DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Sci./Syllabi/Model Coll.Sem.-I & II/86/2016

It is hereby inform to all concerned that, on the recommendation of the Committee, the Hon'ble Vice-Chancellor has accepted the **"Syllabi of B.Sc. Honors degree courses in [1] Biotechnology, [2] Bio-Chemistry & [3] Computer Science Ist & IInd Semester under Credit Based System"** on behalf of the Academic Council under Section-14[7] of the Maharashtra Universities Act, 1994 run **at Model College, Ghansawangi, Dist-Jalna**.

The admission criteria for the courses as per U.G.C. norms.

This is effective from the Academic Year 2015-16 & onwards as appended herewith.

All concerned are requested to note the contents of the circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/SCI./MODEL COLL./
2016/15975-84
Date:- 16-02-2016.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to:-

1] The Principal, Model College, Ghansawangi, Dist-Jalna.

Copy to :-

1] The Controller of Examinations,
2] The In-Charge, E-Suvidha Kendra, [Professional Unit], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr. Babasaheb Ambedkar Marathwada University,
3] The Section Officer, [B.C.S. Unit],
4] The Programmer [Computer Unit-1] Examinations,
5] The Programmer [Computer Unit-2] Examinations,
6] The Record Keeper.

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S*/-150216/-

NAAC 'A' Accreditation

Dr.Babasaheb Ambedkar Marathwada University

Aurangabad-431004

Affiliated

Model College, Ghansavangi,

Jalna

Syllabus of

B. Sc. (Honors) Degree Course (Bio-Chemistry)

(Effective from 2015-16 and onwards)

	Language	**Vocational**		**Core**	**Supportive**	**Applied**		**Total credit**
	English SL	JOC VOC	I	Molecules of life	Cell biology	Tools and technique of biochemistryI	Laboratory Course-I	
	8	4		5	4	4	5	30
I	English SL	JOC VOC	II	Enzymology	Protein biochemistry	Protein purification techniques	Laboratory Course-II	
	8	4		5	4	4	5	30
	English SL	JOC VOC	III	Metabolism I (Carbohydrate and lipids)	Hormone biochemistry and function	Membrane biology and bioenergetics	Laboratory Course-III	
	8	4		5	4	4	5	30
	English SL	JOC VOC	IV	Metabolism II (Aminoacds and nucleotides)	Gene organization replication and repair	Immunology	Laboratory Course-IV	
				5	4	4	5	30
	Research methodology-I	Project	V	Gene expression and regulation	Bioinformatics	Nutritional biochemistry	Laboratory Course-V/project	
				5	4	4	5	30
	Research methodology-II	Project	VI	Recombinant DNA technology	Plant biochemistry	Clinical biochemistry	Laboratory Course-VI/project	
				5	4	4	5	30

Semester I

BCHC-1: MOLECULES OF LIFE (THEORY)
SEMESTER - I

CREDITS: 5

Unit 1 The foundations of biochemistry
Cellular and chemical foundations of life

Unit 2 Water
Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 3 Carbohydrates and glycobiology
Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates

Unit 4 Lipids
Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments

Unit 5 Amino acids
Structure and classification, physical, chemical and optical properties of amino acids

Unit 6 Nucleic acids
Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit 7 Vitamins
Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

BCHS-1 : CELL BIOLOGY (THEORY)
SEMESTER - I

CREDITS: 4

Unit 1 Introduction to cell biology
Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models.

Unit 2 Tools of cell biology
Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.

Unit 3 Structure of different cell organelles
Structure of nuclear envelope, nuclear pore complex. ER structure. Organization of Golgi. Lysosome. Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome.

Unit 4 Protein trafficking
Selective transport of proteins to and from the nucleus. Regulation of nuclear protein import and export. Targeting proteins to ER, smooth ER and lipid synthesis. Export of proteins and lipids from ER and into ER. Lipid and polysaccharide metabolism in Golgi. Protein sorting and export from Golgi. Mechanism of vesicular transport, cargo selection, coat proteins and vesicle budding, vesicle fusion. Protein import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit 5 Cytoskeletal proteins
Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella.

Unit 6 Cell wall and extracellular matrix
Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

Unit 7 Cell cycle, cell death and cell renewal
Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.

BCHA-1 : TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEMESTER – I

CREDITS : 4

Unit I Hydrodynamic methods Sedimentation – sedimentation velocity, preparative and analytical ultracentrifugation techniques, determination of molecular weight by hydrodynamic methods (derivations excluded and numerical included).

Unit II Measurement of pH Principles of glass and reference electrodes, types of electrodes, complications of pH measurement (dependence of pH on ionic strength, electrode contamination and sodium error) and use of pH paper.

Unit III Radioisotopic techniques Types of radioisotopes used in Biochemistry, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid and stripping), isotopes commonly used in biochemical studies – ^{32}P, ^{35}S, ^{14}C and ^{3}H), Autoradiography. Biological hazards of radition and safety measures in handling radioisotopes. Biological applications.

Unit IV Spectroscopic techniques Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic techniques (structure elucidation and numerical excluded). Principle and application of NMR, ESR, Mass spectroscopy. Fluorescent and emission spectroscopy.

Unit V Immunological Techniques Immunodiffusion, Immuno electrophoresis, radioimmunoassay, ELISA, immunofluorescence

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BCH Laboratory course -I

Unit 1 Biochemical reagents and solutions

Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.

Exercise

- Preparation of a buffer of given pH and molarity.

Unit 2 Spectrophotometric techniques

Principle and instrumentation of UV-visible and fluorescence spectroscopy.

Exercises

- Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).
- Measurement of fluorescence spectrum.
- Determination of concentration of a protein solution by Lowry/BCA method.

Unit 3 Introduction and importance of virtual labs in biochemistry

Semester II

BCHC-2 : ENZYMES (THEORY)
SEMESTER – II

CREDITS: 5

Unit 1 Introduction to enzymes
Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes.]

Unit 2 Features of enzyme catalysis
Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.

Unit 3 Enzyme kinetics
Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. K_m and V_{max}, K_{cat} and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme.

Unit 4 Bisubstrate reactions
Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).

Unit 5 Enzyme inhibition
Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors.

Unit 6 Mechanism of action of enzymes
General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues.

Unit 7 Regulation of enzyme activity
Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage- zymogen**.** Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit 8 Involvement of coenzymes in enzyme catalysed reactions
TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid.

Unit 9 Applications of enzymes
Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

SEMESTER – II

BCHA-2 Protein Biochemistry

CREDITS: 4

Unit 1 Introduction to amino acids, peptides and proteins
Amino acids and their properties - hydrophobic, polar and charged. Biologically important peptides - hormones, antibiotics and growth factors. Multimeric proteins, conjugated proteins and metallo proteins. Diversity of function

Unit 2 Extraction of proteins for downstream processing
Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation.

Unit 3 Separation techniques
Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization. Ion-exchange chromatography, molecular sieve chromatography, hydrophobic interaction/reverse phase chromatography, affinity chromatography, HPLC and FPLC

Unit 4 Characterization of proteins
Determination of purity, molecular weight, extinction coefficient and sedimentation coefficient, IEF, SDS-PAGE and 2-D electrophoresis.

Unit 5 Covalent structure of proteins
Organization of protein structure into primary, secondary, tertiary and quaternary structures. N-terminal and C-terminal amino acid analysis. Sequencing techniques - Edman degradation. Generation of overlap peptides using different enzymes and chemical reagents. Disulfide bonds and their location. Mass spectrometric analysis, tandem MS. Solid phase peptide synthesis

Unit 6 Three dimensional structures of proteins
Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Dihedral angles psi and phi. Helices, sheets and turns. Ramachandran map. Techniques used in studying 3-D structures - X-ray diffraction and NMR. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin

Unit 7 Protein folding and conformational diseases
Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding and molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases –Alzheimer's and Prion based.

Unit 8 Introduction to protein structure databases
Protein sequence and structure databases (PDB). Use of sequence and domain information. Viewing protein structures using *in silico* tools.

Unit 9 Myoglobin and haemoglobin

Oxygen binding curves, influence of 2,3-BPG, CO_2 and Cl^-. Hill plot. Cooperativity between subunits and models to explain the phenomena - concerted and sequential models. Haemoglobin disorders.

Unit 10 Specialized proteins - antibodies and actin-myosin motors

Antibody structure and binding to antigens. ATP activated actin - myosin contractions.

Unit 11 Membrane proteins

Integral and membrane associated proteins. Hydropathy plots to predict transmembrane domains. Significance of membrane proteins - bacteriorhodopsin.

Semester II

BCHA-2 :
TOOLS AND TECHNIQUES IN BIOCHEMISTRY SEMESTER – II

CREDITS: 4

Unit I Chromatography General principles and applications of :

1. Adsorption chromatography
2. Ion-exchange chromatography
3. Thin-layer chromatography
4. Molecular-sieve chromatography
5. Hydrophobic chromatography
6. Gas-liquid chromatography
7. HPLC
8. Affinity chromatography
9. Paper chromatography

Unit II Electrophoresis Basic principles of agarose electrophoresis, PAGE and SDS-PAGE, Two-dimensional electrophoresis, its importance. Isoelectrofocussing.

Unit III Centrifugation

Sedimentation, preparative analar centrifugation

Unit IV Nucleic acid related techniques

Sanger dideoxy method, Maxam Gilbert, Southern blotting , Nothern blotting, western blotting, Micro array, Hybridisation methods

BCH Laboratory course –II

1. Qualitative tests for :
   a. Carbohydrates
   b. Proteins and amino acids
   c. Lipids
2. Determination of saponification value and iodine number of fats.
3. Estimation of ascorbic acid.
4. Titration curve for amino acids and determination of pK value.
5. Verification of Beer-Lambert's law.
6. Estimation of
   i) Carbohydrate by anthrone method.
   ii) Blood glucose by the methods (a) Folin-Wu, (b) Nelson-Somogyi
7. Estimation of amino acids by ninhydrin method.
8. Isolation and assay of glycogen from rate liver.
9. i) Extraction of total lipids by Folch method
   iii) Estimation of food adulterant.
10. Estimation of DNA and RNA.
11. Separation of sugars using paper chromatography.