

GONDWANA UNIVERSITY GADCHIROLI



FACULTY OF SCIENCE

Syllabus for the S.Y.B. Sc.

Program: B. Sc.

Course: Biochemistry

Choice Based Credit System with effect from the
academic year 2018-19

GONDWANA UNIVERSITY, GADCHIROLI

CHOICE BASED CREDIT SYSTEM

S.Y.B.Sc.

BIOCHEMISTRY

(SEMESTER III & IV)

(With effect from academic session 2018-19)

- There shall be two semesters in B.Sc.Part II. Each semester comprise of two theory papers, practical and internal assessment.
- The syllabus is based on six theory periods and six practical periods per week.
- Each theory paper divided into four units.
- Scheme of examination: It is divided into two parts- Internal assessment (college assessment) and external assessment (semester end examination conducted by university).
- The internal assessment marks assigned to each theory paper shall be awarded on the basis of assignment / Class test / Project assignment / Seminar / Case studies/ Quizzes/ Viva, any other innovative practice / activity.
- The Semester End Examination for Biochemistry course will be as follows:
50 marks Paper I + 50 marks Paper II (External assessment- University examination)
10 marks Paper I + 10 marks Paper II (Internal assessment- College Assessment)
Total - 120 Marks Theory and one practical course: 30 marks
- Duration of examination for each theory paper will be 3 hours.
- The practical examination shall be of 6 hours duration.
- Question paper will consist of five questions and each question will be of 10 marks.
- All questions will be compulsory and with internal choice.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
- Practical examination for odd semester will be at college level and for even semester at university level with external examiner.
- Students are expected to perform the entire practicals mentioned in the syllabus. However a minimum of seven practical in each semester is mandatory.
- The B.Sc.students of Biochemistry shall pay at least one visit to any Industry, Biochemical/Research Institute as a study tour during three year (six semester) degree course.
- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA and CGPA

Scheme of Teaching and Examination:

Semester	Paper No	Paper code	Title of Paper	Periods / week	Max Marks		Total Marks	Credits	Total:Th+ Pract
					External(U.A.)	Internal(C.A.)			
III	I	USBCT-C05	Macromolecules	03	50	10	60	2	150
	II	USBCT-C06	Biophysical and Biochemical Techniques I	03	50	10	60	2	
	Practical	USBCP-03	Core 05 + 06 Practical	06	30	-	30	2	
IV	I	USBCT-C07	Enzymology	03	50	10	60	2	150
	II	USBCT-C08	Biophysical and Biochemical Techniques II	03	50	10	60	2	
	Practical	USBCP-04	Core 07 + 08 Practical	06	30	-	30	2	

Internal Assessment for Theory Paper

S.No	Type of Evaluation	Marks	
		Paper I	Paper II
1	One class test	05	05
2	Active participation in routine class activities / seminars etc.	03	03
3	One assignment	02	02
	Total	10	10

Distribution of Marks in Practical:

S.No	External assessment	Marks
1	Experimental work	20
2	Practical record	05
3	Viva-voce	05
	Total	30

QUESTION PAPER PATTERN
S.Y.B.Sc.Semester III&IV
(CBCS)
BIOCHEMISTRY

Time: 3 Hours

Max. Marks: 50

Note: All questions are compulsory and carry equal marks
Draw well labeled diagrams wherever necessary

- Q 1 Long answer type question from Unit I 10 Marks
OR
a) Short answer type question from Unit I 2½ Marks each
b) Short answer type question from Unit I
c) Short answer type question from Unit I
d) Short answer type question from Unit I
- Q 2 Long answer type question from Unit II 10 Marks
OR
a) Short answer type question from Unit II 2½ Marks each
b) Short answer type question from Unit II
c) Short answer type question from Unit II
d) Short answer type question from Unit II
- Q 3 Long answer type question from Unit III 10 Marks
OR
a) Short answer type question from Unit III 2½ Marks each
b) Short answer type question from Unit III
c) Short answer type question from Unit III
d) Short answer type question from Unit III
- Q 4 Long answer type question from Unit IV 10 Marks
OR
a) Short answer type question from Unit IV 2½ Marks each
b) Short answer type question from Unit IV
c) Short answer type question from Unit IV
d) Short answer type question from Unit IV
- Q 5 Solve any 10 out of 12 questions (3 questions from each unit) 10 Marks

B. Sc. Part II (CBCS)

SEMESTER III

PAPER – I

USBCT-C05: MACROMOLECULES

TOTAL PERIODS: 48

CREDITS: 2

UNIT I: Amino acids, peptides and proteins:

- a) Amino acids: Classification, structure of standard amino acids, Zwitter ionic structure, Physiochemical properties a) Solubility, boiling and melting point b) Edman's, Sanger's, Dansylchloride, Ninhydrin and Formaldehyde reactions of amino acids, non proteinous amino acids (ornithine, citrulline and β alanine).
- b) Peptides: structure of peptide bonds, peptide mapping, naturally occurring peptides – glutathione, enkephalin (structure and functions).
- c) Proteins: Classification based on solubility, shape and functions, Determination of primary structure of proteins (end group analysis, cleavage of disulfide bonds, amino acid composition, use of endopeptidase specificity, assignment of disulfide position).

UNIT II: Proteins: -

- a) Secondary structure of proteins: - The α helix, β pleated sheet structures.
- b) Tertiary structure of proteins: Forces that stabilize the structure, Concept of domains, Protein denaturation.
- c) Quaternary structure of proteins: Subunit interaction
- d) Structure and biological functions of Collagen, co-operative binding of O_2 to hemoglobin.

UNIT-III: Nucleic acids I

- a) Chemical structure and base composition of nucleic acids, Structure of purines and pyrimidines, nucleosides, nucleotides. Stability and formation of phosphodiester linkages. Chargaff's rules.
- b) Double helical structures, Watson - Crick Model (B-DNA), Other DNA helices (A- and Z- DNA).
- c) Forces stabilizing nucleic acid structures, Base pairing, Base stacking, Hydrophobic and ionic interactions.

UNIT-IV: Nucleic acids II

- a) Denaturation and renaturation, T_m and buoyant density and their relationship with G-C content in DNA, Satellite DNA.
- b) DNA sequencing: Maxam-Gilbert and Sanger's dideoxynucleotide sequencing.
- c) Structure of m-RNA, r-RNA and t-RNA.

B. Sc. Part II (CBCS)

SEMESTER III

PAPER – II

USBCT-C06: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES I

TOTAL PERIODS: 48

CREDITS: 2

UNIT I: Buffers and pH:-

- a) Concept of acids, bases and buffers, Isoelectric pH.
- b) Buffer capacity, Mechanism of buffer action, Henderson-Hasselbalch equation, Biochemically and Physiologically important buffers.
- c) Titration curve of weak acids, Titration curve of amino acids.
- d) Electrometric determination of pH (pH Meter).

UNIT II: Spectrophotometry:-

- a) Concepts of electromagnetic radiation's, Spectrum, Absorption of electromagnetic radiations.
- b) Orbital theory, Concept of orbitals and their involvement in absorption of electromagnetic radiations.
- c) Concept of chromophores, Laws of absorption, deviations of Beer's law, Extinction coefficient.
- d) Instrumentation and applications of UV and Visible spectrophotometry.
- e) Spectrofluorometry, Flame photometry- absorption and emission

UNIT III: Chromatography I

- a) Partition principle, partition coefficient, Nature of partition forces.
- b) Detailed account of Paper, Thin layer chromatography.
- c) Detailed account of Column adsorption chromatography:- Column packing(Column efficiency and concept of plates), sample application, column development, collection and analysis of effluent.
- d) Gel filtration: - Concept of distribution coefficient, Types of gels and glass beads, Applications.

UNIT IV: Chromatography II

- a) Ion-Exchange chromatography: - Principle, Types of resins, Choice of buffers, Applications.
- b) Affinity chromatography: - Principle, Selection of ligand, Ligand attachment, Specific and non-specific elution, Applications.
- c) Elements of High Pressure Liquid Chromatography and Gas Chromatography.
- d) GCMS:- Principle and applications

S.Y.B.Sc. Semester III

USBCP-03: PRACTICALS

- 1) Preparation of standard solutions (% , Molar, Molal and Normal) of acids and alkali, stock and working solutions.
- 2) Quantitative estimation of amino acids using Ninhydrin reaction.
- 3) Determination of albumin and A / G ratio in serum.
- 4) The validity of Beer's law for colorimetric estimation of creatinine.
- 5) Estimation of blood sugar by Orthotoluidine method.
- 6) Determination of absorption maxima of protein.
- 7) Separation of amino acids by two-dimensional TLC.
- 8) Separation of amino acids by descending\ascending paper chromatography.
- 9) Estimation of glycine by Sorenson's formal titration.
- 10) Preparation of standard buffers and determination of a pH of a solution.
- 11) Determination of pKa of weak acid by pH meter.
- 12) Determination of isoelectric pH of casein, egg albumin and BSA.
- 13) Titration of mixture of strong acid and weak acid.
- 14) Titration curves of amino acid/weak acids and determination of pK value.

(Mandatory to perform at least 7 practical)

SUGGESTED READINGS

- 1) Harper's Biochemistry – Murray, Granner, Mayes, Rodwell- Prentice Hall International Inc.
- 2) Biochemistry – Lehninger – CBS publishers.
- 3) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
- 4) T.B.of Biochemistry – West, Todd, Bruggen, Mason – Amerind publishing Co. Pvt. Ltd.
- 5) Fundamentals of Biochemistry- J.L.Jain, Sanjay Jain, Nitin Jain- S.Chand and Co.Ltd.
- 6) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
- 7) A Biologists Guide to Principle & Techniques of Practical Biochemistry – Williams & Wilson – Edward Erndol Publ.
- 8) The Tools of Biochemistry – T. G. Cooper.
- 9) Principles&Techniques of Practical Biochemistry–Wilson,Walker-Cambridge Univ.Press.
- 10) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
- 11) Biologist's Physical Chemistry – T. G. Morris.
- 12) Physical Biochemistry – H. B. Bull – John Wiley & Sons.
- 13) Chromatography – G. Abbott.
- 14) Methods in Experimental Biology – R. Ralph.
- 15) Physical biochemistry – vanHolde – Prentice Hall Inc.
- 16) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.
- 17) Chromatography: A Lab Handbook of chromatographic and electrophoretic methods – Erich Heftman – Van Nostrand Reinhold, NY.

B. Sc. Part II (CBCS)

SEMESTER IV

PAPER - I

USBCT-C07: ENZYMOLOGY

TOTAL PERIODS: 48

CREDITS: 2

UNIT I

- History, Terminology: - Enzyme, Apoenzyme, Holoenzyme, Prosthetic group, Enzyme specificity, Turnover number, IU, Coenzyme and Cofactor.
- Classification of enzymes in to six major classes with an example of each class, nomenclature of enzymes, Specificity of enzyme action (Lock and key model and Induced fit model).
- Enzyme catalysis:- Proximity and Orientation effect, covalent catalysis, acid-base catalysis, metal ion catalysis.
- Regulatory enzymes:- Allosteric (ATCase) and covalently modulated (Glycogen phosphorylase) enzymes. Isoenzymes (LDH), Multienzyme complexes (PDH), Ribozyme .

UNIT II

- Principles of energy of activation, transition state. Mechanism of Enzyme action (concept of active site, single and bi- substrate reaction), Mechanism of action of Ribonuclease and Lysozyme.
- Effect of enzyme concentration on enzyme activity, upward and downward curvatures with examples.
- Effect of temperature on enzyme activity and temperature quotient, Effect of pH.
- Role of vitamins as coenzyme precursors (Riboflavin, Niacin, Pyridoxine, Biotin and Thiamine)

UNIT III

- Enzyme kinetics: Importance of measuring initial velocities, Derivation of Michaelis-Menten equation, Single and double reciprocal plots.
- Enzyme inhibition- irreversible and reversible, types of reversible inhibitions- competitive, uncompetitive and non-competitive.
- Graphical representation of various inhibitors (Competitive, Noncompetitive and Uncompetitive) on Lineweaver-Burke plots.
- Importance of K_{cat}/K_m . Bisubstrate reactions – brief introduction to sequential and ping-pong mechanisms with examples.

UNIT IV

- a) Concept of enzyme assay and its importance, Enzyme activity units (Katal and Specific activity)
- b) Enzyme isolation and purification:- Enzyme solubilization, Brief idea of various fractionation procedures, Criteria for enzyme purity and homogeneity.
- c) Enzyme immobilization: Definition, Types - adsorption on carriers, covalent binding, intermolecular cross linking, gel entrapment.
- d) Industrial applications of immobilization.

B. Sc. Part II (CBCS)

SEMESTER IV

PAPER – II

USBCT-C08: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES II

TOTAL PERIODS: 48

CREDITS: 2

UNIT I: Electrophoresis I

- a) Migration of ions in electric field, Factors affecting electrophoretic mobility.
- b) Paper electrophoresis:- Electrophoretic run, Detection techniques, Cellulose acetate electrophoresis, High voltage electrophoresis, Applications.
- c) Gel electrophoresis:-Types of gels, Solubilizers, Procedure, Column and slab gels, Detection, Recovery and Estimation of macromolecules, Applications.

UNIT II: Electrophoresis II

- a) SDS-PAGE Electrophoresis, Disc-Gel electrophoresis: - Principle, Procedure and applications.
- b) Isoelectric focusing: - Principle, Establishing pH gradients, Stabilization against convection, Procedures and applications.
- c) Immunological techniques: Immuno-electrophoresis, Radioimmuno assay (RIA) and ELISA.

UNIT III: Isotopic tracer technique:

- a) Radioactive and stable isotopes, Pattern and rate of radioactive decay. Units of radioactivity.

- b) Measurement of radioactivity:- Geiger-Muller counter, Solid and Liquid scintillation counters (Basic principle, instrumentation and technique), Autoradiography.
- c) Isotopes commonly used in biological studies – ^{15}N , ^{32}P , ^{14}C , ^3H , ^{131}I
- d) Applications of isotopes in biology: - Principles of tracer techniques its advantages and limitations, Distribution studies, Metabolic studies, Clinical application.

UNIT IV: Centrifugation:

- a) Basic principles, Mathematics and theory (RCF, Sedimentation coefficient, Svedberg constant)
 - b) Types of centrifuge:- Desk top, High speed and Ultracentrifuges.
 - c) Preparative centrifugation: - Differential and density gradient centrifugation, Applications (Isolation of cell components).
 - d) Analytical centrifugation: - Determination of molecular weight by sedimentation velocity and sedimentation equilibrium methods.
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B. Sc. Part II Semester IV

USBCP-04: PRACTICALS

- 1) Isolation of casein by isoelectric precipitation method.
- 2) Estimation of proteins by Folin-Lowry's method.
- 3) Fractionation of proteins by ammonium sulphate and determination of its purity by PAGE electrophoresis.
- 4) To show using PAGE that commercially available BSA is not a homogeneous preparation.
- 5) SDS-PAGE of BSA and comparison of results with previous (PAGE) experiment.
- 6) Immobilization of enzymes / cells by entrapment in alginate gel.
- 7) Isolation of cell organelles by differential centrifugation
- 8) Assay of salivary amylase
- 9) Isolation of Urease and demonstration of its activity
- 10) Paper electrophoresis of serum proteins
- 11) Gel electrophoresis of serum proteins
- 12) Effect of pH on activity of enzyme
- 13) Effect of temperature on activity of enzyme
- 14) Demonstration of Salting-Out of proteins by ammonium sulphate precipitation.

(Mandatory to perform at least 7 practicals)

SUGGESTED READINGS

- 1) Biochemistry – Lehninger – CBS publishers.
- 2) Biochemistry – Stryer – W. H. Freeman & Co. – New York.
- 3) The nature of enzymology – Foster – Croom Helm, London.
- 4) Fundamentals of enzymology – Price & Stevens – Oxford Science Publ.
- 5) Principals of enzymology for food science – J. R. Whitkar – M. Dekker Publs.
- 6) Enzymes – Dixon & Webb – Academic press.
- 7) Enzyme Kinetics – Paul Engel.
- 8) Enzyme Technology – Chaplin, Buche – Cambridge Univ. Press.
- 9) Enzyme Kinetics – Irwin H. Segal – Wiley Intersci. Publ.
- 10) Enzymes Biochemistry, Biotechnology and Clinical Chemistry -Trevor Palmer
- 11) Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath – Himalaya Publ. House.
- 12) A Biologists Guide to Principle & Techniques of Practical Biochemistry– Williams & Wilson: Edward Erndol Publ.
- 13) The Tools of Biochemistry – T. G. Cooper.
- 14) Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ. Press.
- 15) Outlines of Biochemistry – Conn and Stumpf.
- 16) Principles of Biochemistry – White, Handler, Smith – McGrew Hill Publ.
- 17) Biologist's Physical Chemistry – T. G. Morris.
- 18) Methods in Experimental Biology – R. Ralph.
- 19) Physical biochemistry – vanHolde – Prentice Hall Inc.
- 20) Physical Biochemistry – D. Friefelder – W. H. Freeman & Co.
- 21) Immunology – Riott, Brastoff, Male – Mosby
- 22) Immunology – Janis Kuby. – W. H. Freeman and Co

