

Gujarat University
Syllabus for Biochemistry at B. Sc. Semester V
 (To be effective from 2013)

BIC 301	Metabolism
BIC 302	Molecular Biology
BIC 303	Enzymology
BIC 304	Introduction to Microbiology & Nutrition
BIC 305	Subject Elective
BIC 306	Practicals

Course Structure with respect to credit, hours and marks

Type of Course	Paper No.	Credits	Total Marks	Internal Marks	External Marks	No. of hours per week	Exam hours
Foundation Course (FC-V)	FC - 301	2	100	30	70	3	3
Core Course	BIC 301	4	100	30	70	4	3
	BIC 302	4	100	30	70	4	3
	BIC 303	4	100	30	70	4	3
	BIC 304	4	100	30	70	4	3
Subject Elective Course (SEC)	BIC 305	2	100	30	70	3	3
Practicals Core Course	BIC 306	5	100	30	70	12	12
Total Credits		25					

N.B.: The practical batch should be minimum of 10 students with respect to the credits.

Third Year	Semester V		Semester VI	
	301: Metabolism		307: Nutrition and Diseases	
4 Credits	Unit 1:	Introduction & Metabolism of Carbohydrates	Unit 1:	Obesity and Diabetes Mellitus
	Unit 2:	Metabolism of Proteins	Unit 2:	Nutritional Anaemias, Rickets, Osteomalacia
	Unit 3:	Metabolism of Lipids	Unit 3:	PEM & Role of lipids in Coronary Heart Diseases (CHD)
	Unit 4:	Energy metabolism	Unit 4:	Scurvy, Xerophthalmia and Food Toxicity
	302: Molecular Biology		308: Advanced Microbiology	
4 Credits	Unit 1:	Introduction, History, DNA Replication	Unit 1:	Bacteriological Media and Sterilisation.
	Unit 2:	DNA Repair, Genetic code, Transcription, Mutations.	Unit 2:	Growth and culturing of Bacteria
	Unit 3:	Translation, Control of gene expression. Lac, Trp operons	Unit 3:	Chemotherapy and Microbial Diseases
	Unit 4:	Techniques in Molecular Biology & Genetic Engineering	Unit 4:	Fermentation technology & Industrial microbiology.
	303: Enzymology		309: Immunology and Bacterial Genetics	
4 Credits	Unit 1:	Introduction to Enzymes	Unit 1:	Introduction, Organs and cells of Immune system
	Unit 2:	Metalloenzymes, Isoenzymes & Membrane bound enzymes	Unit 2:	Host defence mechanism, Structure and types of Immunoglobulin and immune response
	Unit 3:	Enzyme Classification, Factors affecting enzyme catalysis	Unit 3:	Immunochemical techniques, Hybridoma techniques hypersensitivity, Active and Passive immunisation
	Unit 4:	Regulatory enzymes and	Unit 4:	Bacterial Genetics

		Two Substrate Enzyme Reaction Mechanism		
4 Credits	304: Introduction to Microbiology & Nutrition		310: Advanced Enzymology	
	Unit 1:	Morphology of Bacteria & their role in human welfare	Unit 1:	Enzyme kinetics
	Unit 2:	Major groups of microorganisms & Microbial Staining	Unit 2:	Quantitative methods for following enzyme reactions
	Unit 3:	Essential Macro Nutrients in Human diet	Unit 3:	Enzyme isolation & purification , Enzyme units
	Unit 4:	Energy Balance and Food Groups	Unit 4:	Applications of Enzymes and Immobilized enzymes
5 credits	306: Practicals		312: Practicals	
2 credits	305: Biochemistry Elective		311: Biochemistry Elective	

Semester V

301: Metabolism

(4 credits)

Unit 1: Introduction & Metabolism of Carbohydrates

Introduction to Metabolism, Terms, Overall View of Metabolism

Glycolysis, energetics, regulation of Glycolysis, Fates of pyruvate, Feeder pathways, (Introduction & Design only) Glycogen degradation, Glycogen synthesis, Regulation of glycogen metabolism, Gluconeogenesis, Reciprocal regulation of Glycolysis & Gluconeogenesis, Cori cycle, Pentose phosphate pathway. Inborn errors of carbohydrate metabolism: Lactose intolerance, Galactosemia, all Glycogen Storage diseases (only the name of the defective enzyme & disease caused due to it)

Unit 2: Metabolism of Proteins

Over view of the fate of carbon skeletons of amino acids, Gamma-Glutamyl cycle, Transamination, Oxidative Deamination, Non-oxidative, Glucose Alanine shuttle, Decarboxylation, Urea cycle, Regulation, Energetic, Significance, Uric acid formation, Creatine metabolism. Inborn errors of

Protein: PKU (in detail), Homocysteinuria, Albinism, Maple syrup urine diseases (only the name of the defective enzyme & disease caused due to it)

Unit 3: Metabolism of Lipids

Introduction, mobilization of fat, β -Oxidation of saturated, Unsaturated and odd chain fatty acids, Energetic and regulation, alpha and omega oxidation, Ketone bodies synthesis & Utilization, FA synthesis, Steps, Stoichiometry, Regulation, Desaturation and Elongation of FA, Comparison of synthesis and oxidation, TG & PL synthesis, Sphingomyelin synthesis, Ganglioside synthesis, Role of liver and adipose tissue in lipid metabolism. Integration of Metabolism (Role of Hormones (Glucagon, Epinephrine, Insulin) in Fuel Metabolism, Inborn errors of lipid metabolism (only the name of the defective enzyme & disease caused due to it)

Unit 4: Energy Metabolism

PDH Complex, TCA Cycle, Energetic, Regulation, Anaplerotic & Amphibolic Nature, Glyoxylate Cycle, Glycerol Phosphate And Malate- Aspartate Shuttle, ETC, Inhibitors Of ETC, Chemiosmotic Hypothesis for ATP Production, Oxidative Phosphorylation, Binding Change Hypothesis, P/O Ratio, Uncouplers & Inhibitors of Oxidative Phosphorylation, Energy Rich Compounds

References:

1. Berg JM, and Tymoczko TJ Stryer L.: Biochemistry (6th ed), (2008).WH Freeman Publishers
2. Bhagvan NV: Medical Biochemistry (4th ed) Bartlett Publishers.
3. Donald Voet and Voet J: Biochemistry (4th ed) 2011, Wiley Publications.
4. Grisham and Garrett: Biochemistry (3rd ed)
5. Jeoffrey Zubay: Principles of Biochemistry, McGraw Hill Publications, (1996).
6. Murray RK, Rodwell VW: Harpers review of Biochemistry (25th ed), (2000).
7. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008.

Semester V

302: Molecular Biology

(4 credits)

Unit 1: Introduction, History, DNA Replication

Griffith's experiment, Avery & Mcleod's experiment, Phage mode of Roger Herriot, Hershey and Chase's experiment, Chargaff's experiments and postulates, Watson and Crick's model of DNA. Structure of nucleic acids, various forms (A,B and Z), Secondary structure of RNA, Properties of DNA: Denaturation, Renaturation, Hypochromicity, Hyperchromicity, Melting

temperature and Factors affecting T_m , Super coiling and its biological significance.

Types of replication (conservative, semi conservative, dispersive), Messelsons and Stahl's experiments, Mechanism of replication, Initiation, Elongation and Termination, Role of various enzymes, Methods of replication (Rolling circle and D-loop replication)

Unit 2: Genetic code, DNA repair, Mutations, Transcription

Genetic code & its characteristics

Repair of DNA by Photo reactivation mechanism and Excision repair mechanism

Mutation, types of mutations, Mutagenic agents both Physical & Chemical agents. Physical agents: X-rays, UV radiation, Ionizing radiation; Chemical mutagenic agents: Nitrous acid, Base analogue, Acridine dye and other chemical agents

Transcription: promoters, properties and functions of RNA polymerase and its subunits, Steps in initiation (transcription bubble), elongation and, termination (rho dependent and independent), Post transcriptional processing

Unit 3: Translation, Control of gene expression, Lac & Trp Operons

Ribosomes as translational factory, Role of tRNA as an adaptor in protein synthesis (activation, initiation, elongation, translocation, termination), Post translational modifications

Regulation of protein biosynthesis, Lac and Trp operons

Unit 4: Techniques in Molecular Biology and Genetic engineering

Steps in gene cloning, Tools of genetic engineering: Restriction endonuclease, Vectors (plasmid and λ bacteriophage), Properties of host organisms

Splicing and insertion of DNA

Applications, Potential biohazards and ethics of genetic engineering

DNA Hybridization, Southern, Northern, and Western blotting, DNA sequencing, Isolation and estimation of DNA: Agarose gel electrophoresis, Spectrophotometry

References:

1. Berg JM, and Tymoczko TJ, Stryer L,: Biochemistry (6th ed)
2. Brown TA: gene cloning

3. De Robertis and de robertis: Cell and Molecular Biology
4. Donald Voet and Voet J: Biochemistry (4th ed) 2011
5. Grisham and Garrett: Biochemistry (3rd ed)
6. Lewin: Genes
7. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008

Semester V

303: Enzymology

(4 credits)

Unit 1: Introduction to Enzymes

Introduction & Definition of Enzymes, Coenzymes, Cofactors, Apoenzymes, Holoenzyme, Abzymes, Synzyme, Ribozyme, Extremozyme, Historical Development in Enzymology, Characteristics of enzymes, Enzyme Vs Chemical Catalysts, Enzyme mechanism & Activation Energy, Enzyme Specificity, Fischer and Koshland Models

Role of B complex Vitamins in Enzyme catalyzed reactions

Multienzyme Complex: Properties, Examples with Reactions (PDH Complex, Fatty Acyl Synthase Complex, Tryptophan Synthase), Physiological Importance, Advantages of MEC

Zymogens, Properties with examples and Activation of Chymotrypsinogen

Unit 2: Metalloenzymes, Isoenzymes & Membrane Bound Enzymes

Role of Metals in Enzyme Function, Enzyme Activation by Ions with examples

Isoenzymes, Definition and Identification, Separation of Isoenzymes, Metabolic Importance with an example of LDH

Membrane Bound Enzyme and its importance, examples Adenylate Cyclase, Glycerol Phosphate Dehydrogenase

Unit 3: Enzyme Classification and Factors Affecting Enzyme Catalysis

Need For Classification, Four Digit Classification, Examples from Each Class Including Trivial Name, Systematic Name and EC Number

Factors affecting enzyme reactions: Enzyme Concentration, Substrate Concentration, pH, Time, Temperature, Radiation, Oxidizing Agents, Inhibitors and Activators

Unit 4: Regulatory enzymes & two substrate enzyme reaction mechanism

Allosteric enzymes with their properties, Regulatory role of allosteric enzymes in metabolism, some examples of allosteric enzymes: Threonine Dehydratase, PFK-1, Fructose 1, 6 Bisphosphatase, Acetyl CoA Carboxylase, ATCase (Aspartate Transcarbamylase), Evidence for allosteric site on enzymes

Covalently modulated enzymes with example Glycogen Phosphorylase & Glycogen Synthase

Ordered, Random and Ping Pong Reactions with Examples

References:

1. Dixon, M, Webb EC: Enzymes (1979)
2. Price NL and Stevens: Fundamentals of Enzymology (1989)
3. Foster RL: The nature of Enzymes (1980)
4. Palmer T: Understanding enzymes (1981)
5. Conn and Stumpf: Outlines of Biochemistry
6. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008
7. Palmer T: Enzymes: Biochemistry, Biotechnology and clinical applications (1981)
8. Berg JM, and Tymoczko TJ Stryer L,: Biochemistry (6th ed), (2008).WH Freeman Publishers

Semester V

304: Introduction to Microbiology & Nutrition

(4 credits)

Unit 1: Morphology of Bacteria & their role in human welfare

Size, shape and arrangement of bacterial cell, Bacterial flagella and motility, capsules, cell wall of both gram +ve and gram -ve bacteria, protoplasts, spheroplasts, sporulation and spore germination, mesosomes, and inert cytoplasmic inclusions (Metachromatic granules)

Role of microorganisms in human welfare in brief: Recycling of elements, Sewage treatment, Dairy products, SCP, Insect pest control.

Unit 2: Major groups of Micro organisms & Microbial Staining

Brief introduction to Mycoplasmas, Archaeobacteria, Fungi, Viruses (Short notes with respect to characteristics only)

Dyes and stains, Importance, Definitions of terms: Stain, Chromogen, Acidic stain, Basic stain, Neutral and Amphoteric stain, Smear, Fixation, Mordant,

Intensifier, Compound stain, Leuco compounds, Dyes used as pH indicators.
Physical and Chemical theory of staining

Monochrome staining, Negative staining, Differential staining: Gram staining, Acid fast staining, Structural staining techniques: Capsule, Metachromatic, spore staining.(one staining method only for each)

Unit 3: Essential Macro Nutrients in Human diet

Carbohydrates: Dietary Fibers and their Therapeutic Roles, Dental caries, Carbohydrate Loading, Role of carbohydrates, RDA

Proteins: Role, RDA, Complete and Incomplete Proteins, Supplementary value, Reference Proteins, Nitrogen balance and factors affecting it. Methods used to evaluate Protein Quality (Just mention the methods)

Lipids: Role, MUFA, PUFA, Trans fats, Ketosis, Fat transport, Mobilisation and Storage

Unit 4: Energy Balance and Food groups

Energy balance: Unit of Energy, Energy value of foods, RQ, BMR and factors affecting it, SDA, Physical Activity. Methods to find out energy intake and expenditure (food composition tables and FAO method).Balanced Diets and RDA (Definitions only)

Nutritional Value of foods of Plant Origin: Cereals, Legumes, Fruits and Vegetables.

Nutritional Value of Foods of Animal origin: Milk, Eggs, Fish and Meat.

Vegetarian vs. Non-vegetarian foods

References:

1. Atlas R: Microbiology: Fundamentals and Applications (2nd ed) 1997.
2. Frobisher, Hinsdill, Crabtree, Goodheart: Fundamentals of Microbiology(8th ed)
3. Pelczar Reid: Microbiology (5th ed)
4. Prescott, Harley Kleins : General Microbiology.(7thed)
5. Stainer: General Microbiology
6. Microbiology an introduction (6thed) 1998.
7. Microbiology: Brock 11thed)2006
8. Introduction to Microbiology: Ingraham & Ingraham.
9. B. Srilakshmi: Dietetics, 4TH Edition, 2008, New Age International Publishers.

- 10.B. Srilakshmi: Nutrition Science, 4TH Edition, 2008, New Age International Publishers.
- 11.V. Hegarty: Decisions in Nutrition, 1988, Times Mirror/Mosby college publishers.
- 12.Christopher Haslett: Davidson's principles and Practice of medicine (18th edition) 1999. Churchill Livingston.
- 13.B. Srilakshmi: Food Science, 4TH Edition, 2008, New Age International Publishers.
- 14.Shubhangi Joshi: Nutrition and dietetics, 1992, Tata McGraw Hill Publishers.
- 15.Rajlakshmi: Applied Nutrition, 3rd edition, 1990, Oxford & IBH publishing company.
- 16.Davidson and Passmore: Human Nutrition and Dietetics, 8th Edition, 1986, ELBS.
- 17.Swaminathan: Essentials of Food & Nutrition Volume I &II, 1991, BAPPCO Publishers.
18. Gordon Wardlaw: Contemporary Nutrition, 4th Edition, 2000, McGraw Hill publishers.
- 19.Guthrie: Introductory Nutrition,4th Edition,1979,C.V. Mosby Company
20. Garrow: Human Nutrition & dietetics,10th Edition,2000,Churchill Livingstone Publishers.

305: Practicals

(5 credits)

Duration: 3hr

Marks: 100

(A) Clinical Biochemistry

1. Estimation of Urea from serum
2. Estimation of Phosphorus in serum
3. Estimation of serum Creatinine
4. Estimation of Uric acid

(B) Microbial Staining

5. Preparation of stains
6. Monochrome staining
7. Negative staining
8. Gram staining
9. Spore staining by Schaffer & Fulton's method
- 10.Capsule staining
- 11.Metachromatic granule staining
- 12.Permanent Slides (Fungal)

(C) Liver Function Tests

- 13.Estimation of SGPT from serum (Demonstration)
- 14.Estimation of SGOT from serum (Demonstration)
- 15.Estimation of serum Bilirubin.

16. Estimation of Alkaline phosphatase (Enzyme involved in hydrolysis of ester)
(Demonstration)

(D) Enzyme Kinetics

17. Extraction of beta glycerol phosphatase enzyme from potato and its activity measurement.
18. Effect of enzyme concentration on phosphatase enzyme from potato.
19. Effect of pH on phosphatase enzyme from potato.
20. Effect of substrate concentration of phosphatase enzyme from potato.

(E) Study tour

21. Tour to study advanced biochemical techniques

References:

1. Oser: Hawk's Physiological Chemistry (14th ed)
2. Plummer: An introduction to practical Biochemistry
3. Sheela Sharma: Experiments and Techniques, 2007.
4. Thomas and Schalkhammer: Analytical Biochemistry, 2002
5. Varlery H: Practical Clinical Biochemistry
6. Whatton and McCarty: Experimental methods in Biochemistry
7. Willard and Merrit: Instrumental methods of analysis
8. S. Shanmugam, TSathish Kumar, K Panneer Selvam: Laboratory Handbook on Biochemistry, 2010, PHI Learning Pvt. Ltd.
9. Practical Microbiology : R.C. Dubey & D.K. Maheshwari S.Chand. 2009.
10. Experimental Microbiology Vol-1&2, Rakesh J. Patel, Aditya Publications, 5th edition.