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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22/7/16
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.

Revised Syllabus of

B.Sc. BIOTECHNOLOGY

SECOND YEAR

THREE YEAR HONORS DEGREE COURSE

Semester–III & IV

Run at Model College, Ghansawangi

[Effective for 2016-17]

B. Sc. Biotechnology Scheme for Semester III

Sr. No	Curriculum	Name of the subject	Teaching Plan (Credits) Contact hours each week				Evaluation Scheme (Marks)		
			Lec.	Pr.	Total con. Hr	Credits	Th.	Pr.	Total Marks
01	Indian Language	Marathi/Hindi	02	04	04	04	60	40	100
02	English	English	02	04	04	04	60	40	100
03	A. Major Core	A. Central Dogma	03	04	05	05	60	40	100
		B.Introduction to Physiology	03	04	05	05	60	40	100
04	B. Major Supportive	Introductory Enzymology	02	04	04	04	60	40	100
05	C. Major Applied	Microbial diversity, food and dairy microbiology	02	04	04	04	60	40	100
06	JOSS	Job Oriented Soft Skills	02	-	02	02	50	-	50
07	VOC	Value Oriented Course	02	-	02	02	50	-	50
Total			18	24	42	30	460	240	700

B. Sc. Biotechnology Scheme for Semester IV

Sr. No	Curriculum	Name of the subject	Teaching Plan (Credits) Contact hours each week				Evaluation Scheme (Marks)		
			Lec.	Pr.	Total con. Hr	Credits	Th.	Pr.	Total Marks
01	Indian Language	Marathi/Hindi	02	04	04	04	60	40	100
02	English	English	02	04	04	04	60	40	100
03	A. Major Core	Gene Expression	03	02	05	05	60	40	100
		Development Biology	03	02	05	05	60	40	100
04	B. Major Supportive	Advanced & Applied Enzymology	02	02	04	04	60	40	100
05	C. Major Applied	Environmental and Agricultural Microbiology	02	02	04	04	60	40	100
06	JOSS	Job Oriented Soft Skills	02	-	02	02	50	-	50
07	VOC	Value Oriented Course	02	-	02	02	50	-	50
Total			18	24	42	30	360	240	700

B. Sc. Biotechnology Part II (Semester III)

Paper V **Central Dogma (Core B -30 hours -3 Cr. Th)**

Unit 1. **Perpetuation of genetic material**

Replicon: Definition, types of bacterial replicon, eukaryotic replicon, Extrachromosomal replicon –plasmid, virus, mitochondria and chloroplast. Experimental evidences of bidirectional replication.

Replication in Prokaryotes –*Escherichia coli* replication as role model, DNA polymerases –with reference to their functional properties, formation of replication fork, primer formation, replication on leading and lagging strand, termination of replication.

Eukaryotic DNA replication: Origin Recognition Complex, Licensing factor, components of replicase and other polymerases. Replication fork –experimental proof for multiple replication forks in eukaryotes. Process of replication, initiation, elongation and termination.

Replication of Extrachromosomal material, plasmid replication –rolling circle, plasmid partitioning, plasmid incompatibility, mitochondrial DNA replication,

Unit 2. Trans**cription**

Prokaryotic transcription

Transcription in *Escherichia coli* -a role model for prokaryotes –RNA polymerase:- structural components and assembly of core and holoenzyme.

Transcrition initiation- Bacterial transcription; RNA Polymerase, transcription initiation, transcription elongation, transcription termination and antitermination.

Eukaryotic transcription

RNA polymerases

Transcription initiation; Transcription elongation; Transcription termination

Unit 3 **Translation**

Prokaryotic translation –translation initiation, ribosome assembly, RBS – Shine Dalgarno sequence, initiation codon, initiation complex, initiator tRNA, P site,A site and E site –their relevance in translation, translocation,**Translation elongation** structural different between initiator tRNA and methionine tRNA during elongation, transpeptidation and chain elongation. Translation fidelity.**Translation termination** factors and release of ribosomes and their recycling.

Eukaryotic translation: T r a n s l a t i o n I n i t i a t i o n ; Formation of initiation complex, P site, A site and E site, their role during mRNA translation. **Translation elongation;** comparative studies of elongation with *E. coli*.

Translation termination; factors, release of ribosomes and recycling, regulation.

References:

1. Molecular Biology –David Frifelder
2. Genes IX –Benjamin Lewin
3. Molecular biology of the gene J. D. Watson and *et. al.,*
4. Molecular Biology of the Cell –Bruce Alberts and *et. al.,*

Section B –Central Dogma
(practical component)

1. Demonstration of Mitosis –onion root tips experiment
2. Meiosis slide demonstration (permanent slides)
3. Plasmid DNA isolation
4. Plasmid Curing
5. Isolation of total proteins from bacterial cell.

B. Sc. Biotechnology Part II (Semester III)

Paper V **Introductory Physiology (Core B -30 hours -3 Cr. Th)**

Unit 1. Elements of Animal Physiology

Definition of digestion, types of digestion – (extra and intracellular), general principles of digestion

Definition of excretion; Forms of nitrogenous waste material and their formation;

Types of respiration – external and internal respiration;

Transport of oxygen and CO_2

General structure and types of muscles, Ultra structure of skeletal muscle.

Structure of nerve cell; Nature and Properties of nerve impulse

Hormones of hypothalamus, Adenohypophysis, Neurohypophysis, pineal gland, thyroid gland, parathyroid, thymus, adrenal and pancreas. (Names and functions)

Concept of Homeostasis and its basic working mechanism. (giving three illustrations viz., Hormonal control of glucose levels, Water and ionic regulation by freshwater and marine animals and temperature regulation in man.)

Unit 2. Photobiology of plants

Significance, site of photosynthesis, pigments, photochemical phase. Electron transport chain. Photophosphorylation, (cyclic and non cyclic). Biosynthetic phase, Calvin cycle, C3 and C4 pathways. Photorespiration, Crassulacean Acid Metabolism, factors affecting photosynthesis.

function and mechanisms of action of phytochromes, cryptochromes and phototropins; photoperiodism and biological clocks. Brief account only.)

Unit 3. Elements of Plant Physiology

Plant Cell as a physiological unit. Osmosis, Imbibition. Diffusion, D.P.D. Water potential, Absorption of water, (active & passive). Plasmolysis, cohesion, tension and transpiration pull theory. Significance, factors affecting transpiration,

Phases of growth, growth curve. Plant growth regulators - Auxins, Gibberillins, Cytokinins Ethylene, Absisic acid - physiological functions only. Senescence - brief account only.

Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

Reference books

1. 'Essentials of Animal Physiology' by S.C.Rastogi'
2. 'Animal Physiology' by H.C. Nigam.
3. 'Biology' by Campbell & Reece.
4. 'Animal Physiology' – Agarwal, R.A. Srivastava, Kaushal, Anil and Kumar.
5. 'Animal Physiology and Biochemistry' by Dr. B.Annadurai.
6. 'Principles of Animal Physiology' by Christopher D.Moyes, Patricia M Schulte.
7. 'Biology: The Science of Life' by R.A. Wallace, G.P. Sanders & R.J. Ferl.
8. 'Biology: Concepts and Applications' by Starr
9. Bilgrami K.S & Dube - A text book 0n Modern Plant Pathology. Vikas Publishing House, New Delhi.
10. Develin & Witham - Plant Physiology-C.B.S.Publishers.
11. Fritsch F.E - Structure and reproduction of Algae. Vol 1 and Vol II Cambridge University Press London.
12. Kumar & Purohith - Plant Physiology. Fundamentals- Agrobios.
13. Kumar. H.D& Singh A.N - A text book on Algae. Chand & Company.
14. Malik C.P & Srivastava.- A text book of Plant Physiology Kalayani Publishing Co. New Delhi.
15. Pandae & Trivedi - A text book of Fungi, Bacteria and Virus Vikas Publishing House New Delhi.
16. Parihar N.S - An introduction to Bryophyta Central Book Depot Allahabad

17. Smith G.M Cryptagamic Botany Vol 11Mc Grae Hill Co. New Delhi.
18. Smith K.M - A text book of Plant diseases S. Chand & Company.
19. Sporne K.R. - Morphology of Pteridophytes.- Hutchins university Library . London.
20. Vashista P.C. - Gymnosperms—S. Chand & Company. New Delhi
21. Vasistha B, - Bryophyta, S. Chand & Company.
22. Willam G. Hopkins. - Introduction to Plant Physiology. John Wiley.
23. Robert A Wallace. Biology, The world of life. Harper Collins

B. Sc. Biotechnology Part II (Semester III)

Supportive (**Introductory Enzymology**)

Unit 1 Introduction to enzymes

Introduction & Definition of Enzymes, Historical Development in Enzymology, Enzyme Vs Chemical Catalysts Coenzymes, Cofactors, Apoenzymes, Holoenzyme, .Isoenzymes and multiple forms of enzymes , Characteristics of enzymes, Concept of active centre, binding sites, Enzyme mechanism & Activation Energy, Enzyme Specificity, , Fischer and Koshland Models Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes,

Unit 2 enzyme kinetics

ES complex formation Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of Vmax and Km, Graphical procedures in enzymology - advantages and disadvantages of alternate plotting.

Enzyme inhibition - types of inhibitors - competitive, noncompetitive and uncompetitive, their mode of action and experimental determination ,

Unit 3: Enzyme isolation and purification

Introduction, Criteria for selection of tissue/ organism, Enzyme solubilization techniques,Techniques used for enzyme isolation, Methods of enzyme purification, Fractionation of the proteins on the basis of solubility in aqueous solutions of salts or organic solvents, Chromatographic separation of the enzymes (brief discussion on applications of Ion exchange chromatography Adsorption chromatography Gel filtration (Molecular sieve) chromatography Affinity chromatography in enzyme separation)

Miscelleneous methods: Electrophoretic techniques, Ultrafiltration Dialysis Crystallization

Criteria of purity of the enzymes, Preparation of purification table, Characterization of enzymes Determination of molecular weight of the enzyme protein, Sodium dodecyl sulfate (SDS) polyacrylamide gel electrophoresis for subunit molecular weight determination,

Suggested Readings :

1. Dixon & Webb –Enzymes; Academic press New York
2. A.L. Lehninger- Biochemistry
3. A.L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
4. Cohn & Stump – Outline of Biochemistry; Wiley Eastern Ltd.
5. LubertStryer – Biochemistry
6. R.L. Foster – The nature of Enzymology; Croom-Helm London

7. Harpers -Review of biochemistry –;Prentice HallNew york
8. R.A. Copeland -Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis,; John Wiley and Sons Inc.

Zuby,Parson, and Vanse –principles of Biochemistry; Wm.C. Brown Publishers

B. Sc. Biotechnology Part II (Semester III)

Applied

Microbial diversity, food and dairy microbiology

Unit I Algae, Fungi and Protozoa, eubacteria, Gram positive aerobic, Gram positive anaerobic, Gram negative facultative anaerobic, Gram negative anaerobic.

Units II –Dairy Microbiology; milk definition, sources of contamination, Microbial count, pasteurization, milk products.

Unit III –Food preservations, radiation, low temperature, high temeperature, chemicals, antimicrobials, FDS, ISI, and EPA.

Reference Books –

1. Brocks Biology of Microorganisms. 8th Edition by Michael T. Madigan, John M. Martinko. Jack Parker.
2. Microbiology by Pelczar.
3. Microbial Diversity by Colwd, D. 1999, Academic Press.
4. Microbiology: Dynamics and Diversity by Perry.
5. Microbial Ecology. Fundamentals and Applications by Ronald M. Atlas and Richard
6. Food Microbiology. 2nd Edition By Adams
7. Basic Food Microbiology by Banwart George J.
8. Food Microbiology: Fundamentals and Frontiers by Dolle
9. Dairy Microbiology by Robinson.
10. Applied dairy Microbiology, by Elmer H. Marth , James L. Steele
11. Text book of modern pathology by Dube H.C. and Bilgrami. K.S.(1976) Vikas publishing house. New Delhi

PRACTICAL

1 Isolation of *Staphylococcus aureus* from spoiled food samples.

2 Isolation of *Salmonella typhi* from spoiled food samples.

3 Standard plate count of milk.

4 Determination of quality of milk by MBRT test.

5 Phosphatase test for Pasteurised milk sample

6. Isolation of Fungi from soil and water samples.

7.. Isolation of Actinomycetes from soil and water samples.

8. Isolation of bacteria from soil and water samples

9. Study of algae and protozoa.

10. Isolation of thermophiles from soil.

11. Isolation of Acidophiles from soil.

B. Sc. Biotechnology Part II (Semester IV)

Paper VII **Gene Expression (Core B -30 hours -3 Cr. Th)**

Unit 1: Basics of Gene Expression

Regulatory elements/factors: (Inculcate concepts with suitable examples for; Cis-acting elements,Trans-acting factors. Exceptional proteins behaving Cis-acting).Regulation of transposition of Tn3 and Tn9. Modifications of Cis-acting elements to influence and to affect regulation. Influencing or affecting gene expression as a presence/or absence of functional form of protein factor. Concept of Activator, Co- activator, Repressor (with suitable examples). Examples with mechanisms; specific regulator and global regulator.

DNAproteininteractions,RNAproteinInteractions– conditions favoring and affecting these interactions (to be dealt with ref to Motifs).

Unit 2: Bacterial Gene Expression and regulation

Concept of Operon, Regulation of gene expression; **positivecontrol**–the *ara* operon,**negativecontrol**–paradigm the *lac* operon and **attenuation mediated control** or post-transcriptional regulatory control–the *trp* operon. (Mustinclude structural organization of above operons, functional relevance of genes within, regulatory circuit,modes by which the operon can be regulated other than above mentioned mode.) Concept of Catabolite Repression. Examples of non-catabolite sugars and their regulation, catabolite repression in amino acid metabolism–examples at molecular level.

Unit3 Eukaryotic Gene Expression and regulation

Activators:-gene specific and generalized type of activator.Domains of activators, proteinand DNA/or RNA binding domain. Modification of activator.Enhancer mediated gene expression – examples. Gene expression of metallothionin egeneexpression. Response elements suchas; steroid hormone response elements, metal response elements, Basal Expression response elements.Regulation of gene expression at a step of activation of basal apparatus, Postinitiation gene expression– mechanism of relieving roadblock (stuttering of RNA polymerase) with example.Regulation of mRNA molecules involving both nonstop and nonsense mechanisms Gene regulation with example–posttranscriptional–yeastand *Drosophila* genes, insulators in

genomic imprinting–concept and example.

References:

1. Biochemistry–Lehninger
2. PrinciplesofBiochemistry–NelsonandCox
3. Microbialgenetics–DavidFrifelder
4. MolecularBiology–DavidFrifelder
5. Genes –IX
6. Genes -X
7. Principlesofgenemanipulations–OldandPrimrose
8. Biochemistry–JeremyM.Berg,JohnL.Tymoczko,andLubertStryer
9. PrinciplesofGeneManipulationsLPEPearson-Watson
10. Genetics–Strickberger

Gene Expression (Practical Component)

1 **IsolationofLactosenegativemutants**
2 Study of catabolite repression with the example of *gal* operon
3 Study of non-catabolite repression.
4 Study of impact of catabolite repression on amino acid metabolism
5 Yeastâ-galactosidase assay.
6 Two-hybrid system demonstration (demonstration thru kit–could be asked in examination).
7 Isolation of Trptophan negative mutant and theoretical mapping.
8 Isolation of Arabinose negative mutant and theoretical mapping.
9 Study of the β-galactosidase assay of the *lacY* and *lacZ* mutants.
10 Study of mutants isolated with mutagen with reference to differential- galactosidase activity.

B. Sc. Biotechnology Part II (Semester IV)

Paper VIII **Developmental Biology (Core B -30 hours -3 Cr. Th)**

Unit 1 Developmental Biology an overview

Introduction of animal development:Development among unicellular eukaryotes– *Acetabularis,Naegleria*.The origins of sexual reproduction. Fertilization: structure of gamets, recognition of sperm and egg–action at distance and contact of gametes. Cleavage: Patterns of embryonic cleavage, radial holoblastic cleavage, spiral holoblastic cleavage, mechanisms of cleavage–regulation of cleavage cycles.

Unit 2 Early Embryonic Development ,Cell death and regeneration

Gametogenesis,Fertilization,Embryo sac development and double fertilization in plants, blastula formation, Types of Cleavage, Gastrulation and formation of germlayers in animals. Study of extra-embryonic membrane in chick, concept of regeneration programmed cell death and aging and senescence

Unit3 Morphogenesis and organogenesis in animals

Cell aggregation and differentialin *Dictyostelium;* axes and pattern formation in *Drosophila,*organogesis–vulva formation in *Caenorhabditis elegans;* eyelens induction, limb development invetebrates, neuron differentiation,-larval formation, metamorphosis; environmental regulation of normal development.

References:

1. Developmental Biology by Scott Gilbert-9th edition
2. Balinsky–An introduction to embryology CBScollege Publishers
3. LodishH,*et.al.,* Molecular Cell Biology
4. Alberts Bruce, *et.al.,* MolecularBiologyoftheCellSinauer
5. Grant–Biology of Development systems, Holt.Reihart,Winston.
6. Developmental Biology website companion to Gilbert- http://www.devbio.com/contents.php

PRACTICALS

–Developmental Biology

1. Study of meiosis in Grasshopper testis/ onion buds
2. Study of development of frog embryo from permanent slides (at least five)

3. Study of different types of cancer cell

B. Sc. Biotechnology Part II (Semester III)

Supportive (**Advanced and Applied Enzymology)**

Unit 1: Regulatory Enzymes &Structure Function Relations:

Allosteric enzymes with their properties, Regulatory role of allosteric enzymes in metabolism, Mechanism of ALLOSTERIC INTERACTIONS:Protein ligand binding including measurements, analysis of binding isotherms, co-operativity Hill and Scatchard plots and kinetics of allosteric enzymes
Modes of enzyme regulation: Allosteric regulationProduct inhibition, feedback control, enzyme induction and repression and covalent modification.
Specific examples of enzymes with respect to Structure Function Relations
Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase, : PFK-1, Fructose 1, 6 Bisphosphataseglutamine synthetase and phosphofructo kinase. Multi enzyme complexes - pyruvate dehydrogenase and fatty acid synthetase; Na - K ATPase.

Unit 2: Immobilized Enzymes:
Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids) , microencapsulation and gel entrapment. Immobilized multienzyme systems
Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors
Unit 3: Enzyme DisoredersIn Humans
Enzyme involved, diagnostics, physiological effects, physical impact (if any), treatment and cure, prevention of manifestation of following disordersTay-Sachs Disease, Gaucher's Disease, Galactosemia, MethylmalonicAcidemia, Propionic Acidemia, Alkaptonuria, Phenylketonuria G6PD Deficiency,Congenital Adrenal Hyperplasia, Pyruvate Kinase Deficiency.

Suggested Readings :

1. Dixon & Webb –Enzymes; Academic press New York
2. A.L. Lehninger- Biochemistry
3. A.L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
4. Cohn & Stump – Outline of Biochemistry; Wiley Eastern Ltd.
5. LubertStryer – Biochemistry

6. R.L. Foster – The nature of Enzymology; Croom-Helm London
7. Harpers -Review of biochemistry –;Prentice Hall New york
8. R.A. Copeland -Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis,; John Wiley and Sons Inc.
9. Zuby,Parson, and Vanse –principles of Biochemistry; Wm.C. Brown Publishers

B. Sc. Biotechnology Part II (Semester IV)

Applied **(Environmental and Agricultural Microbiology)**

Unit – I Soil microorganisms,
Symbiosis, Neutralism, Commensalism, Competition, Ammensalism,
Synergism, Parasitism.

Unit II Rhizospheric microflora and its role
Composting and humus formation
Carbon, Nitrogen, Sulphur, Phosphorous Cycles.

Unit III Biofertilizers: Bacterial, Cyanobacterial , fungal
Biopesticides : Bacterial, Viral, Fungal

Reference Books –

1. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Publishing Co.
2. Martin A. (1977) An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
3. Subba Rao N. S. (1977) Soil Microbiology, 4th Ed., Oxford & IBH Publishing Co. Pvt. Ltd.

1. Ralph Mitchell (1974) Introduction to Environmental Microbiology Prentice-Hall,
2. Microbiology by Pelczar.

PRACTICAL

1. Isolation of Rhizospheric micro organism.
2. Isolation of Rhizobium from root nodules.
3. Isolation of Azotobacter from soil.
4. Production of Azotobacter biofertilizer.

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