

**North Maharashtra University, Jalgaon**



'A' Grade  
NAAC Re-Accredited  
(3<sup>rd</sup> Cycle)

**Structure of syllabus for**

**M. Sc. Part I**

**Biochemistry**

**[2018-19]**

## M. Sc. Part: I Biochemistry

### Preamble

The biological sciences converge to molecular aspects of living organisms, hence, curriculum is designed impart basic and applied knowledge of biochemistry. The major objectives considered during syllabus design is to impart more technical skills to the students. The theory and practical from biochemistry, human physiology, molecular biology, and microbial physiology would be helpful to unravel various environmental, agriculture, metabolic and infectious problems in day to day life.

**Learning outcome:** After completion of the course, student is expected to have knowledge about:

- Fundamental concept of enzyme biology, properties, kinetics and regulation of enzyme catalyzed reaction.
- Key structure, classification and significance of biomolecules and biosynthetic pathways
- Characteristics, types and classification and growth and nutrition of microorganisms
- Principle, working and application of bioinstruments
- Separation of biomolecules based on size, mobility, charge, density and affinity.
- Fundamentals of hematopoiesis, clotting and functions of hormones.
- Basis, origin, mechanisms of immune response, allergy and autoimmunity
- Basis of Ag-Ab reactions, immunological and diagnostic techniques.
- Clinical significance of blood/serum components
- Ability to integrate the problem and look at problems from different perspectives
- Ability to work safely, design experiments independently and assess the research paper critically

### Course Structure

**Duration:** The duration of M.Sc. (Microbiology) degree program shall be TWO years.

**Medium of instruction:** The medium of instruction for the course shall be English.

Subject Code	Title of the Paper	Duration (Hrs./Wk)	Max. Mark	Exam. Time (Hrs.)
<b>Semester - I (Theory courses)</b>				
BC-101	Enzymes and Enzyme Technology	04	100	03
BC-102	Bioenergetics and Metabolism	04	100	03
BC-103	Microbial Physiology	04	100	03
<b>Semester - I (Practical)</b>				
BC-104	Methods in Microbiology	04+04	100	06
BC-105	Methods in Biochemistry	04+04	100	06
<b>Semester - II (Theory courses)</b>				
BC-201	Cell Physiology	04	100	03
BC-202	Analytical Biochemistry	04	100	03
BC-203	Immunology	04	100	03
<b>Semester-II (Practical)</b>				
BC-204	Methods in Enzymology	04+04	100	06
BC-205	Methods in Clinical and Diagnostic Immunology	04+04	100	06

- Each theory and practical course has to complete in 50 lectures, respectively of 60 min duration,
- Each theory and practical course will be of 100 marks comprising of 40 marks internal (20 marks of 2 internal examinations) and 60 marks external examination.
- **Theory examination** (60 marks) will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks (12 marks each). The pattern of question papers shall be:

- **Question 1** (12 marks): 6 sub-questions, each of 3 marks; answerable in brief and based on entire syllabus, attempt any 4 out of 6 questions.
- **Question 2, 3 and 4** (12 marks each): based from Unit I, II, and III, respectively, each question has 3 sub-questions of 6 marks each and answer only 2 sub-questions from each Q2, Q3, and Q4.
- **Question 5** (12 marks): answer only 3 out of 5 in brief, based from all 3 units, Each 4 marks.
- **Internal examination** (40 marks each semester): Internal assessment of the student by respective teacher will be comprehensive and continuous, based on written test. The written test shall comprise of both objective and subjective type questions.
- **Practical Examination:** Practical examination shall be conducted by the respective college at the end of the semester. Practical examination will be of minimum 5 – 6 hours duration and shall be conducted as per schedule (10 am to 5 pm on schedule date or can be scheduled 10 am -1pm/ 2 – 5 pm for 2 consecutive days) in case of microbiology practicals where incubation condition, allied aspects are essential. There shall be 5 marks for laboratory log book and well written journal, 10 marks for viva-voce and minimum three experiments (major and minor). Certified journal is compulsory to appear for practical examination. There shall be one expert and two examiners (external and internal) per batch for the practical examination
- **Equivalence** for M.Sc. (Biochemistry) is given below:

Sr. no	Old Syllabus (June 2015- 16) Semester I (Pattern 60:40)	New Syllabus (w. e. f. June 2018-19) Semester I (Pattern 60:40)
1	BC 101- Enzymes and Enzyme Technology	BC 101- Enzymes and Enzyme Technology
2	BC 102 - Bioenergetics and Metabolism	BC 102 - Bioenergetics and Metabolism
3	BC 103- Microbial Physiology	BC 103- Microbial Physiology
4	BC 104- Laboratory Course – I	BC 104- Methods in Microbiology
5	BC 105 - Laboratory Course – II	BC 105 - Methods in Biochemistry
Sr. no	Old Syllabus (June 2015- 16) Semester II (Pattern 60:40)	New Syllabus (w. e. f. June 2018-19) Semester II (Pattern 60:40)
1	BC 201- Human Physiology and Biochemistry of Specialized Tissues	BC 201- Cell Physiology
2	BC 201- Analytical Biochemistry	BC 201- Analytical Biochemistry
3	BC 203 - Immunology	BC 203 - Immunology
4	BC 204 - Laboratory Course – III	BC 204 – Methods in Enzymology
5	BC 205 - Laboratory Course – IV	BC 205 – Methods in Clinical and Diagnostic Immunology

## BC 101: Enzymes and Enzyme Technology

Unit	Topic	Lectures
I	<p><b>Enzyme:</b> Chemical nature and properties, classification, coenzyme, enzyme-substrate complex, concept of active centre/site, effect of temperature, pH and substrate concentration on reaction rate, activation energy, transition state theory. Enzyme activity: International units, specific activity, turnover number.</p> <p><b>Enzyme kinetics:</b> Michelis - Menten equation and its derivation, significance of V<sub>max</sub> and K<sub>m</sub>, Bisubstrate reaction, examples and reaction rate equations.</p> <p><b>Enzyme inhibition:</b> Types of inhibitors- competitive, non-competitive and uncompetitive inhibition of enzymes, examples and experimental determination.</p>	10
II	<p><b>Enzyme catalysis:</b> factors affecting catalytic efficiency of enzymes, proximity and orientation effect, distortion or strain, acid base and nucleophilic catalysis.</p> <p>Mechanism of enzyme catalysis in lysozyme, ribonuclease, chymotrypsin and carboxypeptidase.</p>	10
III	<p><b>Enzyme regulation:</b> General mechanism of enzyme regulation, feedback inhibition, enzyme regulation by cAMP, covalent modification and allosteric regulation of enzymes.</p> <p><b>Allosteric enzymes:</b> Kinetics and physiological significance of symmetric and sequential model for action of allosteric enzymes, Isoenzymes.</p> <p><b>Enzyme turn over/ Degradation -</b> Kinetics, methods for measurement of degradation, factors affecting degradation, mechanism of degradation and significance of enzyme turn over/ degradation.</p>	10
IV	<p><b>Multienzyme complexes:</b> pyruvate dehydrogenase and fatty acid synthetase, properties and advantages of multienzyme complex.</p> <p><b>Oligomeric enzymes</b></p> <p><b>Clinical aspects of enzymology:</b> enzymes in diagnosis of diseases, enzyme deficiency and disease, enzyme inhibition and drug design, use of enzyme in determining the concentration of metabolites of clinical importance (glucose, uric acid, cholesterol, triglycerides, creatinine), enzyme therapy.</p>	10
V	<p><b>Enzyme Technology :</b> Use of isolated enzyme in industrial processes, carbohydrate and protein metabolizing enzymes used in industry, use of enzymes in making of alcoholic beverages, bread, cheese, detergent, sweeteners and tenderization of meat and clarification of fruit juice, beer and wine.</p> <p><b>Enzyme Immobilization:</b> Methods of immobilization, adsorption, entrapment, micro encapsulation, covalent binding, cross linking, stabilization of soluble enzyme, application of immobilized enzymes.</p> <p><b>Biosensors:</b> Principle, general features, types of biosensors, electrochemical, conductometric, thermometric, optical etc., applications of biosensors.</p>	10
<b>Suggested readings:</b>		
<ol style="list-style-type: none"> <li>1. N. C. Price and L. Stevens (1989) Fundamentals of Enzymology, Oxford University Press,</li> <li>2. M. Dixon and E. C. Webb (1964) Enzymes, Academic Press,</li> <li>3. L. Stryer (2012) Biochemistry, W. H. Freeman and Company,</li> <li>4. D. L. Nelson and M. M. Cox (2007) Lehninger's Principles of Biochemistry, W. H. Freeman and Co.</li> <li>5. U. Satyanarayana (2010) Biotechnology, Books and Allied Pvt. Ltd.,</li> </ol>		

## BC 102: Bioenergetics and Metabolism

Unit	Topic	Lectures
I	<p><b>Concept of atom,</b> molecules and chemical bonds, Laws of thermodynamics, various aspects of energy (free energy, enthalpy, entropy and free energy changes). Vande Walls interaction, Henderson Hasselbatch equation.</p>	10

	<b>Oxidation and reduction reactions:</b> biological perspective, High energy compounds, structure and significance of ATP, ATP synthetase complex, detailed study of oxidative phosphorylation, substrate level phosphorylation.	
II	<b>Carbohydrates:</b> Classification, structure and properties of carbohydrates and their building blocks (sugars), detailed study including energetics, regulation and significance of glycolysis, citric acid cycle and gluconeogenesis. Alternate pathways of carbohydrate metabolism (pentose phosphate pathway, glyoxalate cycle and glucuronic acid cycle), Biosynthesis and degradation of glycogen and starch.	10
III	<b>Lipids:</b> Classification, structure and properties of lipids and their building blocks (fatty acids), $\beta$ -Oxidation of even and odd number carbon atom fatty acids, their energetics, regulation and significance. <b>Biosynthesis of fatty acids,</b> fatty acid synthase complex, regulation of fatty acid biosynthesis. Desaturases and elongases and their role, <b>Biosynthesis of triacylglycerols,</b> phospholipids. Formation and utilization of ketone bodies, metabolism of circulating lipids. <b>Biological role of lipids</b>	10
IV	<b>Amino acids</b> - Classification, structure and properties of proteins and their building blocks (amino acids), biosynthesis and degradation of amino acid and their regulation. Transamination and oxidative deamination. Urea cycle and its regulation. Inborn errors of amino acid metabolism. Ramachandran plot, Cot value	10
V	<b>Purines and pyrimidines</b> - Types, structure and properties of nucleic acids and their building blocks (purines and pyrimidines), Biosynthesis and catabolism of purines and pyrimidines and their regulation. Ribonucleotide reductase, biosynthesis of ribonucleotides and deoxyribonucleotides. Inhibitors of nucleic acid biosynthesis.	10
<b>Suggested readings:</b>		
<ol style="list-style-type: none"> <li>1. L. Stryer(2012) Biochemistry, W. H. Freeman and Co.,</li> <li>2. D. L. Nelson and M. M.Cox (2007) Lehninger's Principles of Biochemistry, W. H. Freeman and Co.,</li> <li>3. R. K. Murray et al. (eds) (2015) Harpers Biochemistry, McGraw Hill,</li> <li>4. G. L. Zubay(1996) Principles of Biochemistry, McGraw Hill,</li> </ol>		

### BC 103: Microbial Physiology

Unit	Topic	Lectures
I	<b>Bacterial taxonomy:</b> Domain and Kingdom concepts in classification of microorganisms, Five kingdom system of classification of bacteria Conventional and molecular taxonomy, Bergey's Manual, Numerical taxonomy, chemotaxonomy Molecular approaches: Ribotyping, Denaturing Gradient Gel Electrophoresis (DGGE), Temperature Gradient Gel Electrophoresis, (TGGE), Amplified rDNA Restriction Analysis <b>Microbial nutrition:</b> Concept, construction of culture media, enrichment culture techniques for the isolation of chemoautotrophs and photosynthetic micro-organisms.	10
II	<b>Bacterial growth:</b> Mathematical expression of growth, growth curve, measurement of growth and growth yield, synchronous growth, continuous culture cultivation. <b>Growth parameters:</b> Temperature, acidity, alkalinity, water availability and oxygen, effect of toxic environments	10
III	<b>Microbial Diseases:</b> Host-Pathogen interactions; Microbes infecting humans, veterinary animals and plants, entophytes and their significance, Disease reservoirs, epidemiological terminologies, Introduction to infectious disease transmission,	10

	respiratory infections caused by bacteria and viruses, tuberculosis and its prevention and control using chemotherapy <b>Disease transmission:</b> Sexually transmitted diseases syphilis, AIDS. Diseases transmitted by animals: rabies, plague, rickettsia, Lyme disease, malaria. Mycosis, cutaneous, subcutaneous and mycotoxins	
<b>IV</b>	<b>Control of microorganism:</b> Necessity of aseptic condition Disinfection: Concept of disinfectant and characters of an ideal disinfectant, Phenol coefficient, Mode of action and applications of Phenol and Phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, H <sub>2</sub> O <sub>2</sub> . Physical methods: Control of microbes by Ultraviolet light, gamma rays, Low Temperature, , Desiccation, Osmotic pressure, Surface tension Sterilization: Heat (Dry heat, Moist heat), Radiation (X-rays, Gamma rays and UV rays), Filtration (Membrane filter, LAF (HEPA), Nucleopore filters) Chemicals (Ethylene oxide and Formaldehyde) <b>Antimicrobial agents:</b> Sulpha drugs, antiviral drugs	<b>10</b>
<b>V</b>	Physiology of bacterial flagellar motility, Bioluminescence in bacteria and fungi Microbial communication system using Quorum sensing Chemotaxis in bacteria Response to various stress in bacteria	<b>10</b>
<b>Suggested readings:</b>		
<ol style="list-style-type: none"> <li>1. Stainer, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (1992) General Microbiology, McMillan, New York</li> <li>2. Dimmock, N. J. and Primrose, S. B. (2007) Introduction to Modern Virology, Blackwell Science Ltd., London</li> <li>3. Topley, Wilson and Arnold Miles (1984) Topley and Wilson's Principles of Bacteriology, Virology and Immunity, Williams and Wilkins, Baltimore</li> <li>4. Pawar, CB, and Dagainawala, HF. (1998) General Microbiology, Vol. I and II, 1<sup>st</sup> edition, Himalaya Publishing House, Mumbai.</li> <li>5. Black, JG. (2008) Microbiology: Principles and Explorations, 7th edition, Prentice Hall, New Jersey.</li> <li>6. Madigan, MT and Martinko, JM. (2014) Brock Biology of Micro-organisms, 14<sup>th</sup> edition, Parker J. Prentice Hall International, Inc., New Jersey.</li> <li>7. Frobisher, M. Hinsdill, R., Crabtree, KT., and Goodheart, CR. (1974) Fundamentals of Microbiology, 9th edition, WB Saunder's Co., Many, USA.</li> <li>8. Pelczar MJ, Chan, ECS and Krieg, NR. (1993) Microbiology, 5th edition, McGraw Hill Book Company, Penguin, USA</li> </ol>		

### **BC 104: Methods in Microbiology**

<b>1</b>	Isolation and Morphology of microorganisms by streak plate and spread plate method
<b>2</b>	Measurement of bacterial population by Pour plate method using serial dilution
<b>3</b>	Determination of motility of microorganisms by hanging drop method.
<b>4</b>	Staining of microorganisms using Monochromatic stain and Negative stain method.
<b>5</b>	Staining of microorganisms by Gram's staining.
<b>6</b>	Staining of microorganisms by Acid fast/ Spore staining.
<b>7</b>	Isolation and cultivation of a common fungal strain from habitat
<b>8</b>	Isolation of coliforms from water or sewage sample.
<b>9</b>	Determination of efficiency of a disinfectant using phenol coefficient method
<b>10</b>	Determine sterility of autoclave with chemical and biological indicator method
<b>11</b>	Estimation of bacterial growth using cell dry weight biomass and cell activity method
<b>12</b>	Demonstration of sterilization efficacy of laminar air flow system

<b>Suggested readings:</b>	
9.	K. Wilson and J. Walker (2003) Practical Biochemistry: Principles and techniques, Cambridge University Press,
10.	D. Plummer (2005) An Introduction to Practical Biochemistry, Tata McGraw Hill,
11.	J. Jayaraman (2008) Laboratory Manual in Biochemistry, New Age Int. Publishers,
12.	S. Sadashivam and A. Manikam (2008) Methods in Agricultural Biochemistry, New Age Int. Publishers,
13.	J. G. Cappuccino and N. Sherman (2014) Microbiology – a Laboratory Manual, Addison Wesley Publishing Company Inc.,
14.	H. J. Benson (2005) A Laboratory Manual in General Microbiology, McGraw-Hill Higher Education,
15.	K. R. Aneja (2007) Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Cultivation, New Age International Publishers,
16.	J. P. Harley and L. M. Prescott (2008) Lab Exercise in Microbiology, Wm. C. Brown Publishers,

### **BC 105: Methods in Biochemistry**

<b>1</b>	Preparation of buffers, molar solution, normal solution and ppm solution.
<b>2</b>	Thin Layer Chromatography (TLC) of Chlorophyll/Tannin/Carotenoids.
<b>3</b>	Paper Chromatography of Amino acids.
<b>4</b>	Qualitative tests for Carbohydrates.
<b>5</b>	Qualitative tests for Proteins.
<b>6</b>	Quantitative Estimation of Carbohydrates (reducing sugar) by DNSA method.
<b>7</b>	Quantitative Estimation of Proteins by Biuret's method.
<b>8</b>	Quantitative Estimation of Proteins by Folin & Lowry's method.
<b>9</b>	Estimation of methionine in food grains.
<b>10</b>	Quantitative estimation of DNA by Diphenyl amine method.
<b>11</b>	Quantitative estimation of RNA by Orcinol method.
<b>12</b>	Demonstration of Gas Chromatography (GC), High Performance Thin Layer Chromatography (HPTLC)
<b>Suggested readings:</b>	
1.	K. Wilson and J. Walker (2003) Practical Biochemistry: Principles and techniques, Cambridge Publishing Co.,
2.	D. Plummer (2005) An Introduction to Practical Biochemistry, Tata McGraw Hill,
3.	J. Jayaraman (2008) Laboratory Manual in Biochemistry, New Age Int. Publishers,
4.	Schmauder, H.P, Schweizer, M. and Schewizer, L.M. (2003) Methods in Biotechnology, Taylor and Francis Ltd., London

### **BC 201: Cell Physiology**

<b>Unit</b>	<b>Topic</b>	<b>Lectures</b>
<b>I</b>	<b>Blood:</b> Composition of blood, blood cells, blood plasma, plasma proteins. <b>Clotting:</b> Biochemistry of blood clotting, clotting factors, intrinsic and extrinsic pathways, mechanism of formation of thrombin, fibrin, fibrin clot, role of vitamin K in clotting process, Lysis of fibrin clot. <b>Water balance:</b> regulation of water balance, water balance disorders, electrolyte balance and its regulation.	<b>10</b>
<b>II</b>	<b>Acid – Bases:</b> Regulation of acid-base balance, types and functions of acid-base buffers, mechanism of pulmonary and renal control of acid base balance, clinical abnormalities associated with acid-base imbalance.	<b>10</b>

	<b>Hormones:</b> Types, examples, mechanism of action of steroid and protein hormones, role of prostaglandins, cAMP, calcium, diacyl glycerol, IP3, regulation gene expression by steroid hormones.	
<b>III</b>	<b>Signal transduction cascade</b> , chemoreceptors and types, flagellar rotation, methylation of chemoreceptors. Retinal rod cell, rhodopsin, G protein cascade, biochemistry of vision, recovery and adaptation, visual cycle, colour vision. Tyrosine kinase and growth and differentiation, cancer and signal transduction proteins, ras proteins and their role.	<b>10</b>
<b>IV</b>	Biochemistry of muscle contraction, myosin and actin, structure and physiological role, regulation of muscle contraction, role of troponin and tropomyosin, <b>Respiration (Breathing)</b> , respiratory air volumes and capacities, control of respiration, factors affecting respiration, principles of gaseous exchange during respiration, transport of oxygen and carbon dioxide in the blood, chloride shift, regulation of respiration, disorders of gas exchange.	<b>10</b>
<b>V</b>	<b>Transport of molecules</b> - Biological membranes and transport, physico-chemical properties of cell membranes, molecular constituents and architecture of membranes, asymmetric organization of membrane lipids and proteins. Ion transport across membranes, types of transport. Membrane channels and pumps, acetylcholine receptor channel, ligand and voltage gated channel, generation of action potential during nerve impulse transmission. Active transport, Na/K pump, structure, mechanism of action and significance.	<b>10</b>
<b>Suggested readings:</b>		
<ol style="list-style-type: none"> <li>1. Darnell, Lodish and Baltimore (2000) Molecular Cell Biology, W. H. Freeman and Co.,</li> <li>2. L. Stryer(2012) Biochemistry, W. H. Freeman and Co.,</li> <li>3. D. L. Nelson and M.M. Cox (2007) Lehninger's Principles of Biochemistry, W. H. Freeman and Co.,</li> <li>4. A.C. Guyton (2015) Text Book of Medical Physiology, Saunders,</li> <li>5. J. W. Hole Jr. (2016) Human Anatomy and Physiology, McGraw-Hill Higher Education,</li> </ol>		

## BC 202: Analytical Biochemistry

Unit	Topic	Lectures
<b>I</b>	<b>Concepts of biophysical chemistry:</b> Interactions in aqueous system, concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism <b>Microscopy</b> - principle and applications of phase contrast, fluorescence and Electron microscopy (SEM and TEM).	<b>10</b>
<b>II</b>	<b>Spectrophotometry:</b> Beer and Lambert's law. Principle, instrumentation and applications of - UV-visible spectrophotometry, FTIR spectroscopy, NMR spectroscopy, Atomic absorption spectroscopy and X-ray diffraction spectroscopy.	<b>10</b>
<b>III</b>	<b>Separation techniques:</b> Chromatography - basic principle, instrumentation and applications of paper, thin layer, ion exchange, gel filtration, affinity, gas and high performance liquid chromatography.	<b>10</b>
<b>IV</b>	<b>Separation techniques:</b> Principle and applications of dialysis & ultrafiltration. <b>Separations of proteins</b> precipitation: solubility, salting out, precipitation with solvents, precipitation organic polymers and with selective denaturation: temperature, pH and organic solvent <b>Electrophoresis:</b> principle and applications of paper, agarose, polyacrylamide gel, isoelectrofocussing, density gradient gel and pulse field gel electrophoresis, Western blotting, Northern blotting.	<b>10</b>
<b>V</b>	<b>Centrifugation:</b> principle, types and applications of ultracentrifugation. <b>Tracer techniques:</b> Radioactive isotopes, half-life of radioactive compounds, autoradiography, Cerenkov radiation, liquid scintillation counter.	<b>10</b>
<b>Suggested readings:</b>		
1. D. Freifelder (1983) Physical Biochemistry, W. H. Freeman and Co.,		



2. D. Cooper (1977) Tools in Biochemistry, Wiley, New York
3. D. Holmes and H. Peck (1998) Analytical Biochemistry, Longman,
4. Upadhye, A and Upadhye, N (2009) Biophysical Chemistry, Himalaya Publ. House, New Delhi
5. K. E. van Holde (2005) Physical Biochemistry, Prentice Hall,

### BC 203: Immunology

Unit	Topic	Lectures
I	<b>Overview of immunology:</b> Concepts of health and diseases, scope of immunology. <b>Cells and tissues of the immune system:</b> Hematopoietic stem cells, Lymphocytes, antigen presenting cells, bone marrow, thymus , lymph nodes and lymphatic system, spleen, cutaneous immune system , mucosal immune system.	10
II	<b>Immunity and its types,</b> Elements of innate immunity, Adaptive immunity and its features, self from non-self-recognition <b>Immunoglobulins:</b> Structure, types and function, Antigenic determinants on <b>Immunoglobulins:</b> Isotype, allotype, and idiotype. Clonal selection theory, <b>Organization and expression:</b> of Ig genes, generation of antibody diversity, primary and secondary immune response. <b>Antigens:</b> Requirements for immunogenicity, Foreignness, Size, Chemical complexity, Dosage and route of administration. Superantigens, haptens and adjuvant	10
III	<b>Complement system:</b> Complement and its role in immune response, the classical, lectin and alternative complement pathways, biological consequences of complement activation. <b>Major Histocompatibility Complex:</b> Structure, properties and cellular distribution of MHC gene products, genomic organization and expression of MHC proteins. <b>Antigen processing and presentation to T cells:</b> Cytosolic and endocytic pathway.	10
IV	<b>Cytokines</b> – Properties, functions and examples <b>Humoral immune response:</b> B cell maturation, activation and differentiation. B cell receptor. <b>Cellular immune response:</b> T cell receptor and its types, co-receptor molecules. T cell maturation and activation. <b>Hypersensitivity:</b> Types and Mechanisms <b>Autoimmunity:</b> Concepts, Causes/Mechanisms, Types and treatment.	10
V	<b>Antigen antibody interactions:</b> Ab affinity, avidity and cross reactivity. <b>Antigen antibody reactions:</b> Precipitation reaction in fluids and gels– Radial immunodiffusion, Double immunodiffusion. Agglutination reactions, Coomb’s test. Immunoassays: RIA, ELISA and its types, western blotting, immunoelectrophoresis.	10

#### Suggested readings:

1. J. Kuby, R. Goldsby, T. Kindt and B. Osorne (2006) Immunology, W.H Freeman and Co.,
2. R. Coleman, M. Lombard and R. Sicard (1992) Fundamental Immunology, William C Brown,
3. A. Abbas and A. Lichtman (2014) Cellular and Molecular Immunology, WB Saunders Co.,
4. Lesley Jane Eales (2007) Immunology for Life Scientists, Wiley-Interscience,
5. K.R.Joshi and N. O. Osamo (2012) Immunology, Agrobios,
6. J. W. Kimball (1983) Introduction to Immunology, Macmillan,
7. D. M. Weir and J. Steward (1993) Immunology, ELBS,

### BC 204: Methods in Enzymology

1	Determination of activity of proteases
2	Determination of activity of amylases
3	Determination of activity of lipases
4	Purification of enzyme by ammonium sulphate method and Dialysis.
5	Purification of enzyme ( $\beta$ - Amylases) from plant (sweet potato).
6	Purification of enzyme from Microbial source ( <i>Bacillus spp</i> / <i>Aspergillus spp</i> )

7	Determination of $K_m$ and $V_{max}$ of enzyme Diastase by double reciprocal plot.
8	Determination of specific activity of enzyme (Amylase).
9	Studies on effect of inhibitors and activators on enzyme activity.
10	Studies on effect of temperature and pH on enzyme activity.
11	Determination of enzyme hydrolysis of proteins and analysis of their products.
12	Immobilization of enzymes using cell entrapment/ crosslinking/ physical adhesion method
<b>Suggested readings:</b>	
<ol style="list-style-type: none"> <li>1. K. Wilson and J. Walker (2003) Practical Biochemistry Principles and techniques, Cambridge Publ. Co.,</li> <li>2. D. Plummer (2005) An Introduction to Practical Biochemistry, Tata McGraw Hill,</li> <li>3. J. Jayaraman (2008) Laboratory manual in Biochemistry, New Age Int. Publishers,</li> <li>4. S. Sadashivam and A. Manikam (2008) Methods in Agricultural Biochemistry, New Age Int. Publishers,</li> </ol>	

### **BC 205: Clinical and Diagnostic Immunology**

1	Estimation of serum cholesterol.
2	Estimation of SGOT and its pathological significance
3	Estimation of SGPT and its pathological significance
4	Estimation of serum proteins
5	Determination of serum alkaline phosphatase.
6	Estimation of glucose in blood by enzymatic method
7	Estimation of serum bilirubin.
8	Detection of fibrin antigens (WIDAL).
9	Malarial antigen detection test.
10	Quantitative estimation of antigen by antibody capture method (Sandwich ELISA).
11	Rocket Immuno-Electrophoresis
12	Purification of antigen by Column chromatography (Demonstration).
<b>Suggested readings:</b>	
<ol style="list-style-type: none"> <li>1. G. P. Talwar and S. K. Gupta (2009) A handbook of practical and clinical Immunology, CBS Publishers and Distributors, New Delhi</li> <li>2. K. Wilson and J. Walker (2003) Practical Biochemistry: Principles and Techniques, Cambridge Publishing Co.,</li> <li>3. D. Plummer (2005) An Introduction to Practical Biochemistry, Tata McGraw Hill,</li> <li>4. J. Jayaraman(2008) Laboratory manual in Biochemistry, New Age Int. Publishers,</li> <li>5. S. Sadashivam and A. Manikam (2008) Methods in Agricultural Biochemistry, New Age Int. Publishers,</li> </ol>	