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

<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>
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N.B.: The practical batch should be minimum of 10 students with respect to the credits.
<table>
<thead>
<tr>
<th>Third Year</th>
<th>Semester V</th>
<th>Semester VI</th>
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<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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<td>Unit 2: Metabolism of Proteins</td>
<td>Unit 2: Nutritional Anaemias, Rickets, Osteomalacia</td>
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<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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<td>Unit 4: Energy metabolism</td>
<td>Unit 4: Scurvy, Xerophthalmia and Food Toxicity</td>
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| 302: Molecular Biology | 308: Advanced Microbiology |
| **4 Credits** | **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** | **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 |
### 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

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<th>Credits</th>
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<td>304</td>
<td>Introduction to Microbiology &amp; Nutrition</td>
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<tr>
<td>4</td>
<td>310</td>
<td>Advanced Enzymology</td>
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<td>Biochemistry Elective</td>
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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, \( \beta \)-Oxidation of saturated, Unsaturated and odd chain fatty acids, Energetic and regulation, alpha and omega oxidation, Ketone bodies synthesis & Utilization, FA synthesis, Steps, Stochiometry, 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**


**References:**

**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 Tm, 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:**

2. Brown TA: gene cloning
Semester V  
303: Enzymology (4 credits)

Unit 1: Introduction to Enzymes


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:
5. Conn and Stumpf: Outlines of Biochemistry

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, Archaebacteria, 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)


Vegetarian vs. Non-vegetarian foods

References:
3. Pelczar Reid: Microbiology (5th ed)
4. Prescott, Harley Kleins : General Microbiology.(7th ed)
5. Stainer: General Microbiology
8. Introduction to Microbiology: Ingraham & Ingraham.

**305: Practicals**

**3 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)
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
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