Gujarat University

Syllabus for Biochemistry at B. Sc. Semester VI

(To be effective from 2019)

BIC 307 Nutrition & Diseases

BIC 308 Advanced Microbiology

BIC 309 Immunology & Bacterial Genetics

BIC 310 Advanced Enzymology

BIC 311 Subject Elective (Applied Biotechnology)

BIC 312 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-VI)	FC - 302	2	100	30	70	3	3
Core Course	BIC 307	4	100	30	70	4	3
	BIC 308	4	100	30	70	4	3
	BIC 309	4	100	30	70	4	3
	BIC 310	4	100	30	70	4	3
Subject Elective Course (SEC)	BIC 311	2	100	30	70	3	3
Practical Core Course	BIC 312	5	100	30	70	12	12
Total Credits		25					

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

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	
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 Two Substrate Enzyme Reaction Mechanism	Unit 4:	Applied Immunology
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
	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 VI

307: Nutrition and Diseases (4 credits)

Unit 1: Obesity and Diabetes Mellitus

Introduction, Prevalence, Etiology, Assessment, Complications and Treatment of Obesity

Introduction, Prevalence, Types, Etiology, Clinical Features, Biochemical features, Complications and Diagnosis & Treatment (in brief) of Diabetes Mellitus.

Metabolic Syndrome: Introduction

Unit 2: Nutritional Anaemias, Rickets, Osteomalacia

Introduction, Prevalence, Types of Anaemias

Prevalence, Etiology, Clinical features of Iron deficiency Anaemia & Megaloblastic Anaemias (due to Vitamin B12 and Folic acid Deficiency)

Etiology, Clinical features, Biochemical features and Treatment of Rickets, Osteomalacia.

Unit 3: PEM and Role of Lipids in Coronary Heart Diseases (CHD)

Introduction, Etiology, Biochemical Features, Clinical Features, & Classification of PEM.

Role of Lipids in CHD.

Unit 4: Scurvy, Xerophthalmia, Food toxicity

Etiology, Clinical features and Biochemical features of Scurvy and Xerophthalmia

Natural Food toxins.

References:

1. B. Srilakshmi: Dietetics, 4TH Edition, 2008, New Age International Publishers.
2. B. Srilakshmi: Nutrition Science, 4TH Edition, 2008, New Age International Publishers.
3. V. Hegarty: Decisions in Nutrition, 1988, Times Mirror/Mosby college publishers.
4. Christopher Haslett: Davidson's principles and Practice of medicine (18th edition) 1999. Churchill Livingston.
5. B. Srilakshmi: Food Science, 4TH Edition, 2008, New Age International Publishers.

6. Shubhangi Joshi: Nutrition and dietetics, 1992, Tata McGraw Hill Publishers.
7. Rajlakshmi: Applied Nutrition, 3rd edition, 1990, Oxford & IBH publishing company.
8. Davidson and Passmore: Human Nutrition and Dietetics, 8th Edition, 1986, ELBS.
9. Swaminathan: Essentials of Food & Nutrition Volume I &II, 1991, BAPPCO Publishers.
10. Gordon Wardlaw: Contemporary Nutrition, 4th Edition, 2000, McGraw Hill publishers.
11. Guthrie: Introductory Nutrition,4th Edition,1979,C.V. Mosby Company
12. Garrow: Human Nutrition & dietetics, 10th Edition, 2000, Churchill Livingstone Publishers.
13. Murray RK, Rodwell VW: Harpers review of Biochemistry (25th ed), (2000).
14. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008.

Semester VI

308: Advanced Microbiology (4 credits)

Unit 1: Bacteriological media & Sterilization

Nutritional requirements & broad categories in bacteria with one example each.
Preparation of media, Types of media, (Natural, Empirical, Synthetic, Defined, Special media.)
Definition of terms: sterilization, disinfection, microbiostasis, asepsis, antiseptic, sanitization, pasteurization & tyndallisation etc.
Factors that affect sterilization and disinfection, sterilization and disinfection by moist, dry heat, (autoclave, hot air oven) radiations, (U.V rays, gamma rays) filtration (Nucleopore & Millipore)
Phenol co-efficient, Mode of action, uses, limitation of: Chlorine, Phenol, Heavy metals (Hg) as disinfectants.
Mode of action, uses, limitations of Microbial gases: (Beta propiolactone &Ethylene oxide)

Unit 2: Growth, Isolation, Culturing & Preservation of Bacteria

Definition & calculation of generation time, Growth curve, Diauxic growth.
Factors affecting growth (Temperature, pH, Oxygen, water.) Define types based on specific requirement: Thermophilic, Psychrophilic, Barophilic, Xerophylic, Acidophilic, Alkaliphylic, and Halophilic.
Cultivation of anaerobes,

Pure culture isolation & preservation methods.

Unit 3: Chemotherapy & Microbial diseases

Definition: Chemotherapeutic agent, Antibiotics, Drugs, Chemotherapeutic index.
General properties of antimicrobial agent, Drug resistance
Mode of action of antibiotics, its uses & limitations: Penicillin, Tetracycline, Chloramphenicol, Sulfa drugs
Other uses of antibiotics
Diseases: Tuberculosis, Typhoid, AIDS (causatative agent, transmission, pathogenesis & symptoms, diagnostic tests list, prophylaxis)

Unit 4: Fermentation Technology & Industrial microbiology

Introduction to Fermentation process, Basic concepts-batch, continuous and fed batch culture, Bioreactor design: Parts & Functions, advantages & disadvantages Submerged reactor. Packed bed reactor (in brief)
Industrial production of: Penicillin, Beer, Transformation of steroid, Lysine production, Vinegar.

References:

1. Bailley and Ollis, 1986, Biochemical Engineering Fundamentals, McGraw Hill, Newyork.
2. E.MT.El-Mansi .,& C.F.A.Bryce Fermentation Microbiology and Biotechnology
3. Mooyoung 1985. Comprehensive Biotechnology, Vol.I, II, III & IV Pergamon
4. Stanbury,P.F., & Whitakar, A., 1984. Principles of Fermentation Technology.
5. Atlas R: Microbiology: Fundamentals and Applications (2^{nd} ed) 1997.
6. Frobisher, Hinsdill, Crabtree, Goodheart: Fundamentals of Microbiology(8^{th}ed) Pelczar Reid: Microbiology (5^{th} ed)
7. Prescott,Harley.Kleins : General Microbiology.(7^{th}ed)
8. Stainer: General Microbiology (7^{th}ed)
9. Tortora: Microbiology an introduction (6^{th}ed)1998.
10. Brock 11^{th}(ed) 2006 : Microbiolgy
11. Ingraham & Ingraham: Introduction to Microbiology
12. Jacquelyn G. Black. : Microbiology principles & Explorations
13. Pelczar: Microbiology an application based approach. 2010.
14. C. B. Powar & Daginawala : Text book of Microbiology. Vol I & Vol II.

Semester VI

309: Immunology and Bacterial Genetics (4 credits)

Unit 1: Introduction, Organs and Cells of Immune system

Introduction & terminology in immunology

Cells & Organs of immune system (B Cells, T Cells, Null cells, Mononuclear cell, Granulocytes, Mast cells)

Portal of entry for microbes

Microbial factors for invasiveness: Enzymes & microbial metabolites, Toxins: Endotoxins & Exotoxins, Mechanism of action of toxins

Unit 2: Host defence mechanism, Structure and types of Immunoglobulin, Immune response

Host defence mechanism: First line (Nonspecific defence): Physico chemical Barriers , second line(Nonspecific defence) : Chemical barriers; compliments, interferons, lysozymes, Basic peptides & Acids, Inflamatory responses, Phagocytosis , third line of defence (Specific defence); Immunoglobulins: Structure, types and functions

Types of Antigens, Immunological properties of antigen: Epitopes, Antigenicity, Factors that influence immunogenicity

Ag-Ab interactions affinity, avidity

Primary and secondary immune response

Cell mediated & Humoral immune response

Unit 3: Immunochemical techniques, and their application:

Immunochemical techniques, Serology (precipitations reactions, agglutination reactions), Immunoelectrophoresis, RIA, ELISA

Hybridoma technique & its application

Active and passive immunisation: (Both natural and artificial)

UNIT IV: **Applied Immunology:**

- Hypersensitivity: Type I, II, III & IV
- Vaccines: Introduction. Principle of vaccination.
- Types of Vaccines: Natural Live, Attenuated, Toxoids, Polysaccharide Vaccines, Recombinant vaccines.
- New approach for vaccines development
- Transplantation: Introduction.
- Graft and classification of graft
- Graft rejection and types of graft rejections & mechanism of rejection
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References:

1. Immunology (5th ed) : Kuby J
2. immunology (6th ed) : Ivan Roitt
3. The elements of Immunology :Fahim Halim Khan
4. Introduction to Immuniology:John W Kimball
5. Immunology: Klein & V.Horejsi
6. Immunology : K.R.Joshi & N.O.Osama
7. Principles of Microbilogy :Ronald Atlas
8. Fundamentals of Microbiology: Martin Frobisher

Semester VI

310: Advanced Enzymology (4 credits)

Unit 1: Enzyme Kinetics

Enzyme Kinetics and Its Importance, Derivation of Michaelis Menton Equation, Methods of Km and Vmax Determination

Enzyme Inhibitors Reversible (Competitive, Noncompetitive, Uncompetitive), Irreversible Inhibition, Suicide Inhibitors with examples, Kinetics of Inhibition as observed by various plots such as Michaelis Menten plot and Line Weaver Burk plot, Hofstee plot, Woolf plot, Hane's plot

Kinetic aspects of allosteric enzymes with examples, ATCase, MWC and KNF models for allosteric enzymes

Unit 2: Quantitative methods for following enzyme reactions

Methodology, sampling & continuous methods with examples, advantages, disadvantages of: (a) Spectrophotometric method (b) Spectrofluorometric method (c) Thumberg method (d) Electrochemical methods (e) Polarimetric method (f) Chromatographic method (g) Manometric method and (h) Chemical method

Handling of enzymes, Enzyme assays

Enzyme units and specific activity of enzyme

Unit 3: Enzyme isolation and purification

Need for purification and general outline of purification scheme, Purification table, methods for protein determination, purification methods with respect to source, principle, isolation and extraction method, efficiency with examples and advantages or disadvantages during use.

Methods to check enzyme purity such as ultracentrifugation, electrophoresis & solubility

Unit 4: Applications of enzymes

Clinical aspects of enzymology, Enzymes as analytical reagents in estimation of various metabolites, Medical and therapeutic applications of enzymes, Enzyme in industries: food, Biotechnology & and other industry

Immobilized enzyme: (Elementary aspects) Methods, properties, kinetics, industrial applications, Biosensors

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. Wiseman: A handbook of Enzyme Biotechnology
9. S N Jogdand: Advances in Biotechnology, 5th Revised edition, 2005, Himalaya Publishing House

312: Practicals (5 credits)

Duration: 3hr **Marks: 100**

(A) Microbiology I:

1. Introduction to various apparatus used in microbiology laboratory and their uses
2. Sterilization of glassware
3. Preparation and sterilization of some common nutrient media
4. Determination of flagellar motility by hanging drop method
5. Isolation of pure culture and study its characteristics
6. Growth curve of microorganism by turbidometric method

(B) Microbiology II:

7. Antibiotic sensitivity test by plate diffusion method
    i. Agar cup method
    ii. Agar ditch method
8. Biochemical reaction of bacteria
    i. Fermentation of sugar to alcohol and glycerol
    ii. IMVIC test
9. Check the presence of specialized enzyme in bacteria
    i. Amylase
    ii. Catalase
    iii. Lipase
    iv. Gelatinase
    v. Dehydrogenase
10. Qualitative analysis of milk (MBRT)
11. Analysis of microorganism from Water (MPN)

(C) Nutritional & Clinical Biochemistry

12. Estimation of Iron by KSCN method
13. Estimation of Magnesium
14. Estimation of Cholesterol from egg
15. Estimation of Nitrogen by Kjeldahl's method (Demonstration)
16. Estimation of Serum total proteins & A/G ratio from serum

(D) Immunology practicals & other practicals

17. Determination of Obesity by i) Weight ii) Body mass Index
18. Production of alcohol during fermentation of glucose by yeast
19. Single radial Immunodiffusion technique
20. Double radial Immunodiffusion technique

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. Varley H: Practical Clinical Biochemistry
6. Wharton and McCarty: Experimental methods in Biochemistry
7. Willard and Merrit: Instrumental methods of analysis.
8. Seeley HW and Van Denmark PJ: Microbes in Action
9. Wistreich GA and Lechman MD: Laboratory Exercise in Microbiology
10. S. Shanmugam, TSathish Kumar, K Panneer Selvam: Laboratory Handbook on Biochemistry, 2010, PHI Learning Pvt. Ltd.
11. Practical Microbiology, R.C. Dubey& D.K.Maheshwari S.Chand. 2009.
12. Experimental Microbiology Vol-1&2, Rakesh J. Patel, Aditya Publications, 5th edition.

BIOCHEMISTRY ELECTIVEPAPER
SEMESTER VI

APPLIED BIOTECHNOLOGY

(Applicable from 2019)

Unit 1: Enzyme Biotechnology

Immobilized Enzymes
Biosensors
Enzyme Reactors: Stirred Tank Reactor, Membrane & Continuous Flow Reactor
Enzyme Engineering

Unit 2: Food Biotechnology

Fermented Foods- Probiotics
Single cell protein
GM foods
Use of Enzymes in Food industry

Unit 3: Medical Biotechnology

Recombinant vaccines
Disease Diagnosis & Treatment (Detection of genetic Disease, DNA finger printing, Tissue Engineering)
Gene therapy

Unit 4: Environmental Biotechnology

Bioremediation
Biocontrol
Biofertilizers
Xenobiotics & their degradation

References

1. Biotechnology by U.Satyanarayana
2. Biotechnology by B.D.Singh
3. A text book of Biotechnology by R.C.Dube
4. Advanced Biotechnology by R.C.Dube
5 Environmental biotechnology by Bimal C Bhattacharya & Ritu Banerjee

Semester VI REVISED

Biochem Elective 311: Endocrinology (2 credits)

Unit 1: Hormone action

Introduction to hormones, adrenergic receptors, different models of hormone action

Unit 2: Thyroid and PTH Thyroid hormones: chemistry, biosynthesis, diseases associates with thyroid hormones.Parathyroid hormones: chemistry, biosynthesis, diseases associates with parathyroid hormones. Calcium homeostasis.

Unit 3: Pancreatic Hormones Pancreatic hormones: chemistry, biosynthesis, diseases associates with pancreatic hormones.

Unit 4: Adrenal and Gonadal hormones Chemistry, biosynthesis of hormones of adrenal cortex and medulla. Chemistry, biosynthesis of hormones of Gonads.

Ref:

1. Negi, CS., Introduction to Endocrinology, (2009), PHI Learning Pvt Ltd, New Delhi
2. Murray RK, Rodwell VW: Harpers review of Biochemistry (25th ed), (2000).