

SCIENCE FACULTY

**NORTH MAHARASHTRA UNIVERSITY  
JALGAON**



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**NAAC ACCREDITED**

**SYLLABUS FOR**

**F.Y. B.Sc.**

**BIOCHEMISTRY**

**(WITH EFFECT FROM JUNE 2015)**

## North Maharashtra University, Jalgaon.

Class:- F.Y.B.Sc.

**Subject: Biochemistry**

**With Effect from June, 2015**

The board of studies in Life Sciences in its meeting held on 30/03/2015 resolved to accept the revised syllabus for F.Y.B.Sc. (Biochemistry) as per guidelines of Academic Council and with references to UGC model curriculum. The courses codes and titles for the courses are as given below.

**BC: Biochemistry**

**YSC: Y- Year, S – Semester, C – Course No.**

### COURSE STRUCTURE

Course Code	Title of the Course	Semester	Lectures	Marks		
				Ext.	Int.	Total
BC-111	Chemistry of Biomolecules	I <sup>st</sup>	45	60	40	100
BC-112	Cell Biology	I <sup>st</sup>	45	60	40	100
BC-113	Basic Techniques in Biochemistry-I (Practical course)	I <sup>st</sup>	45	60	40	100
BC-121	Basic Biochemistry	II <sup>nd</sup>	45	60	40	100
BC-122	Fundamentals of Microbiology	II <sup>nd</sup>	45	60	40	100
BC-123	Basic Techniques in Biochemistry-II (Practical course)	II <sup>nd</sup>	45	60	40	100

- Each theory course will have a weightage of 100 marks. (40 marks internal and 60 university examination)
- Practical course will have a weightage of 100 marks (40 marks internal and 60 marks external) and practical examination will be held at the end of the semester.
- Each theory course is divided into three units and to be completed in 45 lectures of 50 minutes duration each (15 lectures per unit).

## BC-111: Chemistry of Biomolecules

### Unit I: Carbohydrates

(15L)

- Definition, scope of Biochemistry
- Biomolecules: Names of Biomolecules, their repeating units and their main function
- Definition and biological importance of Carbohydrate
- Classification of Carbohydrates: Monosaccharides, Oligosaccharides and Polysaccharides (definition, general formulae, and examples)
- D & L forms of carbohydrates, epimers of glucose
- Cyclic structure of monosaccharides: hemiacetal, hemiketal, pyranose and furanose form (glucose and fructose)
- Mutarotation: definition, example & mechanism
- Derivatives of monosaccharides: sugar alcohols, sugar acids, sugar phosphates, deoxysugars, and amino sugars
- Reactions of glucose – oxidation with bromine water and nitric acid, reduction, acetylation, addition of HCN,  $\text{NH}_2\text{OH}$  and phenyl hydrazine
- Disaccharides: sucrose, lactose, maltose
- Homopolysaccharides: Starch, Glycogen, Cellulose
- Heteropolysaccharides: Mucopolysaccharides, Hyaluronic acid, Chondroitin sulfate

### Unit –II: Lipids

(15L)

- Definition and functions of lipids
- Classification of lipids: Simple lipids, Compound lipids and Derived lipids with examples
- Fatty acids: definition, nomenclature, Even & odd chain fatty acids, Saturated and unsaturated fatty acids
- Essential fatty acids: definition, examples, functions, deficiency
- Triacylglycerol: definition, occurrence, functions, structure (mono, di and triglycerols), simple and mixed triacylglycerol
- Properties of triacylglycerol: hydrolysis, saponification, rancidity, antioxidant, lipid peroxidation
- Tests to check purity of fats and oils: Iodine number, saponification number, Reichert-Meissl number, acid number
- Differences between animal and plant fat
- Phospholipids – functions and classification - Glycerophospholipids- phosphatidic acid, lecithins, cephalins (structure and importance); Sphingophospholipids- structure and importance.
- Steroids – structure and function of cholesterol, progesterone

### Unit –III: Amino acids, peptides and proteins

(15L)

- Amino acids - definition, general structure, optical isomers, classification of amino acids based on structure, nutrition and metabolic fate.
- Chemical properties of amino acids – general reactions of amino acids with NaOH, alcohol, ammonia, ninhydrin, decarboxylation, transamination, oxidative deamination
- Peptides – definition and formation of peptide bonds, N- and C- terminals, representation of peptide chain, naming of peptide chain

- Protein - definition and levels of organization (primary, secondary, tertiary and quaternary).
- Bonds responsible for protein structure - covalent bonds (peptide and disulfide), non-covalent bonds (hydrogen, hydrophobic, and electrostatic bonds. Van der Waals forces).
- Classification of proteins based on shape, composition and solubility, biological functions and nutrition.
- Denaturation of protein - agents and characteristics of denaturation.

**Recommended Books:**

1. Lehninger's Principles of Biochemistry: D. L. Nelson and M. M. Cox (W. H. Freeman & company)
2. Outlines of Biochemistry: Eric E. Conn and P. K. Stumpf (Wiley)
3. Biochemistry: L. Stryer (W. H. Freeman & company)
4. Biochemistry: S. C. Rastogi (Tata McGraw-Hill Education)
5. Biochemistry: U. Satyanarayana (Books and Allied Pvt. Ltd.)
6. Text Book of Biochemistry: R. A. Agrawal (Krishna Prakashan Media Pvt. Ltd.)
7. Fundamentals of Biochemistry: J. L. Jain, S. Jain and N. Jain (S. Chand and Company Ltd.)

## BC-121: Basic Biochemistry

### Unit - IV: Enzymes

(15 L)

- Definition and historical background of enzyme.
- Terminologies - intracellular enzymes, extracellular enzymes, holoenzymes, apoenzymes, prosthetic group, cofactor, coenzymes, isoenzymes, katalas, international unit, turnover number and active site.
- Nomenclature on the basis of – substrate acted upon by enzyme, type of reaction catalysed, substrate acted upon and type of reaction catalysed, substance (product) that is synthesized, over all chemical reaction taken into consideration (Enzyme commission number).
- Classification of enzymes - six major classes with description and examples each with EC number and reaction.
- Factors affecting enzyme activity - effect of substrate concentration, enzyme concentration, product concentration, pH, temperature, activators, time, and inhibitors.
- Specificity of enzyme action - absolute specificity, group specificity, optical specificity and geometrical specificity.
- Active site - definition and salient features of active site.
- Mechanism of enzyme action – lock and key model, induced fit model.
- Industrial applications of enzymes.

### Unit – V: Nucleic acids

(15 L)

- Definition and types of nucleic acid - DNA and RNA.
- Structural components of DNA and RNA - phosphoric acid, pentose sugar, nitrogenous bases - purines and pyrimidine (numbering of purine and pyrimidine rings and chemical names).
- Nucleosides - involved, deoxyribonucleosides, ribonucleosides and nomenclature of nucleosides.
- Nucleotides - deoxyribonucleotides, ribonucleotides, nomenclature of nucleotides, mono-, di- and tri- ribo and deoxyribonucleotides, functions of nucleotides.
- DNA - formation of 3'5'-phosphodiester bond, Watson and Crick model of DNA, Chargaff's rule.
- Forms of DNA - A-DNA, B-DNA, C-DNA and Z-DNA (condition, shape, helix sense, helix diameter, rise per base pair, base pair per turn of helix, helix pitch, rotation per base pair, base pair tilt, glycosidic bond, major and minor grooves).
- RNA - : structure, differences with DNA and types of RNA. rRNA - prokaryotic and eularyotic rRNA and types. tRNA - cloverleaf structure. mRNA - hnRNA, exons, introns, splicing, 5' capping, 3' poly A tail.

### Unit – VI: Vitamins

(15 L)

- Definition, history and nomenclature. Classification - fat-soluble and water soluble vitamins.
- Fat-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin A, D, E and K.
- Water-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin C, B1, B6, and B12.

**Recommended Books:**

1. Lehninger's Principles of Biochemistry: D. L. Nelson and M. M. Cox (W. H. Freeman & company)
2. Outlines of Biochemistry: Eric E. Conn and P. K. Stumpf (Wiley)
3. Biochemistry: L. Stryer (W. H. Freeman & company)
4. Biochemistry: S. C. Rastogi (Tata McGraw-Hill Education)
5. Biochemistry: U. Satyanarayana (Books and Allied Pvt. Ltd.)
6. Text Book of Biochemistry: R. A. Agrawal (Krishna Prakashan Media Pvt. Ltd.)
7. Fundamentals of Biochemistry: J. L. Jain, S. Jain and N. Jain (S. Chand and Company Ltd.)

## **BC-112: Cell Biology**

### **Unit I- Ultra structure of cell (15L)**

- Cell basics- definition and cell elemental composition
- Characteristics- prokaryotic and eukaryotic cell
- Differences between plant and animal cell
- Structure and functions of cell organelles- cell wall, cell membrane (Fluid Mosaic model), cytoplasm, mitochondria, golgi complex, endoplasmic reticulum (smooth and rough), chloroplast, nucleus, ribosomes, lysosomes

### **Unit II- Cell division (15L)**

- Introduction to cell division
- Mitosis- interphase, different phases and significance of mitosis
- Meiosis- different phases of meiosis-I and II and its significance
- Differences between mitosis and meiosis

### **Unit III- Tissues and cell junctions (15L)**

- Tissues- definition and types
- Epithelial tissues- general characteristics, functions and classification
- Simple and compound epithelial tissues- types, their introductory description, functions and locations
- Connective tissues- general characteristics and functions
- Types of connective tissues (cartilage, bone and blood)- their introductory description, functions and locations
- Muscular tissues (skeletal, cardiac and smooth)- their introductory description, functions and locations
- Nervous tissues (neuron and neuroglia)- their introductory description, functions and locations
- Cell junctions (complexes)- definition and types- tight junction, belt desmosome, spot desmosome and gap junction

### **Recommended Books:**

1. Cell Biology, C.B. Powar, Himalaya Publishing House, Mumbai
2. Human physiology Vol. I – C.C. Chatterjee, Medical allied Agency
3. Lehninger's Principles of Biochemistry: D. L. Nelson and M. M. Cox (W. H. Freeman & company)
4. Outlines of Biochemistry: Eric E. Conn and P. K. Stumpf (Wiley)
5. Biochemistry: L. Stryer (W. H. Freeman & company)
6. Biochemistry: S. C. Rastogi (Tata McGraw-Hill Education)
7. Biochemistry: U. Satyanarayana (Books and Allied Pvt. Ltd.)

# BC-122 Fundamentals of Microbiology

## Unit I: Characteristics of Microorganisms (15L)

- Types of microorganisms. General characteristics and significance of bacteria, algae, fungi, virus and protozoa. Nutrition, classification and mode of reproduction.
- Major characteristics of microorganisms – morphological, chemical, metabolic, antigenic, and genetic characteristics.
- Role of microorganisms in infection, fermentation, environment and agriculture.
- Morphology and fine structure of bacteria - size, shape, arrangements, structure of bacterial cell,
- Structure and functions of flagella, pilli, fimbriae, glycocalyx, capsule and cell wall of Gram positive and Gram negative bacteria.

## Unit-II: Growth, Nutrition and Isolation of microorganisms (15L)

- Concept of growth. Growth curve – lag, log, stationary and death phase.
- Mathematical expression of growth – growth rate and generation time.
- Measurement of growth
  - Methods for determination of cell number- direct (breed method, counting chamber method, Coulter method, proportion counting method) and indirect (total viable count)
  - Determination of cell mass – direct (measurement of dry weight of cell, measurement of cell nitrogen) and indirect (turbidometric) methods.
  - Determination of cell activity
- Nutritional classification of microorganisms. Media – ingredients, types on the basis of physical state, composition and use.
- Methods of isolation of bacteria on solid media - streak plate method, pour plate method, roll tube method and spread plate method.
- Staining - concept of stains, acidic and basic stain, leuco compounds, intensifiers and mordant, aims of staining.

## Unit-III: Control of Microorganisms (15L)

- Definitions- sterilization, disinfection, antisepsis, sanitization, decontamination, pasteurization, preservation, germicidal and bactericides
- Sterilization
  - Heat- thermal death point, thermal death time, decimal reduction time
    - Moist heat- mode of action, steam under pressure, Fractional sterilization, Boiling water, Pasteurization and canning
    - Dry heat- mode of action, incineration, hot air oven
  - Radiation- ionizing radiations, non-ionizing radiations
  - Chemical sterilization- ethylene oxide, formaldehyde
  - Filtration
- Disinfection: characteristics of an ideal disinfectant
  - Disinfectants- phenol and phenolic compounds, alcohol, heavy metals, halogens, dyes, detergents, hydrogen peroxide



**Recommended Books:**

1. General Microbiology: R. Y. Stanier, J. L. Ingraham, M. L. Wheelis and P. R. Painter (Macmillan Press Ltd.)
2. Microbiology: M. J. Pelczar Jr., E. C. S. Chan, N. R. Krieg (Tata McGraw-Hill)
3. Brock Biology of Microorganisms : M. T. Madigan, J. M. Martinko and J.Parker (Benjamin-Cummings)
4. Foundation of Microbiology: S. B. Chincholkar, A. B. Chaudhari, U. K. Patil (Nirali Prakashan)

## **BC – 113: Basic techniques in Biochemistry – I** **(Practical course in biochemical and cytological techniques)**

1. Safety measures in the laboratory and introduction of laboratory instruments - water bath, autoclave, hot-air oven, incubator, refrigerator, centrifuge, laminar air flow cabinet, pH meter, weighing balance, spectrophotometer.
2. Introduction to normality, molarity, percent solutions, buffers, pH, ppm, and ppb. Preparation and titration of 0.1 N acid and base solutions.
3. Qualitative tests for carbohydrates- anthrone test, iodine test, Barfoed test, Seliwanoff's test, Fehling's test, Bial's test
4. Isolation of starch from potato.
5. Qualitative tests for lipids- solubility test, acrolein test, presence of free fatty acids and unsaturated fatty acids
6. Qualitative tests for amino acids- Ninhydrin test, Xanthoproteic test, Ehrlich's test, Sodium nitroprusside test, Sullivan and McCarthy's test, Millon's test
7. Isolation of casein from milk.
8. Use, handling and care of compound microscope.
9. Study of various phases of mitosis using suitable sample.
10. Temporary mounting of available tissues.

### **Recommended Practical Books:**

1. Microbiology – a Laboratory Manual: J. G. Cappuccino and N. Sherman.(Addison Wesley Publishing Company Inc.)
2. Practical Biochemistry:Principles and techniques: K. Wilson and J. Walker. (Cambridge University Press)
3. An Introduction to Practical Biochemistry: D. Plummer. (Tata McGraw Hill)
4. Handbook of bacteriological techniques: F. J. Baker. (Butterworths)
5. Hawk's physiological chemistry: B. L. Oser(ed.) (McGraw-Hill Book Co.)
6. Laboratory Manual in Biochemistry: J. Jayaraman. (New Age International Publishers)
7. Methods in Agricultural Biochemistry: S. Sadashivam and A. Manikam. (New Age Int. Publishers)
8. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Cultivation : K. R. Aneja. (New Age International Publishers)
9. Laboratory Manual in Microbiology: P. Gunasekaran. (New Age International Publishers)
10. Experimental Biochemistry: A student companion: B. S. Rao and V. Deshpande. (Anshan)

## **BC – 123: Basic techniques in Biochemistry – II** **(Practical course in biochemical and microbial techniques)**

1. Qualitative test for amylase.
2. Quantitative determination of DNA and RNA by spectrophotometric method.
3. Estimation of ascorbic acid by volumetric method.
4. Monochrome staining.
5. Negative staining.
6. Gram staining techniques.
7. Isolation and culture characterization of bacteria by streak plate techniques
8. Determination of viable count.
9. IMViC test.
10. Demonstration of quality of drinking water

### **Recommended Practical Books:**

11. Microbiology – a Laboratory Manual: J. G. Cappuccino and N. Sherman.(Addison Wesley Publishing Company Inc.)
12. Practical Biochemistry:Principles and techniques: K. Wilson and J. Walker. (Cambridge University Press)
13. An Introduction to Practical Biochemistry: D. Plummer. (Tata McGraw Hill)
14. Handbook of bacteriological techniques: F. J. Baker. (Butterworths)
15. Hawk's physiological chemistry: B. L. Oser(ed.) (McGraw-Hill Book Co.)
16. Laboratory Manual in Biochemistry: J. Jayaraman. (New Age International Publishers)
17. Methods in Agricultural Biochemistry: S. Sadashivam and A. Manikam. (New Age Int. Publishers)
18. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Cultivation : K. R. Aneja. (New Age International Publishers)
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20. Experimental Biochemistry: A student companion: B. S. Rao and V. Deshpande. (Anshan)