Vidyasagar University
Syllabus of M.Sc. Course in Biochemistry
(Choice Based Credit System- CBCS)

Distribution of Marks :-

I. M.Sc. Part-I

SEMESTER – I

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIC-101	Chemistry of Biomolecules	Theory (Core)	10	40	50	4
BIC - 102	Biophysical Chemistry and Bioenergetics	Theory (Core)	10	40	50	4
BIC - 103	Physiological Chemistry	Theory (Core)	10	40	50	4
BIC-104	Cell and Molecular Biology	Theory (Core)	10	40	50	4
BIC-105	Physical Biochemistry	Practical (Core)	10	40	50	4
BIC-106	General Biochemistry	Practical (Core)	10	40	50	4
Total marks and Credits					**300**	**24**

SEMESTER – II

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIC-201	Microbiology	Theory (Core)	10	40	50	4
BIC-202	Biostatistics and Basic Bioinformatics.	Theory (Core)	10	40	50	4
BIC-203	Enzymology, Intermediary metabolism & nutrition	Theory (Core)	10	40	50	4
BIC-	Environmental management and	Theory	10	40	50	4

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204	sustainable development	(Elective Course)				
BIC-205	Food and nutrition Biochemistry	Practical (Core)	10	40	50	4
BIC-206	Microbiology	Practical (Core)	10	40	50	4
Total marks and Credits					**300**	**24**

SEMESTER – III

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIC-301	Methods and Techniques employed in Biochemistry	Theory (Core)	10	40	50	4
BIC-302	Imunology	Theory (Core)	10	40	50	4
BIC-303	Gene regulation & Recombinant DNA technology	Theory (Core)	10	40	50	4
BIC-304	Food/Nutrition Nutragenomics	Theory (Elective Course)	10	40	50	4
BIC-305	Clinical Biochemistry	Practical (Core)	10	40	50	4
BIC-306	Cell & Molecular Biology, Immunology	Practical (Core)	10	40	50	4
Total marks and Credits					**300**	**24**

SEMESTER – IV

- Theoretical -200 marks
- Practical -100 marks

Paper Code	Paper name	Type of Paper	IA	EA	Maximum marks	Credits
BIC-401	Pharmaceutical Biochemistry	Theory (Core)	10	40	50	4
BIC-402	Medical Biochemistry	Theory (Core)	10	40	50	4
BIC-	Research Technique and	Practical (Core)	10	40	50	4

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403	advanced methodology					
BIC-404	Seminar, and Comprehensive Viva.	Practical (Core)	10	40	50	4
BIC-405	Project Work	Practical (Core)	-	-	50	4
BIC-406	Project Presentation and Viva-voce	Practical (Core)	-	-	50	4
Total marks and Credits					**300**	**24**

Total Marks (Semester I to IV): 1200

- Number of Theoretical papers- 15
  (Total credits: 15x4=60 Credits)
- Number of Practical papers- 09
  (Total credits: 9x4=36 Credits)

- Total Credits (Semester I to IV) : 96.
- One Paper= 50 marks= 4 credits

Each E.A.=40 marks (40 Hours duration) =3.2 credits
Each I.A.=10 marks =0.8 credits

DISTRIBUTION OF MARKS

Each theoretical and practical paper carries 40 marks each.10 marks will be allotted for internal assessment.

Questions for each theoretical paper:

Q.no.1. – 05 questions out of 8 (x2) = 10 marks.
Q.no.2. – 02questions out of 4(x5) = 10marks
Q.no.3. – 02 questions out of 4 (x10) = 20 marks

Total- 40 marks.

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VIDYASAGAR UNIVERSITY

SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

SEMESTER – I

Paper – I (BIC-101)

(50 marks, 50 lectures, 4 credits)

CHEMISTRY OF BIOMOLECULES

1. Carbohydrate Chemistry :- General structure and classification of monosacchasides, cyclic structure of monosacchasides – Pyran, furan, Mutarotation. Isomerism. Compounds derived from monosacchasides (Ascorbic acid, Sugar-alcohols, amino sugars), Chemical properties of monosacchasides, homo- and heteropolysacchasides. **12 L**

2. Amino acid and protein Chemistry :- Structure, classification, Physio-chemical properties, nonstandard protein amino acids, non protein amino acids. Major chemical reactions of amino acids.

Peptide and Protein Chemistry:- General idea about Peptides. Protein configuration – Primary, secondary, tertiary and quarternary structure. Ramachandran plot Globular proteins, myoglobin, haemoglobin; collagen. Classification of Proteins.

18 L

3. Nucleic acid chemistry:- DNA and RNA chemistry, Double helix model, DNAs with unusual structutes, Single stranded DNA. Informosome. Denaturation and renaturation. C-value paradox, Cot curve.

12 L

4. Lipid chemistry:- Simple lipids (Fats and oils, waxes); Compound lipids (Phospho lipids, Phosphoglycerides, Phosphosphingosides, Glycolipids, sulfo lipids), derived lipids (Steroids, terpenes, Carotenoids). **8 L**

Reference books:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry 4th edition Pub WH Freeman Co.
2. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 rd Indian edition, Pub. Oxford.
3. Mathews, Van Holde and Ahern, Biochemistry by 3 rd edition, Pub Pearson education
4. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
5. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 nd edition Pub: Tata.
6. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
7. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
8. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers. Oxford.
9. Edwards and Hassall. Biochemistry and Physiology of the cell 2 nd Edn. McGraw Hill Co. UK. Ltd.

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

Paper – II (BIC-102)

(50 marks, 50 lectures, 4 credits)

BIOPHYSICAL CHEMISTRY AND BIOENERGETICS

1. Chemical and Physical forces involved in Chemical bond formation between atoms and molecules, mechanism of bond formation based on electronic orbitals, sigma, Pi bonds, covalent, ionic, electrostatic, co-ordinate bonds, hydrophobic and van-der-waal interaction and their properties. Chemical bonds between Carbon and Carbon, Carbon and Nitrogen and Carbon with other atoms such as hydrogen, oxygen, Phosphorous and sulphur. **12 L**

2. Bioenergetics – Coupling, the concept of free energy, Thermo dynamic principles (First law, second law, combination of two laws), Standard free energy change and equilibrium constant, AG and AGO'. AG as universal currency of free energy in biological system free energy of hydrolysis of ATP and other organophosphates. Phosphoryl group transfer Potential of ATP. Biological oxidation – reduction reaction. **12 L**

3. Instrumentation:- (Working principle only)

Microscopy, Ultracentrifugation, viscometry, FACS, flame Photometer, Atomic absorption spectrophotometer, Mass spectrometry, UV-visible, IR spectrophotometry. Chromotography including Electrophoresis including 2D gel, NMR and ESR. Scintilation counter, autoradiography, radioactivity. **26 L**

Reference books:

1. Mathews, Van Holde and Ahern, Biochemistry by 3 rd edition, Pub Pearson education
2. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
3. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 nd edition Pub: Tata.
4. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
5. Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 4th Edn. Blackwell publishers.
6. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell.
7. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.

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VIDYASAGAR UNIVERSITY
SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PAPER III (BIC-103)

(50 marks, 50 lectures, 4 credits)

PHYSIOLOGICAL CHEMISTRY

1. Introduction to Organic Chemistry:-

General nature of organic reactions, Reaction kinetics, Handerson – Hasselbatch equation and application. Nomenclature of aromatic compounds. **7 L**

2. Alkanes:- Structural formulae, Nomenclature, homologous series, Alkenes, Conformational analysis, Alkenes and Alkynes, Orbital Picture, Geometrical isomerism. Monohydric alcohols, Polyhydric alcohols, Unsaturated alcohols, ether, and acids. **7 L**

3. Structure and function of the cell and its organelle:- Endoplasmic reticulum, Golgi Complex, Lysosome, mitochondria, chloroplast, nucleus and nucleosomes, ribosomes, Peroxisomes. Cytoskeleton.

Membrane system:- Models, membrane lipid, Membrane enzymes and receptors and their isolation. Transport through membranes (ionic Pumps, ionic channels, carriers).Preparation and structural arrangement in monolayer, bilayer and liposome. **13 L**

4. Human Biology:- i) Gastrointestinal system, Digestion, absorption and nutrition.

ii) Chemistry and biology of Liver and biliary system.

iii) Haematopoietic system: Blood and buffer system (an overview)

iv) Overview of Heart and cardiovascular system.

v) Physiology of nerve and muscle homeostasis.

vi) Excretion and acid-base regulation. **19 L**

5. Photosynthesis, Respiration, C3, C4 pathway (light & dark cycle). **7 L**

Reference books:

1. Textbook of Organic Chemistry, Subtitle: Author Rakesh K. Parashar, V.K. Ahluwalia ISBN 9788130917740

2. Advanced Organic Chemistry, Francis A. Carey, Richard A. Sundberg, Part A: Paperback, 1199 Pages 5th Edition, 2007 ISBN-13: 978-0-387-44897-8
Springer

3. *Guyton* and Hall Textbook of Medical *Physiology.*

4. Ganong's Review of Medical Physiology, 24th Edition (Lange Basic Science) Paperback – Import, 1 May 2012, by Kim E. Barrett (Author)

5. For human physiology Human Physiology: From Cells to Systems (Lauralee Sherwood)

6. For cellular physiology the best one ((Cell Physiology Source Book, 4th Edition)) bu Sperilakis

7. Cell and Molecular Biology 8 Sub Edition by E. D. P. De Robertis (Author)

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PAPER IV (BIC-104)

(50 marks, 50 lectures, 4 credits)

CELL AND MOLECULAR BIOLOGY

1. DNA metabolism:- Enzymes, DNA replication in Prokaryotes and Eukaryotes. DNA topology, DNA mutation & repair. **13 L**

2. Transcription, Transcription factors, RNA Processing, regulation of transcription initiation in prokaryotes and eukaryotes. **7 L**

3. Protein biosynthesis in prokaryotes and eukaryotes. Role of RNAs in Protein systhesis. Aminoacylation and translation mechanism in Prokaryotes and eukaryotes. Deciphering the genetic code. **10 L**

4. Regulation and expression of prokaryotic genes: Operon systems **3 L**

5. Protein transport:- Sites of synthesis of organelle and membrane Protein. Signal hypothesis. Glycosylation of proteins, Envelop carrier hypothesis. Protein targeting to nucleus, chloroplast mitochondria, Peroxisomes and lysosomes. Eukaryotic Protein transport across membranes. Protein import by receptor mediated endocytosis. **7 L**

6. Cell cycle and its regulation:- Phases of the cell cycle. Mitosis and control of entry and exit from mitosis. Regulation of MPF activity, Cell cycle control in mammalian cells. Role of check points in cell cycle regulation, cell signaling/ cAMP, Ca2+. Meiosis and its significance. Crossing over. Cell cycle and cancer. Apoptosis. **10 L**

References:

1. Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 4th Edn. Blackwell publishers.
2. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell.
3. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.
4. Darnell, J., Lodish, H., Baltimore, D. (1990). Molecular Cell Biology. Scientific American Books Inc. NY.
5. Edwards and Hassall (1980). Biochemistry and Physiology of cell, 2 nd Edn. McGraw Hill Company.
6. Garrett, R.H., Gresham, C.M. (1995). Molecular aspects of Cell Biology, International edition, Saunders College Pub.
7. Holy Ahern (1992). Introduction to Experimental Cell Biology, Wm. C. Brown Publishers.
8. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
9. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.
10. Tobin and Morel (1997). Asking about “Cells” Saunders College Publisher.

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11. Wolfe, S.L. (1991). Molecular and Cellular Biology, Wordsworth Pub.Co.
12. Hallwell, B., Gutteridge, J.M.C. (2002). Free Radicals Biology and Medicine. Oxford Press.UK.
13. Kanugo, M.S. (2002) Genes and aging. Cambridge University Press.
14. David Freifelder. (2004). Microbial genetics. 10th edition, Norosa publisher, New Delhi.
15. Lodish, H.D., Baltimore, A., Berk, B.L., Zipursky, P., Mastsydairs and Darnell, J. (2004). Molecular cell biology. Scientific American Books Inc., NY.
16. Gardner/Simmons/Snustad. (2006). Principal of Genetics. 8th Edn. John Wiley & sons.
17. Klug, W.S.,Cummings. (2003). Concepts of genetics, 7th Edn. Pearson Education.
18. Dale, J.W. (1994). Molecular Genetics of bacteria, John Wiley & Sons.
19. Streips and Yasbin. (2001). Modern microbial Genetics. Niley Ltd.
20. John Ringo (2004). Fundamental Genetics. Cambridge University Press.
21. Molecular Biology Genes to Proteins, 3rd Edition B. E. Tropp, Jones and Bartlett Publishers, Sudbury, Massachusetts, USA, 2008, 1000 pp., ISBN 978-0-7637-0916-7

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PRACTICAL PAPERS

Paper-V(BIC-105)

Physical Biochemistry

1) Chromatographic techniques-two dimensional paper chromatography. Thin layer chromatography, ion exchange chromatography.

2) Electrophoresis techniques: - SDS polyacrylamide gel electrophoresis.

3) Conductometric titration: - acid-base, precipitation by conductometer.

4) Potentiometric experiments: - acid-base, redox system by potentiometer.

5) Preparation of buffers (acetate, phosphate, tris-Hcl).

6) Colorimetric determination of pk.

7) Measurement of specific rotation by polarimeter.

8) Experiment on distribution law.

9) Determination of energy of activation.

10) Establishment of validity of lambert-beers' law and determination of extinction co-efficient of a protein.

11) Determination of reaction kinetics(0 order and 1^{st} Order) `

Paper-VI (BIC-106)

General Biochemistry

1) Determination of protein content by biuret method, Bradford's method and Lowry's method.

2) Determination of glycogen content in a given liver extract.

3) Determination of amino acids by formal titration and by ninhydrin method.

4) Determination of specific activity of alkaline phosphatase.

5) Determination of km and Vmax value of alkaline phosphatase.

6) Isolation, determination and quantification of DNA and RNA.

7) Spectrophotometric estimation of α-amylase, protease and dehydrogenase.

8) Estimation of cholesterol by colorimetric method.

9) Determination of saponification value and iodine number of lipids.

10) Estimation of total and reduced ascorbic acid by DCIP and DNPH method.

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VIDYASAGAR UNIVERSITY

SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

SEMESTER – II

PAPER – VII (BIC-201)

(50 marks, 50 lectures, 4 credits)

MICROBIOLOGY & VIROLOGY

1. Prokaryotic Organisms:-Characteristics, Classification and importance of microorganisms. Bergey's manual of systematic bacteriology. Contribution of Leeuwenhock, Pasteur, Koch, Jenner and other microbiologists. **5 L**

2. Cell structure and other characteristics of Eubacteria, Rickettsiae, Mycoplasma, Spirochetes and Cyanobacteria. Eukaryotic microorganisms:-Structure and reproduction of yeast and molds. **8 L**

3. Morphology and fine structure of bacteria. Bacterial cell wall. Peptidoglycan structures of Staphylococcus aureus, E. coli, Micrococcus luteus etc. Outline of bacterial cell wall biosysthesis and effect of various cell wall biosynthetic inhibitors. Cell wall hydrolytic enzymes. **8 L**

4. Growth Kinetics of bacteria:-Nutritional classification and requirements. Effects of Physical and Chemical factors on microbial growth. Biogeochemical cycle: Nitrogen, Sulphur and Phosphorus emphasizing role of microorganisms. **8 L**

5. Microbial genetics: Recent advances in molecular genetics of viruses and bacteria. Transformation, conjugation and transduction, complementation. **8 L**

6. Elements of Virology. General introduction and classification of virus. structure of Bacterial (T4), Plant, TMV and Animal Viruses, Influenza virus. General idea about Bacteriophages: Lambda phases, T7 and M13 phases. Fine structure gene expression in phase lambda: Early transcription events, Molecular basis of Lytic and Lysogenic pathways. Site specific recombination in bacteriophage lambda. **13 L**

References:

1. Microbiology by MJ Pelczar Jr, ECS Chan, NR Krieg 5th Edition, Pub: Tata Mcgra-Hill Publishing Co Ltd.
2. Introductory Microbiology by Heritage Pub Heritage
3. General Microbiology by Stainer Pub; Ingraham and Wheeler (McMillan)
4. Alexander M (1977) Introduction to soil microbiology, John Wiley and Sons Inc.N.Y.
5. Atlas R.M. (1998) Microbiology, Fundamentals and applications 2nd Edition, Milan Publishing Co.
6. Brock T.D. and Madigan M.T (1992) Biology of Microorganisms 6th Edn. Prentice Hall, Eagle wood cliffs N.j.
7. Holt J.S. Kreig N.R., Sneath P.H.A and Williams S.T (1994) Bergey‟s Manual of Systemic Bacteriology 9th Edn. William and Wilkins, Baltimore.
8. Prescott L.M, Harley T.P and Klein D.A. (1996) Microbiology WMC. Brown publishers

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PAPER-VIII (BIC-202)

(50 marks, 50 lectures, 4 credits)

BIOSTATISTICS AND BASIC COMPUTATIONAL METHODS

1. Scope of statistical methods in scientific studies: Frequency distribution, relative and cumulative frequencies. Diagrammatic representation of frequency polygons. **7 L**

2. Measures of central tendency: Arithmetic mean, mode, median. Measures of variability, Range, mean deviation, standard deviation and coefficient of variation, skewness and kurtosis. **8 L**

3. Probability: Events, sample space. Conditional probability and Bayes theorem, application of Bayes theorem in biological problems. Standard Probability models: Binomial, poison and Gaussian. **8 L**

4. Population and sample: Random sample, use of table of random numbers, sampling distribution of sample means, standard error. **8 L**

5. Hypothesis testing: Basic concepts and definitions, tests based on normal, student T, chi-sequare and F- distribution, Analysis of variance. **8 L**

6. Computer basics: Operating systems, Windows and UNIX, Hardware, software disc operating system, multimedia network concepts. Introduction and Bioinformatics Resources: Knowledge of various databases and bioinformatics tools available at these resources. **11 L**

Reference books:

1. Daniel (1999). Biostatistics (3rd edition) Panima Publishing Corporation.
2. Khan (1999). Fundamentals of Biostatistics, Panima Publishing Corporation
3. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh
4. Bazin, M.J. (1983). Mathematics in microbiology Academic press
5. Green, R.H. (1979). Sampling design & Statistical methods for environmental Biologists, Wiley Int. N.Y.
6. Campbell, R.C. (1974). Statistics for Biologists, Cambridge Univ. Press, Cambridge
7. Bliss, C.I.K. (1967). Statistics in Biology, Vol.1 Mc Graw Hill, New York.
8. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series
9. Jan (2001). Nucleic acid research, Genome Database issue
10. Higgins & Taylor (2000). Bioinformatics, OUP.
11. Baxavanis (1998). Bioinformatics.
12. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford.
13. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PAPER-IX (BIC-203)

(50 marks, 50 lectures, 4 credits)

ENZYMOLOGY, INTERMEDIARY METABOLISM & NUTRITION

1. Classification of enzymes. General properties. Coenzymes – structure and function. Factors affecting enzyme properties. Enzyme kinetis. Michaelis – Menten equation. Lineweaver – Bark equation. Enzyme inhibition (Competitive, non-competitive, uncompetitive and irreversible inhibition). **12 L**

2. Enzyme specificity, Mechanism of Catalysis. Regulations of enzyme activity. Isozymes. Allosteric and covalent modification of enzymes. Rate limiting enzyme, feed back and feed forward regulation. Allosteric control of enzyme activity, feed back inhibition. **7 L**

3. Carbohydrate metabolism: Glycolysis, citric acid cycle, pentose phosphate pathway, glyconeogenesis, Glycogenolysis, Metabolism of sugar other than glucose. Glyoxalate cycle, electron transport system, oxidative phosphorylation. Metabolic regulation. **10 L**

4. Amino acid and protein metabolism: Metabolism of a few individual amino acids. Amino acids as biosynthetic precursors. Protein Catabolism – protelytic enzymes. Protein turnover. Nitrogen excretion and urea cycle, metabolic diseases. **5 L**

5. Lipid metabolism: Biosynthesis of saturated and unsaturated fatty acids, formation of triglycesides. Lipid breakdown- β- oxidation of fatty acids and its energetic, α -oxidation, ω - oxidation. Lipid storage and transport, lipoproteins, regulation of lipid metabolism. **5 L**

6. Nucleic acid metabolism: Biosynthesis of purines and pyrimidines. Regulation, formation of nucleosides and nucleotide. Abnormal metabolism of purine, pyrimidines and associated diseases. **5 L**

7. Nutritional status: Dietary assessment, clinical assessment, Anthropometric measurements, BMR, SDA, RQ. Protein- Calorie malnutrition states. Nutritional status and toxicological interaction. Pre and probiotics, neutraceuticals, neutritionally important phytochemicals. **6 L**

References:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry, 4th Eition Pub WH Freeman Co.
2. Daniel, L, Purich, Melvin, I. Simon, John, N., Abelson. (2000). Contemporary enzyme kinetics and mechanism.
3. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 rd Indian edition, Pub. Oxford.
4. Mathews, Van Holde and Ahern, Biochemistry by 3 rd edition, Pub Pearson education
5. Stryer, L. Biochemistry 4th Edn. W.H. Freeman and Co. NY.
6. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 nd edition Pub: Tata.
7. Voet, D., Voet J.G. (2004). Biochemistry 2nd Edn.
8. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
9. Jack kite. (1995). Mechanisms in protein chemistry, Garland publishers.
10. Gerhartz, W. (1990). Enzymes in industry: Production and applications. VCH publishers,

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PAPER-X (BIC-204)

Elective courses (50 marks, 50 lectures, 4 credits)

Environmental management and sustainable development

1. TRANSMISSION OF PATHOGENS AND WASTEWATER TREATMENT

Transmission of pathogens-Bacterial, Viral, Protozoan, Indicator organisms of water-Coliforms, total coliforms, E. coli, Streptococcus, Clostridium, Control of microorganisms, Microbiology of biological treatment processes- aerobic anaerobic, K-oxidation, β-oxidation, nitrification and denitrification, eutrophication. 13 **L**

2. Toxicology
Ecotoxicology, toxicants and toxicity, factors influencing toxicity, Effects- acute, chronic, concentration response relationships, Test organisms- toxicity testing, bioconcentration- bioaccumulation, biomagnifications, bioassay, biomonitoring, bioleaching. 9 **L**

3. Concepts of sustainable development
Definition of sustainability- history and emergence of the concept of sustainable development, Millennium development goals, environment and development linkages, Globalization and environment,- population, poverty and pollution,- Global regional and Local environmental issues,- Resource degradation, greenhouse gases, and climate change- Desertification- industrialization. 9 **L**

4. Components of sustainability- complexity of growth and equity – Social, economic and environmental dimensions of sustainable development-environment biodiversitym natural resources, ecosystem integrity, clean air and water, - carrying capacity, equity, quality of life, prevention and precaution, Preservation and public participation, Structural and functional linking of developmental dimensions-sustainability in national and regional context. 9 **L**

5. Role of developed countries in the development of the developing countries- international summits-

Stockholm to Johanesburg – Rio principles – Agenda 21- Convension agreement- Tokyo declarations-

doubling statement-Transboundary issues- integrated approach for resource protection and management.

10 **L**

References:

Agrawala, S., A. Moehner, M. El Raey, D. Conway, M. van Aalst, M. Hagenstad and J. Smith, 2004b: Development and Climate Change in Egypt: Focus on Coastal resources and the Nile. OECD, Paris.

Agrawala, S., T. Ota, T., Ahmed, A.U., Smith, J. and M. van Aalst, 2003b: Development and Climate Change in Bangladesh: Focus on coastal flooding and the Sundarbans. OECD, Paris.

Kumar, P., 2001: Valuation of ecological services of wetland ecosystems: A case study of Yamuna flood plains in the corridors of Delhi. Mimeograph, Institute of Economic Growth, Delhi.
Modi, V., S. McDade, L. Lallement, J. Saghir, 2006: Energy Services for the Millenium Development Goals. Energy Sector Management Assistance Program, United Nations Development Programme, UN Millennium Project, World Bank, New York, USA, 109 pp.

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

PRACTICAL PAPERS

Paper-XI (BIC-205)

Food and Nutrition Biochemistry

1) Analysis of milk and milk products- lactose content of milk by phosphomolybdic acid. Lactose content by benedict titration. Protein content of milk by biuret method. Phosphatase test for pasteurization. Dry weight of milk powder.

2) Phosphorus content of milk powder. Calcium content of milk powder. Riboflavin content of milk powder. Vitamin a content of milk powder.

3) Analysis of cereal products: - dry weight of cereal powder. Ash content of cereal powder. Protein content of cereal powder by Zeldahl method. Carbohydrate content of cereal powder.

4) Analysis of fats oils:- iodine number, Vitamin A, Vitamin E, Vitamin D, Rancidity of Fat.

5) Detection of adulterants of food: - NaHCO3 in milk. Glucose in milk. Starch in milk. Borax in milk. Argemone oil in oil. Mineral oil in vegetable oil. Dalda in ghee.

6) Chemical estimation of thiamine, riboflavin and niacin in foodstuffs.

Paper-XII (BIC-206)

Microbiology

1) Preparation and sterilization of culture media

2) Simple staining, gram staining, endospore staining and capsule staining.

3) Preparation of bacterial growth curve.

4) Estimation of viable cells in a bacterial suspension.

5) Determination on minimum inhibitory concentration (MIC) of antibiotic.

6) Isolation of microorganisms from air and soil

7) Bacteriological analysis of water – (1) presumptive test, (2) confirmed test, (3) completed test.

8) Biochemical tests of bacteria: - indole production. Tests for catalase, protease, amylase and oxidase. Starch hydrolysis test. Methyl red test.

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IIIrd Semester:

Paper – XIII (BIC-301)

(50 marks, 50 lectures, 4 credits)

Methods and Techniques Employed in Biochemistry

1. Spectroscopy: Ultraviolet and visible adsorption spectroscopy, Infrared spectroscopy, Raman spectroscopy, Resonance Raman spectroscopy, Circular Dichroism (CD) spectroscopy. **13 L**

2. Centrifugation: Principles of Centrifugation, Density gradient Centrifugation, Analytical ultracentrifugation. Application of centrifugation. **6 L**

3. Determination of structure of proteins: X-ray Crystallography, Nuclear Magnetic Resonance method. MALDI-TOF, mass spectroscopy. **6 L**

4. Electrophoresis: Agarose Gel Electrophoresis, Pulsed Field Electrophoresis, Rotating Gel Electrophoresis, Disc electrophoresis, Isoelectric focusing, Two-dimensional electrophoresis capillary Gel electrophoresis. **5 L**

5. Chromatography: Paper chromatography, Thin-layer chromatography, HPTLC, Ion exchange chromatography, Affinity chromatography. HPLC, GC-MS. **7 L**

6. Electron Cryomicroscopy: Freezing, sample preparation, Imaging, Low dose of electrons methods used in cryomicroscopy. **5 L**

7. Immunological Techniques: Molecular basis of antigen – antibody reaction, Agglutination, Precipitation, Immuno diifusion, immunoelectrophoresis, ELISA, RIA, Western blot. Hybridome Technology. Production of toxoids and production of recombinant Vaccine. **8 L**

Reference books:

Medical Instrumentation Application and Design Hardcover – Import, 6 Feb 2009
by John G. Webster (Author)

Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, Second Edition (Biomedical Engineering) 2nd Edition
by Robert B. Northrop (Author)

Biological Instrumentation & Methodology Paperback – 1 Dec 2010
by P.K. Bajpai (Author)

Organic Structural Spectroscopy by Lambert, Joseph B., Gronert... ISBN: 9780321592569

Nuclear Magnetic Resonance Spectroscopy An Introduction to Principles, Applications, and Exp... by Lambert, Joseph B., Mazzola... ISBN: 9780130890665

Spectrochemical Analysis
by Ingle, James D., Jr., Crouch, Stanley R.

Molecular Spectroscopy
by Jeanne L. McHale

Chromatography: Fundamentals and applications of chromatography and related differential migration methods - Part A: Fundamentals and techniques
E. Heftmann

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SYLLABUS OF M.Sc. COURSE IN BIOCHEMISTRY (CBCS)

Paper – XIV (BIC-302)

(50 marks, 50 lectures, 4 credits)

IMMUNOLOGY

1. General Properties of Immune System: History of Immunology. Innate and adaptive immunity, cells of the immune system, primary and secondary lymphoid organs. **5 L**

2. Antigens and antibodies: Immunogenicity, antigenicity, Haptens, adjuvents, Molecular structure of antibodies, Antibody classes and Biological activities. Immunoglobulin genes, antibody diversity. Complement system. **10 L**

3. Major histocompatibility Complex (MHC): Structure and Properties of MHC molecules, characteristics of Peptide –MHC interactions. **5 L**

4. Immune response: T-Cell and B-Cell development. T-Cell Maturation, activation and differentiation, T-Cell receptor. Signal transduction by the TCR –Complex. Antigen processing and presentation. General features of humoral immune response, B-cell maturation, activation and antibody production. B-Cell receptor. Kinetics of immune response. **13 L**

5. Effector mechanism: Overview of cytokines with special reference to TNF-α, IFN-γ, IL-2, IL-6, IL-12 etc. Development of Effector T-cells, migration of effector mechanisms of cell – mediated immunity Antibody mediated opsonization and phagocytosis. **7 L**

6. Hypersensitivity: General features of hypersensitivity reactions overview of Type – I, Type – II, Type – III and Type – IV hypersensitivity. **5 L**

7. Immunodeficiencies: Congenital immunodeficiencies and Acquired immunodeficiencies. General features of autoimmune diseases. **5 L**

References:

1. Abdul, K., Abbas, Andrew K. L., Jordan, S. P. (1998). Cellular and Molecular Immunology. Sanders College Pub.
2. Basic Concepts in Immunology Allied Book Agency 2014 Dr Somenath Roy
3. Benjamine, E., Cocoi., Sunshine. (2000). Immunology 4 th edition- Wiley- Liss. Publ.NY.
4. Borrebacc, C.A.K. (1995). Antibody Engineering, 2nd eidtion. Oxford University Press.
5. Dimmock, N.J., Primrose, S.B. (1994). Introduction to Modern Virology, Blackwell Science Ltd.Oxfird.
6. Hyde, R.M. (1992). Immunology, 2nd edition, Williams and Wilkins, Baltimore.
7. Kuby, J. (2003). Immunology 5th Edition. WH. Freeman and Company, NY.
8. Klaus D. Elgert (1996). Immunology. ELBS, Blackwell Scientific Publishers, London.
9. Roitt, I.M. (1998). Essential Immunology, ELBS, Blackwell Scientific Publishers,London.
10. Richard A., Goldsby, Thomas, J., Kindt, Barbara, A., Osborne (2000). Kuby Immunology, 4th edition. W.H. Freeman and Company, NY.
11. Tizard I.R.(1995). Immunology, 4th edition, Saunder College Pub.
12. William E Paul (1989). Fundamentals in Immunology, Raven Press. NY.

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Paper – XV (BIC-303)

(50 marks, 50 lectures, 4 credits)

Gene regulation and RDT

1. **Chromosomal basis of inheritance** (Mendelian inheritance, extension of Mendelian genetics, linkage and genetic mapping); Non- Mendelian inheritance (Extra-nuclear inheritance, maternal effect); pattern of single gene inheritance, molecular and biochemical basis of some genetic diseases; variation in chromosome number and structure, chromosomal basis of sex determination. Hardy-Weinberg law. **13 L**

2. Genome organization, genome analysis, human genome project, sequence variation in the human genome, polymorphisms (SNPs, indels, length polymorphisms). **5 L**

3. Functional genomics: experimental method to generate high throughput proteomic data, studying gene expression using microarray process and data, metabolomics & pharmacogenomics. **5 L**

4. Regulation of eukaryotic gene expression, transcription factors, translational regulation of gene expression. Development and environmental regulation of gene expression. Chromosome folding, HATs, Gene silencing, Exon shuffling, Frame shifting, Protein splicing, RNA editing and all other mode of regulation of gene expression. **8 L**

RDT

5. Gene cloning - General concept, restriction endonuleases, enzymatic tools for gene cloning, linkers and adaptors.
Vectors: Plasmids (pBR 322, pUC Vectors,).
DNA cloning, therapeutic cloning, reproductive cloning, somatic cell nuclear transfer,
In vitro mutagenesis: site directed and PCR based, gene sequencing, DNA footprinting
Gene transfer methods and gene manipulation. gene knockout and gene therapy technologies. Si RNA, antisense-RNA. **18 L**

Reference books:

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rd Ed.) University press.UK. 2008
2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK. 1996.
3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim,Germany Reprinted by Panima Publishing Corporation,New Delhi. 2003
5. Benjamin Lewis, Genes IX (3rd Ed.) Oxford University & Cell Press,NY.2004
6. Robert Williamson.Genetic Engineering (1st Ed.) Academic Press.1981.USA
7. Rodriguez. R.L (Author), Denhardt D.T. Vectors: A Survey of Molecular Cloning Vectors and Their Uses (1st Ed.) Butterworth-Heinemann publisher.UK. 1987
8. Ansubel F.M., Brent R., Kingston R.E., Moore D.D. et al. Short protocols in molecular biology(4th Ed), Wiley publishers. India. 1999.
9. Sambrook J et al. Molecular cloning Volumes I, II and III. Cold Spring Harbor laboratory Press, New York, USA. (1989, 2000)
10. Terence A Brown. Genomes, (2nd Ed.) BioScientific Publishers.UK.2002

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Paper – XVI (BIC-304)

(Elective course)

(50 marks, 50 lectures, 4 credits)

Food Nutrition and Nutragenomics

1. Nutritional science, Basic nutrition, Role of vitamins and minerals, maternal nutrition, growth & development. Therapeutic Nutrition, Nutritional strategies in diseases **13 L**

2. Community Nutrition & Extension Education, Community level nutritional assessment & awareness program for community, Food Microbiology & Food Toxicology, Food borne diseases and food spoilage by microbes, Toxicants present in food **12 L**

3. Dietetics & Food Safety, Dietetics & Meal Planning using different case studies, Food poisoning, Microbrial food spoilage, Disinfection processes. Food Adulteration, Dietary assessment, Anthropometric measurements, BMR, SDA, RQ. Protein-Calorie malnutrition states. Specificity of amino acids in several physiological processes – eg. Suppression of pain, stimulation of appetite, Effect of metal and non-metal in nutritional **13 L**

4. Biochemistry. Nutritional status and toxicological interaction. Neutragenomics and neutraceuticals. Nutrient gene interaction, Transcription factors and nuclear receptor interaction. Drug and nutrient metabolism. Important vitamins and their physiological role, mechanism.

12 L

Reference books:

1. An Introduction and Overview of Nutritional Genomics: Application to Type 2, Diabetes and International Nutrigenomics (Jim Kaput).
2. The Pursuit of Optimal Diets: A Progress Report (Walter C. Willett).
3. Gene - Environment Interactions: Defining the Playfield (Jose M. Ordovas and Dolores Corella).
4. Metabolomics: Bringing Nutrigenomics to Practice in Individualized Health Asssessment (J. Bruce German, Cora J. Dillard, S. Luke Hillyard, Matthew C Lange, Jennifer T. Smilowitz, Robert E. Ward, and Angela M. Zivkovic).
5. Gene - Gene Epistasis and Gene - Environment Interactions Influence Diabetes and Obesity (Sally Chiu, Adam L. Diament, Janis S. Fisler, and Craig H. Warden).

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Practical papers

Paper XVII (BIC-305)

Clinical Biochemistry

- Estimation of glucose by GOD-POD method.
- Estimation of cholesterol by enzymatic method.
- Estimation of triglyceride by enzymatic method.
- Estimation of SGPT and SGOT by enzymatic method.
- Estimation of alkaline phosphatase by KA method.
- Estimation of Bilirubin.
- Estimation of total protein, albumin and globulin.
- Estimation of urea DAM method.
- Estimation of uric acid by enzymatic method.
- Estimation of creatinin by alkaline pieret method.
- Biochemical detection of urine abnormalities.
- DC of human WBC and TC of human WBC and RBC.
- Estimation of ESR.
- Estimation of PCV.
- Estimation of haemoglobin.
- Examination of sputum sample.

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PAPER XVIII (BIC-306)

(Practical Paper)

MOLECULAR BIOLOGY & IMMUNOLOGY

MOLECULAR BIOLOGY

1) Isolation of plasmid DNA from *E. coli* by Alkaline SDS method
2) Isolation of genomic DNA from bacteria
3) Isolation of genomic DNA from plant cell/animal cell
4) Gel electrophoresis of isolated DNA
5) Transformation by CaC12 and PEG method
6) Selection of cloned micro-organism by blue/white colony
7) DNA amplification by PCR method
8) Restriction digestion and Gel electrophoresis

IMMUNOLOGY

1) Staining and identification of blood cells
2) Precipitation of immunoglobulins (Igs) from serum by ammonium sulphate precipitation followed by dialysis of ammonium sulphate precipitated Immunoglobulins.
3) Electrophoresis of the immunoglobulin preparation
4) Blood group testing
5) Immunoprecipitation test
6) Western Blotting
7) Immuno-diffusion .

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IVth Semester:

Special Paper Paper- BIC-401

(50 marks, 50 lectures, 4 credits)

Medical Biochemistry

1. Stress and diseases.

Stress induced genes and their role. Concept of stress, free radicals and antioxidant defense systems.

7 L

1. Metabolomics and Molecular basis of metabolic disorders.

Biochemistry and molecular basis of different disorders related to carbohydrate, protein fat and nucleic acids, Inborn errors of metabolism. Diabetes, atheroscelrosis cardio vascular diseases, kidney disorder.

18 L

2. Molecular mechanism of cancer. Oncogene and antioncogene. Viral cancer.Retroviruses: Structure, replication, life cycle and transformation. Retrotransposons. Steps in HIV infection and pathogenesis. Diagnostic and therapeutic implication of cancer

i) Liver , ii) Brest and cervical iii) GI tract **18 L**

3. Neurodegenerative disorders. **7 L**

Alzheimer's disease, Parkinsonism, human multiple sclerosis. Molecular basis, biochemistry and clinical manifestations.

Reference books:

1. Editor(s): Christopher D. Byrne, Sarah H. Wild Published Online: 10 JUN 2011 02:59AM EST Print ISBN: 9781444336580 Online ISBN: 9781444347319 DOI: 10.1002/9781444347319
2. Inborn Metabolic Diseases: Diagnosis and Treatment 5th ed. 2012 Edition by Jean-Marie Saudubray (Editor), Georges van den Berghe (Editor), John H. Walter (Editor)
3. Nutrition Management of Inherited Metabolic Diseases: Lessons from Metabolic University 2015th Edition by Laurie E. Bernstein (Editor), Fran Rohr (Editor), Joanna R Helm (Editor)
4. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics Paperback – 26 Apr 2012 by Lauren Pecorino (Author)
5. The Biology of Cancer Paperback – Import, 12 Jun 2013 by Robert A. Weinberg (Author), Robert A Weinberg (Author)
6. The Molecular Biology of Cancer: A Bridge from Bench to Bedside, 2nd Edition Stella Pelengaris (Editor), Michael Khan (Editor) May 2013, ©2013, Wiley-Blackwell
7. Neurodegenerative Diseases: Neurobiology, Pathogenesis and Therapeutics by M. Flint Beal (Author), Dr Anthony E. Lang (Author), Albert C. Ludolph (Author)
8. Neurodegeneration: The Molecular Pathology of Dementia and Movement Disorders 2nd Edition by Dennis Dickson (Editor), Roy O. Weller (Editor)
9. Neurodegenerative Diseases Editors: Ahmad, Shamim (Ed.)
10. Neurodegenerative Diseases Editor(s): Nitsch R.M. (Zürich)
11. Neurodegeneration with Brain Iron Accumulation Disorders Overview Synonym: NBIA Allison Gregory, MS, CGC and Susan Hayflick, MD.

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Special Paper

Paper- BIC-402

(50 marks, 50 lectures, 4 credits)

Pharmaceutical Biochemistry, Nanotechnology & Bioinformatics

1. Nanotechnology.

Defination and origin. Fundamental concepts larger to smaller: a materials perspective, simple to complex: a molecular perspective, molecular nanotechnology: a long term view, Current research-Nanomaterials. Bottom-up approaches, Top-down approaches, functional approaches. Tools and techniques, Applications. **16 L**

2. Drug metabolizing enzymes, CYP450, SULTS, GULT. Pharmakokinetics, pharmakodynamics, LD50, ED50. Role of Nuclear receptors and transcription factors on drug metabolizing gene expression **16 L**

2. Bioinformatics:

Pattern recognition in DNA and Protein sequences: Sequence analysis – sequence reading, sequence alignment – Global local sequence alignment, Pair-wise sequence alignment, Multiple sequence alignment, phylogenetic analysis, coding region identification. Web-based structure tools,

Introduction to System Biology, Structural Biology, Structural bioinformatics, Chemoinformatics. Concept of metabolome and metabolomics.

Protein Secondary structure prediction algorithms of Chou Fasman, GOR methods.Tertiary Structure prediction basic principles and protocols, The concepts in 3D structure comparison.

Molecular Dynamics, Molecular modeling and simulations. Computer aided drug design (CADD), Molecular Docking. **18 L**

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1. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series
2. Jan (2001). Nucleic acid research, Genome Database issue
3. Higgins & Taylor (2000). Bioinformatics, OUP.
4. Baxavanis (1998). Bioinformatics.
5. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford.
6. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh
7. http://www.bioinformatics.org/wiki/recommended_books

"Darwin's Radio" by Greg Bear [Ballantine Books; ISBN 0345435249] is a wonderful hard SF thriller which stretches ideas derived from genome discoveries to their breaking point. It's gripping and humane.

Leonard Crane, the author of *Ninth Day of Creation* kindly sent me a copy for review. So far it's an excellent read. If you'd like to read a well-researched, but speculative, novel containing actual scenes of practicing bioinformatics then try it.

Ken Allen contributed the following reviews:

"*Frameshift* [Tor Books; ISBN 0812571088] by Robert J. Sawyer---based around the HGP---reasonable read, but poor / confused ending."
Calculating God [Tor Books; ISBN 0812580354] by the same author---has a subtler bio connection and is a much better read. Near the start an alien spacecraft lands, the alien emerges and says 'take me to your paleontologist'

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Paper- BIC-403

Special Paper (Practical)

Research Technique and Advanced Methodology

Cell and tissue fractionation

ELISA

Western blot

Immunoelectrophoresis

Rocket immunoelectrophoresis

2-D gel electrophoresis

Auto-analyzer based estimation of clinical Sample.

PCR

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