Gujarat University

Syllabus for Biochemistry at B. Sc. Semester VI

(To be effective from 2013)

BIC 307 Nutrition & Diseases
BIC 308 Advanced Microbiology
BIC 309 Immunology & Bacterial Genetics
BIC 310 Advanced Enzymology
BIC 311 Subject Elective
BIC 312 Practicals

Course Structure with respect to credit, hours and marks

<table>
<thead>
<tr>
<th>Type of Course</th>
<th>Paper No.</th>
<th>Credits</th>
<th>Total Marks</th>
<th>Internal Marks</th>
<th>External Marks</th>
<th>No. of hours per week</th>
<th>Exam hours</th>
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<tbody>
<tr>
<td>Foundation Course (FC-VI)</td>
<td>FC - 302</td>
<td>2</td>
<td>100</td>
<td>30</td>
<td>70</td>
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<tr>
<td>Core Course</td>
<td>BIC 307</td>
<td>4</td>
<td>100</td>
<td>30</td>
<td>70</td>
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<td>BIC 308</td>
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<td>BIC 309</td>
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<td>BIC 310</td>
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<tr>
<td>Subject Elective Course (SEC)</td>
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<td>Practical Core Course</td>
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<tr>
<td>Total Credits</td>
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</table>

N.B.: The practical batch should be minimum of 10 students with respect to the credit.
<table>
<thead>
<tr>
<th>Third Year</th>
<th>Semester V</th>
<th>Semester VI</th>
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</thead>
<tbody>
<tr>
<td>301: Metabolism</td>
<td>307: Nutrition and Diseases</td>
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<tr>
<td><strong>4 Credits</strong></td>
<td><strong>4 Credits</strong></td>
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<tr>
<td>Unit 1: Introduction &amp; Metabolism of Carbohydrates</td>
<td>Unit 1: Obesity and Diabetes Mellitus</td>
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<tr>
<td>Unit 2: Metabolism of Proteins</td>
<td>Unit 2: Nutritional Anaemias, Rickets, Osteomalacia</td>
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<tr>
<td>Unit 3: Metabolism of Lipids</td>
<td>Unit 3: PEM &amp; Role of lipids in Coronary Heart Diseases (CHD)</td>
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<tr>
<td>Unit 4: Energy metabolism</td>
<td>Unit 4: Scurvy, Xerophthalmia and Food Toxicity</td>
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<tr>
<td>302: Molecular Biology</td>
<td>308: Advanced Microbiology</td>
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<tr>
<td><strong>4 Credits</strong></td>
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<tr>
<td>Unit 1: Introduction, History, DNA Replication</td>
<td>Unit 1: Bacteriological Media and Sterilisation</td>
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<tr>
<td>Unit 2: DNA Repair, Genetic code, Transcription, Mutations.</td>
<td>Unit 2: Growth and culturing of Bacteria</td>
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<tr>
<td>Unit 3: Translation, Control of gene expression. Lac, Trp operons</td>
<td>Unit 3: Chemotherapy and Microbial Diseases</td>
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<tr>
<td>Unit 4: Techniques in Molecular Biology &amp; Genetic Engineering</td>
<td>Unit 4: Fermentation technology &amp; Industrial microbiology.</td>
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<td>303: Enzymology</td>
<td>309: Immunology and Bacterial Genetics</td>
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<tr>
<td><strong>4 Credits</strong></td>
<td><strong>4 Credits</strong></td>
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<tr>
<td>Unit 1: Introduction to Enzymes</td>
<td>Unit 1: Introduction, Organs and cells of Immune system</td>
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<tr>
<td>Unit 2: Metalloenzymes, Isoenzymes &amp; Membrane bound enzymes</td>
<td>Unit 2: Host defence mechanism, Structure and types of Immunoglobulin and immune response</td>
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<tr>
<td>Unit 3: Enzyme Classification, Factors affecting enzyme catalysis</td>
<td>Unit 3: Immunochemical techniques, Hybridoma techniques, hypersensitivity, Active and Passive immunisation</td>
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<tr>
<td>Unit 1:</td>
<td>Unit 2:</td>
<td>Unit 3:</td>
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<tr>
<td>Morphology of Bacteria &amp; their role in human welfare</td>
<td>Major groups of microorganisms &amp; Microbial Staining</td>
<td>Essential Macro Nutrients in Human diet</td>
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<tr>
<td>Enzyme kinetics</td>
<td>Quantitative methods for following enzyme reactions</td>
<td>Enzyme isolation &amp; purification, Enzyme units</td>
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</table>

**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

**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:


Semester VI
308: Advanced Microbiology (4 credits)

Unit 1: Bacteriological media & Sterilization
Nutritional requirements & broad categories in bacteria with one example
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) filtration (Nucleopore & Millipore)
Phenol co-efficient, Mode of action, uses, limitation of: Chlorine, phenol, compounds of heavy metals (Hg) as disinfectants.
Mode of action, uses, Limitations of microbial gases: (Beta propiolactone &Ethylene oxide)

**Unit 2: Growth & Culturing of Bacteria**
Definition & calculation of generation time, Growth curve, Diauxic growth.
Measuring bacterial growth, (Serial dilution, SPC, Direct microscopic count)
Factors affecting growth (Temperature, pH, Oxygen, water, pressure.) Define types based on specific requirement: Thermophilic, Psychrophilic, Barophilic, Acidophilic, and Halophilic.
Cultivation of anaerobes, pure culture isolation & preservation

**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
Types of reactor: Submerged reactor, Mechanically stirred, Draught-tube reactor, Air lift reactor, Packed bed reactor (in brief)
Industrial production of: Penicillin, Beer, Transformation of steroid, lysine production, Vinegar, & Vaccine

**References:**

2. E.M.T.El-Mansi ,& C.F.A.Bryce Fermentation Microbiology and Biotechnology
7. Prescott,Harley,Kleins : General Microbiology.(7th ed)
8. Stainer: General Microbiology (7th ed)
10.Brock 11th(ed) 2006 : Microbiolgy
11.Ingraham & Ingraham: Introduction to Microbiology
12.Jacquelyn G. Black. : Microbiology principles & Explorations

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, Inflammatory 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, Hybridoma technique, Hypersensitivity, Active and Passive immunisation

Immunochemical techniques, Serology (precipitations reactions, agglutination reactions), Immunelectrophoresis, RIA, ELISA
Hybridoma technique & its application
Hypersensitivity: Type I, II, III & IV
Active and passive immunisation: Acquired immunity

Unit 4: Bacterial Genetics
Conjugation, F & Hfr Factors, Mating types, Chromosomal mapping, Transduction (Generalized & specialized), Transformation

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 Microbiology :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

**Unit 3: Enzyme isolation and purification, Enzyme units**

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

Enzyme units and specific activity of enzyme

**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:**

5. Conn and Stumpf: Outlines of Biochemistry
8. Wiseman: A handbook of Enzyme Biotechnology

**312: Practicals**

| 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
4. Thomas and Schalkhammer: Analytical Biochemistry, 2002
5. Varley H: Practical Clinical Biochemistry
6. Wharton and McCarty: Experimental methods in Biochemistry
8. Seeley HW and Van Denmark PJ: Microbes in Action
9. Wistreich GA and Lechman MD: Laboratory Exercise in Microbiology