B.Sc Biochemistry **Course Syllabus** **Session 2015-18**

Course details : Semester I

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credit
1	BBIO 101	Basic Biochemistry	70	30	100	3
2	BBIO 102	Physical aspects of Biochemistry	70	30	100	3
3	BBIO 103	Biochemical techniques	70	30	100	3
4	BBIO104	Basic Microbiology	70	30	100	3
5	BENG 105	Communicative English I	35	15	50	1.5
6	BENV 106	Environmental Sciences	35	15	50	1.5
7	BMICP 107	Microbiology	35	15	50	1.5
8	BBIOP 108	Biochemistry	35	15	50	1.5
		Total	420	180	600	18

BBIOC 101 BASIC BIOCHEMISTRY

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
1	**Bioenergetic**	6 hours	Lectures Demonstration	Written
	1.1 First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them	2 hours	Lectures Demonstration	Written
	1.2 Standard free energy change and equilibrium constant	1 hour	Lectures Demonstration	Written
	1.3 Coupled reactions and additive nature of standard free energy change 1.4 Energy rich compounds: Phosphoenolpyruvate, 1,3-Bisphosphoglycerate, Thioesters, ATP	3 hours	Lectures Demonstration	Written

References *(Chapter14, Lehninger Principles of Biochemistry by Nelson DL and Cox MM , 5th Ed., W.H. Freeman and Company, 2008, Pages: 490-509)*

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
2	**Carbohydrates**	10 hours	Lectures Demonstration	Written
	2.1 Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses.	2 hours	Lectures Demonstration	Written
	2.2 Stereo isomerism of monosaccharides, epimers	1 hour	Lectures Demonstration	Written
	2.3 Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose. Haworth projection formulae for glucose; chair and boat forms of glucose	2 hours	Lectures Demonstration	Written
	2.4 Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid	2 hours	Lectures Demonstration	Written
	2.5 Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose	2 hours	Lectures Demonstration	Written
	2.6 Polysaccharides, storage polysaccharides, starch and	2 hours	Lectures Demonstration	Written

	glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin			

References *(Chapter 9, Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5th Ed., W.H. Freeman and Company, 2008, Pages: 293-321)*

S.no	**Topic/Sub-Topic**	**No. of hours**	**Mode/s of Teaching**	**Mode of Evaluation**
3	**Lipids**	10 hours	Lectures Demonstration	Written
	3.1 Definition and major classes of storage and structural lipids.	2 hours	Lectures Demonstration	Written
	3.2 Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification	2 hours	Lectures Demonstration	Written
	3.3 Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine. Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebrosides and gangliosides	3 hours	Lectures Demonstration	Written
	3.4 Lipid functions: cell signals, cofactors, prostaglandins	1 hours	Lectures Demonstration	Written

	3.5 Introduction of lipid micelles, monolayers, bilayers	2 hours	Lectures Demonstration	Written

***Reference**: (Chapters 11&12, Lehninger Principles of Biochemistry by Nelson DL and Cox MM, 5th Ed., W.H. Freeman and Company, 2008, Pages: 363-379 &389-393).*

S.no	**Topic/Sub-Topic**	**No. of hours**	**Mode/s of Teaching**	**Mode of Evaluation**
4	**Proteins**	10 hours	Lectures Demonstration	Written
	4.1 Functions of proteins	1 hour	Lectures Demonstration	Written
	4.2 Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its significance	2 hours	Lectures Demonstration	Written
	4.3 Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction.Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline	2 hours	Lectures Demonstration	Written
	4.4 Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid	1 hour	Lectures Demonstration	Written
	4.5 Oligopeptides: Structure and	1 hour	Lectures Demonstration	Written

	functions of naturally occurring glutathione and insulin and synthetic aspartame			
	4.6 Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins	1 hour		
	4.7Tertiary and quaternary structures of proteins. Forces holding the polypeptide together. Human haemoglobin structure	1 hour		
	4.8 Quaternary structures of proteins	1 hour		

Reference: Chapter 4, Biochemistry by Voet,D. and Voet J.G., 3rd Ed., John Wiley and Sons, 2004: Pages: 65- 78); Chapter 8, Biochemistry by Voet,D. and Voet J.G., 3rd Ed., John Wiley and Sons, 2004, Pages: 219-240; 265-266)

S.no	**Topic/Sub-Topic**	**No. of hours**	**Mode/s of Teaching**	**Mode of Evaluation**
5	**Enzymes**	10 hours	Lectures Demonstration	Written
	5.1 Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors	2 hours	Lectures Demonstration	Written
	5.2 Classification of enzymes	1	Lectures Demonstration	Written

	5.3 Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number	2	Lectures Demonstration	Written
	5.4 Multienzyme complex : pyruvate dehydrogenase; isozyme: lactate dehydrogenase	2	Lectures Demonstration	Written
	5.5 Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive- sulfa drugs; non-competitive-heavy metal salts	2	Lectures Demonstration	Written

Reference : (Chapter 8, Prescott, Harley and Klein's Microbiology by Willey MJ, Sherwood, LM & Woolverton C J. 7th Ed., McGrawHill, 2008, Pages: 117-182;Chapter 13, Biochemistry by Voet,D. and Voet J.G., 3rdEd., John Wiley and Sons, 2004: Pages:459-471).

SUGGESTED READING

1.Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2.Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3.Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4.Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

ONLINE READING MATERIAL

1. Chapter on Structures and Functions of Biomolecules URL--http://nsdl.niscair.res.in/handle/123456789/59

2. Chapter on Enzymes in Microbial Physiology and Biochemistry URL- http://nsdl.niscair.res.in/handle/123456789/392

BBIOC102 PHYSICAL ASPECTS OF BIOCHEMISTRY

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
1	1.1Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations.	2 hours	Lectures Demonstration	Written
	1.2 Dissociation of weak acids and electrolytes, Bronsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases	2 hours	Lectures Demonstration	Written
	1.3 Meaning of Ka and pKa values, Buffers: buffer action, buffers in biological system, Henderson -Hasselbach equation with derivation, simple numerical problems involving application of this equation.	2	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
2	**Solutions**		Lectures Demonstration	Written
	2.1 Definition of true solution, colloidal solution, and coarse suspension, distinction between	2 hours	Lectures Demonstration	Written

	lyophilic and lyophobic sols			
	2.2 Fundamental study of Donnan equilibrium- application in biological system, Methods of preparation of colloidal solution, membrane permeability, separation of colloidal solutions, elementary study of charge on colloids, Tyndall effect, application of colloidal chemistry, emulsion and emulsifying agents. .	1	Lectures Demonstration	Written

S.no	**Topic/Sub-Topic**	**No. of hours**	**Mode/s of Teaching**	**Mode of Evaluation**
3			Lectures Demonstration	Written
	3.1 Definition of normality, molarity, molality, percentage solution, mole fractions, simple numerical problems	2 hours	Lectures Demonstration	Written
	3.2 Fundamental principles of diffusion and osmosis, definition of osmotic pressure, isotonic, hypotonic and hypertonic solutions, Biological importance of osmosis, Relationship of osmotic pressure to gas laws, General equation for dilute solutions, influence of ionization and molecular size on osmotic pressure. .	3	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
4		2 hours	Lectures Demonstration	Written
	4.1 Classification of isomerism, oxidation reduction reactions, substitution, addition, elimination, condensation and decarboxylation with examples for each,	2 hours	Lectures Demonstration	Written
	4.2 Intra and Intermolecular interactions in biological system: Hydrogen bond, Covalent bond, hydrophobic interaction, disulphide bond, Peptide bonds, glycosidic bond, Phosphodiester linkage, Watson- Crick base pairings, Vander Wall's force. .	1	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
5	**Chemical kinetics**	2 hours	Lectures Demonstration	Written
	5.1 Introduction to chemical kinetics, equilibrium reactions, law of mass action, equilibrium constant, definition of catalysis	2 hours	Lectures Demonstration	Written
	5.2 Basic principles of thermodynamics: free energy, enthalpy, entropy, reversible and irreversible reactions- as applied to biological systems.	1 hours	Lectures Demonstration	Written

Reference books

Biochemistry: A Students survival Guide by Hiram. F. Gilbert (2002 Introduction to Biophysics by Pranab Kumar Banerjee (2008)

BBIOC 103 BIOCHEMICAL TECHNIQUES

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
1	**Separation techniques**	2	Lectures Demonstration	Written
	1.1 Different methods of protein precipitation: Precipitation using inorganic salts (salting out) and organic solvents, isoelectric precipitation, Dialysis, Ultrafilteration, Lyophilization	2 hours	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
2	**Chromatography**	5 hours	Lectures Demonstration	Written
	1.1 Basic principles of chromatography: Partition coefficient, concept of theoretical plates, various modes of chromatography (paper, thin layer, column), preparative and analytical applications, LPLC and HPLC	2 hours	Lectures Demonstration	Written
	1.2 Different types of chromatography: Paper Chromatography, Thin Layer Chromatography. Molecular Sieve Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Liquid	3 hours	Lectures Demonstration	Written

	Chromatography			

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
3	**Electrophoresis**	6 hours	Lectures Demonstration	Written
	3.1 Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels, agarose gel electrophoresis	3 hours	Lectures Demonstration	Written
	3.2 buffer systems in electrophoresis, electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification (staining procedures), molecular weight determination, Isoelectric Focusing of proteins.	3hours	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
4	**Centrifugation.**	2 hours	Lectures Demonstration	Written
	4.1 Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various types of centrifuges, different types of rotors, differential	2 hours	Lectures Demonstration	Written

	centrifugation, density gradient centrifugation (Rate zonal and Isopycnic)			

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
5	**Spectrophotometry**	2hours	Lectures Demonstration	Written
	5.1 Principle of UV-Visible absorption spectrophotometry, instrumentation and applications	2 hours	Lectures Demonstration	Written

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Mode of Evaluation
6	**Flourimetry.**	2 hours	Lectures Demonstration	Written
	6.1 Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and applications	2 hours	Lectures Demonstration	Written

Suggested Textbooks

1.Freifelder, D. (1982) Physical Biochemistry 2nd edition, W.H. Freeman and Co., N.Y. USA.

2.Cooper, T.G. (1977) The Tools of Biochemistry John Wiley and Sons, N.Y. USA.

BBIOC104 BASIC MICROBIOLOGY

S.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Evaluation
1	**History of Development of Microbiology**	10	Lectures/demonstration	Written
	1.1 Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von	2	Lectures Demonstration	Written

	Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming			
	1.2 Role of microorganisms in fermentation	1	Lectures Demonstration	Written
	1.3 Germ theory of disease	1	Lectures Demonstration	Written
	1.4 Development of various microbiological techniques and golden era of microbiology	2	Lectures Demonstration	Written
	1.5 Development of the field of soil microbiology : Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman	2	Lectures Demonstration	Written
	1.6 Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner	2	Lectures Demonstration	Written

References: (Chapters 1,2, General Microbiology by Stanier RY, Ingraham JL, Wheelis ML and Painter PR, 5th Ed., McMillan, 2005, Pages: 1-20)
(Chapter 1, Microbiology by PelczarMJ, Chan ECS and Krieg NR, 5th Ed., Tata McGraw-Hill Publishing Company Limited, 2003 (Reprint), Pages: 3-36

.no	Topic/Sub-Topic	No. of hours	Mode/s of Teaching	Evaluation
3	**Diversity of Microorganisms**	6	Lectures/Demonstration	Written
	2.1 Systems of classification : Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility	2	Lectures Demonstration	Written
	2.2 General characteristics of	2	Lectures Demonstration	Written

	different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya : Algae, Fungi and Protozoa) giving definitions and citing examples			
	2.3 Protozoa : Methods of nutrition, locomotion & reproduction - Amoeba, Paramecium and Plasmodium	2	Lectures Demonstration	Written

References: (Chapter 19, Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM and Woolverton

CJ, 7th Ed., McGraw Hill Higher Education, 2008, Pages: 474, 481, 491)(Chapters 1,19, Microbiology by Pelczar MJ, Chan ECS and Krieg NR, 5th Ed., Tata McGraw-Hill Publishing Company Limited, 2003 (Reprint), Pages: 3-15, 389-405)

SUGGESTED READING

1.Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education

2.Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2009). Brock Biology of Microorganisms. 12th edition. Pearson International Edition

3.Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

ONLINE READING MATERIAL

1.Introduction to Microbiology : www.mona.uwi.edu/ biochem/…/bc10m_introduction_microb.ppt

2.Industrial Microbiology : www.sku.ac.ir/academic/members/.../Industrial %20Microbiology.pdf

ITM-U/BENG 105 Communicative English

Parts of speech: Noun, Pronoun, verb, adverb, adjective, preposition, conjunction, interjection. Exercises for all parts of speech

Past tense, present tense

Positive, Comparative and superlative form of adjectives.

Make sentences

Vocabulary building: synonyms, antonyms

Use of older, elder, near, next, farther, further

Letter writing:

Apology letter

Request for leave

Acknowledgement letter

Request for permission

Request for information

Friendly letters

ITM-U/BENV 106 ENVIRONMENTAL SCIENCES

Definition, Scope and Importance

Natural Resources: Renewable and Nonrenewable Resources

Unit I – Forest, Water and Mineral resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people and relevant forest Act. Use and over-utilization of surface and ground water, floods drought, conflicts over water, dams benefits and problems and relevant Act. Use and exploitation, environmental effects of extracting and using mineral resources.

Unit II- food, Energy and Land resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging , salinity. Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land as a resource, land degradation, man induced landslides soil erosion and desertification.

UNIT III- ECOSYSTEM

Concept, Structure and Function of and ecosystem

Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession

Food chains, food webs and ecological pyramids. Introduction, Types, Characteristics Features, Structure and Function of Forest, Grass, Desert and Aquatic Ecosystem.

Unit IV- Biodiversity and its Conservation

Introduction - Definition: genetic. species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: Consumptive use. productive use, social ethics, aesthetic and option values, Biodiversity at global, National and local levels, India as mega-diversity nation, Hot spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life, conflict,dangered and endemic species of India, Conservation of biodiversity: In situ and Ex-situ conservation of biodiversity.

UNIT V- Causes, effect and control measures of

Air water, soil, marine, noise, nuclear pollution and Human population, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Disaster Management: floods, earthquake, cyclone and landslides.

PRACTICALS

BBIOCP 107 : BIOCHEMISTRY & MOLECULAR BIOLOGY

S.No	Name of Practical	Hours	Method
1	**Basic Lab requirements** Volumetric flask, falcons, mortar and pestle, watch glass, wash bottle, beaker, measuring cylinder, dropper, burette, spatula, reagent bottle, test tube stand, pipette stand, tripod stand, Bunsen burner, wire gauze, crucible, funnel, centrifuge tubes	5 hours	Practical
2	**Instruments** Separatory funnel, centrifuge, pH meter, Electric balance, hot plate	4 hours	Practical
3	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water	3 hours	Practical
4	Preparation of Normal solution- NaOH	3 hours	Practical
5	Preparation of percentage/ vov-vol solutions- Sulphuric acid	3 hours	Practical
6	Paper Chromatography- Isolation of the pigments from leaves of Raddish		

BMICROP 108 : MICROBIOLOGY

S.No	Name of Practical	Hours	Method
1	**Basic Lab glassware:** Test tubes, screw capped tubes, pipette, Pasteur pipettes, Erlenmeyer flask, Eppendorf tubes, pipette tips, cover slip and slides, Volumetric flask, falcons, mortar and pestle, watch glass, wash bottle, beaker, measuring cylinder, dropper, burette, spatula, reagent bottle, test tube stand, pipette stand, tripod stand, Bunsen burner, wire gauze, crucible, funnel, centrifuge tubes	10 hours	Practical
2	**Basic Lab instrumentation:** Autoclave, incubator, Hot air oven, pH meter, Centrifuge, Laminar air flow.Separatory funnel, centrifuge, pH meter, Electric balance, hot plate	5 hours	Practical
3	Serial dilution with methyl orange indicator	3 hours	Practical
4	Priciples & Working of the pH meter	3 hours	Practical
5	Determination of pH of water samples from different sources.	3 hours	Practical
6	Determination of pH of various solutions using a pH meter – NaOH, sulphuric acid, distilled water	3 hours	Practical

Course details : Semester 2

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credit
1	BBIOC 201	Enzymology	70	30	100	3
2	BBIOC 202	Metabolism I	70	30	100	3
3	BBIOC 203	Plant biochemistry	70	30	100	3
4	BBIOC 204	Cell Biology	70	30	100	3
5	BENG 205	Communicative English II	35	15	50	1.5

6	BCBM 206	Basic of Computer/Math for Biologists	35	15	50	1.5
7	BBLTP 207	Practical - Basic Lab Technology	35	15	50	1.5
8	BBIOCP 208	Practical -Biochemistry	35	15	50	1.5
			420	180	600	18

ITM-BBIOC- 201- ENZYMOLOGY

Learning Objective: This module is a general introduction to the basic concepts of Enzymes and their functions. The module also gives insight to importance of Enzymes.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**History & Terminology** 1.1) Classification & nomenclature of enzymes, Specificity of enzyme action (Lock & key model & Induced fit model). 1.2) Enzyme catalysis: Proximity & Orientation effect, covalent catalysis, acid-base catalysis, metal ion catalysis. 1.3) Regulatory enzymes: - Allosteric (ATCase) & covalently modulated (Glycogen phosphorylase) enzymes.	8 hours	Lecture/ power point	Written
2	2.1) Mechanism of action of Chymotrypsin and Ribonuclease. 2.2Role of vitamins as coenzyme precursors (Riboflavin, Niacin, Pyridoxine, Biotin and Thiamine)	10 hours	Lecture/ power point	Written

	2.3) Effect of enzyme concentration, upward & downward curvatures with examples. 2.4) Effect of temperature on enzyme activity & temperature quotient.			
3	**Enzyme kinetics:** 3.1) Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single & double reciprocal plots, Graphical representation of various **i**nhibitors (Competitive, Noncompetitive & Uncompetitive) on Lineweaver-Burke plots. Importance of Kcat / Km . Bisubstrate reactions – brief introduction to sequential and ping-pong mechanisms with examples.	8 hours	Lecture/ power point	Written
4	4.1) **Effect of pH**, General pH profile diagram with exceptions. 4.2) Concept of enzyme assay & its importance, Enzyme activity units (Katal & Specific activity) 4.3) Enzyme isolation and purification:- Enzyme solubilization, Brief idea of various fractionation procedures, Criteria for enzyme purity and homogeneity,	8 hours	Lecture/ power point	Written
5	**Immobilization of Enzymes** iple and methods of enzyme	6 hours	Lecture/ power point	Written

	immobilization i-enzyme system strial processes, utilization and regeneration of co-factors			

REFERENCE BOOKS:

1) Biochemistry – Lehninger – CBS publishers.

2) Biochemistry – Stryer – W. H. Freeman & Co. – New York.

3) The nature of enzymology – Foster – Croom Helm, London.

4) Fundamentals of enzymology – Price & Stevens – Oxford Science Publ.

5) Principles of enzymology for food science – J. R. Whitkar – M. Dekker Publs.

6) Enzymes – Dixon & Webb – Academic press

ITM-BBIOC- 202- METABOLISM -1

Learning Objective : This module is a general introduction to the metabolism of biomolecules (Carbohydrates, Lipids and the basic energetics).

Teaching Methodology : Lectures and demonstration by audio visual aids,seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Bioenergetics:** 1.1) Concept of free energy, Entropy, Enthalpy & Redox Potential. Determination of DG0' for a reaction. 1.2) High energy phosphate compounds (Ex. ATP, Phosphoenol pyruvate, Creatine phosphate etc.) – phosphate potential, Free energy of	6 hours	Lecture/ power point	Written

	hydrolysis of ATP along with reasons for high DG0,. Other high energy compounds. 1.3) ATP-ADP Cycle, Energy charge (Phosphate potential) & its relation to metabolic regulation.			
2	**Lipid metabolism: -** 2.1) Hydrolysis of triacylglycerols, transport of fatty acids into mitochondria (Carnitine), Detailed account of b- oxidation of fatty acids (b-oxidation in mitochondria and peroxisomes), Oxidation of unsaturated fatty acids & odd carbon fatty acids. aOxidation- Brief idea. ATP yield from fatty acid oxidation. Regulation. 2.2) Detailed account of HMP Shunt & its significance in general, its connection to lipid metabolism.	8 hours	Lecture/ power point	Written
3	**Lipid metabolism: -** 3.1) Ketogenesis, Ketosis & ketoacidosis in physiology & pathology. 3.2)Biosynthesis of fatty acids, Fatty acid synthase complex, Regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids. 3.3) Biosynthesis of triglycerides & phospholipids (Phosphatidyl-ethanolamine, choline, inositol), sphingolipids.	8 hours	Lecture/ power point	Written
4	**Carbohydrate metabolism: -** 4.1) Detailed account of glycolysis	7 hours	Lecture/ power point	Written

	with energy considerations & regulation, Entry of fructose, mannose & galactose in glycolysis, Cori cycle, Futile or substrate cycles in carbohydrate metabolism. 4.2) Glycogenolysis & Glycogenesis – Detailed account & hormonal control. Glycogen storage diseases. 4.3) Formation of acetyl CoA & detailed account of TCA Cycle, Isotopic tests of TCA cycle (Concept of Prochirality), Regulation, Amphibolic and anaplerotic nature of TCA cycle.			
5	**Carbohydrate metabolism:-** 5.1) Glyoxylate cycle and its role in conversion of fats into carbohydrates. 5.2) Gluconeogenesis– Detailed account of bypass reactions, Regulation, Malate & glycerophosphate shuttle system. 5.3) Electron Transport chain-Structure of mitochondria, oxidative and substrate level phosphorylation, Electron carriers of ETC, Incomplete reduction of oxygen (Cell injury – superoxide radicle), ATP Synthase (F1 F0 ATPase), Chemiosmotic hypothesis, Sites of ATP synthesis, Specific inhibitors and uncouplers of oxidative phosphorylation.	8 hours	Lecture/ power point	Written

REFERNCE BOOKS:

1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell – Prentice Hall International Inc.

2) Biochemistry – Lehninger – CBS Publishers.

3) Biochemistry – Stryer – W. H. Freeman & Co. New York.

4) Biochemistry – Geoffrey L. Zubay – McGraw Hill.

5) Biochemistry – J. David Rawn – Neil Patterson publs. NC.

6) Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.

ITM-BBIOC- 203- Plant Biochemistry

Learning Objective: This module is a general introduction to Photosynthesis, Nitrogen metabolism,Plant diseases and plant hormones.

Teaching Methodology :
Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**PHOTOSYNTHESIS:** 1.1) Significance of photosynthesis, Ultrastructure of chloroplast, photosynthesis, Photosynthetic pigments. Light absorbtion phenomenon, Photosynthesis in C_3 and electron transport, Photophosphorelation: Photorespiration, CAM. Bacterial photosynthesis, photochemistry and electron transport and CO_2 fixation.	10	Lecture/ power point	Written
2	**NITROGEN METABOLOSIM:** 2.1) Metabolism of N- compound in plants, biological nitrogen cycle, nitrogenase structure and function, nitrate reduction,nitrification denitrification, symbiotic and non symbiotic nitrogen fixation, Nif-gene-organization, function and regulation, Assimilation of fixed nitrogen by plants.	6	Lecture/ power point	Written
3	**PLANT HORMONES:** 3.1) Definition of phyto hormones, Auxins, biochemistry and mode of	6	Lecture/ power point	Written

	action of auxin, Gibberellin, Cytokinins and other natural growth hormones in plants (ethylene, abscissic acid).			
4	**PLANT DISEASES AND DEFENCE MECHANISM:** 4.1) Biochemistry of bacterial and viral and fungal disease, Micro and Macro nutrient deficiency in plants (biochemical role of inorganic ions in plants)	8	Lecture/ power point	Written
5	**SECONDARY METABOLISM IN PLANTS:** 5.1) Phenolic metabolism shikimate and phenyl propanoid pathways, flavonoids, lignins, and anthocyanins. Isoprenoid metabolism, terpenoids and carotenoids, alkeloids, cyanogenic glycosides and non protein amino acids.	7	Lecture/ power point	Written

REFERENCE BOOKS

1. Plant Biochemistry: Hans-Walter Heldt and Heldt
2. Biochemistry and Molecular Biology of Plant, II Ed. Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones
3. Plant Biochemistry: P. M. Dey, J. B. Harbone
4. Advances In Plant Biochemistry: K.N. P. Singh

ITM-BBIOC- 204- Cell Biology

Learning Objective: This module is a general introduction to cell biology, its imporatnce in pathology body functioning.

Teaching Methodology :
Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Structure of Cell** 1.1 Plasma membrane: Structure and transport of small molecules 1.2 Cell Wall: Eukaryotic cell wall, Fluid mosaic model and details,Extra cellular matrix and cell matrix interactions Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) 1.3 Ribosomes, chloroplasts and peroxisomes 1.4 Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules	10	Lecture/ power point	Written
2	**Nucleus** 2.1Nuclear envelope, nuclear pore complex and nuclear lamina 2.2Chromatin –Molecular organization 2.3Nucleolus	6	Lecture/ power point	Written
3	**Protein sorting & transport** 3.1EndoplasmicReticulumStructure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids 3.2 Golgi Organization, protein glycosylation,and Apparatus protein sortingand export for Golgi apparatus 3.3 Lysosomes	6	Lecture/ power point	Written
4	**Cell Signalling** 4.1Signalling molecules and their receptors 4.2Function of cell surface receptors 4.3Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway	5	Lecture/ power point	Written
5	**Cell Cycle, Cell Death and Cell Renewal** 5.1Eukaryotic cell cycle and its	8	Lecture/ power point	Written

	regulation 5.2Development of cancer, causes and types 5.3 Programmed cell death 5.4Stem cells 5.5 Embryonic stem cells induced pluripotent stem cells			

References:

1. *(Chapters 11, 12, 13 &14, The Cell : A Molecular Approach by Geoffrey. M. Cooper and Robert. E. Hausman, 5th Ed., Sinauer Associates, 2009, Pages: 433-444, 452-459, 464-468,473,479-487, 496- 511, 529-557, 571-596)*
2. *(Chapter 9, The Cell : A Molecular Approach by Geoffrey. M. Cooper and Robert. E. Hausman. 5th Ed., Sinauer Associates, 2009, Pages: 355-361, 370-378)*
3. *(Chapter 10, The Cell: A Molecular Approach by Geoffrey. M. Cooper and Robert. E. Hausman. Fifth Edition Sinauer Associates, 2009, Pages : 383-407, 408-415, 423-428)*
4. *(Chapter 15, The Cell : A Molecular Approach by Geoffrey. M. Cooper and Robert. E. Hausman. Fifth Edition Sinauer Associates, 2009, Pages : 603-621, 622-624, 630-634)*
5. *(Chapters 16 17,& 18, The Cell : A Molecular Approach by Geoffrey. M. Cooper and Robert. E. Hausman. 5th Ed., Sinauer Associates, 2009, Pages: 653-672, 725-734, 693-705, 705-714,714-720)*

ITM-BENG- 205 – Communicative English II

Learning Objective: The module is designed to provide introduction to Communicative English. It also
gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

Learning outcomes: After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Vocabulary building: Synonyms & antonyms	5	Lecture/ power point	Written
2	Parts of specch: Noun, pronoun, verb, adverb, adjective, conjunction, interjection & prepositions and Excercises, Jumbled sentences, correct the spellings	10	Lecture/ power point	Written
3	Reading Comprehension	4	Lecture/ power point	Written
4	Sentences: Simple, compound, Complex	3	Lecture/ power point	Written
5	Essay writing	4	Lecture/ power point	Written

References:
1. Wren & Martin

ITM-BCBM- 206 – Basics of Computer & Math for Biologists

Learning Objective: The module is designed to provide introduction to Basic math and provides practical approach to hone your computer skills.

Learning outcomes: After successful completion of this module the students would be able to use basic computers to make their projects, presentations and perform statistical functions.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Basic integrals	5	Lecture/ power point	Written
2	Basic statistics: Mean, median, mode	5	Lecture/ power point	Written
3	Word, power point, excel	10	Lecture/Practical	Written
4	Internet and its advantages & disadvantages ** Scholarly article search engine, sites	5	Lecture/Practical	Written

Practicals

ITM-BBLTP- 207 – Basic Lab Technology

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Spots and techniques** d. Cotton plugs preparation di. Method of sterilization dii. Auclaving diii. Microscope div. Media dv. Plating methods	8	Practical	Written/Practical
2	Media preparation	2	Practical	Written/Practical
3	Plating techniques, slant preparation	2	Practical	Written/Practical
4	Stab culture	1	Practical	Written/Practical
5	Isolation of bacteria from air, soil, water	2	Practical	Written/Practical
6	Preparation of blood smear	1	Practical	Written/Practical
7	Identification of blood group (Kit)	2	Practical	Written/Practical
8	Amylase test	2	Practical	Written/Practical
9	Protein estimation by Folin Ciocalteau Reagent (Lowry method)	2	Practical	Written/Practical

10	Buffer Preparation (Sodium)	2	Practical	Written/Practical
	Total hours	24		

ITM-P/BBIOCP- 208 – Biochemistry

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Practical hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Spots (10)**	8	Practical	Written/Practical
2	Blood Urea Nitrogen (BUN)	2	Practical	Written/Practical
3	Glucose	6	Practical	Written/Practical
4	Vitamin C (Ascorbic Acid)	2	Practical	Written/Practical
5	Hemoglobin	2	Practical	Written/Practical
6	Lactate Dehydrogenase (LDH)/Serum Glutamate Pyruvate Transaminase (SGPT)	2	Practical	Written/Practical
7	mation of Lipid peroxidation	2	Practical	Written/Practical
	Total hours	24		

Course details -Semester 3

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credits
1	BBIOC 301	Biomolecules	70	30	100	3
2	BBIOC 302	Metabolism II	70	30	100	3
3	BBIOC 303	Diagnostic Biochemistry	70	30	100	3
4	BBIOC 304	Molecular Biology	70	30	100	3
5	BENG 305	Communicative English III	35	15	50	1.5
6	BARII 306	Analytical reasoning I	35	15	50	1.5
7	BBIOCP 307	Clinical Diagnostic Practical	35	15	50	1.5
8	BBIOCP 308	Molecular Biology Practical	35	15	50	1.5
			420	180	600	18

ITM-BBIOC-301- Biomolecules

Learning Objective: This module is a general introduction to the basic concepts of biomolecules and their functions. The module also gives insight to importance of biomolecules and vitamines.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Biomolecules:** General introduction of composition of living matter, Cell wall structure with reference to gram positive and gram negative bacteria, plant and animal.	4 hours	Lecture/ power point	Written
2	**Carbohydrate:** Monosaccharides and their inter relationship, structure of sugar,Stereoisomerism and optical isomerism of sugars. Ring structure and tautomeric forms, mutarotation. Important derivatives of Monosaccharides,	10 hours	Lecture/ power point	Written

	Disaccharides and Trisaccharides (Glucose, fructose, maltose, lactose, cellobiose, gentiobiose, Melibiose, Turanose, Sucrose, Trehalose, Mannotriose, Rabinose, Rhamnose, Raffinose, Gentionose, Melizitose.) Structure, occurance and biological importance ofstructural polysaccharides e.g. Cellulose, chitin, agar, algenic acids,pectins,glycoproteins, proteoglycans, sialic acids, blood group polysaccharides, bacterial cellwall polysaccharides.			
3	**Amino acids:**Classification and formulae, Proteinaceous and non-proteinaceous, Essential and Non-Essential amino acids. Physical, chemical and optical properties of amino acids. Introduction to biologically active peptides e.g. Glutathione, Oxytocin, Insulin.	10 hours	Lecture/ power point	Written
4	**Fatty acids and Lipids:** Building block of lipids - fatty acids, glycerol, sphingosine Definition and classification of lipids. Classification of fatty acids, physio-chemical properties of fatty acids, separation of fatty acids, distribution of fatty acids in nature and characterization of fatty acids, saponification and iodine number. Properties of glycerol, fats and oils. Plasmalogens, sphingolipids - sphingosine, ceramide, sphingomyelin, glycolipids cerebrosides, gangliosides and sialic acids. Properties and function of phospholipids and Prostaglandins. Isoprenoids- types and structures, structure of sterols, Bile acids, steroid hormones,	10 hours	Lecture/ power point	Written

	plant sterol, ergosterol, stigma sterol, cholesterol, glucocorticoid. Lipoproteins and its functions.			
5	**Nucleic acids and its structural biochemistry:** Importance of nucleic acids in living system, general composition of nucleic acids, the purine and pyrimidine bases, structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and crick model for DNA. Different types of DNA and RNA.	8 hours	Lecture/ power point	Written
6	**Vitamins:** Structure of fat soluble vitamins A, D, E & K. Water soluble vitamins, their co- enzyme forms and deficiency disorders, Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.	6 hours	Lecture/ power point	Written

Suggested Textbooks

1. Nelson, D.L. and Cox, M.M.(2009). Lehninger`s Principles of Biochemistry, W.H. Freeman and Company, New York.

ITM-BBIOC-302-Metabolism II

Learning Objective: This module is a general introduction to the basic concepts of metabolism of the body and functions of biomolecules. The module also gives insight to importance of biomolecules and vitamines.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Nitrogen Balance:** Positive and negative nitrogen balance, protein quality: complete and incomplete proteins, criteria to assess protein quality, protein calorie malnutrition, Kwashiorkor and Marasmus.	4 hours	Lecture/ power point	Written
2	**Amino Acids metabolism:** Digestion, absorption and uptake of Amino Acids including γ-glutamyl cycle; Transamination, oxidative and nonoxidative deamination, glucose-alanine cycle, urea cycle and inherited defects of urea cycle, Glucogenic and ketogenic amino acids, catabolic pathways for the standard amino acids; Metabolism of one-carbon units, Biosynthesis of non-essential amino acids; biosynthesis of Essential amino acids (Only overview-in plants) and their regulation.	10 hours	Lecture/ power point	Written
3	**Disorders of amino acid metabolism:** Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Methylmalonic aciduria, Parkinson's disease, Homocystinuria, and Hartnup's disease	4 hours	Lecture/ power point	Written
4	**Precursor function of Amino acids:** Biosynthesis of Creatine, Creatine phosphate and creatinine; Creatine-Creatine phosphate energy shuttle; polyamines (putresine, spermine, spermidine,); catecholamines (dopamine,	6 hours	Lecture/ power point	Written

	epinephrine, nor-epinephrine); and neurotransmitters such as serotonin, GABA; porphyrin biosynthesis and disorders of porphyrin metabolism.			
5	**Biosynthesis of purine nucleotides:** Biosynthesis of IMP; pathways from IMP to AMP and GMP; conversion to triphosphates; regulation of purine nucleotide biosynthesis, salvage pathways; synthesis of coenzymes (NAD+, FMN, FAD, HSCoA)	8 hours	Lecture/ power point	Written
6	**Matabolic pathway of pyrimidine nucleotides:** Biosynthesis of UMP, conversion of triphosphate and regulation of Biosynthesis of pyrimidine nucleotide synthesis; Deoxy ribonucleotides and synthesis of dTTP; inhibitors of nucleotide metabolism and their use as anti bacterial / anticancer drugs. Degradation of purine and pyrimidine nucleotides.	6 hours	Lecture/ power point	Written
7	**Disorders of nucleotide metabolism**: Lesch Nyhan syndrome, Gout, SCID, Adenosine deaminase deficiency	2 hours	Lecture/ power point	Written

Suggested Textbooks

1. Nelson, D.L. and Cox, M.M. (2005); Lehninger Principles of Biochemistry, 4th edition, W.H.Freeman and company, N.Y. USA.
2. Garret, R.H. and Grisham, C.M. (2005) Biochemistry, 3rd Edition. Thomson Learning INC.
3. Voet, D and Voet, J.G, (2009) Biochemistry, John Wiley and Sons, N.Y. USA.

ITM-BBIOC-303- Diagnostic Biochemistry

Learning Objective: This module is a general introduction to the basic concepts of biomolecules and their functions. The module also gives insight to importance of biomolecules and vitamines.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Specimen collection and processing (Blood, urine, feaces), anti-coagulant and preservatives for blood and urine. Transport of specimens.	4 hours	Lecture/ power point	Written
2	Blood sugar level -factors controlling blood sugar level -hypo, hyper glycemia, Diabetes mellitus, types -GTT. Iron absorption and excretion- Anemia classification. Sickle cell anemia and Talassemia	10 hours	Lecture/ power point	Written
3	Metabolism of Bilirubin-Jaundice -types differential diagnosis and liver function tests	10 hours	Lecture/ power point	Written
4	Renal functional test -clearance test - Urea, Creatinine, Inulin, PAH test, concentration and dilution test.	10 hours	Lecture/ power point	Written
5	Gastric functional tests -collection of gastric contents, examination of gastric residues, FTM stimulation test, tubeless gastric analysis.	8 hours	Lecture/ power point	Written
6	Inborn errors of metabolism - Alkaptonuria, Phenyl ketonuria,	6 hours	Lecture/ power point	Written

	Cystinuria, Galactosemia, Fanconi's syndrome and Albinism. Cholesterol -importance, Lipoproteins - Factor affecting blood cholesterol - Atherosclerosis, Risk factor			

1.Clinical chemistry in Diagnosis & Treatment -P.D. Mayne, ELBS/ Arnold, N.Delhi.
2.Clinical chemistry W.J. Marshall and S.K. Bangert [1995]
3.Textbooks of medicine K.V. Krishnedas [1996], Jaypee Brothes
4. Principles of internal medicine [1998] Harrison, T.R. Fauci, Branuwalad and Isselbaeher, McGraw Hills.
5. Clinical Biochemistry with clinical correlation Devin, Wiley.
6.Practical clinical biochemistry Harold Varley, CBS, New Delhi.
7.Medical Laboratory technology kanai L. Mukherjee, Tata McGraw Hill Publication and Co. ltd., vol I, II, III.
8.Clinical chemistry in diagnosis and treatment, Joan F. ZilvaA, PR Pannall, Llyods Luke [medical Books ltd., Lon
9. Biochemistry U.Sathyanarayana & U. Chakrapani, Third edition, Book and Allied (p) ltd.
10.Text book of medical biochemistry Fourth editionMN. Chatterjee, Rana Shine, jaypee Publisher

ITM-BBIOC-304- Molecular Biology

Learning Objective: This module is a general introduction to the nucleic acid, genes and genomes. The module also gives insight to importance and role of chromosome and genetic material.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Nucleic Acids convey Genetic Information:** DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis, Genomics.	4 hours	Lecture/ power point	Written

2	**The Structures of DNA and RNA/Genetic Material:** DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology- linking number, topoisomerases; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. RNA Structure Organelle DNA -- mitochondria and chloroplast DNA.	10 hours	Lecture/ power point	Written
3	**Genome Structure, Chromatin and the Nucleosome:** Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin. Regulation of Chromatin Structure and Nucleosome Assembly. Organization of Chromosomes	10 hours	Lecture/ power point	Written
4	**The Replication of DNA (Prokaryotes and Eukaryotes):** Chemistry of DNA synthesis, general principles - bidirectional replication, Semiconservative, Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and	10 hours	Lecture/ power point	Written

	other accessory proteins.			
5	**The Mutability and Repair of DNA:** Replication Errors, DNA Damage and their repair.	8 hours	Lecture/ power point	Written

SUGGESTED BOOKS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6Th edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. 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.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.

ITM-BENG- 305 – Communicative English III

Learning Objective: The module is designed to provide introduction to Communicative English. It also
gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

Learning outcomes: After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1.	Sentence formation	5	Lecture/Power point	Written
2	Details of tenses	5	Lecture/Power point	Written
3.	Essay writing	5	Lecture/Power	Written

			point	
4.	Listening comprehensions.	5	Lecture/Power point	Written
5	Dictations, Reading Skills -Types Of Reading	5	Lecture/Power point	Written

ITM-BARI- 306 – Analytical Reasoning I

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Verbal Reasoning:** • Analogy	2	Lecture/ power point	Written
2	• Classification	3	Lecture/ power point	Written
3	• Word formation	2	Lecture/ power point	Written
4	• Statement and conclusions	5	Lecture/ power point	Written
5	• Syllogism • Statement and assumptions • Statement and arguments	6	Lecture/ power point	Written
6	• Coding Decoding • Blood Relations • Passage and conclusions	7	Lecture/ power point	Written

PRACTICALS

BBIOCP 307 : Clinical Diagnostic Practical
Standard of passing:

Total Marks (70+ 30)= 100marks

35 marks : ESE Passing Marks: 14

15 marks : CCE Passing Marks: 6

S.No	Name of Practical	Hours	Method
1	Refer to the theory syllabus	30 hours	Practical

BBIOCP 308 : Molecular biology Practical

Standard of passing:

Total Marks (70+ 30)= 100marks

35 marks : ESE Passing Marks: 14

15 marks : CCE

S.No	Name of Practical	Hours	Method
1	Demonstration of Northern Blotting.	5 hours	Practical
2	Demonstration of Western Blotting	4 hours	Practical
3	Perform DNA amplification by PCR.	3 hours	Practical
4	Refer to the theory syllabus	18 hours	Practica

Course details :Semester 4

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credits
1	BBIOC 401	Human Physiology	70	30	100	3
2	BBIOC 402	Biochemical correlation in disease	70	30	100	3
3	BBIOC 403	Proteins	70	30	100	3
4	BBIOC 404	Genetic engineering & Biotechnology	70	30	100	3
5	BENG 405	Communicative English IV	35	15	50	1.5
6	BARII 406	Analytical Reasoning II	35	15	50	1.5
7	BBIOCP 407	Protein Practical	35	15	50	1.5
8	BBIOCP 408	Biotechnology Practical	35	15	50	1.5
			420	180	600	18

ITM-BBIOC- 401- Human Physiology

Learning Objective: This module is a general introduction to the organization of body fluid, cardiovascular physiology and neurotransmission. The module aims to understand the mechanisms of living, from the molecular basis of cell function to the integrated behaviour of the whole body.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Homeostasis and the organization of body fluid compartments** 1.1) Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components. Plasma as an extracellular fluid, RBC, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis.	8 hours	Lecture/ power point	Written
2	**Cardiovascular physiology** 2.1 Pressure, flow and resistance. Anatomy of heart. Physiology of the cardiac muscle, automacity of the cardiac muscle contraction, excitation contraction coupling, relationship between cardiac cycle, heart sound, ventricular volumes and the ECG, control	10 hours	Lecture/ power point	Written

	of cardiac function and output. 2.2 The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues. Portal circulations. Arterial pressure and its regulation. Hypertension, congestive heart disease, atherosclerosis and myocardial infarction			
3	**Respiration** 3.1 Organization of the pulmonary system. Mechanism of respiration, pulmonary ventilation and related volumes, pulmonary circulation. 3.2 Principles of gas exchange and transport. Regulation of respiration. Pulmonary oedema and regulation of pleural fluid. Hypoxia, hypercapnea, pulmonary distress, emphesema, ARDS.	8 hours	Lecture/ power point	Written
4	**Neurochemistry and neurophysiology** 4.1 Central Nervous system. Peripheral Nervous system. Blood brain barrier and CSF. Membrane potentials. Synaptic transmission. 4.2 Neurotransmitters. Sensory receptors and neural pathways.Somatic sensation, EEG, sleep, coma, learning and memory.-	8 hours	Lecture/ power point	Written

	Enzyme solubilization, Brief idea of various fractionation procedures, Criteria for enzyme purity and homogeneity,			

Suggested reading :
Text book of Physiology -Tortora
Anatomy & physiology – Khurana

ITM-BBIOC- 402- Biochemical Correlations in Diseases

Learning Objective: This module is a general introduction to the basic concepts of Enzymes and their functions. The module also gives insight to importance of Enzymes.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Introduction to recombinant DNA technology** 1.1) Overview of recombinant DNA technology. Plasmids and bacteriophage DNA as cloning vectors, pBR322, pUC8. Purification of plasmid and bacteriophage DNA. Enzymes used in manipulating DNA, separation by electrophoresis.	8 hours	Lecture/ power point	Written
2	**Cloning vectors for prokaryotes and eukaryotes** 2.1 Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors	10 hours	Lecture/ power point	Written

	based on E. coli plasmids, pBR322, pUC8, pGEM3Z. 2.2 Cloning vectors based on M13 and λ bacteriophage.Vectors for yeast, higher plants and animals.			
3	**Construction, selection and identification of recombinants** 3.1 Ligation of DNA molecules. Transformation and electroporation, selection for transformed cells. Identification for recombinants, blue-white selection. Identification of recombinant phages. 3.2 Direct selection, marker rescue. Gene libraries. Identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.	8 hours	Lecture/ power point	Written
4	**Polymerase chain reaction and DNA sequencing** 4.1 Fundamentals of polymerase chain reaction, designing primers for PCR. Analysis of PCR products. DNA sequencing by Sanger's method and automated DNA sequencing.	8 hours	Lecture/ power point	Written

5	**Expression of cloned genes** 5.1 Vectors for expression of foreign genes in E. coli, cassettes and gene fusions. Challenges in producing ecombinant protein in E. coli. Production of recombinant protein by eukaryotic cells Fusion tags and their role in purification of recombinant proteins.	6 hours	Lecture/ power point	Written

ITM-BBIOC- 403- Proteins

Learning Objective: This module is elucidating the detailed molecular structure of proteins and their functions. The module also gives insight to importance of proteins.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Introduction to amino acids, peptides and proteins** 1.1) Amino acids and their properties - hydrophobic, polar and charged. Biologically important peptides - hormones, antibiotics and growth factors. 1.2 Multimeric proteins, conjugated proteins and metallo proteins. Diversity of function.	8 hours	Lecture/ power point	Written

2	**Extraction of proteins for downstream processing** 2.1 Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation.	10 hours	Lecture/ power point	Written
3	**Separation techniques & Characterization of proteins** 3.1 Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization. 3.2Determination of purity, molecular weight, extinction coefficient and sedimentation coefficient, IEF, SDS-PAGE and 2-D electrophoresis.	8 hours	Lecture/ power point	Written
4	**Three dimensional structures of proteins** 4.1 Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Dihedral angles psi and phi. Helices, sheets and turns. 4.2 Ramachandran map. Techniques used in studying 3-D structures -X-ray diffraction and NMR. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin.	8 hours	Lecture/ power point	Written

5	**Protein folding and conformational diseases** 5.1 Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding & molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases – Alzheimer's and Prion based.	6 hours	Lecture/ power point	Written

Suggested Textbooks

1. Nelson, D. L. and Cox, M.M.(2008). Lehninger , Principles of Biochemistry, 5th Edition, W.H.Freeman and Company, N.Y., USA.
2. Voet, D. and Voet, J.G.(2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA. 3. Price, N.C. and Stevens, L.(1996). Fundamentals of Enzymology, Oxford University Press Inc. N.Y.,

ITM-BBIOC- 404- Genetic engineering & Biotechnology

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Introduction to Genetic Engineering** 1.1Milestones in genetic engineering and biotechnology 1.2 Restriction modification systems: types i, ii and iii. Mode of action, nomenclature, applications of type ii restriction enzymes in genetic engineering. 1.3 Analysis of restricted DNA: agarose gel electrophoresis and southern blotting. 1.4 DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyltransferase, kinases and phosphatases, and ligases. 1.5 Cloning: use of linkers and adaptors. 1.6 Transformation of DNA: By chemical method.	10 hrs	Lecture/ power point	Written
2	**vectors** 2.1Cloning vectors:, definition and properties 2.2Plasmid vectors: pbr and puc series .2.3 Bacteriophage lambda and m13 based vectors. 2.4 Cosmids, bacs, yacs 2.5Expression vectors: e.coli lac and t7	10 hrs	Lecture/ power point	Written

	promoter-based vectors, yeast yip, yep and ycp vectors, baculovirus based vectors mammalian sv40-based expression vectors.,			
3	**DNA Amplification And DNA Sequencing** 3.1PCR: basics of pcr, rt-pcr, real-time pcr 3.2Sanger's method of DNA sequencing: traditional and automated sequencing 3.3Primer walking and shotgun sequencing. .	7 hrs	Lecture/ power point	Written
4	**Construction and screening of genomic and cDNA libraries** 4.1Genomic and cDNA libraries: preparation and uses. 4.2Screening of libraries: colony hybridization and colony PCR. 4.3 Chromosome walking and chromosome jumping.	7 hrs	Lecture/ power point	Written
5	**Applications of DNA Technology** 5.1 Gene delivery: microinjection, electroporation, biolistic method (gene gun),liposome and viral-mediated delivery, 5.2 Products of recombinant DNA technology: products of human therapeutic interest - insulin, hgh.	8 hrs	Lecture/ power point	Written

SUGGESTED READING

1.Brown ta. (2010). Gene cloning and dna analysis. 6th edition. Blackwell publishing, oxford, u.k.
2.Clark dp and pazdernik nj. (2009). Biotechnology: applying the genetic revolution. Elsevier academic press, usa
3.Primrose sb and twyman rm. (2006). Principles of gene manipulation and genomics, 7th edition. Blackwell publishing, oxford, u.k.
4. Sambrook j and russell d. (2001). Molecular cloning-a laboratory manual. 3rd edition. Cold spring harbor laboratory press
5.Wiley jm, sherwood lm and woolverton cj. (2008). Prescott, harley and klein's microbiology. Mcgraw hill higher education
6.Brown ta. (2007). Genomes-3. Garland science publishers
7.Primrose sb and twyman rm. (2008). Genomics: applications in human biology. Blackwell publishing, oxford, u.k.

ITM-BENG- 405 – Communicative English IV

Learning Objective: The module is designed to provide introduction to Communicative English. It also
gives scope to develop proficiency in the language and will help increase the usage of better vocabulary.

Learning outcomes: After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Conversational English	5	Lecture/ power point	Written
2	Rephrasing	5	Lecture/ power point	Written
3	Writing skill development	5	Lecture/ power point	Written
4	Paragraph, Letter Writing, Essay writing, Memo, Circular, Notice, Cover Letter, Resume, Thesis, Summary, Précis, Speaking	10	Lecture/ power point	Written

ITM-BARI- 406 – Analytical Reasoning II

Learning outcomes: After successful completion of this module the students would be able to understand and write the language with confidence which would help in their personality development.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (35+ 15)= 50marks

35 marks : Theory Paper Passing Marks: 14

15 marks : CCE Passing Marks: 6

Theory hours: 25 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Alphabet test • Series Test • Number , Ranking and time sequence	5	Lecture/ power point	Written
2	• Direction sense Test • Decision making test	5	Lecture/ power point	Written
3	• Figure series • Input/output, Assertion and reasoning • Sitting Arrangement	5	Lecture/ power point	Written
4	**Non-Verbal Reasoning:** • Series test • Odd figure Out	5	Lecture/ power point	Written
5	• Analogy • Miscellaneous Test etc.	5	Lecture/ power point	Written

BBIOCP 407 : Protein Practical

S.No	Name of Practical	Hours	Method
1	Refer to syllabus	30 hours	Practical

BBIOCP 408 : Biotechnology Practical

S.No	Name of Practical	Hours	Method
1	Refer to syllabus	30 hours	Practical

Course details -Semester 5

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credits
1	BBIOC 501	Basic concepts in Genetics	70	30	100	3
2	BBIOC 502	Hormones Biochemistry	70	30	100	3
3	BBIOC 503	Food Biochemistry	70	30	100	3
4	BBIOC 504	Immunology I	70	30	100	3
7	BBIOCP 505	Immunology Practical	35	15	50	1.5
8	BBIOCP 506	Food Biochemistry Practical	35	15	50	1.5
			350	150	500	15

ITM-BBIOC- 501- Basic Concepts in Genetics

Learning Objective: This module is a general introduction to the genetics and its practical value for human welfare . The module also gives insight to chromosome abnormalities.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Introduction to model organisms and Mendelism** 1.1) Model organisms: Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Caenorhabditis elegans, Danio rerio and Arabidopsis thaliana, Basic principles of heredity.	8 hours	Lecture/ power point	Written
2	**Applications of Mendel's principles & chromosomal basis of heredity** 2.1 Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.	10 hours	Lecture/ power point	Written
3	**Extensions of Mendelism** 3.1 Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy	8 hours	Lecture/ power point	Written

	gene interaction - epistatic and non epistatic, interaction between gene(s) and environment. Penetrance and expressivity, norm of reaction and phenocopy.			
4	**Genetic definition of a gene** 4.1 Complementation test, limitations of cis-trans test, intragenic complementation, rII locus of phage T 4 and concept of cistron	8 hours	Lecture/ power point	Written
5	**Genetics of bacteria and viruses** 5.1 Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.	6 hours	Lecture/ power point	Written

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India. 2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis. W. H. Freeman and Co.

ITM-BBIOC- 502- Hormone Biochemistry

Learning Objective: This module is a general introduction to the basic concepts of hormones and their functions. The module also gives insight to importance of hormones.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	**Introduction to endocrinology** 1.1) Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. 1.2 Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.	10 hours	Lecture/ power point	Written
2	**Hypothalamic and pituitary hormones** 2.1 Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus.	8 hours	Lecture/ power point	Written
3	**Thyroid hormone** 3.1 Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological andbiochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema,Hashimato's disease.	8 hours	Lecture/ power point	Written
4	**Hormones regulating Ca 2+ homeostasis**	8 hours	Lecture/ power	Written

	4.1 PTH, Vitamin D and calcitonin. Mechanism of Ca 2+ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.		point	
5	**Pancreatic and GI tract hormones** 5.1 Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin gghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II.	6 hours	Lecture/ power point	Written

Suggested Books

Nelson, D.L. and Cox, M.M.(2005). Lehninger Principles of Biochemistry, W.H. Freeman & Com

2. Widmaier, E.P.,Raff, H. and Strang, K.T.(2008).Vander,Sherman,Luciano's Human Physiology, McGraw- Hill Higher Education.
3. Darnell, J.,Lodish, H. and Baltimore, D.(2008). Molecular Cell Biology, Scientific American Books.

ITM-BBIOC- 503- Food Biochemistry

Learning Objective: This module is a general introduction to the basic concepts of food and nutrition. The module also gives insight to importance of dietary component to healths.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation

1	**Introduction to Nutrition and Energy Metabolism** 1.1) Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. 1.2 Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism,physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, 1.3 BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.	10 hours	Lecture/ power point	Written
2	**Dietary carbohydrates and health** 2.1 Review functions of carbohydrates. Digestion, absorption ,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.	8 hours	Lecture/ power point	Written
3	**Minerals** 3.1 Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization ,	8 hours	Lecture/ power point	Written

	Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, 37Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources			
4	**Fat and water soluble Vitamins** 4.1 Vitamin A, C, E,K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. 4.2 Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. 4.3Role in metabolism, Biochemical basis	8 hours	Lecture/ power point	Written

	for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.			

ITM-BBIOC- 504- Immunology I

Learning Objective: This module is a general introduction to the basic concepts of immunity of the body and how it works. The module also gives insight to importance of immunity.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Cells and organs of the immune system: cells of the immune system; hematopoiesis; HSC; hematopoietins and the role of stromal cells in blood cell formation; key characteristics, distribution and function(s) of lymphoid and myeloid cells; CD nomenclature; structure and function of primary and secondary lymphoid tissues and organs; lymphatic circulation.	8 hours	Lecture/ power point	Written
2	Innate immunity: Non- immunological barriers; cells and soluble mediators of innate immunity; pattern recognition receptors (PRR)-soluble and cell surface and	10 hours	Lecture/ power point	Written

	pathogen associated molecular patterns (PAMPS); induced innate response and acute phase proteins; acute inflammatory response; role of cell adhesion molecules, cytokines and chemokines in recruiting cells. Complement system, biological consequences of activation and complement regulatory proteins.			
3	Adaptive immunity: salient features; clonal selection theory; collaboration between adaptive and innate immunity.	6 hours	Lecture/ power point	Written
4	B-Cell Biology (i) Antibody structure: IgG, IgM, IgA, IgD & IgE; structure of the B-cell receptor (BCR) and isotype, allotype and idiotype; epitope- paratope interactions; distribution and effector functions of Ig and cells expressing Fc- receptors. (ii) B-cell development: Antigen-independent phase of B-cell development; characteristics of the major stages of maturation & important cell surface changes; B-1 and B-2 cells. (iii) Receptor diversity: Dreyer- Bennett model for the structure of Ig and its experimental demonstration; organization of Ig genes- kappa, lambda and heavy chain multi-gene families, immunoglobulin diversification mechanisms.	15 hours	Lecture/ power point	Written

	(iv) Humoral response: Initiation in peripheral lymphoid organs and tissues; signals required for the activation of naïve B-cells; T-dependent proliferation, maturation, somatic hyper-mutation, class switching & the formation of plasma and memory cells; haptens carriers and adjuvant.			
5	T-Cell Biology T-cell development; structure of T-cell receptor (TCR), MHC restriction; MHC locus; structure, function and distribution of MHC glycoproteins; non-classical MHC proteins; antigen presenting cells; T cell epitopes and cell mediated immune responses by different T cell sub populations.	8 hours	Lecture/ power point	Written
6	Mucosal immune system: organization and distinctive features; lymphocytes populations and their role; mucosal response to infection, regulation of the immune responses; oral tolerance.	6		

Suggested Textbooks:

1. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. (2007). Kuby Immunology, W.H. Freeman and Co, New York.
2. Murphy, K, Travers, P. and Walport, M. (2008). Janeway's Immunobiology, Garland Science, Taylor and Francis Group, LLC

BBIOCP 505 : Immunology Practical

S.No	Name of Practical	Hours	Method
1	Enzyme-linked Immunosorbent assay (ELISA)	5 hours	Practical
2	Cytotoxic Assay-LDH	4 hours	Practical
3	lymphocytes populations count	3 hours	Practical
4	Refer to the syllabus	-	Practical

BBIOCP 506 : Food Biochemistry Practical

S.No	Name of Practical	Hours	Method
1	Refer to the theory course for syllabus	5 hours	Practical

Course details -Semester 6

S.No	Paper Code	Paper Name	ESE	CCE	Total Marks	Credits
1	BBIOC 601	Scientific methodology, Biostatistics & Technical writing	70	30	100	3
2	BBIOC 602	Immunology II	70	30	100	3
3	BBIOC 603	Dissertation	100	-	100	3
			240	60	300	9

ITM-BMLT- 601- Scientific methodology, Biostatistics & Technical writing

Learning Objectives: The student will learn to collect, tabulate, & analyze data as a researcher.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 30 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of	Mode of

			teaching	Evaluation
1	**Research Methodology** 1.1 Introduction & types,y. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.	8 hours	Lecture/ power point	Written
2	**Literature survey** 2.1 Importance & Primary and secondary sources	4 hours	Lecture/ power point	Written
3	**Research Design** 3.1 Basic principles, Characteristics of a good design.	4 hours	Lecture/ power point	Written
4	**Formulation of hypothesis** Meaning , Techniques & precautions of interpretation	4 hours	Lecture/ power point	Written
5	**Research Report Writing** 5.1Structure and components of scientific reports, Types of report,Different steps in the preparation – Layout, structure and Language of typical reports –Illustrations and tables , Bibliography,referencing and footnotes.	10 hours	Lecture/ power point	Written

Suggested reading
Research Methodology 3rd edition-Kothari & Garg

ITM-BBIOC- 602- Immunology II

Learning Objective: This module is a general introduction to the basic concepts of Enzymes and their functions. The module also gives insight to importance of Enzymes.

Teaching Methodology : Lectures and demonstration by audio visual aids, seminars & group discussions.

Standard of passing:

Total Marks (70+ 30)= 100marks

70 marks : Theory Paper Passing Marks: 28

30 marks : CCE Passing Marks: 12

Theory hours: 35 (minimum)

S.No	Topic/ Sub Topic	Duration	Mode of teaching	Mode of Evaluation
1	Techniques based on antigen- antibody interactions inhibition; ELISA and variations of the basic technique; radioimmnoasay, western blotting, immunoprecipitation and immunofluorescence; Hybridoma technology.	6 hours	Lecture/ power point	Written
2	Hypersensitivity: Gell and Coombs classification; representative examples of type I, II, III and IV hypersensitive reactions against innocuous antigens, auto antigens (wherever applicable) and potentially harmful antigens.	10 hours	Lecture/ power point	Written
3	Autoimmunity: Organ specific and systemic autoimmune diseases; animal models for autoimmune disease; mechanisms for the induction of autoimmunity and treatment. Immunodeficiency: primary (humoral and cell mediated) and secondary immunodeficiency; treatment.	8 hours	Lecture/ power point	Written

5	Immune response against major classes of pathogens: bacteria (extracellular and intracellular); viruses (influenza); protozoan's (Plasmodium) and parasitic worms (helminthes); reemergence of some infectious diseases; evasion and subversion of immune defenses: antigenic variation; immunosuppression; inappropriate immune responses; blocking antigen processing and presentation etc.	6 hours	Lecture/ power point	Written
6	Transplantation immunology: typing of tissues; characteristics of graft rejection; major and minor histocompatability antigens; alloreactivity of T cells; immunosuppressive therapy; Graft Vs host disease (GVHD) and privileged sites.	6 hours	Lecture/ power point	Written
7	Tumor immunology: Introduction to malignant transformation of cells; tumor antigens; immune response against tumors; tumor evasion of immune system and cancer immunotherapy.	6 hours	Lecture/ power point	Written
8	Immunomodulation (i) Immunosuppressive drugs: corticosteroids, cytotoxic drugs; cyclosporine and rapamycin. Vaccines: types of vaccines-live attenuated, inactivated organisms, toxoids, subunit vaccines, DNA vaccines and recombinant vector vaccines; requirements vaccination , Cytokines	6 hours	Lecture/ power point	Written

Suggested Textbooks:

1. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. (2007). Kuby Immunology, W.H. Freeman and Co, New York.
2. Murphy, K, Travers, P. and Walport, M. (2008). Janeway's Immunobiology, Garland Science, Taylor and Francis Group, LLC

BBIOCP 603 : Dissertation

Total Marks = 100marks

Passing marks= 40

Assessment and Evaluation Pattern

Each semester will consist of both Continuous and Comprehensive Evaluation (CCE) throughout the semester and End Semester Examination (ESE) conducted in June/December for the subjects prescribed in the syllabus for each semester. The faculty will conduct the examination as per schedule prepared and communicated by the Department of Medical Laboratory Technology.

1.**CCE (Continuous and comprehensive evaluation)** : It is for 30 marks where a complete assessment will be done throughout the semester. The break up for the 30 marks is as follows:

b. Assignment : It will be class or home assignment given individually to the student after first month of the academic theory sessions.

c. Presentation : It will be an oral presentation to be given by the student individually on the topic given by the faculty. It is to improve the communication skills and aiming towards overall personality development. It increases self confidence and reduces stage fear. I also enhances the content development skills as students have to prepare and present on the given topic. D.
D. Attendance : Attendance of a student is allotted a total of 5 marks per subject. A minimum of 70 % attendance is compulsory for a student to be able to appear for the semester-end examination. An additional attendance of students will be credited with marks for the respective subject in the following manner-

70.01 % to 75.00 %	: 1 mark
75.01 % to 80.00 %	: 2 marks
80.01 % to 85.00 %	: 3 marks
85.01 % to 90.00 %	: 4 marks
Above 90.01 %	: 5 marks

The theory exams will be averaged for 20 marks, while the assignments and presentations for 5 marks and the attendence for another 5 marks, making up 30 marks of the internal/ CCE.

2. **ESE (End Semester Examination)** : It comprises of a 100 Marks Written Paper for each subject at the End of Each Semester (June/December).

3. **Practical Examination** : Each subject will assessed 35 marks for the practicals in two subjects. The practical examination will conducted before/after the ESE individually for the subjects.