

University of Mumbai



No. AAMS_UGS/ICC/2022-23/108

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/121 of 2017-18 dated 28th July, 2017 relating to the revised syllabus F.Y.B.Sc. (Biochemistry) (Sem. I & II) (CBCS).

They are hereby informed that the recommendations made by the Ad-Hoc Board of Studies in **Biochemistry** at its meeting held on 23rd June, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 05th July, 2022 vide item No. 6.14(R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 vide item No. 6.14 (R) and that in accordance therewith, the revised syllabus of F.Y.B.Sc. (Biochemistry) (Six Units) (Sem. I & II) (CBCS), has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

MUMBAI - 400 032

20th October, 2022

(Dr. Shailendra Deolankar)
I/c Registrar

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.14(R)/11/07/2022

No. AAMS_UGS/ICC/ 2022-23/108

20th October, 2022

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Ad-Hoc Board of Studies Biochemistry,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL.

(Dr. Shailendra Deolankar)
I/c Registrar

Desktop/Circular Faculty of Science/priya

Copy to :-

1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),
2. The Deputy Registrar, College Affiliations & Development Department (CAD),
3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),
4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),
5. The Deputy Registrar, Executive Authorities Section (EA),
6. The Deputy Registrar, PRO, Fort, (Publications Section),
7. The Deputy Registrar (Special Cell),
8. The Deputy Registrar, Fort/Vidyanagari Administration Department (FAD) (VAD), Record Section,
10. The Professor-cum- Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. P.A. to Hon'ble Vice-Chancellor,
2. P.A. to Pro-Vice-Chancellor,
3. P.A. to Registrar,
4. All Deans of all Faculties,
5. P.A. to Finance & Account Officer, (F. & A.O.),
6. P.A. to Director, Board of Examination & Evaluation,
7. P.A. to Director, Innovation, Incubation and Linkages,
8. P.A. to Director, Board of Lifelong Learning and Extension (BLLE),
9. The Director, Dept. Of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,
10. The Director of Board of Student Development,
11. The Director, Department of Students Welfare (DSD),
12. All Deputy Registrar, Examination House,
13. The Deputy Registrars, Finance & Accounts Section,
14. The Assistant Registrar, Administrative sub-campus Thane,
15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,
16. The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri,
17. The Assistant Registrar, Constituent Colleges Unit,
18. BUCTU,
19. The Receptionist,
20. The Telephone Operator,
21. The Secretary MUASA,

for information.

UNIVERSITY OF MUMBAI



Revised Syllabus for F.Y. B.Sc. (Biochemistry)

**Semester: I & II
(CBCS)**

(With effect from the academic year 2022-23)

UNIVERSITY OF MUMBAI



Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	F.Y.B. Sc. (Biochemistry)
2	Eligibility for Admission	Ordinance no. O.2145 Circular no. UG/394 of 2004 dated 6 th September 2004
3	Passing Marks	40%
4	Ordinances / Regulations (if any)	
5	No. of Years / Semesters	Three years – Six Semesters
6	Level	P.G./ U.G. / Diploma / Certificate (Strike out which is not applicable)
7	Pattern	Yearly / Semester (Strike out which is not applicable)
8	Status	Revised / New (Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year : 2022-2023

Date : 15-07-2022

Signature :
Dr. Samidha M. Pawaskar
Chairperson of Ad-hoc/BoS of Biochemistry

Dr. Anuradha Majumdar
Dean, Science and Technology

Preamble

Biochemistry is central to all areas of the “biological” and “life” science. It aims to provide an understanding of every aspect of the structure and function of living things at cellular level. Being an interdisciplinary subject it is spanning a wide range of areas from microbiology to plant and animal sciences to pathology of diseases and nutrition.

The impact of studies in biochemistry on modern life is enormous. Therefore, the syllabus is structured to touch upon broad base at the beginning. Unique physical and chemical characteristics of water enable it to function in ways essential to human and other life processes due to its structure and composition. Life on Earth began more than 3 billion years ago, evolving from the most basic of microbes into a dazzling array of complexity over time, which makes it necessary to study the origin of life and evolution of a modern species over span of years. After an in-depth understanding of how the first cells originated, students are introduced to detailed structural organization of basic unit of a living system “The Cell”. Biomolecules are the basic and important constituents of a living system. Hence, it is mandatory to study structure, occurrence and functions of large biomolecules like carbohydrates, lipids and proteins along with nucleic acids. In order to prepare the students for detailed course in Applied Nutrition in the higher education, the syllabus is made to understand human nutrition and its significance. In order to understand the biological processes occurring in the living body, processes as digestion, absorption, respiration and excretion are necessary to be studied. As stated earlier, life evolved from a small microbe, it is our aim to study living microscopic size organisms which include bacteria, fungi, protozoa and special type of microorganisms called extremophiles

Objectives of the first year of the course

- Develop an adequate background to enable the first-year students to study more advanced biochemistry topics.
- Acquaint the learners with the unique properties of the universal solvent - water, essential for life processes.
- Understand the life constituting bio molecules: proteins, carbohydrates, lipids, nucleic acids.
- Familiarize the learners about the origin of life and take them through the process of evolution.
- Focus on Cell as the basic unit of life which is the center for all biochemical processes.
- Familiarize the learners to the world of microorganisms which exist as independent cellular units.
- Develop an interest in the learner in nutrition for sustaining life, and physiology and functioning of life systems.
- Appreciate the importance of the broad spectrum of biochemistry.
- Provide familiarity with basic biochemistry laboratory techniques.
- Develop the practical skills of students to enhance their observational skills and to use these skills for problem solving.

Teaching pattern:

One (01) Credit would be of thirty to forty (30-40) learning hours; of this, more than fifty per cent of the time will be spent on classroom instructions including practical as prescribed by the University. Rest of the time spent invested for assignments, projects, journal writing, case studies, library work, industrial visits, attending seminars/workshops, preparations for examinations etc. would be considered as notional hours. The present syllabus considers (45 Lectures as classroom teaching and 15 lectures as Notional hours/ paper). Each lecture duration would be for 48 min. The names of the reference books provided in the syllabus are for guidance purpose only. Students and faculty are encouraged to explore additional reference books, online lectures, videos, science journals for latest/ additional information.

Scheme of Examination:

The performance of the learners shall be evaluated into TWO Parts.

1. Internal Assessment with 25 marks and
2. Semester End Examinations with 75 marks.

Practical Training will have Practical Examination for 100 marks per practical paper at the end of Semester.

The allocation of marks for the Internal Assessment and Semester End Examinations are as follows: -

Internal Examamination-25 Marks with 2 components of 15 marks and 10 marks respectively.

Semester end assessment: It is defined as the assessment of the learners on the basis of performance in the semester end theory/ written/ practical examination.

a) Theory paper of 75 marks for duration of 2.5 hours

Q1) Objective questions based on all units with no internal options: 15 marks

- a) Define the following / Answer in brief (10 marks) : (each question will carry 2 marks)
- b) True or False with reasons (5 marks): (Provide 5 statements, for each the student has to state whether it is true or false and provide reasons.)

Q2) Questions based on Unit I 20 marks

(either answer any 4 out of 5 sub-questions)

Q 3) Questions based on Unit II 20 marks

(either answer any 4 out of 5 sub-questions)

Q4) Questions based on Unit III 20 marks

(either answer any 4 out of 5 sub-questions)

b) Practicals 50 marks

The Course having Practical training will have Practical Examination for 50 marks at the end of Semester, out of which 40 marks for the Practical task assigned at the time of examination. The 10 marks are allotted as Internal Assessment.

Sr. No	Evaluation type	Marks
1	Two best practicals	05
2	Journal	05

Practical External Assessment

40 marks

F. Y. B. Sc. Biochemistry Syllabus

Credit Based Credit System

To be implemented from the academic year 2022 - 2023

Semester I

Course Code	Unit	Topics	Credits	Lectures
Biomolecules and Nutrition-I				
USBCH101	I	Water	2	15
	II	Amino acids and proteins		15
	III	Carbohydrates		15
Introduction cell biology, Physiology and Microbiology-I				
USBCH102	I	Origin of life and Evolution	2	15
	II	The cell wall, cell membrane, cell organelles and cell division		15
	III	Microbiology-I		15
USBCHP01		Practicals based on both courses in theory - USBCH101 and USBCH102	2	2

Semester II

Course Code	Unit	Topics	Credits	Lectures
Biomolecules and Nutrition-II				
USBCH201	I	Lipids	2	15
	II	Nucleic acids		15
	III	Nutrition		15
Introduction cell biology, Physiology and Microbiology-II				
USBCH202	I	Physiology of digestion and absorption	2	15
	II	Physiology of respiration and excretion		15
	III	Microbiology-II		15
USBCHP02		Practicals based on both courses in theory - USBCH201 and USBCH202	2	2

F.Y.B.Sc. Biochemistry Syllabus
Restructured for Credit Credit System
to be implemented from the Academic year 2022 – 2023
Semester I
USBCH101 - Bio molecules and Nutrition-I

Course Code	Title	Credits
USBCH101	Biomolecules and Nutrition-I	2 Credits (45 lectures)
Unit I: Water 1.1 Water: Its effect on Biomolecules, hydrogen bonding and structure, properties (surface tension, latent heat, specific heat, viscosity, dielectric constant, colligative properties) of water and their biological significance, water as a universal solvent. 1.1.1 Entropy and dissolution of solute 1.1.2 Effect of non-polar compounds on the structure of water 1.1.3 Weak interactions of biomolecules in aqueous solutions 1.2 Solutions 1.2.1 Concepts of mole, molar, molal, molar equivalent and normal, % solution, ppm, Dalton 1.3 Ionization of water, weak acids and weak bases 1.3.1 pH: pH scale, H ⁺ and OH ⁻ concentrations 1.3.2 Weak acids and bases and their dissociation constants K _a & K _b 1.3.3 Buffers - definition, action, physiological buffers - phosphate and carbonate (No derivations. Numericals on above concept)		15 Lectures
Unit II: Amino acids and proteins 2.1 Amino acids 2.1.1 Amino acid structure - D & L forms of all 20 amino acids (structure of D-amino acids and overview of D and L amino acids) 2.1.2 Detailed classification based on polarity, essential and nonessential amino acid 2.1.3 Physical properties: Zwitter ions, pI of amino acids, amino acids as ampholytes, melting point, optical rotation, UV absorption and chemical properties 2.1.4 Chemical reactions of amino acids with Ninhydrin, 2.1.5 Protein sequencing reactions: Sanger's reagent, Edman's reagent and Dansyl chloride 2.2 Peptides and Proteins 2.2.1 ASBC - APS classification on the basis of shape and function 2.2.2 Primary structure - Formation and characterization of the peptide bond 2.2.3 Secondary structure - Alpha helix and beta-sheet structure 2.2.4 Tertiary (myoglobin) and Quaternary (hemoglobin) structures - Comparative overview 2.2.5 Protein denaturation- agents of denaturation 2.2.6 Protein renaturation		15 Lectures

Unit III: Carbohydrates.

15 Lectures

3.1 Definition, Classification, and functions of carbohydrates
(mono, oligo polysaccharides)

3.2 Monosaccharides

3.2.1 Classification in terms of aldoses and ketoses

3.2.2 Occurrence, structures and significance of glucose, fructose, galactose, mannose, and ribose

3.2.3 Properties:

a) Physical - isomerism D & L, optical; epimers : anomers

b) Chemical reactions -

i) oxidation to produce aldonic, aldaric and uronic acids
(with respect to glucose);

ii) reducing action in boiling alkali, enediol formation
(with respect to glucose and fructose)

iii) Osazone formation (with respect to glucose and fructose).

iv) Orcinol (with respect to ribose)

3.3 Disaccharides

3.3.1 Formation of glycosidic bonds

3.3.2 Occurrence and structure of maltose, lactose and sucrose

3.4 Polysaccharides

3.4.1 Classification based on function. storage and structure

a) Composition: homo & hetero. -Starch and hyaluronic acid

b) Storage : starch and glycogen - action of amylase on starch

c) Structural: cellulose, chitin

USBCH102 - Introduction to Cell biology, Physiology and Microbiology-I

Course Code	Title	Credits
USBCH102	Introduction to Cell biology, Physiology and Microbiology-I	2 Credits (45 lectures)
Unit I: Origin of Life & Evolution 1.1 Big bang theory, Theories on the origin of life: Abiogenesis, Heterotroph hypothesis, RNA world, protein world, Miller's experiment, Formation of the first cell, endosymbiont theory 1.2 Evolution - Darwinian theory, Modern synthetic theory of evolution and its factors: Gene mutations(recombination), heredity, natural selection and isolation 1.3 Biological evidences: Fossil record, chemical and anatomical similarities of related life forms, geographic distribution of related species, genetic changes in living organisms overgenerations and Mechanism of evolution, Gene flow and genetic drift, Hardy-Weinberg principle		15 Lectures
Unit II: The cell- cell wall, cell membrane, cell organelles and cell division 2.1 <i>Structural organization of cells</i> 2.1.1 Prokaryotic, Eukaryotic (plant & animal) and yeast cells - a comparative overview 2.2 Cell wall structure (plant), cell membrane (fluid mosaic model) Cytoskeleton: microtubules & microfilaments 2.3 <i>Cell organelles: Structure and function</i> 2.3.1 Mitochondrion: Organization of the mitochondria genome 2.3.2 Chloroplast: Organization of the chloroplast genome, other plastids 2.3.3 Ribosome: 2.3.4 Endoplasmic reticulum 2.3.5 Golgi apparatus 2.3.6 Peroxisome & Lysosome 2.3.7 Nucleus: nuclear envelope, nuclear pores, nuclear matrix and Nucleolus 2.4 Mitosis and Meiosis- Different phases and Comparative overview of mitosis and meiosis		15 Lectures

Unit III: Microbiology I 3.1 Historical background (contributions of Leeuwenhoek, Pasteur, Koch). 3.2 General characteristics of Bacteria: Major Characteristics, Morphological, Chemical, Cultural, Metabolic, antigenic, pathogenic and Ecological 3.3 <i>Microbial Taxonomy:</i> Microbial species and strains 3.4 Classification of bacteria based on morphology (shape and flagella), staining reaction- Acid fast and differential staining based classification, nutrition and extreme environment 3.5 <i>Bacterial cell wall:</i> Structure and function, components of peptidoglycan framework (structures of NAG and NAMA not necessary) 3.6 Extremophiles: thermophiles, psychrophiles, halophiles, magnetotactic, radiation resistant - examples with their application 3.7 Staining methods - principles of staining - gram staining, endospore, capsule and lipids, and microscopic identification of bacteria	15 Lectures
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SEMESTER I - USBCHP01

PRACTICAL – I

45 Lectures
hours

1. Preparation & Standardisation of laboratory reagents
Primary standards - 0.1N oxalic acid
Secondary standards - 0.1N NaOH, 0.1N HCl
2. Preparation and determination of pH of buffers - acetate and phosphate
3. Determination of pKa of acetic acid
4. Qualitative tests for Carbohydrates –
 - Monosaccharides (glucose and fructose),
 - Disaccharides (lactose ,maltose and sucrose)
 - Polysaccharides (starch and dextrin)
 -
5. Qualitative test for amino acids
6. Effect of heat, organic solvents and ammonium sulphate on proteins

DEMONSTRATION EXPERIMENT

pH meter - working of a pH meter

PRACTICAL – II

45 Lectures
hours

1. Effect of isotonic, hypertonic and hypotonic solutions on cells - onion peel / Tradescantia
2. Staining of bacterial yeast cells (negative staining)
3. Staining techniques-
 - gram staining,
 - endospore,
 - capsule and
 - lipids
4. Calibration of glassware
5. Study of stages of mitosis using onion root tips
6. Permanent slides of mitosis and meiosis

DEMONSTRATION EXPERIMENT

1. Microscopy - study of a compound microscope

Semester II
USBCH201- Bio molecules and Nutrition-II

Course Code	Title	Credits
USBCH201	Biomolecules and Nutrition-II	2 Credits (45 lectures)
Unit I : Lipids 1.1 Definition, classification (Bloor's) and functions of Lipids 1.2 Fatty' acids and Triacylglycerol 1.2.1 Classification & Chemistry, Saturated fatty acids - classification of C2 to C20: even carbon: Common and IUPAC names. Unsaturated fatty acids MUFA, PUFA (2.3.4 double bonds) Omega - 3, 6,9 fatty acids. Triacyl glycerol - simple and mixed - names and structure 1.2.2 Chemical Reactions of fats Saponification, Iodination, Ozonolysis, Auto-oxidation, Action of heat on glycerol and choline, Rancidity Definition & significance - Acid number, Saponification number, Iodine number, Reichert - Meissel number 1.3 Compound Lipids Functions of glycerophospholipids (PE.PC.PL) Phosphosphingolipids (ceramide, sphingomyelin), Glycolipids /Cerebrosides (gluco & galactocerebrosides) 1.4 Steroids Cholesterol structure and biochemical significance.		15 Lectures
Unit II : Nucleic Acids 2.1 Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) Formation of polynucleotide strand with its shorthand Representation 2.2 RNAs (various types in prokaryotes and eukaryotes) mRNA & rRNA - general account, tRNA - clover leaf model, Ribozymes 2.3 DNA 2.3.1 Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features 2.3.2 Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA. 2.3.3 Reactions of nucleic acids (with DPA and Orcinol)		15 Lectures
Unit III: Nutrition 3.1 Definition: Calorie, Joule, Food calorimetry - calorific value determination by bomb calorimeter, calorific values of proximate principles, concept of BMI, BV and PER 3.2 BMR - definition, factors affecting BMR, Significance of BMR in clinical diagnosis 3.3 SDA/DIT -General concept and significance, energy requirement of individuals for various activities- sedentary, moderate and heavy 3.4 Nutritional significance of carbohydrates, Protein, lipids, vitamins, minerals and water 3.5 Composition of balanced diet 3.6 Numerical problems based on above concepts		15 Lectures

USBCH202 - Introduction to Cell biology, Physiology and Microbiology-II

Course Code	Title	Credits
USBCH202	Introduction to Cell biology, Physiology and Microbiology-II	2 Credits (45 lectures)
Unit I: Physiology of digestion and absorption 1.1 Parts and Functions of gastro intestinal tract (GIT) 1.2 Organs and Glands associated with GIT Secretions and Juices of GIT (Saliva, Gastric juice, Intestinal juice, pancreatic and Bile juice) 1.3 Digestion and Absorption of carbohydrates 1.4 Digestion and Absorption of Lipids 1.5 Digestion and Absorption of Proteins 1.6 Disorders - Peptic ulcer, Lactose Intolerance		15 Lectures
Unit II : Physiology of respiration and excretion 2.1 Respiratory system, 2.2 Breathing - inspiration and expiration, 2.3 Composition of air and partial pressure of gases 2.4 Physical exchange of gases 2.4.1 Transport of oxygen 2.4.2 Transport of carbon dioxide Respiratory disorders - cyanosis, respiratory acidosis and alkalosis 2.5 Excretion 2.5.1 Structure of the nephron: Bowman's capsule & glomerulus - Structure & function, (ultrafiltration, pressures involved, GFR, regulation of GFR); Renal tubule - structure & function (proximal and distal convoluted tubules and Henle's loop) 2.5.2 Urine formation: Reabsorption / Secretion of glucose, Na ⁺ , K ⁺ , HCO ₃ ⁻ , Cl ⁻ and H ⁺ : renal threshold, Excretory disorder: Nephritis		15 Lectures
Unit III: Microbiology II 3.1 Microbial Growth - Growth Curve, Mathematical expression, Synchronous growth, Generation time 3.2 Methods for estimation of microbial growth: Cell mass, Cell count and cell activity 3.3 Culture media (N, C, Special requirements), Natural and Synthetic media 3.4 Sterilization and Disinfection techniques 3.5 Physical Agent of sterilization - Temperature- Pressure (Hot Air Oven, Autoclave), Radiations (UV, Gamma) (examples with mechanism) Chemical agents of sterilization - Alcohol, Halogens, Formaldehyde		15 Lectures

SEMESTER II – USBCHP02

PRACTICAL – I

45 Lecture hours

1. Qualitative tests for lipids
 - a) Miscibility test
 - b) Saponification test
 - c) Unsaturation test
 - d) Sudan black dye test
 - e) Salkowski test for cholesterol
2. Determination of SAP value of given oil sample
3. Determination of Acid value of give oil sample
4. Staining of DNA and RNA (methyl green: pyronine) using onion peel
5. Qualitative tests for DNA (DPA) & RNA (Orcinol) (Neumann's test for presence of phosphorus) -
6. Estimation of Calcium by oxalate method
7. Qualitative analysis for Proteins (albumin, peptone , gelatine and casein - any four proteins)

SEMESTER II

PRACTICAL – II

45 Lecture hours

1. Preparation of culture medium
2. Microbial examination of food, water and air
3. Identification of organs / parts of (i) digestive system (ii) respiratory system (iii) excretory system
4. Analysis of the action of salivary α - amylase action on starch- Achromic point
5. Concept of Dialysis using parchment paper -Test with BaCl_2 for presence of sulphate in the buffer or water outside
6. Estimation of total acidity of gastric juice
7. Urine analysis:
 - Inorganic constituents: SO_4^{2-} (BaCl_2), Cl^- (AgNO_3), Na^+ , K^+ (Flame test)
 - Organic constituents: Urea, Uric acid, Creatinine
 - Abnormal constituents - glucose by Benedicts method, proteins by Hellers ring test

Suggestion: Artificial samples to be used for physiological experimrents

Suggested Reading

1. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
2. Becker W. M. Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Lehninger, Albert L, Biochemistry, Kalyani Publishers
5. Nelson, D. L. and Cox, M.M, (2008). Lehninger, Principles of Biochemistry 5th Edition, W. H. Freeman and Company, NY., USA.
6. Voet, D. and Voet, J.G. (2004) Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA. Biochemistry by Zubay, Geoffrey L.; Wm. C. Brown publishers
7. Zubay, Geoffrey L., Biochemistry; Wm.C.Brown publishers
8. Stryer, Lubert; W.H.; Biochemistry; Freeman publishers.
9. Harpers illustrated biochemistry by Murray, Robert K. et al.; Mc Graw Hill
10. Freifelder, D. (1982) Physical Biochemistry 2nd edition, W.H. Freeman and Co. NY. USA.
11. Cooper, T.G. (1977) The Tools of Biochemistry John Wiley and Sons, N.Y. USA.
12. Pattabhi. V. and Gautham N. (2002) Biophysics. Narosa Publishing House, India.
13. Roy, R.N. (2005) A Textbook of Biophysics. New Central Book Agency(P) Ltd., Calcutta, India
14. Guyton, Arthur C. and Hall, John E.; Text book of Medical physiology ; Harcourt Brace & Company Asia Pvt. Ltd.
15. Orten, J.M. and Neuhaus, O.W.; Human biochemistry; Mosby publishers.
16. Davidson, S. et al; Human nutrition and dietetics; Churchill Livingstone Publishers.
17. Joshi, Shubhangini A.; Nutrition and dietetics; Tata Mc Graw and Hill publishers.
18. Srilakshmi, B.; Nutrition Science; New Age International publishers.
19. Plummer, David T.; Introduction to practical biochemistry; Tata Mc. Graw and Hill publishers.
20. Boyer, Rodney F. Modern experimental biochemistry
21. Sawhney, S.K. and Singh, Randhir; Introductory practical biochemistry ; Narosa Publishing House.
22. Verma, P.S. and Agarwal V.K.; Cell Biology, Genetics, Molecular biology, Evolution and Ecology ; Publishers : S. Chand and Co. Ltd., (2009)
23. Essential Cell Biology Ed: Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson (2009) 3rd Edition Pub: Garland Science
24. B. Hall and B. Hallgrimsson Strickberger's Evolution ; 4th Edition (2008) Jones and Bartlett Publishers

25. Sean B. Carroll, Remarkable Creatures: Epic Adventures in Search of the Origin of Species (2009).
Mariner Books
26. Stanier, Ingraham et al, General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd 6.
27. Pelczar Michael J.; Chan Jr., E.C.S. , Krieg , Noel R.; Microbiology TMH 5th Edition .
28. Ananthanarayanan and Panniker, Textbook of Microbiology 5th Edition (1996). Orient Longman