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 Sambhajinagar.
-431 004.
REF.No.SU/2024/1786-94
Date:- 21.06.2024.

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Deputy Registrar,
Academic Section

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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 Sambhajinagar.

2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR

Curriculum of

B.Sc.Microbiology

Third Year

V & VIth semester

Under Choice Based Credit & Grading System

UNDER THE FACULTY OF SCIENCE & TECHNOLOGY.

[Effective from 2024-25 & onwards]

Chairman
BOS in Microbiology

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	CIA	UA	Min. Marks
Optional I(DSE-1A) Core courses	MCB-511	Core Course DSE-1 (Theory Paper-XVI) **A1: Enzymology and Metabolism** **B1:Microbial Biotechnology** **C1:Biouinstrumentation and Biotechniques** **D1:Nanobiotechnology**	45(3/ week)	2	50	10	40	20
	MCB 512	Core Course DSE -2 (Theory paper -XVII) **A2: Microbial genetics** **B2:Microbial Biocontrol-QC/QA in Food and Pharma Industry** **C2:Pharmaceutical Microbiology** **D2:Clinical Pathology**	45(3/ week)	2	50	10	40	20
	MCB 521	Lab Course 7(Practical Paper based on MCB 511) **A1: Enzymology and Metabolism** **B1:Microbial Biotechnology** **C1:Biouinstrumentation and Biotechniques** **D1:Nanobiotechnology**	45(3/ week)	1.5	50	10	40	20
	MCB 513	Lab Course 7(Practical Paper based on MCB 511) **A2: Microbial genetics** **B2:Microbial Biocontrol-QC/QA in Food and Pharma Industry** **C2:Pharmaceutical Microbiology** **D2:Clinical Pathology**	45(3/ week)	1.5	50	10	40	20
Skill Enhancement Course (SEC-3)	MCB 513	**Good Manufacturing Practices**	45(3/ week)	2	50	10	40	20
			225	9	250	50	200	100

Semester - VI								
	Course Code	Course Title	Total Periods (Teaching periods/week)	Credits	Scheme of Examination			
					Max. Marks	CIA	UA	Min. Marks
Optional I(DSE-1A) Core courses	MCB-611	Core Course DSE-3 (Theory Paper-XVI) **A1: Molecular Biology and genetic Engineering** **B1:Environmental Technology** **C1:Medical Microbiology** **D1:Microbial Ecology**	45(3/ week)	2	50	10	40	20
	MCB 612	Core Course DSE -4 (Theory paper -XVII) **A2: Industrial Microbiology** **B2:Biostatistics and Bioinformatics** **C2:Agricultural Microbiology** **D2:Microbial Diversity**	45(3/ week)	2	50	10	40	20
	MCB 621	Lab Course 9 (Practical Paper based on MCB 511) **A1: Molecular Biology and genetic Engineering** **B1:Environmental Technology** **C1:Medical Microbiology** **D1:Microbial Ecology**	45(3/ week)	1.5	50	10	40	20
	MCB 613	Lab Course 10 (Practical Paper based on MCB 511) **A2: Industrial Microbiology** **B2:Biostatistics and Bioinformatics** **C2:Agricultural Microbiology** **D2:Microbial Diversity**	45(3/ week)	1.5	50	10	40	20
Skill Enhancement Course (SEC-4)	MCB 613	**Microbiological Tools and Techniques in Industry**	45(3/ week)	2	50	10	40	20
			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 **(I0)**

- 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, pharmaceutics Is and clinical)
- Enzyme Immobilization

Unit: III **(I0)**

- Definitions: Metabolism, anabolism. catabolism, free energy,
- Bioenergetics: chemical links between catabolism and biosynthesis, energy coupling through ATP and through pyridine nucleotides. Centra! role of ATP-ADP system.
- Modes of energy yielding metabolism: Definition and features of fermentation. Respiration and photosynthesis.
- Fermentation of carbohydrates:
- BMP, HMP, ED. Phospoketolase 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 adds (16 carbon) by β-Oxidation

•Degradation of proteins and amino acids: proteolysis, putrefaction,

•Transformation of amino acids: oxidation, reduction, decarboxylation, deamination (one example of each).

•Nucleic add 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: - α-amylase, caseinase, catalasc, desulfurase, gelatinase, lecithinase, oxidase.

3. Effect of pH, temp. substrate concentration on α- 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-1 MCB 511

Microbial Biotechnology (BI)

Semester V

Total hours : 45 **Credits : 2**

Unit I : Basic Principles of Microbial biotechnology and genetic engineering **5**

- Microbial biotechnology: Scope and applications in human therapeutics, agriculture (Bio fertilizers, PGPR. Mycorrhizae), environmental and food technology
- Genetically engineered microbes for industrial applications- bacteria and yeast

Unit II: Therapeutic and industrial biotechnology **15**

- Production of streptokinase
- Hepatitis B vaccine
- COV1D 19 vaccines
- Microbial polysaccharides and polypeptides
- Microbial production of bio pesticides , bioplastics
- Microbial biosensors

Unit III: Application of microbes in biotransformation **10**

- Microbial products and their recovery- microbial product purification - filtration, ion exchange and affinity chromatography , immobilization methods and their applications
- Microbial based transformation of steroids and sterols
- Production of high fructose syrup
- Production of coca butter substitute

toil IV: Microbes for bioenergy and environment It

- Bioethanol and biodiesel production; commercial production from lignocellulosic waste and algal biomass
- Hydrogen production using microbial culture
- Microorganisms in degradation of xenobiotics, mineral recovery
- Intellectual Property Rights(IPR)- Patents, Copyright and trademarks

Unit V: Seminar/ Assignment / Presentation/ Tutorial **5**

Lab Course-07 MCB-521 (B1)

Microbial Biotechnology (CBCS)

University exam - 40 Marks

Study tour and report submission - 10 Marks

1. Study of yeast cell immobilization in calcium alginate gel
2. Study of enzyme immobilization by sodium alginate method
3. Pigment production from fungi (Trichoderma/Aspergilhus/Penicillium)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal single cell protein

DSE-1 MCB-511(C1)

Bioinstrumentation and Biotechniques

Semester V

Unit- 1 Basic laboratory Instruments **10**

Principle, working and applications of following instruments pH meter, Colorimeter, Laminar air flow and biosafety cabinets, Incubator Rotary shakers, BOD and COD incubators, ; centrifuge: types of centrifuge machines, preparative and analytical centrifuges, differential centrifugal ion, density gradient centrifugal kin :PCR machine

2 -Unit Spectroscopy **10**

Principles and applications of spectroscopic techniques turbidometry, nephlometry, luminometry, UV and visible spectrophotometry , IR and Raman spectroscopy , NMR Spectroscopy, fluorescence spectroscopy , atomic absorption spectrophotometry , mass Spectroscopy, Application of NMR Spectroscopy for protein and DNA structure determination.

Unit -3 Chromatographic techniques **10**

Theory, principles and applications of paper chromatography , thin layer(chromatography (TLC , gel filtration chromatography , ion-exchange chromatography , affinity chromatography ,gas-liquid chromatography, high pressure/ performance liquid chromatography (HPLC).

Unit- 4 Electrophoretic techniques. X-ray diffraction and Radio-isotopic technique **10**

Basic principles of electrophoresis, theory and application of paper, starch gel,agarose,2-D PAGE, SDS-PAGE, native gels, gradient gel electrophoresis. Pulsed field gel electrophoresis(PFGE). DNA and RNA electrophoresis. Electrophoresis of polysaccharide, glycoprotein. lipoproteins. Southern, Northern and Western Blotting.

X-ray diffraction analysis and crystallography. Radio isotopic techniques- nature of radioactivity, methods of detection and measurement, methods of application - tracer, autoradiography.

Unit 5: Seminar/ Assignment / Presentation/ Tutorial **5**

Lab course-07 MCB-521 (C1)

Bioinstrumentation and Biotechniques

1) Measurement of pH of different acidic and basic solutions by pH meter.
2) Standardization and calibration of pH meter
3) Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Handerson-Hasselbach equation.
4) Measurement of OD of different colour solutions at different wavelengths by colorimeter.
5) Study the effect of shaking on the degradation of dyes by bacteria using rotary shaker and colorimeter.
6) Separation of bacterial lipids/amino acids/sugars/organic acids by Paper Chromatography.
7) Separation of bacterial lipids/amino acids/sugars/organic acids by Thin Layer Chromatography.
8) Separation of serum protein by horizontal submerged gel etectrophoresis.
9) Electrophoretic separation of nucleic acids by agarose and polyacrylamide gel electrophoresis.
10) Studies on the principles of light spectroscopy - Beer and Lambert's laws, extinction coefficient and molar extinction coefficient.
11) Study of UV absorption spectra of macromolecules (protein, nucleic acid)
12) Demonstration of PCR, DNA sequencer.
13) Demonstration of Density gradient centrifugation

REFERENCES

1. Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others. 1986. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House. Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
7. Analytical Biochemistry by Holme.

8. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell.
9. Spectroscopy by B.P. Slraughan and S. Walker.
10. Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.
11. Gel Chromatography by Tiber ICremmery. Wiley Publications.
12. Isotopes and radiations in Biology by C.C. Tliornburn, Buttcrwonh and Co. Ltd., London.
13. The use of radioactive isotopes in the life sciences by J.M.Chapman and G.Ayrey, George Alien and Unwin Ltd.. London.
14. Analytical biotechnology edited by Thomas G M Schalkhammer.
15. Instrumentation measurements and analysis - 2nd edition (2003). Nakra and Choudhari, TataMcGraw Hill, India.
16. Nuclear Physics: An Inlroduction. 2nd edition (2011). S. B. Patel. Ansha Publication, India.
17. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath

Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker

DSE-1 MCB-511(D1)
Nanobiotechnology

Semester V

Marks: 50 **Periods: 45**

Unit 1: Introduction to nanotechnology and nanobiotechnology **10**

Scope of nanolechnology, brief history of nanotechnology, nanotechnology and ayurveda, nanomaterials and nanoparticles, change in properties of nanoparticles with size, surface area to volume ratio, advantages of rianomaterialK over hulk materials, challenges in nanotechnology, natural and man-made nanoparticles, nanotechnology in nature and biomaterials and nanoparticlcs (fullerenes, DNA, RNA, protein complexes, viruses, flagellar motor in bacteria, ATPase, ribosomes, lotus leaf effect, diatoms frustules, bacterial S-layers, magnetosomes), nanobiotechnology- the interface between nanotechnology and biology, scope of nanobiotechnology.

Unit 2: Nanoparticles **10**

Types of nanoparticles- based on size, shape and structure, chemical nature and properties; synthesis of nanoparticles- top-down and bottom-up approaches, ball milling, electrospray technique, physical vapour deposition, chemical precipitation, chemical vapour deposition, bio-hased methods with focus on intracellular synthesis, extracellular synthesis, in-vitro synthesis using biomaterials, bio-inspired synthesis, stabilization of nanoparticles; characterization of nanoparticles- visual. UV-visible spectre-photometry, electron microscopy, atomic force microscopy.

Unit 3: Applications of nanotechnology **10**

Materials science- surface coatings, catalysis, electronics (one or two examples of each); environmental sciences- detection of pollutants, removal of pollutants (one or two examples of each), biomcdical sciences- biocompatibility, diagnosis and treatment of diseases (one or two examples of each), largetted drug delivery, food technology- preservation of food, detection of food pathogens (one or two examples of each).

Unit 4: Implications of nanotechnology **10**

Routes of exposure to nanoparticies, nanotoxicology- toxicity of nanoparticles, health hazards, methods of toxicity testing- in-vitro, in-vivo, advantages of biogenic nanoparticles, exponential nanotechnology, industrial/commercial applications of nanotechnology, economical considerations, development of nanotechnology based tools (for visualization, characterization, manipulation, purification and use of nanoparticles), ethical issues in nanotechnology.

Unit 5: Tutorials, seminars, assignments, visit to advanced instruments laboratory.

References:

1. Edward L. Wolf, Nanophysics and Nanotechiiology: Ail Introduction to Modern Concepts in Nanoscicnce, Wiley-VCH (2006).
2. C. Bre'chignac P. Houdy M. Lahmani. Nanomaterials and Nanochemistry, Springer Berlin Heidelberg, Germany (2006).
3. Guozhong Cao, Nanostmctures & Nanomaterials Synthesis, Properties, Applications, World Scientific Publishing Pvy. Ltd., Singapore 2004
4. M. Wilson. K. Kannangara. G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
5. C.N.R.Rao, A.Mulier. A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh & Co, Weinheim, 2004.
6. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wilcy & Sons, Inc., 2001.
7. C.S.S.R.Kurnar, J.Hormes, C.Leuschner, Nanofabrication towards biomedical applications, Wiley-VCH Verlag GmbH & Co. Weinheim, 2004.
8. G.Cao, Nanostructures and Nanomaterials: synthesis, properties and applications. Imperical College Press, 2004.
9. K.E.Drexler. Nano systems, Wiley, 1992.
10. T. Pradeep, Nano: The essentials, understanding Nanoscience and Nanotechnology. Tata McGraw Hill, 2007.
11. Michael J. O'Connell. Carbon nanombcs: Properties and Applications, CRC/Taylor & Francis, (2006).
12. W.R. Fahmer, Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques, Springer, 2005.
13. Kewal K. Jain . The Handbook of Nanomcdicine, Humana Press, (2008).
14. Zhaog, Nanomedicine: A Systems Engineering Approach" 1 st Ed.. Pan Stanford Publishing, (2005).
15. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton. G. L. Homyak. H. F. Tibbals, J. Durta and J J. Moore.
16. Nanoparticles and Catalysis; D. Astnic, Wiiey-VCH, 2008
17. Mirkin Chad. Nanobiotechnology: Concepts, Applications and Perspectives, Wiley
18. Nanobiotechnology in Food: Concepts, Applications and Perspectives by J.M. Hoda Springer
19. Cato T. Laurencin, Temenoff J. S. and Mikos A. G., Biomaterials: The Intersection of Biology and Materials Science[|, Pearson, New Delhi, 2009.
20. Grassian V.H, "Nanoscience and Nanotechnology - Environmental and health impacts", John Wiley & Sons, 2008
21. Ram.M, Andreescu.S.E, Hanming.D, "Nanolechnology for Environmental Decontamination", 20ll.McGrawHill
22. Wiesner M and Bonero J.Y, "Environmental Nanotechnology", McGraw-Hiil, 2007.
23. Geoffrey Hunt and Michael D. Mehta —Nanotechnology: Risk, Ethics and Law, Arthscan/James & James publication (2006)
24. Mark. R. Weisner and Jean-Yves Bottero —Environmental Nanotechnology applications and impact of nanomaterial, The McGraw-Hill Companies (2007).
25. Mihail C. Roco and William Sims Bainbridge —Nauotechnology: Societal Implications II, Individual Perspectives, Springer (2007)

Lab Course -07 MCB-521(D1),

Nanobiotechnology

Total Credits: 1.5 **Marks: 50**

1) Calculation of surface area to volume ratio for particles of different size
2) Synthesis of silver/gold/iron based nanoparticles by chemical method- any one method
3) Detection of nanoparticles in colloidal suspensions using UV-visible spectrophotometer
4) Stabilization of silver/gold nanoparticles using chemical and/or biological agents and its effect on UV-vis absopriton spectrum/plasmon resonance.
5) Effect of chemicals on the stability of silver/gold nanoparticles (salt, acid'alkaii, detergents)
6) Effect of high/low lemperature on (he stability of silver nanoparticles
7) Green synthesis of silver/gold nanoparticles using bacteria/fungi/yeasts- any one method
8) Green synthesis of silver/gold naiiopailicles using plant exlrael/s
9) Antimicrobial activity of silver nanoparticles on bacteria/fungi
10) Decolorization/removal of dye from solution using nanoparticles
11) Biocompatibity of nanoparticles (riemolytic assay)
12) Analysis of SEM, TEM and AFM images

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*, Drossophila 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 ofnentry mapping. Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers.

Unit 4Transposable 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 (HNO2) 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 Agaraose gel eiectrophoresis.

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 (20131. 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

DSE 2 512 (B2)

Microbial Bio Control- QC/QA in Food and Pharmaceutical Industries

Semester V

TOTAL HOURS: 45 **Marks-50** **CREDITS: 2**

Unit 1 Microbiological Laboratory and Safe Practices **10**

Good laboratory practices - Good laboratory practices. Good microbiological practices Biosafety cabinets - Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2. BSL-3. Discarding biohazardous waste - Methodology of Disinfection, Autoclaving & Incineration

Unit 2 Determining Microbes in Food / Pharmaceutical Samples **10**

Culture and microscopic methods - Standard plate count. Most probable numbers, Direct microscopic counts. Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit 3 Pathogenic Microorganisms of Importance in Food & Water **10**

Enrichment culture technique. Detection of specific microorganisms - on XLD agar, Salmonella Shigeila Agar, Manitol salt agar, EMB agar, McConkey Agar, Sabraoud's Agar Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk ai milk collection centres (COB, 10 min Resazurin assay)

Unit 4 HACCP for Fond Safety and Microbial Standards **10**

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water - BIS standards for common foods and drinking water

Unit V; Tutorials, Seminars and Assignments ------ **05**

SUGGESTED READING

1. Harrigan WF (1998) Laboratory Mclhods in Food Microbiology. 3rd ed. Academic Press

2. Garg N. Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology IK International Publishing House Pvt. Ltd.

3. Jay JM. Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutics! and Medical Devices, Taylor and Francis Inc.

Lab Course 8: DSE 522 (B2)

Microbial Bio Control- QC/QA in Food and Pharmaceutical Industries

Marks =- 50

1. Antimicrobial sensitivity testing and determination of MIC and quality control.
2. Qualitative/quantitative examination of food samples (Meat, egg, fruits, vegetables, canned foods etc.) for presence/absence and or quantification of food borne pathogens.
3. Microbial Examination of non-sterile products : Microbial Enumeration Test (Membrane filtration, plate count method (Pour Plate and surface spread method) MPN (Most probable number)
4. Microbial Examination of non-sterile products: Test for specified microorganisms *(Slaphylococcus aureus . E. coli. Salmonella sp., P. aeruginasa)* by using selective medias
5. Sterility testing of sterile pharmaceutical preparations (Direct inoculation & Membrane Filtration Method)
6. Use of biological indicators for validating Ihc sterilization cycle of Autoclave/Dry Heat Sterilizer (Hot Air Oven)
7. D-value determination lest for wild strain of *E.coli / S.aureus / B. subtilis / C. sporogenes*
8. Determination of raw milks quality by MBRT test
9. Disinfectant Efficiency Test (DET) by tube dilution and coupon method
10. Antimicrobial Preservative Efficacy Test
11. Growth Promotion Test For Culture medias (Qualitative/Quantitative)
12. Bacterial Endotoxin Test (Limulus amoebocyte Lysate) semi-quantitative / quantitative method.

DSE 2 MCB 512 (C2)

PHARMACEUTICAL MICROBIOLOGY

Semester V

Total hours 45 **Marks: 50** **Credits: 2**

Unit I: **10**

Principles of chemotherapy: General properties of antimicrobial agents, choice of agents, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage, sensitivity testing.

Unit II: **10**

History of chemotherapy: Plants and arsenic s therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes. Overview of development of synthetic drugs. Antibiotics: the origin, development and definition of antibiotics as drugs, types of antibiotics and classification.

Unit III: **10**

Mode of action of important drugs: Cell wall inhibitors (Beta Lactum-e.g. Penicillin), Membrane inhibitors (polymyxin), Protein synthesis inhibitors (streptomycin), Nucleic acid synthesis inhibitors (nalidixic acid), antifungal antibiotics (nystatin).

Unit IV: **10**

Antimicrobial assays: Assay for growth inhibiting substances, Assay for non medicinal antimicrobials 9Phenol coefficient/RWC). Drug sensitivity testing methods and their importance.

Assay for antibiotics: Determination of MIC, the liquid tube assay, solid agar assay, agar plate assay (Disc diffusion, agar well and cylinders cup method).

Unit V: Tutorials, Seminars and Assignments. **05**

Lab Course -08 MCB- 522-(C2}

PHARMACEUTICAL MICROBIOLOGY

Marks :50

1. Tests for disinfectants (Phenol coefficient)
2. Determination of antibacterial spectrum of drugs/antibiotics
3. Testing for antibiotic/drag sensitivity/resistance.
4. Determination of MIC value for antimicrobial chemicals
5. Microbiological assays for antibiotics (Liquid tube assay, agar rube assay, agar well assays)
6. Microbiological limit test: Salmonella, Shigella. Staphylococcus, *E.coli,* Pseudomonas
7. SPC of pharmaceutical samples: liquid oral supplements. Lotion/ointment/ Tablets
8. Pyrogen testing samples: Sterile injectables

References:

1. Ananthanarayana, R. and Panicker, C.K.S. (2000). Text Book of Microbiology, 6th Edition, Oriental Longman Publications, USA.

2. Gupta, S. (1995). Short Text Book of Medical Microbiology, 8th Edition. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.

3. Annadurai, B. (2008). A Textbook of Immunology and ImmunoTechnology. S. (.'hand & Co. Ltd.. New Delhi.

4. Dey, K, T.K. and Sinha, D. (1999). Medical Bacteriology Including Medical Mycology and AIDS.New Central Book Agency (P) Ltd. Calcutta, India.

5. Shetty, N. 11994). Immunology- Introductory Textbook. New Age International Pvt. Ltd, New Delhi.

6. Singh, R.P. (2007). Immunology and Medical Microbiology. Kalyani Publishers, New Delhi.

7. Reddy, S.R. and Reddy, K.R. (2006). A Text Book of Microbiology - Immunology and Medical Microbiology, Himalaya Publishing House, Mumbai.

8. Lydyard, P.M., Whelan. A. and Fanger. M.W. (2000). Instant Notes in Immunology, Viva Books Pvt. Ltd., New Delhi.

9. Chakraborty, B. (1998). A Text Book of Microbiology, New Central Book Agency (P) Ltd, Calcutta, India. 12

DSE 2 MCB-5I2

Clinical Pathology (D2)

Semester V

Total Hours : 45 **Credits : 2**

Unit 1: Clinical Microbiology and Laboratory Diagnosis of Infectious Diseases (10)

- Study of Compound Microscope. Simple and Gram staining, Negative staining. Acid Fast staining. Capsule and endospore staining, hanging drop technique.
- **Types of media :** Bacteriological- Nutrient Agar, MacConkey's Agar, Mueller-Hinton agar, Eosin Methylene blue Agar, CLED Agar (cystine-lactose-electrolyte-deficient agar), Wilson and Blair medium, Kings Agar, Mannitol Sail Agar. Mycological- Potato - dextrose agar. Sabouraud's agar, Glucose Yeast Extract Agar.
- **Methods of Cultivation:** - Broth, Slant, Stab, Plate.
- **Methods of isolation:** - Streak, Pour and Spread plate methods, enrichment and preservation of cultures.
- **Sterilization and Disinfection:-** Definitions, Physical methods (Heat, Radiation and Filtration), Cleaning, and preparation of glassware for sterilization.
  Chemical Methods (Alcohol, Phenol & phenolic compounds, Chlorine & compounds, Iodine & compounds. Formaldehyde, Ethylene Oxide, β propionilactone).
- **Collection, Preservation , Transport, Processing and disposal of clinical samples**
  Blood, Throat, Sputum, Pus, Urine, Stool, C.S.F, Other body fluids.
- **Short description of diseases caused by and Identification of Microorganisms by morphological. Cultural and biochemical characters.**
  Bacteria (*Escherichia coli, Enterobacter aerogenes, Staphylococcus aureus. Salmonella* spp-- *Mycabacterium tuberculosis, Klebsiella* spp., *Proteus vulgaris, Pseudomonas aeruginosa*)
  Fungi (Species of *Aspergillus, Cryptococcus neoformans, Mucormycetes, Pneumocystis jirovecii. Candida*)
  Protozoa: - (Plasmodium spp, Entamoeba spp, Trichomonas vaginalis, Giardia lamblia)
  Viruses: - Polio, Hepatitis, Rabies, Influenza, Dengue, Chikungunya, Ebola, Covid-19,
- Antibiotic susceptibility test by disk diffusion technique and Kirby-Bauer method.
- Automated bacterial identification and susceptibility testing system VITEK 2
- Polymerase Chain Reaction (PCR), RTPCR test for Covid-19

UNIT -2 Immunology (10)

Antigen- Antibody Reactions: - Definition, types. Mechanism and examples of

Precipitation: Slide and tube tests, Immunodiffusion, Immunoelectrophoresis, Electro immunodiffusion. Slide Flocculation test (VDRL lest), Tube flocculation test (Kahn test for syphilis) Standardization of toxins and antitoxins, Lancified grouping of streptococci. Ring test (C-reactive protein)

Agglutination: - Slide test (Blood group by ABO system. Cross matching, Widal test for typhoid). Tube test (Widal test for Typhoid), Coombs test (Detection of haemolytic disease of the newborn due to Rh incompatibility), Passive agglutination test (RA factor determination test / Rose-Waller test). Pregnancy test. Dengue, Chikungunya

Complement fixation test: - (Wasserman test for syphilis)

Immunofluorescence (Direct and indirect)

Enzyme-Linked Immunosorbent Assay (ELISA): - (Detection of Rota virus, polio virus, HTV,

RadioImmuncAssay (RIA): - Insulin and other hormones

Rapid *Test Kit* **chromatographic immunoassay:** - Urine Pregnancy test. Dengue, Chikungunya, malaria, Covid, HIV, HCV, HBsAg,

Immunological Disorder: - Hypersensitivity, Auto-immunity, Immunodeficiency

Blotting techniques: - Southern, Western, Northern

UNIT-3 Clinical analysis and Biochemistry (10)

Urine analysis - Routine Examination -Physical, Chemical & Microscopic, Correlation of urinary findings in various diseases, Automated Urine Analysis & Reagent Strip Method

Stool analysis - Routine - Physical, Chemical & Microscopic Examination of stool. Significance of presence of blood and excess fat in stool. Concentration methods for detection of intestinal parasites

Semen analysis - Physical, Chemical & Microscopic Examination

Crebrospinal Fluid - Physical, Chemical & Microscopic Examination, Correlation of Abnormal C.S.f. findings in various diseases

Histopathological Techniques - Basic concept of tissue processing. Microtomy & Types of Microtome, Principle & Procedure of Staining techniques

Cestodes - Morphology. Life cycle , Mode of infection and Laboratory diagnosis of *Taenia saginata, Echinocossus granulosus*

Nematodes - Morphology, Life cycle, Mode of Transmission and Laboratory diagnosis of *Trichuris trichiura, Ascaris lumbricoides, Strongiloides stercoralis. Anchylostoma duodenale etc.*

Laboratory Instruments - Acid, Base, pH, Indicators, Buffer and Buffering action, Principle. Component. Operations, Maintenance and Applications of - Balance, pH Meter. Centrifuge. Colorimeter, Spectrophotometer, Biochemistry Auto-Analyzers, Cell counter, ESR tubes. Laminar Air flow. Haemoglobin counter, Haemocytometer. Micropipettes etc.

Biochemical tests - Blood and urine Glucose estimation, Bence-Jones' Proteins and Cryoglobulins, Lipid Profile Tests- cholesterol (LDL, HDL), triglyceride, Lipoproteins. phospholipids and its significance in various disorders. Alkaline Phosphatases, Lactate Dehydrogenases. Amylase, Lipase, Determination of T3, T4, TSH

Function tests: - Liver Function Tests (LFT), Kidney or Renal Function Tests (KFT/ RFT). Cardiac Function Tests (CFT)

Electrolytes and vitamins - Sodium. Potassium, Chloride, Calcium, Phosphorus, Iron, Vitamin B12andD3

UNIT - 4 Haematology and Blood banking (10)

Definition, composition and functions of blood, Collection & Storage of blood: venous and

capillary. Various equipment used for collection of blood samples,

Anticoagulants: Definition and various types along with their mode of action, uses, methods of preparation merits and demerits of each.

Hb Estimation: Different methods-(a) Colorimetric Method, (b) Sahli's Method, and (c)

Specific Gravity Method

RBC count: Normal, abnormal values, and Physiological variations, Morphology of normal and abnormal Red Blood Cells. Reticulocyte count, Erythrocyte Sedimentation Rate (ESR),

Haematocrit: Pack Cell Volume (PCV) and Various Blood indices; their brief description

Total White Blood Cell Count: Normal and abnormal values

Differential WBC Count: - Normal, abnormal values and physiological variation: Preparation of peripheral blood smear. Staining by different methods.

Haemostasis & blood coagulation - Coagulation Factors, Mechanism of Blood Coagulation. Coagulation disorders, Haemophilia A & Haemophilia B

Platelet disorders and Platelet count

Bleeding lime (BT), Clotting time(CT), Prothrombin lime (PT), Activated Partial Thromo Plastin time (APTT), Thrombin time, Fibrinogen, D-dimer test, Fibrin degradation product.

Blood Banking - ABO and Rh blood Group system, Storage and transportation of blood, Cross matching test.

Component preparation: - (Red cell concentrate, Fresh Frozen Plasma, Cryoprecipitate, Platelet concentrate)

Mandatory screening tests- HIV1 &HIV2. HBsAg, HCV, RPR & Malaria.

Automation in Blood collection, Quality control in blood banking

Unit 5: Tutorials . Seminars and Assignments (05 Periods)

Lab Course – 8
Clinical Pathology -522 (D2)

1. Simple and Gram staining. Acid fast staining, Endospore and Capsule staining, Plasmodium spp. staining of blood smear, Entamoeba staining of stool sample, Trichomonas staining of vaginal swab.
2. Preparation of media: - Bacteriological- Nutrient Agar, MacConkey's Agar, Mueller- Hinton agar, Eosin Methylene blue Agar, CLED Agar (cystine-lactose-electrolyte-deficient agar), Wilson and Blair medium, Kings Agar, Mannitol Sail Agar. Mycological- Potato - dextrose agar, Sabouraud's agar, Glucose Yeast Extract agar.
3. Preparation of Broth, Slant, Stab, Plate, and isolation of microorganisms by Streak, Pour and Spread plate methods, enrichment and preservation of cultures.
4. Antibiotic susceptibility test by disk diffusion technique and Kirby-Bauer method.
5. Automated bacterial identification and susceptibility testing system VITEK 2
6. Polymerase Chain Reaction (PCR), RTPCR lest forCovid-19
7. VDRL test for syphilis. Tube flocculation test {Kahn test for syphilis) Standardization of toxins and antitoxins, Ring test (C-reactive protein)
8. Blood group by ABO and Rh system. Cross matching,
9. Widal test for typhoid slide and Tube test
10. Coombs test, RA factor determination test / Rose-Waller test.
11. Rapid Test Kit chromatographic immunoassay tests: - Urine Pregnancy test, Dengue, Chikungunya, malaria, Covid. HIV. HCV. HBsAg.
12. Urine analysis - Physical, Chemical & Microscopic, Automated Urine Analysis & Reagent Strip Method.
13. Stool analysis - Routine - Physical, Chemical & Microscopic Examination of stool. Observation of nematodes and cestodes in stool.
14. Semen and CSF analysis - Physical, Chemical & Microscopic Examination.
15. Blood and urine Glucose estimation, Bence-Jones' Proteins and Cryoglobulins,
16. Lipid Profile Tests- cholesterol (LDL, HDL), triglyceride, Lipoproteins, phospholipids and its significance in various disorders. Alkaline Phosphatases,
17. Lactate Dehydrogenases, Amylase, Lipase, Determination of T3, T4, TSH
18. Function tesls: - Liver Function Tests (LFT). Kidney or Renal Function Tests (KFT/RFT), Cardiac Function Tests (CFT)
19. Electrolytes and vitamins - Sodium. Potassium. Chloride, Calcium, Phosphorus. Iron. Vitamin B12and D3
20. Complete Blood Count: - RBC. WBC. Platelets, Hb. Pack Cell Volume (PCV)
21. Bleeding time (BT), Clotting time(CT), Prothrombin time (PT), Activated Partiai Thromo Plastin time (APTT). Thrombin time, Fibrinogen, D- dimer test,
22. Blood collection and storage for blood banking.

References

1. Text book of Medical Microiology, Ananthnarayan R. and Jayram Paniker C.K. 5th Edn. Orient Longman, Madras.
2. Microbiology, Prescotl M.Harley John P., 8th edition, Lansing, Donald A. Klein, McGraw Hill
3. Text book of Microbiology and immunology, 2nd Edition, Subhash Chandra Parija, ELSEVIER, a division of Reed Elsevier India Private Ltd.
4. Text book of Medical Laboratory Technology, Godkar P B. 2nd Edn.2003 Bhalani Publication.
5. Medical Laboratory Technology, Ramnik Sood, 4th ed., Jaypee Brothers
6. Essential Immunology, Roitt I.M., 6 th Edn. ELBS, London
7. Hand book of Practical Immunology, Talwar G. P.,A 1st Edn. Vikas Publishing House.
8. Immunology, Owen,J udith A., PuntStanford, Sharon A., Jones, Patricia P., Kuby 7th ed. Macmillan Higher education Pub.
9. Parastology: Protozoology and Helthminthology in Relation to Clinical Medicine, Charterjee K.D. (2009). 13th ed., CBC Publishers & Distributors Pvt Ltd It).
10. Medical Parasitology, Arora D.R. and Arora B, (2004). 2nd ed., CBC Publishers &Distributors Pvt Ltd.
11. Clinical Haemalology, Wintrobe's 14th edition, Lippincott Williams & Wilkins
12. Clinical Haematology in Medical Practice. De Gruchy's Sixth edition, Wiley Publications
13. Modern Blood banking and Transfusion Practices, Denise Harmening , 6th Edition 2012.
14. Blood Transfusion in Clinical Medicine. Moltison PL,Engelfriet CP and Marcela Conlreras: 12ih edition. Blackwell Science, 2014
15. Technical Manual, American Association of Blood Banks, 2014
16. A Textbook on Laboratory and Clinical Transfusion Medicine. Choudhury Nabajyoti, Bharucha Zarin Soli., Volume 2: Basics of Blood Bank Practices (Process Control), 2017
17. Practical Biochemistry: Principles & Technique, Wilson K. & Walker J.. 5 cd., Cambridge University Press.
18. Handbook of Quality Assurance in Laboratory medicine., Tambwekar S., Bl
19. Bio instrumentation, Veerakumari L., MJP.
20. Practical Biochemistry: Principles & Technique, Wilson K. & Walker J.. 5 ed.. Cambridge University Press.
21. Textbook of Medical Biochemistry, Chatterjee M. N. and Shinde R. 2007. 8th cd.. Jaypee Brothers Publishers.
22. Practical Clinical Biochemistry, Harold Varlcy, 1990, Indian Edition, Anold Heinemann.

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. Pande

DSE 3 MCB- 611

Molecular Biology And Genetic Engineering (A1)

Semester VI

Total Hours: 45 **Credits: 2**

Unit I: DNA- Molecular structure, properties, replication **10**

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

Unit II: Gene expression and regulation **10**

Salient features of genetic code

Protein synthesis: Central dogma Assembly. transcription and translation processes

Regulation of gene expression :Lac and Ara operon

Unit III: Tools and processes involved in Genetic Engineering **10**

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

Unit IV: Techniques and Application of genetic engineering **10**

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

Unit V: Tutorials, Seminars and Assignments **05**

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 $CaCl_2$ treatment
7. Selection of recombinant clones on suitable medium
8. Measurement of β-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 3 MCB-611

Environmental Technology (B1)

Semester VI

Time: -45 hours **Credit: 2**

Unit I- Introduction to Environmental Technology **10**

Definition and Basic concept: Ecology, Types of ecosystem, Environment, Structure and function of ecosystems-Terrestrial Environment: Soil profile and soil microflora Benevolent and antagonistic interactions. Development of microbial community in biosphere. Ecological homeostasis and co-evolution. Physiological ecology of microorganisms. Ecology of microorganisms in extreme environments, Biofilm and ecological implication.

Unit II- Bio-deterioration and environmental monitoring **10**

Air. Water, Soil pollutions; sources, causes, health hazards

General Characteristics of waste:

a) Liquid waste - pH. electrical conductivity, COD, BOD. totul solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease.

b) Solid waste- pH. electrical conductivity, total volatile solids, ash.

c) Standards as per MPCB.

Eutrophication: Classification of lakes. Sources, Consequences, Control Acid Mine Drainage Development of acid mine drainage, hazards of water pollution by it. Prevention and control of acid mine drainage pollution

Radioactive pollution, pesticides pollution, oil pollution : impacts on environment. Good Laboratory Practices, Bio safety levels (BSL), Environmental monitoring: Definition and purpose. Cleanroom classification, Routine Environmental monitoring programme in pharmaceutical industries- Air monitoring, Surface monitoring and Personnel monitoring, Bioburden test. Environmental Impact Assessment- Concept and Brief introduction

Unit III- Ecological restoration and bioremediation **10**

Sewage Microbiology and Wastewater treatment anaerobic, aerobic process, methanogenesis,

Treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries, solid-Waste treatment: sources and management (composting, vermiculture and methane production, landfill, hazardous waste treatment) Specific bioremediation technologies: land farming, halophiles, composting, bioventing, bio sparging, pump and treat method, phytoremediation; remediation of degraded ecosystems; advantages and disadvantages; degradation of xenobiotics in environment, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides, heavy metals degradative pathways.

UNIT IV: Ecologically safe products and processes **10**

PGPR bacteria: biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen. Integrated pest management, development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation, accumulation and concentration

of metals, metal leaching, extraction; exploitation of microbes in copper and uranium extraction, use of bioreactors for bioremediation

Unit V : Tutorials, Seminars and Assignments **05**

Books Recommended:

1. Environmental Pollution by Chemicals Walker, Hulchiason.
2. Biochemistry and Microbiology of Pollution - Higgins and Bums.
3. Environmental Pollution - Laurent Hodge, Holt.
4. Waste Water Treatment - Datta and Rao (Oxford and IBM)
5. Sewage and waste treatment - Hammer
6. Pollution - Kudesia, PragatiPrakashanMeerat,
7. Environment Chemical Hazards - Ram Kumar (Swarup and Sons. New Delhi).
8. Environment and Metal Pollution - Khan (ABD Pub. Jaipur).
9. Environment Pollution - Timmy Katyal (SatkeAmnol Pub. New Delhi).
10. Ecology of Polluted Water - Vol. II - Anand Kumar (Aph Pub. Co. New Delhi).
11. Microbial Techniques - Paihade and Gocl (ABD Pub. Jaipur).
12. Current Topics in Environmental Sciences - Tripalhi and Pandey (ABD Pub. Jaipur).
13. Environmental impact Assessment - R. K. Trivedy
14. Microbial Limit and Bioburden Tests, 2nd edition - Lucia Clontz (CRC Press)
15. Introduction to Biodeterioration by Dennis Allsopp and Kenneth J.Seal, ELBS
16. Environmental Pollution by Chemicals by Walker C
17. Food Industry wastes: Disposal and recovery by Herzika and Booth (editors) 1980, Allied Science Publishers.
18. Water Pollution Vol. 1 and 11 by R. Milchcll
19. Microbiology of the Atmosphere by P. H. Gregory 2nd edition Leonard Hill
20. Air Pollution Control Theory by Crawford M
21. Basic Microbiology with applications by Brock and Brock
22. Evans. G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2 edition). Wiley-Blackwel] Publications.
23. Scagg. A H 2005 Environmental Biotechnology. Oxford University Press
24. Jordening, HJ. & Winter J. 2005 Environmental Biotechnology: Concepts and Applicalions.John Wiley & Sons.
25. Rittman, B.F. & McCarty. PL., 2001. Environmental Biotechnology .Principles and Applications. McGraw-Hill, New York.
26. Snustad, D.P. & Simmons, MJ. 2011. Principles of Genetics (6th edition). John Wiley &Sons
27. Wainwright, M 1999. An Introduction to Environmental Biotechnology, Springe

Lab Course-09 MCB -621 (B1)
Environmental Technology

1. Physical analysis of sewage / industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD/ COD of different effluents.
3. Bacterial reduction of nitrate from ground waters.
4. Utilization of microbial consortium for the treatment of solid waste [Municipal Solid Waste].
5.Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures. 6.Microbial dye decolorization / adsorption.

Project

1. Dust Fall Jar: Construction and analysis of pollution trend in the selected area.
2. Collection of Data from Internet : Respiratory suspended paniculate matter (RSPM) in various
metro cities in India
3. Fabrication: Fabricate Sedimentation Tank in the laboratory.
4. Effluent and Influent: Collect information on Effluent and Influent composition of petrochemical industry.
5. Sample collection: Collect the sample from municipal solid waste.
6. Identify Industry: Identify and list the industries using the solid waste as raw malerial.
7.ISO Implementation: List and categorize the industries certified with ISO 14000 in India.
8. Environmental Audit: Prepare the sample document for environmental Audit of any Organization.

DSE 3 MCB- 611
MEDICAL MICROBIOLOGY (C1)
Semester VI

Total Hours : 45 **Credits: 02**

Unit 1: Host pathogen interaction **07**

Host pathogen interaction:Definitions - Infection, Invasion, Pathogen. Pathogenicity. Virulence. Toxigenicity, Carriers and their types. Opportunistic infections. Nosocoinial infections. Transmission of infection. Pathophysiologic effects of LPS

Unit 2 Bacteria] diseases **15**

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Respiratory Diseases: Streptococcus pyogenes, Haemophihis influenzae, Mycobacterium tuberculosis Gastrointestinal Diseases: Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum

Unit 3 Fungal and Protozoan diseases **15**

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention

Cutaneous mycoses: Tinea pedis (Athlete's foot)

Systemic mycoses: Histoplasmosis

Opportunistic mycoses: Candidiasis

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Malaria. Kala-azar

Unit 4 Antimicrobial agents: General characteristics and mode of action **08**

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function: Inhibitor of protein synthesis; Inhibitor of metabolism

Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadme, Acyclovir, Azidothymidine Antibiotic resistance, MDR. XDR. MRSA. NDM-I

Unit V: Tutorials, Seminars and Assignments **05**

Lab Course -09 MCB -621 (C1)
MEDICAL MICROBIOLOGY

CREDITS: 02

1. Identify pathogenic bacteria (any three of E. coli, Salmonella. Pseudomonas, Slaphylococcus, Bacillus) on the basis of cultural, morphological and biochemical characteristics: JMViC, TS1, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, McConkey agar. Mannitol salt agar, Deoxycholatc citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox,HPV wans, AIDS (candidiasis), dermatomycoscs (ring worms)
6. Study of various stages of Malarial parasite in RBCs using permanent mounts.

SUGGESTED READING

1. Ananlhanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, UniversltyPress Publication
2. Brooks G.F., Carroll K.C., Butcl J.S., Morse S.A. and Mictzncr, T.A. {2013} Jawetz, Melnick And Adelberg's Medical Microbiology. 26th edition. McGraw Hil! Publication
3. GoeringR., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4lhedition. Elsevier
4. WilleyJM, Sherwood LM. and Woolvcrton CJ.(2013) Prescott, Harley and Klcin's Microbiology.9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. *14th edition. Person Internatinnal Edition*

DSE 3 MCB-611 (D1)

Microbial Ecology

Semester VI

TOTAL HOURS: 45 CREDITS : 2

Unit I **10**

Ecology. Principles, kinds and Eco-factor, Ecological Pyramid.Microbial Landscape.
Soil Microbiology: Microbial groups present in soil. Role of microorganisms in turnover of elements carbon, nitrogen, phosphorus and sulphur, microbes in composting. Importance of mycorrhizal inoculums and types , Production of VAM, and its field applications .

Unit II **10**

Beneficial microorganisms in Environment and its interrelationships between Plant .animals Microbes. Biofertilizer , microbial insecticides.
Microbial agents for control of Plant diseases.
Microbes for Bio-energy and use for sustainable Environment.
Biodegradation, Biogas production, Biodegradable plastics.

Unit III **10**

Management of microbiota for maintaining soil fertility.
Conversion of waste lands into fertile lands.
List of Diseases caused by bacteria and fungi with respect to Air, water and soil.
Role of Biological Control in Ecology.
Bioremediation and its strategies .in situ and Ex situ bioremediation.
Phytoremediation: advantages and disadvantages.

Unit IV **10**

Global environmental issues and its solutions: Ozone, Green house effect. Acid Rain, heavy metal pollution, e-waste. Oil pollution, radioactive wastes. etc.
Microorganisms and ihcir Activities as Indicators of soil health and pollution.

Unit V **05**

Seminar' PPT presentation/Assignments/Tutorials.

Lab Course-9 MCB-621(D1)
Microbial Ecology

TOTAL HOURS: CREDITS: 1.5

1. Analysis of soil - pH, Moisture content and water holding capacity.
2. Study of air microflora by using sedimentation plate method.
3. Enumeration of bacteria, fungi and actinomycetes from soil.
4. Isolation of antibiotic producing bacteria from soil samples
5. Isolation of Actinomycetes from soil.
6. Identification of antibacterial activity of Actinomycetes.
7. Isolation and Identification of antibacterial activity of fungi.
8. Isolation of Rhizobium from root nodules.
9. Isolation of Nonsymbiotic nitrogen fixing Azotobacter from soil.
10. Bio-ethanol and bio-diesel production, using agricultural waste/ production from lignocellulosic waste
11. Biogas production: Methane / hydrogen production using microbial culture.
12. Use of Microorganisms in bioremediation: removal of heavy metals from aqueous effluents
13. Project related to pollution.

References:

1. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi.
2. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBM Publishing Co. New Delhi.
3. MadiganMT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson Benjamin Cummings.
4. Maier RM, Pepper IL and Gerba CP. (2009). Environmenlal Microbiology. 2nd edition, Academic Press
5. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley &Sons Inc.New York & London.
6. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin,'Cummings Science Publishing. USA
7. Willey JM, Sherwood LM, and Wonlvcrton C.I. (2013). Prescott's Microbiology.9th edition.McGraw Hill Higher Education.

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. 9lh Edition. McGraw Hill International.
2. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.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 4lh edition, ASMPress,
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

DSE 4 MCB -612

Biostatistics and Bioinformatics (B2)

Semester VI

TOTAL HOURS: 45 CREDITS : 2

Unit I **10**

Biostatistics: Measures of Central value of Dispersion and Frequency Distribution-mean, median, mode, range, standard deviation, variance.

Basic principles of probability theory. Sampling distribution, statistical inference .

Unit II **10**

Statistical methods for quality management. Sampling theory, time series, and Index number.

Testing of Hypothesis, Types of errors and levels of significance and Degree of freedom, m Analysis and Comparison of variance (F-test), small sample test based on t-test, Z-test : Confidence Interval; Distribution-free test - Chi-square test;. Experimental Designs and Operational Research. Correlation and Linear regression.

Unit III **10**

Definition, nature and scope of bioinformatics. Bioinformatics versus computational biology. Branches of bioinformatics. Basic concepts in bio informatics. Introduction to Biological databases: NCB1, EMBL, EXPASY. P1R. DDBJ, Uniport, Pfam. Concept of World Wide Web: HTML, 11TPP.

Unit IV **10**

Comparative Genomics and proteomics: Molecular phylogenetics: Construction of Phylogenetic trees .Clustering methods. U PGM A & neighbor joining. Local and Global Sequence alignment, pairwise and multiple sequence alignment.

Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes

Genome, transcriptome, proteome, 2-D gel electrophoresis. Fragment assembly, peptide sequencing using mass and spectroscopy data.

Major features of completed genomes: *E.coii, S. cerevisiae*, Human.

Unit V **05**

Seminar.1' PPT presentaiion/Assingments/Tutorials.

Lab Course 10. MCB- 622 (B2)
BIOSTATISTICS AND BIOINFORMATICS

TOTAL HOURS: 3 CREDITS: 1.5

1. Introduction to different operating systems - UNIX, LINUX and Windows
2. Introduction lo bioinformatics databases : NCBI/PDB/DDBJ, Uniprot, PDB
3. Sequence retrieval using BLAST
4. Prediction of different features of a functional gene
5. Mean, Median, Mode from grouped and ungrouped Data set
6. Standard Deviation and Coefficient of Variation
7. Correlation
7. Regression
8. Finding area under the curve using normal probability
9. Testing of Hypothesis- Normal Distribution, t-test and Chi-Square-tcst
10. Patentiiig Inventions in Microbiology

Suggested References

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House

2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed.. BPB Publications

3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International StudentEdition

4. Rastogi S.C., Mcndiratta N. and Rastogi P. (2007) Bioinformalics: methods and applications, genomics. proteomics and drug discovery, 2nd ed. Prentice Hall India Publication

5. Primrose and Twyman (2003) Principles ofGenome Analysis & Gcnomics. Blackweil

6.Mungikar Anil.M.(2003) Biostalistical Analysis. Saraswati Printing Press

7.Rao K. Surya (2010) Biostatistics for Health and Life Sciences. Himalaya Publishing House.

8.N.Gummani (2005) An Introduction to Biostatistics.MJP Publisher.

9. A. Edmondson and D. Druce(1996) Advanced Biology Statistics, Oxford University Press.

10. W. Danial: Biostatisrics(2004)A foundation for Analysis in Health Sciences,John Wiley and Sons.

DSE 4 MCB -612

Agricultural Microbiology (C2)

Semester VI

TOTAL HOURS: 45 CREDITS: 2

Unit 1 Soil Microbiology **12**

Soil as Microbial Habitat, Soil profile and properties. Soil formation. Diversity and distribution of microorganisms in soil. Microbiological Examination of soil. R:S ratio. Mineralization of Organic compounds, Degradation of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium.

Unit 2Microbial Activity in Soil and Green House Gases No of Hours: **12**

Microbial interactions in soil. Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control. Biocontrol mechanisms and ways. Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds
Introduction of Plant Pathology : Regional plant/ crop diseases

Unit 3 Bin fertilization, Phyto-stimulation, Bioinsecticides **11**

Plant growth promoting bateria, biofertilizers - symbiotic *(Bradyrhizobium, Rhizobium, Frankia)*, Non Symbiotic *(Azospirilium, Azotobacter, Mycorrhizae,* MHBs, Phosphate solubilizers, algae). Novel combination of microbes as biofertilizers, PGPRs

Unit 4 Secondary Agriculture Biotechnology **10**

Biotech feed. Silage, Biomanure, biogas, biofuels - advantages and processing parameters
GM crops Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.
Agricultural waste management

Unit V Seminar/ PPT presentation/Assingments/Tutorials **05**

Lab Course-10 MCB-622
Agricultural Microbiology (C2)

TOTAL HOURS: 60 CREDITS : 1.5

1. Study soil profile
2. Study microflora of different types of soils
3. Rhizobium as soil inoculants characteristics and field application
4. Azotobacter & soil inoculants characteristics and field application
5. Isolation and identification of pathogens from infected plants
5. Design and functioning of a biogas plant
6. Isolation of cellulose degrading organisms

SUGGESTED READINGS

1. Agrios GN. (2006). Ptanl Pathology.5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management.7th edition.Oxford & IBM, New Delhi.
3. Click BR, Pasternak J.1, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Ben jam in/Cumm ings Science Publishing, USA
5. Maier RM. Pepper 1L and Gcrba CP. (2009).Environmenta! Microbiology. 2nd edition. Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. CoyneMS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Isl edition. Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The 1-Iaworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Salecm F and Shakoori AR (2012) Development of Bioinsecticidc, Lap Lambert

DSE 4 MB-612

MICROBIAL DIVERSITY (D2)

Semester VI

UNIT 1: INTRODUCTION TO MICROBIAL DIVERSITY **10**

1.1 Biodiversity- Microbial evolution and types of diversity

1.2 Introduction and overview of microbial taxonomy, taxonomic ranks of microorganisms and classification systems (Phenetic, phylogenetic and polyphasic classification)

1.3 Major characteristics used in taxonomy: classical and molecular characteristics

1 .4 Major divisions of life and groups of microorganisms: study of different classifications and place of microbes

1.5 Introduction and overview of Metagenomics and its applications

UNIT 2: PROKARYOTIC DIVERSITY **10**

2.1 Introduction and overview of Bergey's Manual and Habitat and distinguishing features of Grain negative & positive bacteria

2.2 Aerobic/ Microaerophilic Gram negative bacteria:

2.2.1 Motile, helical & vibrioid

2.2.2 Non-motile curved bacteria

2.2.3 Rods and cocci

2.3 Facultative anaerobic Gram negative bacteria:

2.3.1 Rods, curved and helical bacteria

2.3.2 Dissimilatory Sulfate reducers

2.4 Anaerobic Grain negative bacteria:

2.4.1 Anaerobic cocci

2.4.2 Phototrophic bacteria (Anoxygenic and oxygenic phototrophs)

2. 5 Gram positive bacteria - General features of:

2.5.1 Endospore forming rods and cocci

2.5.2 Asporogenous rods and cocci

2.5.3 Mycobacteria and Actinomycetes

UNIT 3: DIVERSITY OF SOME UNL'SVAL PROKATYOTES **10**

3.1 Bacteria with unusual morphology

3.1.1 Budding and appendaged bacteria

3.1.2 Sheathed Bacteria

3.1.3 Mycoplasma

3.2 Bacteria with gliding motility

3.3 Rickettsia and Chlamydia

3.4 Archaebacteria

3.4.1 Introduction and general features of archaea

3.4.2 Types of Extremophilic Microorganisms: overview of Thermophiles. Halophiles, Acidophiles, Alkaliphiles, Barophiles and Methanogens

3.5 Importance of prokaryotic microorganisms

UNIT 4: EUKARYOTIC DIVERSITY **10**

A: FUNGI

4.1 General characteristics, occurrence, Structure, Reproduction (Mucor and Aspergillus)

4.2 Economic importance of fungi

B: ALGAE 4.3 General Characteristics, Occurrence & Ultra - Structure

4.4 Economic importance of Algae

C: PROTOZOA 4.5 General Characteristics. Occurrence, Ultra-Structure & economic importance of Protozoa

Unit V Seminar/ PPT presentation/Assignments/Tutorials **5**

Lab Course-10 MCB -622
MICROB1AL DIVERS1TY(D2)

Practical Hours - 3hrs/day for 2 days/Week **Total Credit -1.5**

1) Isolation of Gram's negative bacteria from the given sample.
2) Identification of Gram's negative bacteria from the given pure culture using biochemical media *(E.coli, Enterobacter aerogenes. Proteus, Salmonella)*
3) Isolation of Gram's positive bacteria from the given sample.
4) Identification of Gram's positive bacteria from the given pure culture using biochemical media *(Bacillus megaterium. Bacillus subtilis. staphylococcus aureus. Streptococcus)*
5) Identification of Fungi on the basis of Morphological Characteristics.
6) Cultivation of yeast from different natural samples and its morphological characterization using microscopic observation.
7) Microscopic observation of different algae from the given samples.
8) Microscopic observation of different protozoa from the given sample.
9) Isolation and cultivation of bacteriophage of E.coli from the given sewage sample.
10) Cultivation of Extremophile
(Halophile/thermophile/acidophile/alkalophile/psychrophile)

REFERENCE BOOKS

1. Frazier. W.C., Westhoff, D.C. (1978). Food Microbiology. Tata McGraw-Hill Publishing Company.
2. Pelczar, M.J., Chan E.C.S., Kricg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
3. Salle, S.J. (1 974).Fundamenta] Principals of Bacteriology, Tata McGraw I lill Publication Co. Ltd. New Delhi.
4. Purohit, S.S.. Microbiology-Fundamentals and Applications-6 th Edition, Agrobios Publications, Delhi.
5. Presscott, M.J.. Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Me GrawHill publication.
6. Stainer, R.Y., lingraham, J.L., Wheclis, M.L., Painter. R.K. General Microbiology, 5th Edition. MacMillan Press Lid., London.
7. Modi. H.A. Elementary Microbiology - Vol -I & II, Akta Prakashan, Nadiyad.
8. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
9. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.
10. Dubey, R.C.and Maheshwari, D.K., A Text Book of Microbiology, S. Chand Publications, New Delhi.
11. Mani, A.. Selwaraj, A.M., Narayanan L.M., and Arumngam, N.. Microbiology, Saras Publication, Delhi
12. Palel. R.J., Patel. K.R., Experimental Microbiology, Vol-1, Aditya Publications, Ahmedabad, India.
13. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications,

Ahmedabad, India.
14. Dubey. R.C., Maheshwari. O.K.. Practical Microbiology. S.Chand & Company Ltd.. New Delhi
15. Konika Sharma, Manual of Microbiology - Tools and Techniques, Ane Books, Delhi

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