

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,  
CHHATRAPATI SAMBHAJINAGAR.



CIRCULAR NO.SU/B.Sc./CBC & GS/17/2024

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, Academic Council at its meeting held on 08 April 2024 has accepted the following Syllabi under the Faculty of Science & Technology as per Choice Based Credit Grading System as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc. Chemistry (Optional)	Vth & VIth semester
2.	B.Sc. Analytical Chemistry (Optional)	Vth & VIth semester
3.	B.Sc. Polymer Chemistry (Optional)	Vth & VIth semester
4.	B.Sc.Biochemistry (Optional)	Vth & VIth semester
5.	B.Sc.Dairy Science & Technology (Optional)	Vth & VIth semester
6.	B.Sc.Microbiology (Optional)	Vth & VIth semester
7.	B.Sc. Botany (Optional)	Vth & VIth semester
8.	B.Sc. Computer Science (Optional)	Vth & VIth semester
9.	B.Sc. Computer Science (Degree)	Vth & VIth semester
10.	B.Sc.Information Technology (Optional)	Vth & VIth semester
11.	B.Sc.Information Technology (Degree)	Vth & VIth semester
12.	Bachelor of Computer Application (Optional)	Vth & VIth semester
13.	Bachelor of Computer Application (Degree)	Vth & VIth semester

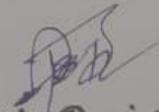
This is effective from the Academic Year 2024-25 and onwards.

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,  
Chhatrapati Sambhajanagar.  
-431 004.

REF.NO.SU/2024/1786-94  
Date:- 21.06.2024.

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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. Babasaheb Ambedkar  
Marathwada University, Chhatrapati Sambhajanagar.
- 2] The Section Officer, [B.Sc. Unit] Examination Branch, Dr. Babasaheb Ambedkar  
Marathwada University, Chhatrapati Sambhajanagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr. Babasaheb Ambedkar  
Marathwada University, Chhatrapati Sambhajanagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr. Babasaheb Ambedkar  
Marathwada University, Chhatrapati Sambhajanagar.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan,  
Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajanagar.
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Chhatrapati Sambhajanagar.
- 7] The Record Keeper, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati  
Sambhajanagar.

**Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati  
Sambhajinagar**  
**Semester Pattern Curriculum under, Choice based Credit System (CBCS)**  
**Under Graduate Bachelor Degree Programme (B.Sc.)**  
**Faculty of Science and Technology**  
**Subject- Microbiology**  
**Course Structure and Curriculum with Examination Scheme**  
**(Effective from academic year 2023-24)**  
**B. Sc. Third Year**

Semester - V								
	Course Code	Course Title	Total Periods (Teaching periods/week)	Credits	Scheme of Examination			
					Max. Marks	CI A	U A	Min. Marks
<b>Optional I(DSE-1A) Core courses</b>	MCB-511	Core Course DSE-1 (Theory Paper-XVI) <b>A1: Enzymology and Metabolism</b> <b>B1:Microbial Biotechnology</b> <b>C1:Biouinstrumentation and Biotechniques</b> <b>D1:Nanobiotechnology</b>	45(3/week)	2	50	10	40	20
	MCB 512	Core Course DSE -2 (Theory paper -XVII) <b>A2: Microbial genetics</b> <b>B2:Microbial Biocontrol-QC/QA in Food and Pharma Industry</b> <b>C2:Pharmaceutical Microbiology</b> <b>D2:Clinical Pathology</b>	45(3/week)	2	50	10	40	20
	MCB 521	Lab Course 7(Practical Paper based on MCB 511) <b>A1: Enzymology and Metabolism</b> <b>B1:Microbial Biotechnology</b> <b>C1:Biouinstrumentation and Biotechniques</b> <b>D1:Nanobiotechnology</b>	45(3/week)	1.5	50	10	40	20
	MCB 513	Lab Course 7(Practical Paper based on MCB 511) <b>A2: Microbial genetics</b> <b>B2:Microbial Biocontrol-QC/QA in Food and Pharma Industry</b> <b>C2:Pharmaceutical Microbiology</b> <b>D2:Clinical Pathology</b>	45(3/week)	1.5	50	10	40	20
<b>Skill Enhancement</b>	MCB 513	<b>Good Manufacturing Practices</b>	45(3/week)	2	50	10	40	20

<b>Course (SEC-3)</b>								
			225	9	250	50	200	100

<b>Semester - VI</b>								
	<b>Course Code</b>	<b>Course Title</b>	<b>Total Periods (Teaching periods/week)</b>	<b>Credits</b>	<b>Scheme of Examination</b>			
					<b>Max. Marks</b>	<b>CI A</b>	<b>U A</b>	<b>Min. Marks</b>
<b>Optional I(DSE-1A) Core courses</b>	MCB-611	Core Course DSE-3 (Theory Paper-XVI) <b>A1: Molecular Biology and genetic Engineering</b> <b>B1:Environmental Technology</b> <b>C1:Medical Microbiology</b> <b>D1:Microbial Ecology</b>	45(3/ week)	2	50	10	40	20
	MCB 612	Core Course DSE -4 (Theory paper -XVII) <b>A2: Industrial Microbiology</b> <b>B2:Biostatistics and Bioinformatics</b> <b>C2:Agricultural Microbiology</b> <b>D2:Microbial Diversity</b>	45(3/ week)	2	50	10	40	20
	MCB 621	Lab Course 9 (Practical Paper based on MCB 511) <b>A1: Molecular Biology and genetic Engineering</b> <b>B1:Environmental Technology</b> <b>C1:Medical Microbiology</b> <b>D1:Microbial Ecology</b>	45(3/ week)	1.5	50	10	40	20
	MCB 613	Lab Course 10 (Practical Paper based on MCB 511) <b>A2: Industrial Microbiology</b> <b>B2:Biostatistics and Bioinformatics</b> <b>C2:Agricultural Microbiology</b> <b>D2:Microbial Diversity</b>	45(3/ week)	1.5	50	10	40	20
<b>Skill Enhancement</b>	MCB 613	<b>Microbiological Tools and Techniques in Industry</b>	45(3/ week)	2	50	10	40	20

<b>Course (SEC-4)</b>								
			225	9	250	50	200	100

**DSE-1 Paper-MCB 511**  
**Enzymology and Metabolism (A1)**  
**Semester V**

**Total hours : 45**

**Credits :**

**2**

**Unit :I**

**(10)**

- *Enzymes*: Definition, properties, specificity, active site, activation of enzymes, Mechanism of action of enzymes {lock and key, Induced fit, ping-pong) Nomenclature and classification of enzymes.
- Factors affecting catalytic activity of enzymes (pH, temp., enzyme concentration, substrate concentration, metal ions, time)
- Michaelis-Menten equation ; derivation and significance.
- Transformation of Michaelis Menten equation
- Types of enzymes extracellular, intracellular. constitutive and inducible,

**Unit: II**

**(10)**

- Enzyme inhibition: Irreversible, reversible (competitive, uncompetitive, non competitive) and metabolic antagonism; feedback inhibition.
- Co-enzymes and respective enzymes, (NAD, FAD. Lipoic acid. Vitamin B12. Thiamine Pyrophosphate)
- Elementary knowledge and uses of *isoenzymes*.
- Commercial uses of enzymes (any five ) - ( food, leather, textile, environment, pharmaceuticals Is and clinical)
- Enzyme Immobilization

**Unit: III**

**(10)**

- Definitions: Metabolism, anabolism. catabolism, free energy,
- Bioenergetics: chemical links between catabolism and biosynthesis, energy coupling through ATP and through pyridine nucleotides. Central role of ATP-ADP system.
- Modes of energy yielding metabolism: Definition and features of fermentation. Respiration and photosynthesis.
- Fermentation of carbohydrates:
- BMP, HMP, ED. Phosphoketolase pathway (pentose, hexose) with structure.
- Alcoholic, homolactic, mixed acid, butanediol, butyric, acetone-butanol fermentations,

**Unit IV**

**(10)**

- Aerobic respiration:
- RETC : location functions, components, redox carriers, oxidative phosphorylation artificial electron acceptor, bacterial cytochrome systems
- TCA cycle, glyoxylate cycle, anaplerotic sequences.

- Catabolism of saturated (16 carbon) and unsaturated fatty acids (16 carbon) by  $\beta$ -Oxidation
- Degradation of proteins and amino acids: proteolysis, putrefaction,
- Transformation of amino acids: oxidation, reduction, decarboxylation, deamination (one example of each).
- Nucleic acid catabolism: DNA, RNA depolymerization, degradation of nitrogenous bases (mention end products without pathway)
- Biosynthesis of nucleotides: Purine and pyrimidine nucleotides, conversion of ribonucleotides to deoxyribonucleotides.

**Unit V : Tutorials, Seminars and Assignments**

**(05)**

**Lab Course -7 MCB 521(A1)**

1. Preparation of buffers and reagents.
2. Study of enzymes: -  $\alpha$ -amylase, caseinase, catalase, desulfurase, gelatinase, lecithinase, oxidase.
3. Effect of pH, temp. substrate concentration on  $\alpha$ - amylase activity.
4. Demonstration of nitrate reduction
5. Demonstration of decarboxylation of amino acid.
6. Isolation of photosynthetic bacteria by column method
7. Primary screening for.
  - i) Starch hydrolyzers.
  - ii) Organic acid producers,
  - iii) Antibiotic producers.

**DSE 2 Paper-MCB 512**  
**MICROBIAL GENETICS (A2)**

**Semester V**

**TOTAL HOURS: 45**

**CREDITS : 2**

**Unit 1 Genome Organization and Mutations**

**10**

Genome organization: *E. coli*, *Saccharomyces*, *Drosophila* Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of Mutations. Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test: replica plating, and fluctuation test. Mutator genes.

**Unit 2 Plasmids**

**10**

Types of plasmids — F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 u, plasmid, Plasmid replication and partitioning, Host range, plasmid incompatibility, plasmid amplification. Regulation of copy number, curing of plasmids.

**Unit 3 Mechanisms of Genetic Exchange**

**10**

Transformation - Discovery, mechanism of natural competence. Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping. Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers.

**Unit 4 Transposable elements**

**10**

Prokaryotic transposable elements - Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Yeast (Ty retrotransposon), *Drosophila* (P elements). Maize (Ac/Ds). Uses of transposons and transposition.

**Unit V: Tutorials, Seminars and Assignments**

**05**

**Lab Course - 08**  
**MICROBIAL GENETICS MCB 522(A2)**

1. Study of spontaneous mutation by Replica Plate Technique.
2. Study the effect of chemical (HNO<sub>2</sub>) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (U V) light
4. Isolation of Plasmid DNA from E.coli
5. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation and transduction
8. Demonstration of AMES test

**SUGGESTED READING**

1. KJug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed- Jones and Bartlett Learning
3. Pierce RA (2011) Genetics: A Conceptual Approach, 4th P.d., Macmillan Higher Education Learning
4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Hd., Benjamin Cummings
5. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
6. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Curamings
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Maloy SR, Cronan JE and Fnefelder D(2004) Microbial Genetics 2nd EDITION.. Jones and Barlett Publishers

**SEC-1 MCB-513(C1)**  
**Good Manufacturing Practices**  
**Semester V**

**Unit I: Introduction**

- Overview of GMP and its importance in the pharmaceutical and healthcare industries
- History and evolution of GMP regulations and guidelines
- Regulatory agencies and their roles in GMP compliance
- Quality management systems and quality assurance in GMP

**Unit II: GMP for Facility and Equipment**

- Facility design and layout considerations for GMP compliance
- Environmental controls, cleanrooms, and HVAC systems
- Equipment qualification and calibration in GMP
- Maintenance and preventive maintenance programs
- Cleaning and sanitation procedures in GMP environments
- Harvesting of cells and cell products

**Unit III: GMP Documentation, Validation, regulatory compliance and Auditing**

- Brief Outline of Documentation and record-keeping requirements in GMP, SOPs
- Brief outline of Validation principles and processes (process, equipment, cleaning, analytical), Risk assessment and mitigation in GMP validation
- Brief outline of Regulatory requirements for GMP compliance (e.g., FDA, EMA, WHO), GMP inspections and audits: Preparation and response, CAPA

**References:**

1. "Pharmaceutical Manufacturing Handbook: Regulations and Quality" by Shayne Cox Gad
2. "Pharmaceutical Quality Assurance" by Prof. Avinash Ade
3. "Pharmaceutical Quality Assurance and GMP" by Dr. S. S. Agrawal
4. "Quality Assurance and Good Manufacturing Practices: Guidelines for Pharmaceutical Products" by R.M. Mehta
5. "Principles of GMP Auditing" by Prof. S. P. Vyas
6. "Pharmaceutical GMP: Indian Pharmaceutical Industry" by N. K. Jain
7. "Good Manufacturing Practices (GMP) in Pharmaceutical Industry" by Dr. S. J. H. Shokri
8. "Good Manufacturing Practices in Pharmaceuticals" by Manohar A. Potdar
9. "Good Manufacturing Practices: Documentation" by S. A. Chaudhari
10. "Pharmaceutical Manufacturing: An Overview" by Madhu Chitkara
11. "Good Manufacturing Practices in Pharmaceutical Industries" by R. M. Pandey

**DSE 3** **MCB- 611**  
**Molecular Biology And Genetic Engineering (A1)**  
**Semester VI**

**Total Hours: 45**

**Credits: 2**

<b>Unit I: DNA- Molecular structure, properties, replication</b>	<b>10</b>
Molecular biology: Definition, concept, Flow of genetic information within a biological system- Central dogma of molecular biology (Francis Crick)	
Molecular structure of DNA	
Molecular properties of DNA	
Melting, Breaching, Flexibility, Linking number, Major and Minor grooves	
DNA replication: Semi conservative mode of DNA replication: Meselson and Stahl experiment	
Replication assembly, role of components and process of replication (continuous and discontinuous synthesis of DNA)	
DNA polymerases: Types and characteristics	
Post replication modification: Methylation	
<b>Unit II: Gene expression and regulation</b>	<b>10</b>
Salient features of genetic code	
Protein synthesis: Central dogma Assembly. transcription and translation processes	
Regulation of gene expression :Lac and Ara operon	
<b>Unit III: Tools and processes involved in Genetic Engineering</b>	<b>10</b>
Genetic engineering: Definition, objectives, steps involved, tools used for cloning Restriction endonuc leases: Types, patterns with examples, respective recognition sequence	
Vectors: Properties of a good vector, characteristics of pBR322, pUC19, Bacteriophage A vector, cosmid, BAC. YAC	
Processes involved in uptake of DNA: Calcium chloride treatment, electroporation, protoplast fusion, liposome	
Selection of recombinant clones: Blue- while script screening	
<b>Unit IV: Techniques and Application of genetic engineering</b>	<b>10</b>
Probes: Definition, characteristics, preparation and labeling	
Polymerase Chain Reaction (PCR):Components, steps involved, application.	
Nucleic acid and protein detection techniques: Southern blotting. Western blotting. Northern blotting, Colony hybridization, DNA sequencing by Sanger's/ dideoxy method	
Application of genetic engineering in: Agriculture- Bt cotton and Golden rice. Human and animal health- Disease diagnosis and HBV vaccine, Industries- Slain improvement. Insulin, Environment- Superbug and Bioremediation	
Ethical issues of genetic engineering	
<b>Unit V: Tutorials, Seminars and Assignments</b>	<b>05</b>

**Lab Course 9 MCB-621(A1)**  
**Molecular Biology And Genetic Engineering (A1)**

**Semester -VI**

**Total hours/practical: 03**

**Credits: 1.5**

1. Isolation of *E.coli* chromosomal DNA
2. Hypochromacity study of chromosomal DNA using UV spectrophotometer
3. Restriction digestion of DNA
4. Isolation of plasmid DNA
5. Separation of plasmid from chromosomal DNA
6. Study of DNA uptake in *E.coli* using  $\text{CaCl}_2$  treatment
7. Selection of recombinant clones on suitable medium
8. Measurement of  $\beta$ -galactosidase activity *E. coli*
9. Demonstration of Polymerase Chain Reaction
10. Visit to molecular biology Laboratory

**SUGGESTED READINGS**

1. Gardner Elden, Simmon Michael and Sncustad Octer; Principles of Genetics, John Wily and Sons, Newyork
2. Avinash and Kakoli Upadhyay. MOLBIO, Himalays Publications
3. James D. Walson; Molecular Biology of Genes, W.A. Benjamin Inc.
4. Alert L. Lehninger, David L. Nelson and Michael M. Cox: Biochemistry. Kalyani Publishers. New Delhi
5. B.D. Singh; Biotechnology Expanding Horizons, Kalyani Publishers
6. S.N. Jogdand, Gene Biotechnology, Himalaya Publishing House
7. Avinash and Kakoli Upadhyay; Molecular Biology and Genetic Engineering, Himalay Publisliing House

**DSE 4                      MCB -612**

**Industrial Microbiology (A2)**

**Semester VI**

**Total hours : 45**

**Credits : 2**

**Unit I: Introduction to Industrial Microbiology**

**10**

- Brief history and developments in Industrial Microbiology
- Lay out of a fermentation Industry- Different units and functions (Stock, production and fermentation. QA. QC . R & D , Packaging )
- Importance of sterility maintenance and checking
- Types of fermentation processes , bioreactors and measurement of fermentation- Types of fermentation processes- solid state . liquid state, batch, fed batch and continuous. Design of a typical fermentor, control of pH, temperature , dissolved oxygen . foaming and aeration

**Unit II: Isolation of industrially important microbial strains and fermentation media**

**10**

- Sources of industrially important microbes and methods for their Screening and isolation
- Preservation and maintenance of industrial strains
- Strain improvement
- Development of inoculum
- Fermentation media - Crude and synthetic media, molasses. SWL, CSL, whey

**Unit III: Down stream processing**

**6**

- Cell disruption
- Filtration
- Centrifugation
- Solvent Extraction
- Precipitation
- Lyophilization

**Unit IV: Microbial production of industrially products (Microorganism involved, media, Fermentation conditions, downstream processing and uses)**

**14**

- Citric acid production
- Ethanol production
- Wine
- Beer
- Penicillin
- Amylase

**Unit V: Seminar/ Assignment / Presentation/ Tutorial**

**5**

**Lab Course 10**  
**Industrial Microbiology (A2)**  
**MCB 622**

1. Production, detection and estimation of ethanol using *S.cerevisioe*
2. Production and estimation of citric acid by *Aspergillus* spp.
3. Identification of fermentation product by Paper chromatography and thin layer chromatography-Citric acid
4. Microbiological assay of penicillin
5. Screening of a my] a se/anti bio tic/organic acid producers
6. Production of alpha amylase by *Aspergillus* spp. / *Bacillus* spp.
7. A visit to any educational institute / industry to see an industrial fermentor and other Down-stream processes and report submission

**Study tour and report submission -**

**10 Marks**

**Suggested reading**

1. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Preston's Microbiology. 9th Edition. McGraw Hill International.
2. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T.Brown Publishers.
3. Pelczar MJ, Chan ECS and Krieg NR, (1993). Microbiology. 5th edition. McGraw Hill Book Company.
4. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. Pearson International Edition
5. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
6. Swartz. J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology. 12. 195-201.
7. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition. Me Graw Hill Publishers.
8. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications.
9. Glazer AN and Nikaido H (2007) Microbial Biotechnology. 2nd edition, Cambridge University Press
10. Click BR, Pasternak J.T, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
11. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates. Inc.
12. Demain, A. Land Davies? J. E. (1999). Manual of Industrial Microbiology and Biotechnology. 2 nd Edition, ASM Press.
13. StanburyPF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science

## SEC-4 MCB-613

### Microbiological Tools and Techniques in Industry

#### Semester VI

##### Unit I: Introduction

- Overview of microbiology's role in industry
- Importance of microbiological tools in various industrial sectors
- Regulatory considerations and quality control in industrial microbiology
- Emerging trends and advancements in industrial microbiology

##### Unit 2: Microbial Identification and Characterization

- Techniques for microbial isolation and cultivation
- Phenotypic and genotypic methods for microbial identification
- Characterization of microbial properties and behaviour
- Rapid microbial detection and identification techniques

##### Unit 3: Quality Control and Microbial Testing in Industry

- Microbial quality control in industrial processes
- Microbial testing methods and standards
- Environmental monitoring and contamination control
- Application of molecular techniques in microbial quality control

#### REFERENCES

1. Industrial Microbiology by Casida Jr.
2. Industrial Microbiology by Patel A.H.
3. A text Book of Biotechnology by Singh B.D.
4. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
5. Analytical biotechnology edited by Thomas G M Schalkhammer.
6. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath
7. Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker