DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. SU/Sci./19/2016

It is hereby inform to all concerned that, on the recommendation of the Committees, the Hon'ble Vice-Chancellor has **accepted the syllabi in Honors Pattern of 1) B.Sc.Bio-Chemistry III & IV Semester ,2) B.Sc.Computer Science III & IV Semester, 3) B.Sc. Biotechnology III & IV Semester under Credit Based System** in his emergency powers under Section-14[7] of the Maharashtra Universities Act, 1994 on behalf of the Academic Council.

This is effective from the Academic Year 2016-17 & onwards as appended herewith under the Faculty of Science.

These syllabi are also available on the university website www.bamu.ac.in.

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/2016/4462-68

Date:- 20-07-2016.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to :-

1] The Principal, Model College, Ghansawangi,
Dr. Babasaheb Ambedkar Marathwada University.

Copy to :-

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

N.B. : All are informed that to download a copy of syllabus from the above website.

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Syllabus of

B.Sc. BioChemistry

Semester–III & IV

UNDER HONORS PATTERN

Run at Model College, Ghansawangi

[Effective from 2016-17 & onwards]

Bsc Biochemistry syllabus for Ghansawangi model college

Course structure

	Language	Vocational		Core	Supportive	Applied		Total credit
	English SL	JOC VOC	I	Molecules of life	Cell biology	Tools and technique of biochemistryl	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 (Aminoacids 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

BCHC-3 : METABOLISM OF CARBOHYDRATES AND LIPIDS (THEORY)

SEMESTER - III

CREDITS: 5

Unit 1 Basic design of metabolism
Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell.

Unit 2 Glycolysis
Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia.

Unit 3 Gluconeogenesis and pentose phosphate pathway
Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance.

Unit 4 Glycogen metabolism
Glycogenesis and glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.

Unit 5 Citric acid cycle
Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle, glyoxalate pathway, coordinated regulation of glyoxalate and citric acid pathways.

Unit 6 Synthesis of carbohydrates
Calvin cycle, regulation of calvin cycle, regulated synthesis of starch and sucrose, photorespiration, C_4 and CAM pathways, synthesis of cell wall polysaccharides, integration of carbohydrate metabolism in plant cell.

Unit 7 Fatty acid oxidation
Digestion, mobilisation and transport of cholesterol and triacyl glycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis.

Unit 8 Fatty acid synthesis
Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.

Unit 9 Biosynthesis of eicosanoids, cholesterol, steroids and isoprenoids
Synthesis of prostagladins, leukotrienes and thromboxanes. Synthesis of cholesterol, regulation of cholesterol synthesis. Synthesis of steroids and isoprenoids.

Unit 10 Biosynthesis of membrane lipids
Synthesis of membrane phospholipids in prokaryotes and eukaryotes, respiratory distress

syndrome, biosynthesis of triacylglycerol, biosynthesis of plasmalogens, sphingolipids and glycolipids, lipid storage diseases.

Unit 11 Starve-feed cycle

Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

BCHS 3
HORMONE : BIOCHEMISTRY AND FUNCTION (THEORY)
SEMESTER – III

CREDITS: 4

Unit 1 Introduction to endocrinology
Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.

Unit 2 Hormone mediated signaling
Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP_3, DAG, Ca^{2+}, NO. Effector systems - adenyl cyclase, guanyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk.

Unit 3 Hypothalamic and pituitary hormones
Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus.

Unit 4 Thyroid hormone
Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease.

Unit 5 Hormones regulating Ca^{2+} homeostasis
PTH, Vitamin D and calcitonin. Mechanism of Ca^{2+} regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.

Unit 6 Pancreatic and GI tract hormones
Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II.

Unit 7 Hormones of adrenals
Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome.

Unit 8 Reproductive hormones
Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception.

Unit 9 Growth factors
PDGF, EGF, IGF-II, and erythropoietin.

BCHA-3

MEMBRANE BIOLOGY AND BIOENERGETICS (THEORY)

SEMESTER - III

CREDITS: 4

Unit 1 Introduction to biomembranes

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.

Unit 2 Membrane structures

Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.

Unit 3 Membrane dynamics

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Unit 4 Membrane transport

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na^+-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na^+/K^+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Unit 5 Vesicular transport and membrane fusion

Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin.

Unit 6 Introduction to bioenergetics

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 7 Oxidative phosphorylation

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. F_o F_1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit 8 Photophosphorylation

General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and *Halobacterium salinarum*. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

BCH Laboratory course –III

CREDITS: 5

1. Estimation of blood glucose.
2. Sugar fermentation of microorganisms.
3. Assay of salivary amylase.
4. Isolation of lecithin, identification by TLC, and its estimation.
5. Isolation of cholesterol from egg yolk and its estimation.

BCHC-4 : METABOLISM OF AMINO ACIDS AND NUCLEOTIDES (THEORY)

SEMESTER - IV

CREDITS: 5

Unit 1 Overview of amino acid metabolism

Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Digestion and absorption of dietary proteins. Protein calorie malnutrition - Kwashiorkar and Marasmus. Nitrogen balance, transamination, role of pyridoxal phosphate, glucose-alanine cycle, Kreb's bicycle, urea cycle and inherited defects of urea cycle.

Unit 2 Catabolism of amino acids

Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids. Metabolism of one carbon units. Disorders of amino acids metabolism, phenylketonuria, alkaptonuria, maple syrup urine disease, methylmalonic acidemia (MMA), homocystinuria and Hartnup's disease.

Unit 3 Biosynthesis of amino acids

Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation.

Unit 4 Precursor functions of amino acids

Biosynthesis of creatine and creatinine, polyamines (putresine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA). Porphyrin biosynthesis, catabolism and disorders of porphyrin metabolism.

Unit 5 Biosynthesis of purine and pyrimidine nucleotides

De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways.

Unit 6 Deoxyribonucleotides and synthesis of nucleotide triphosphate Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates, biosynthesis of coenzyme nucleotides.

Unit 7 Degradation of purine and pyrimidine nucleotides

Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.

Unit 8 Integration of metabolism

Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

BCHS 4
Gene organization replication and repair

SEMESTER – IV

CREDITS: 4

Unit 1 Structure of DNA

DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA.

Unit 2 Genes and genomic organization

Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.

Unit 3 Replication of DNA

The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of E. coli chromosome, relationship between replication and cell division, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.

Unit 4 Recombination and transposition of DNA

Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.

Unit 5 Molecular basis of mutations

Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test.

Unit 6 Various modes of DNA repair

Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair, translesion DNA synthesis.

BCHA-4

IMMUNOLOGY (THEORY)
SEMESTER - IV

CREDITS: 4

Unit 1 Cells and organs of the immune system
Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT).

Unit 2 Innate immunity and leukocyte extravasation
Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Unit 3 Immunogens and antigens
Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Unit 4 Antibody structure and function
Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family.

Unit 5 Generation of receptor diversity
Dreyer-Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

Unit 6 Biology of the B lymphocyte
Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response, anatomical distribution of B cell populations.

Unit 7 Complement system
Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation,
regulation and complement deficiencies.

Unit 8 MHC complex and antigen presentation
General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation.

Unit 9 Biology of the T lymphocyte
Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

Unit 10 Cell mediated cytotoxic responses
General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit 11 Tolerance, autoimmunity and hypersensitivity
Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, 35antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity.

Unit 12 Transplantation immunology and vaccines
Immunological basis of graft rejection, clinical manifestatio
ns, immunosuppressive therapyand privileged sites. Vaccines - active and passive immunization, types of vaccines.

BCH Laboratory course –IV

CREDITS: 5

1. Effect of lipid composition on the permeability of a lipid monolayer.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O_2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.
8. Isolation of lymphocytes from blood and macrophages from peritoneal cavity or spleen.
9. Purification of immunoglobulins.
10. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
11. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.