in Biochemistry – Sheel Sharma, Galgotia Publications.
10. Practical Clinical Biochemistry-Varley,H. CBS Publishers.
11. Practical Clinical Biochemistry –Methods and Interpretations –Ranjna Chawla- Jaypee
12. Manipal Manual of Clinical Biochemistry-Shivande Naik, B - Jaypee Brother Medical publications, New Delhi
13. Hawk's Physiological Chemistry- (ed) Oser, O. Tata-McGraw-Hill
14. Laboratory Manual in Biochemistry. Jayaraman, J. Wiley-Eastern
15. Biotechnology: A laboratory Project in Molecular Biology- Thiel, Bissen and Lyons. Tata McGraw-Hill.
16. Methods in Biotechnology- Hans-Peter Schmauder. Taylor & Francis.

Practical Microbiology:

1. Microbiology – A Laboratory Manual- Cappuccino, J. G. and Sherman, N. Pearson Education.
2. Laboratory Experiments in Microbiology- Gopal Reddy, M., Reddy, M.N., Sai Gopal D. V.R. and. Mallaiah, K.V.
3. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom cultivation- Aneja, K. R - New Age International publishers.
4. Microbiology – A Laboratory Manual- Reddy, S. M. and Ram Reddy, S. Sri Padmavathi Pub.
5. Practical Microbiology- Dubey, R. C. and Maheshwari, D. K. S. Chand & Co.

Mathematical Problems in General Biochemistry:

1. Biochemical Calculations- Segel, I.H. John Wiley & Sons.

Lab Reference Book:

1. Lab Ref A Hand book of Recipes, Reagents and Other Reference Tools for Use at the Bench- (ed) Roskams, J. and Rodgers, L.- I.K International Pvt. Ltd, New Delhi.

MODEL QUESTION PAPER FOR END SEMESTER EXAM

B. Sc Degree Course (CBCS Semester pattern)

B. Sc Biochemistry

Time : 3 Hrs

Max marks : 75

SECTION A

(5 x 5 = 25 marks)

Attempt any five of the following

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

SECTION – B

(10 x 5 = 50 marks)

Attempt all the questions

- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

(OR) Unit I

(OR) Unit-II

(OR) Unit-III

(OR) Unit IV

(OR) Unit V

Distribution of Practical Exam Marks

Practical Exam Time: 3 Hrs

Max marks: 50

1. Major Experiment	20 (Principle -5M, Methodology-10M, Results-05)
2. Minor Experiment	10 (Principle -2M, Methodology-05M, Results-03)
3. Spotters	10 (5 nos. x 2 M)
4. Record	05
5. Viva-voce	05

MODEL QUESTION PAPER FOR SEMESTER END PRACTICAL EXAMINATIONS

B.Sc., Course Semester End Practical examination

B.Sc., Biochemistry

TIME: 3 hours

Max. Marks: 50

- | | |
|---|----------|
| 1. Major experiment. | 20 marks |
| 2. Minor experiment | 10 marks |
| 3. Identify the given spotter and write a brief note on it- A, B, C,D,E, F (5x2M) | 10 marks |
| 4. Record | 05 marks |
| 5. Viva-voce | 05 marks |

MID TERM EXAMINATIONS

(Ist and IInd Internal Assessment Examinations)

Internal assessment; after completion of two Units one internal test will be conducted

No. of internal tests; Two

Average two internal tests will be taken

Total no. of Marks 25

Pattern; out of five short answers three questions have to be attempted each carries 5 Marks.

In essay questions out of two questions, one has to be attempted which carries 10 marks.

MID SEM EXAM MODEL QUESTION PAPER

Ist INTERNAL ASSESMENT EXAMINATION

B. Sc Degree Course (CBCS-Semester pattern)

B. Sc., Biochemistry

Time : 1 Hr

Max marks : 25

SECTION -A

(3 x 5 M= 15M)

Attempt any **THREE** short questions of the following

- 1.
- 2.
- 3.
- 4.
- 5.

SECTION – B

(1x 10M = 10 marks)

Attempt any **ONE** essay question of the following

- 6.
- 7.

MID SEM EXAM MODEL QUESTION PAPER
IIInd INTERNAL ASSESMENT EXAMINATION
B. Sc Degree Course (CBCS-Semester pattern)
B. Sc Biochemistry

Time : 1 Hr

Max marks : 25

SECTION - A

(3 x 5 M= 15M)

Attempt any **THREE** short questions of the following

- 1.
- 2.
- 3.
- 4.
- 5.

SECTION – B

(1x 10M = 10 marks)

Attempt any **ONE** essay question of the following

- 6.
- 7.