

**CIRCULAR NO.SU/B.Sc./CBC&GS /69/2023**

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies, Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc. Biotechnology (Optional)	IIIrd & IVth semester
2.	B.Sc. Microbiology (Optional)	IIIrd & IVth semester
3.	B.Sc. Information Technology (Optional)	IIIrd & IVth semester
4.	Bachelor of Computer Application (Optional)	IIIrd & IVth semester
5.	B.Sc.Polymer Chemistry (Optional)	IIIrd & IVth semester
6.	B.Sc.Computer Science (Degree)	IIIrd & IVth semester
7.	Honors Degree of Computer Science	IIIrd & IVth semester
8.	Honors Degree of Biotechnology	IIIrd & IVth semester

This is effective from the Academic Year 2023-24 and onwards.

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

University Campus,
Aurangabad-431 004.

REF.NO.SU/2023/ 1241-49

Date:- 12.06.2023.

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*Deputy Registrar,
Academic Section*

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**
- 2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
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- 7] The Record Keeper, Dr.BAMU,A'bad.

Dr. Babasaheb Ambedkar Marathwada University
Aurangabad- 431004(MS) India



Undergraduate Bachelor Degree Program
In Science(B.Sc.)
BIOTECHNOLOGY (optional subject)

Course Structure and Curriculum
(Outcome based Curriculum)

Third and Fourth Semester
Choice Based Credit System
(Effective from Academic Year 2023-24)

Dr. Babasaheb Ambedkar Marathwada University
Aurangabad – 431004 (MS) India

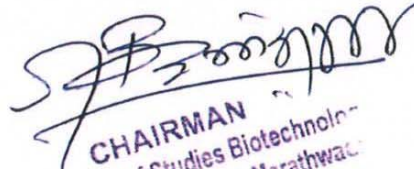
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Ad-Hoc Board of Studies Biotechnology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Structure and Curriculum for
Bachelor of Science (B. Sc.) BIOTECHNOLOGY
(Optional subject)
(Choice Based Credit System)

Semester III								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1C) Core Courses	BTO-311	Metabolism and Bioenergetics (Theory Paper-V)	2 hours	2	50	10	40	20
	BTO-312	Molecular Genetics (Theory Paper-VI)	2 hours	2	50	10	40	20
	BTOP-313	Lab course 2 Metabolism (based on BTO-311)	3 hours	1.5	50	10	40	20
	BTOP-314	Lab course 3 Molecular Genetics (based on BTO-312)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-1)	BTO-315	SEC BT-1(A) MOLECULAR BIOLOGY TECHNIQUES 1 , SEC BT-1 (B) MEDICAL BIOTECHNOLOGY-I	2 hours	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-3)	XXX-331	Communication skills in English-III	3 hours	3	50	10	40	20
	XXX-332	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-III)	3 hours	3	50	10	40	20
Additional credits		Computer	2 hours	2*	50	10	40	20
			18	15	350	70	280	140
Total Credits for Semester III : 15 (Theory : 12 ; Laboratory : 3)								

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Semester IV								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1D) Core Courses	BTO-411	Environmental Biotechnology (Theory Paper-VII)	2 hours	2	50	10	40	20
	BTO-412	Enzymology (Theory Paper-VIII)	2 hours	2	50	10	40	20
	BTOP-413	Lab course 4 Environmental Biotechnology (based on BTO-411)	3 hours	1.5	50	10	40	20
	BTOP-414	Lab course 5 Enzymology 6 (based on BTO-412)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-2)	BTO-415	<u>SEC 2(A) BT-MOLECULAR BIOLOGY TECHNIQUES 2</u> <u>SEC 2 (B) BT- MEDICAL BIOTECHNOLOGY-2</u>	2 hours	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-4)	XXX-431	Communication skills in English-IV	3 hours	3	50	10	40	20
	XXX-432	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-IV)	3 hours	3	50	10	40	20
Additional credits		Computer ability- ENVIRONMENTAL STUDIES	2 hours	2*	50	10	40	20
			18	15	350	70	280	140
Total Credits for Semester IV : 15 (Theory : 12 ; Laboratory : 3)								


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B. Sc. First Year, Semester III
Curriculum for Optional Subject
BIOTECHNOLOGY

Course code	BTO-311
Course title	Metabolism and Bioenergetics
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week</u>
Contact hours	30

Unit: 1

Catabolism and the generation of chemical energy, metabolic strategies, general principles of intermediary metabolism, regulation of pathways, strategies for pathway analysis. Glycolysis, gluconeogenesis and the pentose phosphate pathway, regulation of glycolysis and gluconeogenesis, the pentose phosphate pathway, discovery of the TCA cycle, steps in the TCA cycle, stereochemical aspects of TCA cycle reactions, ATP stoichiometry of the TCA cycle, the glyoxylate cycle oxidation of other substrates by the TCA cycle, regulation of TCA cycle activity.

Unit: 2

The mitochondria, electron transport chain, oxidative phosphorylation, transport of substrates, Pi, ADP and ATP into and out of Mitochondria, Electron transport and ATP synthesis in bacteria.

Unit: 3

Pigments involved in photosynthesis , photoreduction of NAD^+ , light reaction in blue green algae and photosynthetic eukaryotes, dual pigment systems, photosynthetic electron transport, efficiency of light reaction, Calvin cycle, efficiency of dark reaction, comparison of photosynthesis in bacteria, blue green algae and eukaryotes. C_4 pathway for CO_2 fixation.

Unit: 04

Metabolism of Fatty Acids: Fatty Acid Degradation, Biosynthesis of Saturated Fatty Acids, Regulation of Fatty Acid Metabolism.

References:

1. Biochemistry by Lubert Stryer
2. Biochemistry by Lehninger
3. Bioenergetics by Lehninger
4. Biochemistry by Zubey
5. Comprehensive Biotechnology (Vol. 1-4): M.Y.Young (Eds), Pergamon press, Oxford

Course code	BTO-312
Course title	Molecular Genetics
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week</u>
Contact hours	30

Unit: 1

Structure of nucleic acid, eukaryotic nuclear genomes, packaging of DNA into chromosome types, pseudogenes and other gene relics, eukaryotic organelle genomes, physical features and genetic content of organelle genomes, the repetitive DNA content of genomes. Tandomly repeated DNA, Transposons, anatomy of prokaryotic genome: Physical structure, operon concept

Unit: 2

Genome replication: The issues relevant to genome replication, the topological problem, Watson – Crick scheme of DNA replication, variations in semi-conservative theme, DNA topoisomerae. The replication process: initiation, elongation and termination of replication, the diverse functions of topoisomerase, regulation of Eukaryotic genome replication.

Unit: 3

Pseudogenes, synthesis and processing of Non-coding RNA, introns in eukaryotic pre rRNA and pre tRNA. Processing of Pre-RNA by chemical modification, RNA editing, turnovers of mRNAs. Synthesis and processing of the Proteome: Role of tRNA in protein synthesis, amino acylation and Codon-anticodon interaction.

Unit: 4

The genetic code, origin and evolution of Genetic code, ribosome structure, translation, regulation of translation, translation in archea Post-translational processing of proteins, frame shifting, protein folding. Processing by proteolytic cleavage, processing by chemical modification, protein turnover, and degradation of Ubiquittin tagged proteins in the proteasome.

References:

1. Molecular cloning, Sambrook et al, cold spring harbor.
2. Essentials of Molecular Biology, Malacinski and Friefelder Jones and Bartlelt
3. Genomes, T A Brown, John Wiley and sons PTE Ltd.
4. Cell and Molecular Biology, concepts and experiments, Gerald Karp, John Wiley and sons.
5. The cell- A molecular approach, Gm Cooper Asm Press.

Course code	BTOP-313
Course title	Lab course 3 Metabolism (based on BTO-311)
MARKS-	50
Credits	1.5 Cr
Time Duration	<u>3 hours /week.BATCH</u>
Contact hours	45

1. Introduction to measurements: balances and pipetting. Preparation of solutions of given normality and its standardization.
2. pH meter: buffering capacity of a buffer, indicators.
3. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter.
4. Determination of the amount of α -amino nitrogen by the formol titration method.
5. Colorimetry: To determine dissociation constant of a given indicator, calorimetrically and to prepare buffer solutions in the pH range of 2.2 to 8.0
6. Spectrophotometry: Double- beam and recording spectrophotometry, derivatives and difference spectra: Indicators, cytochromes, haemoglobin.
7. To find out the absorption spectrum of a given chromophore and / or oxidized and reduced forms (sodium nitrite and borohydrate).
 - a) Haemoglobin and methemoglobin
 - b) NAD and NADH
 - c) Spectrophotometer absorption spectrum, activity of the fraction.

Course code	BTOP-314
Course title	Lab course 3 Molecular Genetics (based on BTO-312)
MARKS-	50
Credits	1.5 Cr
Time Duration	<u>3 hours /week.BATCH</u>
Contact hours	45

1. Study of conjugation in *E. coli*
 2. Study of transduction in *E. coli*
 3. Plasmid gene mapping in *E. coli*
 4. Tns-5 induced mutagenesis in *E. coli*
 5. Study of mutation in *E. coli*
 6. Isolation of plasmid DNA from different type of bacteria by adopting different methods, purification and calculation of molecular weight of plasmid DNA, plasmid curing (acridine orange, heat shock)
 7. Isolation of genomic DNA from bacteria
 8. Isolation of Genomic DNA from plant cells / animal cells
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Course code	BTO-315 SEC BT-1(A)
Course title	MOLECULAR BIOLOGY TECHNIQUES I
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

Unit I

ISOLATION DNA : Principles, protocols, chemicals, methods, and problems in isolation of DNA from mitochondria, bacterial cell (genomic DNA , plasmid), fungal cell, plant cells animal cells. Quantification of DNA (UV/ Vis) and analysis of purity

Unit II

ELECTROPHORESIS: Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Blotting techniques

Unit III

GENE RECOMBINATION AND GENE TRANSFER

Transformation, Competent cells preparation Transformation, Selection of recombinants – (Antibiotic sensitivity assay/ blue –white screening)

Other methods for gene transfer: Microinjection, Electroporation, Ultrasonication,(brief introduction that include principle, short method, applications)

Unit III

PCR TECHNIQUES

Principle, types, instrumentation, primer-designing and applications of: Polymerase chain reaction (PCR), RT- (Reverse transcription) PCR.

References:

1. Genetics Peter J Russel, The Benjamin/ Qummin publishing Co.
2. Principles of Genetics by Gardner, Siemens.
3. Molecular Genetics by Friefeder.
4. Molecular biology laboratory manual 6th Edn, Cappuccino.
5. Molecular biology and the gene Watson.

Course code	BTO-315 SEC BT-1(B)
Course title	MEDICAL BIOTECHNOLOGY-1
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

Unit-I

Classification of genetic diseases.

Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies,

Structural disorders e.g. deletions, duplications, translocations & inversions, Gene controlled diseases – Autosomal and X-linked disorders,

Unit-II

Molecular basis of human diseases – Pathogenic mutations.

Gain of function mutations: Oncogenes, Huntingtons Disease,.

Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases

Unit-III

Prenatal diagnosis –

Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS),

Non-invasive techniques - Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood.

Unit-IV

Clinical management and Metabolic manipulation – PKU, Familial Hypercholesterolemia,

Rickets, ADA, Congenital hypothyroidism. Gene therapy - *Ex- vivo*, *In-vivo*, *In-situ* gene therapy,

Strategies of gene therapy: gene augmentation

Semester IV

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1D) Core Courses	BTO-411	Environmental Biotechnology (Theory Paper-VII)	2 hours	2	50	10	40	20
	BTO-412	Enzymology (Theory Paper-VIII)	2 hours	2	50	10	40	20
	BTOP-413	Lab course 4 Environmental Biotechnology (based on BTO-411)	3 hours	1.5	50	10	40	20
	BTOP-414	Lab course 5 Enzymology 6 (based on BTO-412)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-2)	BTO-415	SEC 2(A) BT- MOLECULAR BIOLOGY TECHNIQUES 2 SEC 2 (B) BT- MEDICAL BIOTECHNOLOGY-2	2 hours	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-4)	XXX-431	Communication skills in English-IV	3 hours	3	50	10	40	20
	XXX-432	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-IV)	3 hours	3	50	10	40	20
Additional credits		Computer ability	2 hours	2*	50	10	40	20
			18	15	350	70	280	140

Total Credits for Semester IV : 15 (Theory : 12 ; Laboratory : 3)

Course code	BTO-411
Course title	Environmental Biotechnology
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

Unit: 1

Introduction to Ecology and ecosystem. Environmental pollution (Water, soil and Air), noise and thermal pollution, their sources and effects. Waste water (sewage and industrial effluents) treatments: anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic and fermentative bacteria- technical process and condition, emerging biotechnological processes in waste- water treatment.

Unit: 2

Solid waste management: Landfills, composting, earthworm treatment, recycling and processing of organic residues.

Unit: 3

Biodegradation of xenobiotic compounds, organisms involved in degradation of chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants and microbial treatment of oil pollution.

Unit: 4

Microbial leaching and mining: Extraction of metals from ores, recovery of metals from solutions, Microbes in petroleum extraction, Microbial desulfurization of coal. Wasteland: Uses and management, bioremediation and biore restoration of contaminated lands.

References:

1. Environmental Microbiology; W D Grant & P E Long, Blakie, Glasgow and London
2. Microbial Gene Technology: H Polasa (ED) South Asian Publishers, New Delhi.
3. Biotreatment Systems, Vol. 22, D L Wise (Ed) CRC Press, INC
4. Standard Methods for the examination of water and waste water (14th Edition) 1985.
American Public Health Association

Course code	BTOP-412
Course title	Enzymology
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

Unit: 1

Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay

Unit: 2

Enzyme Kinetics: Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of V_{max} and K_m . Bisubstrate reactions. 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 Regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

Unit: 4

Immobilized enzymes and cells: Relative practical and economic advantage for industrial use, 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

References:

1. Enzymes: Dixon and Webb. IRL press.
2. Principles of Enzymology for technological Applications (1993): Butterworth Heinemann Ltd. Oxford
3. Enzymes in Industry: Production and applications: W Gerhartz (1990), VCH Publishers, New York.
4. Biocatalyst for Industry: J S Dordrick (1991), Plenum press, New York.
5. Enzyme Technology-M F Chaplin and Bucke, Cambridge University Press, Cambridge
6. Fundamentals of Enzymology by Prices and Stevens, Oxford Press.

Course code	BTOP-413	
Course title	Lab course 4 Environmental Biotechnology	(based on BTO-411)
MARKS-	50	
Credits	1.5 Cr	
Time Duration	<u>3 hours /week.BATCH</u>	
Contact hours	45	

1. Isolation of rhizosphere microflora
2. Isolation of phylloplane
3. Isolation of actinomycetes from soil
4. Isolation of Rhizobium and Agrobacterium
5. Vessicular Arbuscular Mycorrhiza (VAM)
6. Isolation of sporocarp by sieve method
7. Isolation of air microflora- exposure plate method, rotorod sampler method
8. Water Microbiology Testing for quality of water (coliform test), H₂S strip method

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1. The first step in the process of the cell cycle is the G₁ phase, in which the cell grows and prepares for division. During this phase, the cell increases in size and synthesizes proteins and organelles. The G₁ phase is the longest phase of the cell cycle and is followed by the S phase, in which DNA replication occurs. The S phase is followed by the G₂ phase, in which the cell continues to grow and prepares for division. The G₂ phase is followed by the M phase, in which the cell divides into two daughter cells. The M phase is the shortest phase of the cell cycle and is followed by the G₁ phase, completing the cycle.

Course code	BTOP-414
Course tile	Lab course 5 Enzymology (based on BTO-412)
MARKS-	50
Credits	1.5 Cr
Time Duration	<u>3 hours /week.BATCH</u>
Contact hours	45

1. Enzyme assays
 - (LDH,
 - betagalactosidase,
 - acid phosphatase,
 - arginase,
 - succinic dehydrogenase)
2. Effect of time, temperature, and enzyme concentration on enzyme activity
3. Effect of substrate concentration on enzyme activity
4. Determination of K_m & V_{max}
5. Various kinetic plots : use of computer packages for parametric and non- parametric methods and non-linear regression



Course code	BTO-415 SEC BT-2(A)
Course title	MOLECULAR BIOLOGY TECHNIQUES 2
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

UNIT I DNA SEQUENCING

History, Basic methods, Large-scale sequencing and *de novo* sequencing

High-throughput methods, Methods under development (Tunneling currents DNA sequencing, Sequencing by hybridization, Sequencing with mass spectrometry, Microfluidic, Sanger sequencing, Microscopy-based techniques, RNAP sequencing, *In vitro* virus high-throughput sequencing)

Sample preparation , Development initiatives, Computational challenges

UNIT II Molecular biology laboratory equipment

Automated pipetting system, Biosafety cabinet, DNA sequencer, Plate reader Thermal cycler

UNIT III Proteomic sequencing

Peptide sequences (12 P) , Protein structural motifs (4 C, 56 P) Protein tandem repeats (1 C, 25 P)

Genomics techniques (1 C, 26 P)

UNIT IV RNA sequencing

Bacteroides thetaiotaomicron sRNA ,CITE-Seq, List of RNA-Seq bioinformatics tools, MAP-Seq,Patch-sequencing Perturb-seq, RNA-Seq, Small RNA sequencing SnRNA-seq

Reference Books

1. Genetics Peter J Russel, The Benjamin/ Qummin publishing Co.
2. Principles of Genetics by Gardner, Siemens.
3. Molecular Genetics by Friefeder.
4. Molecular biology laboratory manual 6th Edn, Cappuccino.
5. Molecular biology and the gene Watson.
6. https://en.wikipedia.org/wiki/Category:Molecular_biology_techniques

Course code	BTO-315 <u>SEC BT-1(B)</u>
Course title	MEDICAL BIOTECHNOLOGY-1
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.</u>
Contact hours	30

UNIT I TECHNIQUES IN. MEDICAL BIOTECHNOLOGY

Polymerase Chain Reaction
 Fluorescence In Situ Hybridization (FISH)
 Sequencing of genomes
 Microarrays
 Cell Culture
 Interference RNA
 Genome Editing

UNIT II EMERGING TRENDS IN. MEDICAL BIOTECHNOLOGY

Stem Cells
 The Human Genome Project
 Recombinant DNA Technology

UNIT III PRODUCTS OF MEDICAL BIOTECHNOLOGY

Antibiotics
 Recombinant Proteins
 Hybridoma and MAb
 Vaccines
 Stem Cell Therapy

UNIT IV TISSUE ENGINEERING

Introduction, Types of Cells (Proliferation and Differentiation), Scaffolds, Importance of Biomolecules in Tissue Engineering, Assembly Methods of a Tissue Culture and Its Maintenance, Regeneration of a Damaged Tissue Using Tissue Engineering, The Formation of Bioartificial Organs Using Cell-Based Tissue Engineering, Cell Therapies in Tissue Engineering. Use of Stem Cells and Therapeutic Cloning in Tissue Engineering, Aid of Nanotechnology in Tissue Engineering, The Challenges of Tissue Engineerin

REFERENCE BOOKS

Towards improving quality of life eMERGING FIELDS, ANIMAL AND MEDICAL BIOTECHNOLOGIES
 Volume 1 Edited by DEBMALYA BARH, AND OTHERS ACADEMIC PRESS