Syllabus
BIOCHEMISTRY
Admitted Batch 2008 -2009
(UG courses)

May 2008
A.P. State Council of Higher Education
SUBJECT COMMITTEE

1. Prof. D. Siva Prasad
   Department of Biochemistry,
   Andhra University, Visakhapatnam.

2. Prof. M S K Prasad
   Department of Biochemistry,
   Kakatiya University, Warangal.

3. Prof. K. Thyagaraju
   Department of Biochemistry,
   Sri Venkateswara University, Tirupati.

4. Prof. B. Sashidhar Rao
   Department of Biochemistry,
   Osmania University, Hyderabad.

5. Prof. P.V.V. Satyanarayana,
   Department of Biochemistry,
   Acharya Nagarjuna University,
   Nagarjuna Nagar, Guntur Dist.

6. Prof. D. Sarala Kumari
   Department of Biochemistry,
   Sri Krishnadevaraya University, Anantapur.

7. Dr. G. Sudhakar Reddy
   Govt. Degree College,
   Piler, Chittoor Dist.

8. Dr. G. Seshagiri Rao
   Department of Biochemistry,
   Andhra University, Visakhapatnam.

9. Prof. S. Sanjeevi Rao
   Department of Biochemistry,
   Andhra Medical College, Visakhapatnam.

10. Prof. P. V. Subba Rao
    General Manager,
    Divis Laboratories Ltd. Phippada, Annavaram P,
    Visakhapatnam Dist.
**B.Sc. Courses (Structure)**

### First year:

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Subject</th>
<th>Hrs per week</th>
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<tbody>
<tr>
<td>1.</td>
<td>English language including communication skills</td>
<td>6</td>
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<tr>
<td>2.</td>
<td>Second language</td>
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<tr>
<td>3.</td>
<td>Core1-I</td>
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<tr>
<td>4.</td>
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<td>6.</td>
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<td>7.</td>
<td>Core2-lab I</td>
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<tr>
<td>8.</td>
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<td>9.</td>
<td>Foundation course</td>
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<tr>
<td>10.</td>
<td>Computer skills</td>
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<td><strong>Total</strong></td>
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### Second year:

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<td>Core1-II</td>
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<td>Core2-lab II</td>
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<td>9.</td>
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<td>1.</td>
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<tr>
<td>2.</td>
<td>Core1-IV</td>
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<tr>
<td>3.</td>
<td>Core2-III</td>
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<tr>
<td>4.</td>
<td>Core2-IV</td>
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<td>6.</td>
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<td>7.</td>
<td>Core1-lab III</td>
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<td>8.</td>
<td>Core1-lab IV</td>
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<td>9.</td>
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<td>10.</td>
<td>Core2-lab IV</td>
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<td>11.</td>
<td>Core3-lab III</td>
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<td>12.</td>
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<tr>
<td>13.</td>
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<td><strong>Total</strong></td>
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### A.P. State Council of Higher Education, Hyderabad

**Biochemistry**

**Course Structure, Scheme of Instruction and Examination**

<table>
<thead>
<tr>
<th>Year</th>
<th>Theory / Practical Paper No.</th>
<th>Title</th>
<th>Work load / Hours per Week</th>
<th>Exam Duration Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>Theory Paper I</td>
<td>Biomolecules and Enzymology</td>
<td>4</td>
<td>3</td>
<td>100</td>
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<tr>
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<td>Practicals Paper I</td>
<td>Qualitative Analysis and Enzymology</td>
<td>3</td>
<td>3</td>
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<tr>
<td>II</td>
<td>Theory Paper II</td>
<td>Metabolism and Biochemical Techniques</td>
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<td>Practicals Paper II</td>
<td>Quantitative Analysis and Biochemical Techniques</td>
<td>3</td>
<td>3</td>
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<tr>
<td>III</td>
<td>Theory Paper III</td>
<td>Physiology, Clinical Biochemistry and Immunology</td>
<td>3</td>
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<tr>
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<td>Theory Paper IV</td>
<td>Microbiology and Molecular Biology</td>
<td>3</td>
<td>3</td>
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<td></td>
<td>Practicals Paper III</td>
<td>Nutritional and Clinical Biochemistry</td>
<td>3</td>
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<td>Practicals Paper IV</td>
<td>Microbiology and Molecular Biology</td>
<td>3</td>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

**Note:** **Foundation Course:**

(i) **1<sup>st</sup> Year:** Mathematics for Biology Students / Biology for Mathematics Students

(ii) **2<sup>nd</sup> Year:** Environmental Studies.

(iii) **3<sup>rd</sup> Year:** Computational Science (Biostatistics, Bioinformatics).
## Biochemistry Course Structure

### First Year

<table>
<thead>
<tr>
<th>Theory – Paper-I: Biomolecules and Enzymology</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-I : Carbohydrates and Lipids</td>
<td>100</td>
</tr>
<tr>
<td>Unit-II : Amino acids, Peptides and Proteins</td>
<td></td>
</tr>
<tr>
<td>Unit-III : Nucleic acids and Porphyrins</td>
<td></td>
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<tr>
<td>Unit-IV : Enzymology</td>
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<tr>
<td><strong>Practicals – Paper-I: Qualitative Analysis and Enzymology</strong></td>
<td><strong>50</strong></td>
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</table>

### Second Year

<table>
<thead>
<tr>
<th>Theory – Paper-II: Metabolism and Biochemical Techniques</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-I : Bioenergetics and Biological Oxidations</td>
<td>100</td>
</tr>
<tr>
<td>Unit-II : Carbohydrate and Lipid Metabolism</td>
<td></td>
</tr>
<tr>
<td>Unit-III : Metabolism of Nitrogen Compounds</td>
<td></td>
</tr>
<tr>
<td>Unit-IV : Biochemical Techniques</td>
<td></td>
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<tr>
<td><strong>Practicals – Paper-II: Quantitative Analysis and Biochemical Techniques</strong></td>
<td><strong>50</strong></td>
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</table>

### Third Year

<table>
<thead>
<tr>
<th>Theory – Paper-III: Physiology, Clinical Biochemistry and Immunology</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-I : Physiology</td>
<td>100</td>
</tr>
<tr>
<td>Unit-II : Nutritional Biochemistry</td>
<td></td>
</tr>
<tr>
<td>Unit-III : Clinical Biochemistry</td>
<td></td>
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<tr>
<td>Unit-IV : Immunology</td>
<td></td>
</tr>
<tr>
<td><strong>Theory – Paper-IV: Microbiology and Molecular Biology</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>Unit-I : Microbiology</td>
<td></td>
</tr>
<tr>
<td>Unit-II : DNA Replication and Transcription</td>
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<td>Unit-III : Protein Synthesis and Regulation of Gene Expression</td>
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### Note: Foundation Course:

(i) 1\textsuperscript{st} Year: Mathematics for Biology Students / Biology for Mathematics Students  
(ii) 2\textsuperscript{nd} Year: Environmental Studies.  
(iii) 3\textsuperscript{rd} Year: Computational Science (Biostatistics, Bioinformatics).
Unit – I : Carbohydrates and Lipids 30 hours

Water as a biological solvent and its role in biological processes.

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates (due to functional groups - hydroxyl, aldehyde and ketone). Amino sugars, Glycosides. Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose), structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen). Glycosaminoglycans, Bacterial cell wall polysaccharides. Outlines of glycoproteins, glycolipids and blood group substances.

Lipids: Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils (acid, saponification and iodine values, rancidity). General properties and structures of phospholipids, sphingolipids and cholesterol. Prostaglandins- structure and biological role of PGD₂, PGE₂ and PGF₂α. Lipoproteins: Types and functions.


Unit-II : Amino Acids, Peptides and Proteins 30 hours

pH, Buffers, Henderson- Hasselbalch equation.


Unit-III : Nucleic Acids and Porphyrins 25 hours

Nature of nucleic acids. Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Effect of acids, alkali and nucleases on DNA and RNA. Structure of Nucleic acids- Watson-Crick DNA double helix structure, introduction to circular DNA, super coiling, helix to random coil transition, denaturation of nucleic acids-
Hyperchromic effect, $T_m$-values and their significance. Reassociation kinetics, cot curves and their significance. Types of RNA and DNA.

Prophyrins: Structure, properties and functions of heme, chlorophylls and cytochromes.

**Unit-IV : Enzymes**

35 hours


Factors affecting the catalysis- substrate concentration, $pH$, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of $K_M$ and $V_{max}$. Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive and non-competitive.

Introduction to Good Laboratory Practice (GLP). Principles of Laboratory Hygiene and Safety.

List of experiments:

1. Preparation of buffers (acidic, neutral and alkaline) and determination of pH.
2. Qualitative identification of carbohydrates - glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Qualitative identification of amino acids – histidine, tyrosine, tryptophan, cysteine, arginine.
5. Preparation of Osazones and their identification.
7. Absorption spectra of protein-BSA, nucleic acids - Calf thymus DNA.
8. Titration curve of glycine and determination of pK and pI values.
9. Assay of amylase
10. Assay of urease
12. Assay of phosphatase
Unit- I : Bioenergetics and Biological Oxidations  


Biological oxidations: Definition, enzymes involved- oxidases, dehydrogenases and oxygenases. Redox reactions. Redox couplers. Reduction potential ($\varepsilon$, $\varepsilon_0$, $\varepsilon'_0$). Standard reduction potential ($\varepsilon'_0$) of some biochemically important half reactions.


Unit- II : Carbohydrate and Lipid Metabolism  


Catabolism of fatty acids ($\beta$- oxidation) with even and odd number of carbon atoms, Ketogenesis, de novo synthesis of fatty acids, elongation of fatty acids in mitochondria and microsomes, Biosynthesis and degradation of triacylglycerol and lecithin. Biosynthesis of cholesterol.

Unit-III : Metabolism of Nitrogen Compounds  


Biosynthesis and degradation of heme.
Unit-IV : Biochemical Techniques

Methods of tissue homogenization: (Potter-Elvejham, mechanical blender, sonicator and enzymatic).

Principle and applications of centrifugation techniques- differential, density gradient. Ultra-centrifugation- preparative and analytical.
Principle and applications of chromatographic techniques- paper, thin layer, gel filtration, ion-exchange and affinity chromatography. Elementary treatment of an enzyme purification.

Electrophoresis- principles and applications of paper, polyacrylamide (native and SDS) and agarose gel electrophoresis.


Tracer techniques: Radio isotopes, units of radio activity, half life, β and γ- emitters, use of radioactive isotopes in biology.
List of Experiments:

1. Estimation of amino acid by ninhydrin method.
2. Estimation of protein by Biuret method.
4. Estimation of glucose by DNS method.
5. Estimation of glucose by Benedict’s titrimetric method.
7. Isolation of egg albumin from egg white.
8. Isolation of cholesterol from egg yolk.
9. Isolation of starch from potatoes.
10. Isolation of casein from milk.
12. Determination of exchange capacity of resin by titrimetry.
14. Separation of plant pigments by TLC.
UNIVERSITY
BIO-CHEMISTRY SYLLABUS FOR THE ACADEMIC YEAR 2010-11
3rd Year Theory – Paper-III: Physiology, Clinical Biochemistry and Immunology

Unit- I : Physiology  
24 hours

Digestion and absorption of carbohydrates, lipids and proteins. Composition of blood and coagulation of blood. Hemoglobin and transport of gases in blood (oxygen and CO2).

Heart- structure of the heart, cardiac cycle, cardiac factors controlling blood pressure.

Muscle- kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction.


Unit- II : Nutrition  
21 hours


Vitamins- sources, structure, biochemical roles, deficiency disorders of water and fat soluble vitamins. Introduction to nutraceutical and functional foods. Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F. Obesity and starvation.

Unit- III : Clinical Biochemistry  
23 hours


Structure and functions of the liver. Liver diseases- jaundice, hepatitis, cirrhosis. Liver function tests- conjugated and total bilirubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.
Kidneys-structure of nephron, urine formation, normal and abnormal constituents of urine. Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body. Renal function tests- creatinine and urea clearance tests, phenol red test.


Disorders of lipid metabolism- plasma lipoproteins, lipoproteinemias, fatty liver, hypercholesterolemia, atherosclerosis.

Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins.

Unit- IV : Immunology


List of Experiments:

1. Estimation of calcium by titrimetry
2. Estimation of iron in apple juice by phenanthroline method.
3. Estimation of sodium by flame photometry.
4. Estimation of vitamin C by 2, 6-dichlorophenol indophenol method.
5. Isolation of total lipids by gravimetric method.
6. Determination of iodine value of an oil.
7. Determination of acid value of an oil.
10. Determination of blood group and Rh typing.
11. Visualization of antigen antibody reactions (Ouchterlony technique).
12. Urine analysis for albumin, sugars and ketone bodies.
15. Estimation of serum total cholesterol.
17. Determination of SGOT and SGPT activity
Unit- I : Microbiology  


Industrial uses of *Aspergillus niger*, yeast and Spirulina.


Unit- II : DNA Replication and Transcription  


Transcriptional events in eukaryotic m-RNA synthesis, post-transcriptional modifications of eukaryotic m-RNA. Inhibitors of RNA synthesis.

Unit- III : Protein Synthesis and Regulation of Gene Expression  

Introduction to protein synthesis- Genetic code, structure of t-RNA, deciphering of genetic code, Nirenberg’s and Khorana’s experiments, wobble hypothesis, degeneracy of genetic code.


Regulation of prokaryotic gene expression- induction and repression. Lac operon, catabolite repression. Tryptophan operon and attenuation.

Unit- IV : Recombinant DNA technology  

Outlines of cloning strategies. DNA sequencing- Maxam Gilbert and Sanger’s methods. Tools of r-DNA technology: Enzymes- Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nuclease-S1 and RNAase H.
Restriction mapping. Cloning vectors- Plasmids, Ti plasmids, Cosmids, λ phages, shuttle vectors, expression vectors. Host- *E.coli, Sacchromyces cereviciae, Agrobacterium tumifaciens*.

Construction of c-DNA and genomic libraries. Isolation and sequencing of cloned genes- colony hybridization, nucleic acid hybridization, hybrid released translation (HRT) and hybrid arrested and released translation (HART) using reporter genes [β- galactosidases, green fluorescent proteins (GFP)].

Polymerase chain reaction- principle and applications. Outlines of blotting techniques-Southern, Northern and Western.

Applications of gene cloning- production of insulin and human growth hormone, production of Bt cotton and edible vaccines.

Introduction to Bioinformatics- definitions of proteomics and genomics. Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA.
List of Experiments:

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method.
   (ii) Serial dilution method.
3. Gram staining.
5. Bacterial growth curve.
6. Antibiotic sensitivity by paper disc method.
7. Isolation of DNA from onion/liver/coconut endosperm.
8. Isolation of plasmids.
10. Estimation of DNA by diphenylamine method.
12. Electrophoresis of nucleic acids and visualization by methylene blue staining.
13. Restriction mapping: λ- DNA with any two restriction enzymes.
14. Sequence alignments of insulin/BSA with other proteins using BLAST and FASTA.
Recommended Books for UG Course (Biochemistry)

General Biochemistry


Enzymology


Biochemical Techniques

Physiology, Nutrition and Clinical Biochemistry:

3. Human Physiology – Chatterjee.C.C, Medical Allied Agency

Immunology:


Microbiology:

Molecular Biology and Biotechnology:


Bioinformatics

1. Instant Notes-Bioinformatics- Westhead et al., Viva Books (P), Ltd
2. Introduction to Bioinformatics- Attwood T K and Parry-Smith, D. J. Pearson Education.
3. Introduction to Bioinformatics- Lesk, A.M. Oxford University Press

Practical Biochemistry:

11. Practical Clinical Biochemistry – Methods and Interpretations – Ranjna Chawla-Jaypee

**Practical Microbiology:**

3. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom cultivation-Aneja, K. R - New Age International publishers.

**Mathematical Problems in General Biochemistry:**


**Lab Reference Book:**