



KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಲ (ಎಸ್&ಟಿ) ವಿಭಾಗ



Tele: 0836-2215224
e-mail: academic.st@kud.ac.in
Pavate Nagar, Dharwad-580003
ಪಾವಟೆ ನಗರ, ಧಾರವಾಡ - 580003

NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/SVB-13/AD-HOC /Microbiology (UG) /20-21/ 991

Date:

16 OCT 2020

NOTIFICATION

Sub: Regarding introduction of the syllabus of Microbiology UG under C.B.C.S.
w.e.f. the academic year 2020-21 & onwards.

- Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.
2. Special BOS Res. No. 02, dt. 07.07.2020
3. Special Faculty Res. No. 10, dt. 11.08.2020.
3. Special Academic Council Res. No. 47, dt. 21.08.2020.
4. Vice-Chancellor's order dated - 07 - 10 - 2020

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Microbiology UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may please be brought to the notice of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U.website (www.kud.ac.in).

(Dr. Hanumantappa K.T)
REGISTRAR

To,

1. The Chairman, BOS Microbiology (UG), Dept. of Microbiology, K.U.Dharwad.
2. The Chairman, Dept. of Microbiology, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

Copy fws to:

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Botany, K.U.Dharwad.
2. The Director, IT Section, Examination Section, K.U.Dharwad for information and to upload on K.U.Website (www.kud.ac.in).

Copy to:

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analyst, Computer Unit Exam Section, K.U.Dharwad.



KARNATAK UNIVERSITY, DHARWAD

Syllabus and Structure

For

B. Sc. MICROBIOLOGY

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. 2020 - 2021 onwards

Karnatak University, Dharwad

CBCS syllabus for Under Graduate Programme in Microbiology (opt.) DISCIPLINE SPECIFIC COURSE (DSC) and DISCIPLINE SPECIFIC ELECTIVE (DSE) Effective from 2020-21

Sem ester	Theory/ Practical	Paper	Subject Code	Instruction hour per week	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
I	Theory	DSC	MB-1.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-1.1	04 hrs	03 hrs	10	40	50	02
II	Theory	DSC	MB-2.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-2.1	04 hrs	03 hrs	10	40	50	02
III	Theory	DSC	MB-3.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-3.1)	04 hrs	03 hrs	10	40	50	02
IV	Theory	DSC	MB-4.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-4.1	04 hrs	03 hrs	10	40	50	02
V	*Theory P-I /P- II	DSE	MB-5.1 / MB-5.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	MB-5.1 / MB-5.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
VI	*Theory P-I /P- II	DSE	MB-6.1 / MB-6.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	MB-6.1 / MB\6.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
Total						180	720	900	36

*Candidate shall choose either paper –I or P-II but not both in DSE Papers

SKILL ENHANCEMENT COURSE (SEC) for Microbiology

Sem ester	Theory	Subject Code	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
V	Theory	(SEC-1.1)	02 hrs	30	1.5 hrs	10	40	50	02
V	Theory	(SEC-1.2)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.1)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.2)	02 hrs	30	1.5 hrs	10	40	50	02
Total						40	160	200	08

B.Sc. Microbiology
Proposed Semester-wise distribution of the course structure
Effective from 2020-21

Sl. No.	Code No.	Type of the Paper	Title of the Paper	Credit Pattern in L:T:P	Credit Value	Hours /Week L:T:P
Semester – I						
1	MB-1.1	DSC	Microbiology and Microbiological Techniques	4:0:2	6	4:0:4
Semester – II						
1	MB-2.1	DSC	Microbial Physiology and Genetics	4:0:2	6	4:0:4
Semester – III						
1	MB-3.1	DSC	Molecular Biology and Genetic Engineering	4:0:2	6	4:0:4
Semester – IV						
1	MB-4.1	DSC	Environmental and Agricultural Microbiology	4:0:2	6	4:0:4
Semester – V						
Any one of following						
1	MB-5.1	DSE 1.1	Food and Industrial Microbiology	4:0:2	6	4:0:4
2	MB-5.2	DSE 1.2	Microbial Biotechnology and Bioinformatics	4:0:2	6	4:0:4
Any one of following						
1	SEC-1.1	Discipline specialization	Microbial Quality Control in Food and Industries	2:0:0	2	2:0:0
2	SEC-1.2	Discipline specialization	Microbiological analysis of air and water	2:0:0	2	2:0:0
Semester – VI						
Any one of following						
1	MB-6.1	DSE 1.1	Immunology and Medical Microbiology	4:0:2	6	4:0:4
2	MB-6.2	DSE 1.2	Advances in Microbiology and Biostatistics	4:0:2	6	4:0:4
Any one of following						
1	SEC-2.1	Discipline specialization	Microbial diagnosis in Health Clinics	2:0:0	2	2:0:0
2	SEC-2.2	Discipline specialization	Microbial Infections and Treatment	2:0:0	2	2:0:0

- DISCIPLINE SPECIFIC COURSE- DSC
- DISCIPLINE SPECIFIC ELECTIVE-DSE

- SKILL ENHANCEMENT COURSE –SEC
- L=Lecture, T-Tutorial, P-Practical

SEMESTER-I

CORE COURSE : MICROBIOLOGY

PAPER MB - 1.1 DSC 1A – Microbiology and Microbiological Techniques

(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. **Introduction to Microbiology**

Microbes and origin of life. History scope and relevance of microbiology as a modern science. Branches of Microbiology, Contribution of Scientists in the field of microbiology - Antony Von Leewenhoek, Redi, Needham Lazaro Spallanzani, Louis Pasteur, Joseph Lister. Robert Koch, Alexander Flemming, Iwanowsky & Edward Jenner. (7 hrs)

2. **Microscopy**

Principles of Microscopy - Resolving power. Numerical Aperture, Working distance magnification and Chromatic aberrations. Different types of Microscopes – Compound, Dark field, phase contrast, Stereo microscopes, Fluorescent microscope, Electron microscope - Scanning and Transmission electron microscope. (7 hrs)

3. **Microbial Taxonomy and Diversity**

Haeckel's Three Kingdom system, Whittaker's Five kingdoms classifications - Monera. Protista, Fungi, Plantae and Animalia. Principles and methods of classification. Different trends in classification of microorganisms. Distribution and significance of microorganisms in air, water and soil. (6 hrs)

4. **General Characteristics of Microorganisms**

General characteristics of major groups of micro organisms - Algae, Protozoa. Fungi, Bacteria (Based on Bergey's manual of systematic Bacteriology). Comparison of the 3 domains of organisms: Archaea, Bacteria and Eukarya. General characteristics of viruses, classification of viruses - RNA viruses and DNA viruses. Viroids and Prions. (10hrs)

5. **Sterilization Techniques**

A) **Physical Methods and their mode of action**

- i) **Heat** -
 - a) Dry heat - Hot air oven.
 - b) Incineration.
 - c) Moist heat - Autoclave.
 - d) Tyndallization (Fractional sterilization)

ii) **Filtration methods** - Types of filters, Inorganic (Seitz, chamberland, sintered glass, candle and asbestos filter) and organic filters (HEPA and Membrane filters) .

iii) **Radiations Methods** - UV radiation, Y-rays and cathode rays.

B) **Chemical methods :**

- a) Definition of terms - disinfectants, antiseptics. Sanitizers, Microbicides -bactericides, virucide, Fungicide and Sporicide. Microbiostatic – bacteriostatic and fungistatic agents.
- b) Use and mode of action - Alcohols, aldehydes, halogens, phenols, heavy metals. Detergents: Quaternary ammonium compounds.

(11 hrs)

6. **Culturing of microorganisms**

Culture media – Natural, Synthetic and Semi-synthetic - solid, liquid and semi solid media.
Special media-Basal media, Selective, transport, differential, enrichment media.

Methods of isolation of bacteria, fungi - serial dilution, pour plate, spread plate and streak plate techniques..

Cultivation of Anaerobic bacteria - Anaerobic jar and chamber method.

Maintenance of Pure Cultures, Culture Collection Centres (8 hrs)

7. Stains and Staining techniques

Principles and types of stains - Preparation of smears and fixation in simple staining (Positive and Negative), Differential staining (Grams staining and Acid - Fast staining) Structural staining (Cell wall, Capsule, Flagella and Endospore staining)

(5hrs)

8. Instruments

Working principles and applications of Instruments: Centrifuge, pH meter, Incubator (BOD and Bacterial), autoclave, Hot air oven, Laminar air flow, Colorimeter and Spectrophotometer. Chromatography- Working principles of Paper, Thin layer, Column and Ion-Exchange Chromatography

(6 hrs)

PRACTICAL I

MB - 1.1 - MICROBIOLOGY AND MICROBIOLOGICAL TECHNIQUES

(4 hrs/week)

1. Laboratory safety: General rules and regulations.
2. Study of Microscope - Structure and working principles of Light microscope
3. Demonstrations of laboratory instruments: Autoclave, hot air oven, incubator, Laminar Air Flow, Centrifuge, pH meter, Colorimeter and Spectrophotometer..
4. Cleaning and sterilization of glassware. Decontamination and disposal of culture media.
5. Preparation of culture media - Broth, Semisolid and solid media. Study of bacterial culture techniques: serial dilution, Pour plate. Streak plate and spread plate techniques..
6. Isolation of microorganisms from air, water and soil and studying their characteristics.
7. Staining methods - Simple staining, Gram's staining, Acid fast staining and structural staining. Fungal staining technique
8. Microscopic observations of Prokaryotes and Eukaryotes: Bacteria. Cyanobacteria, Protozoa, Fungi and Algae.
9. Study of Bacterial Motility by Hanging drop method
10. Micrometry and camera lucida.
11. Counting of yeast cells and fungal spores by Haemocytometer.
12. Demonstration of slide culture technique of fungi
13. Demonstration of Chromatographic techniques (Paper Chromatography)

14. Demonstration of Preparation of permanent slides

References:

MICROBIOLOGY AND MICROBIOLOGICAL TECHNIQUES

- ❖ Aneja K.R. Experiments in Microbiology, plant pathology Tissue culture and Mushroom Cultivation. New Age International. New Delhi.
- ❖ Atlas, R. M. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers Cappuccino, J.G and Shermani, N - 1999 "Microbiology - a laboratory Manual Adeliason Wesley.
- ❖ Bhattacharya "Experiments with microorganisms" - Emkay Publishers.
- ❖ Cappucino. J. and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.
- ❖ Carter, J. and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
- ❖ Colwod, D 1999 "Microbial Diversity" Academic Press..
- ❖ Cooper T.G. (1997): "The tools of Biochemistry" John Wiley and sons.
- ❖ Dubey, R. C. and Maheshawari, D.K, (2013). Text book of Microbiology, S Chand and company limited, Ramnagar, New Delhi.
- ❖ Edward Alcamo T. 1997 "Fundamental of Microbiology - 5th edn., Adlison Wesley Longman Inc. New York.
- ❖ Gunashekar, P. "Laboratory Manual in Microbiology" New Age Intl Ltd.
- ❖ Madigan, M.T. Martinko, J.M and Parker, J - 1997 "Biology of Microorganisms-8th edn., McGraw Hill Inc. New York.
- ❖ Nelson David, L and Cox Michael, M., Lehninger, (2008). Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
- ❖ Norris J.R. and Ribbons. D.W. "Methods in Microbiology" Academic Press.
- ❖ Peleczar, M.J.. Chan. E.C.S and Krieg, N.R. - 1982 "Microbiology" Tata MaGraw Hill Book Co. New York.
- ❖ Powar and Daginwala - 1994 "Microbiology - Vol I and II. Himalaya Publication, New York.
- ❖ Prescott's Microbiology 2020 Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition. New York, NY : McGraw-Hill Education
- ❖ Salle, A.J. "Fundamental Principles of Bacteriology" Tata McGraw Hill Publishing Company Ltd., New Delhi.
- ❖ Srivastava, S. and Srivastava, P. S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.
- ❖ Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (2005). General Microbiology. 5th edition McMillan.
- ❖ Sullia S. Band Shantaram. S. 1998 -General Microbiology" Oxford and IBH Publishing Co Pvt Ltd. New Delhi.
- ❖ Sundara R. Rajan "Tools and Techniques of Microbiology" - Anmol Publications.
- ❖ Tortora, G. J., Funke, B. R. and Case, C. L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

SEMESTER-II

CORE COURSE : MICROBIOLOGY

PAPER MB 2.1 DSC 1B - Microbial Physiology and Genetics

(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. Biomolecules

A brief account of the properties, classification and importance of Carbohydrates, Protein and Lipids.

(10 hrs)

2. Enzymes

Nomenclature, classification, properties, mode and mechanism of enzyme action, factors affecting enzyme action, enzyme regulation, competitive and non competitive inhibition and allosteric enzymes, cofactors, coenzymes, Ribozymes and their importance, clinical importance of enzymes. **(6 hrs)**

3. Microbial Growth, Nutrition and Photosynthesis

Nutritional requirements, modes of nutrition – Autotrophs, Heterotrophs, Phototrophs. chemotrophs, methanotrophs, organotrophs and saprotrophs. Bacterial Photosynthesis: Types of bacterial photosynthesis, Photosynthetic pigments. Light reactions. Dark reaction, Comparison of photosynthesis in green plants and bacteria, Oxygenic and Anoxygenic Photosynthesis. Microbial Growth: Growth Rate, generation time and growth curve - phases of growth and their significance physical and chemical factors affecting growth - Temperature, Light. pH, Oxygen and saline requirements. Measurement of growth by cell number, cell mass and cell viability. **(12 hrs)**

4. Bio-energetics and Energy yielding process

Laws of thermodynamics, Free energy, ATP and its production, other high-energy compounds, Oxidation and reduction reactions. Glycolysis, Outline of TCA cycle, Electron transport chain, Oxidative phosphorylation, Oxidation (alpha, beta and Omega oxidation pathway). Amino acid degradation (Transamination. Deamination and Decarboxylation). Anaerobic respiration Alcoholic, Lactic and acetic acid fermentation.

(6hrs)

5. Introduction to Genetics and Genetic code:

Mendelian concepts, principles and classical genetics. Genomic organization in Prokaryotes and Eukaryotes. Genetic Code: Features, triplet code, wobble hypothesis, codons and evolution of genetic code **(10 hrs)**

6. Nucleic Acids

Chemical composition of DNA and RNA, Watson and Crick model of DNA. Ultra structure of DNA. Types of RNA and DNA - A. B. Z and H. Super coiling of DNA, Extra chromosomal DNA. **(6 hrs)**

7. DNA Replication and Genetic Recombination in Prokaryotes

Semi-Conservative method. Rolling circle model, Origin of replication. Primers and template. Replication fork, Unidirectional and Bi-directional. Mechanism of Transformation, Conjugation and Transduction. **(6 hrs)**

8. Transposable Genetic Elements

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Mu transposon.. Mutagenesis. Detection and isolation of mutants by replica plate method. **(4 hrs)**

PRACTICAL II

MB 2.1 - MICROBIAL PHYSIOLOGY AND GENETICS

(4 hrs/week)

1. Qualitative tests for the detection of Carbohydrates

- Glucose** - Benedict's test, Molisch's test, Fehling's test, Picric acid test, Barfoeds test, selwinoffs test and Bials test
2. Qualitative tests for Proteins and Amino acids
Protein -Biurette test. Ninhydrin test. Millons test Xanthoprotein test, sakaguchi and hopkins cole test.
 3. Qualitative tests for Lipids
Lipids - Acrolein test. Sudan III test, emulsification test and solubility test.
 4. Colorimetric estimation of sugar by DNS method.
 5. Colorimetric estimation of protein by biuret method.
 6. Study of Bacterial Growth curve
 7. Biochemical tests for the identification of bacteria
 - a) IMViC
 - b) Fermentation of glucose, sucrose and lactose - Acid and gas production.
 - c) Starch hydrolysis
 - d) Gelatin hydrolysis
 - e) Catalase test
 - f) H₂S
 - g) Casein hydrolysis
 - h) Oxidase test
 8. Effect of pH and temperature on bacterial growth.
 9. Study of genetic recombination in bacteria using charts
Conjugation - v/s F⁺ Hfr⁺ v/s F, F vs/s F
Transformation - Griffith's experiment and Mechanisms
Transduction - Generalized and specialized.
 10. Determination of growth curve for fungi by colony diameter method.
 11. Demonstration of chromatographic Techniques (paper/thin layer chromatography).

References:

MICROBIAL PHYSIOLOGY AND GENETICS:

- ❖ Becker, W. M., Kleinsmith, L. J., Hardin, J. and Bertoni, G. P. (2009). The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
- ❖ Caldwell 1995. "Microbial Physiology and Metabolism" Brown Publisher.
- ❖ Colwod. D 1999 "Microbial Diversity" Academic Press.
- ❖ De Robertis, E. D. P. and De Robertis, E. M. F. (2006). Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- ❖ Dewes. I.W. Southernland. J.W - 1976 "Microbial Physiology" Haistead Press, New York.
- ❖ Gerald Karp "Cell Biology" McGraw Hill Book Co. New York.
- ❖ Gottschalk, G. (1986). Bacterial Metabolism. 2nd edition, Springer Verlag.
- ❖ Jain J.L. "Fundamentals of Biochemistry" S.C. Chand publisher.
- ❖ Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
- ❖ Moat, A. G. and Foster, J. W. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
- ❖ Moat. A.G. and Foster S.W. "Microbial Physiology" John Wiley and Sons New York.
- ❖ Nelson David, L and Cox Michael, M., Lehninger, (2008). Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
- ❖ Peleczar. M.J.. Chan. E.C.S and Krieg, N.R. - 1982 "Microbiology" Tata MaGraw Hill Book Co. New York.

- ❖ Reddy, S. R. and Reddy, S. M. (2005). Microbial Physiology. Scientific Publishers India.
- ❖ Sambrook, J. and Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory Press.
- ❖ Voet D and Voel J.G. (2000) "Biochemistry" John Wiley and Sons New York.
- ❖ Dale J.W. (1994); Molecular Genetics of Bacteria II edition John Wiley and sons. New York.
- ❖ Freifelder David. "Microbial Genetics". Narosa Publishing House, New Delhi. Gupta P.K. "Cytology and Genetics" Rastogi Publications.
- ❖ Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). Principles of Genetics. 8th Ed. Wiley-India.
- ❖ Hariwell L. H et.al. 2000 "Genetics - from Gene to Genomes "McGraw Hill Publications New York.
- ❖ Krebs, J., Goldstein. E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
- ❖ Snustad. P.D. and Simmons. M.J. 2000 : "Principles of Genetics" 2^{IKI} edit.. John Wiley and Sons Inc. New York.
- ❖ Strickberger, M.W. 1995 "Genetics" prentice Hall of India Pvt. Ltd. New Delhi. Watson. J.D. *et. al*, 1987 "Molecular Biology of Genes".

SEMESTER – III
CORE COURSE : MICROBIOLOGY
PAPER MB 3.1 DSC 1 C - MOLECULAR BIOLOGY AND GENETIC
ENGINEERING
(Credits: Theory-4, Practicals-2)
THEORY
Total hours allotted: 60 hrs (4 hrs/week)

1. **Molecular basis of life**
An introduction. Experimental proof of DNA and RNA as genetic material **(5 hrs)**

2. **Transcription and Translation**
Process of transcription, transcription factors, post transcriptional modification. Initiation, elongation and termination of protein synthesis, protein folding comparison of protein synthesis in prokaryotes and eukaryotes.

(10 hrs)

3. **Regulation of gene expression**
Regulation of gene expression in prokaryotes (operon concept) and Eukaryotes (Galactose metabolism in yeast). Gene organization and expression in mitochondria and chloroplasts
(7 hrs)

4. **Mutations and repair mechanisms**
Nature and types of mutations: Induced, Spontaneous. Biochemical basis of mutations, point mutation and Frame shift mutations. Detection of mutations. DNA damage and repair mechanism (SOS and Excision) **(7 hrs)**

5. **Introduction and Tools of genetic engineering**
Introduction to genetic engineering
Tools of Genetic Engineering

- a) **Modifying enzymes** : Restriction enzymes, ligases, methylases.
- b) **Cloning vehicles:** Naturally occurring plasmids. cloning plasmids (PBR 322 and PUC 18), Viruses as cloning vehicles (λ DNA. M₁₃), Hybrid vectors (cosmid, YAC)
- c) **Cloning host:** E. coli (8hrs)

6. **Techniques in genetic engineering**

- a) *In vitro* construction of rDNA molecules: Isolation of DNA from bacteria (gene of interest) and isolation of vector DNA (Bacteria)
- b) Cutting of DNA molecules: Physical methods, enzymatic methods and joining of DNA molecules - Homopolymertails. Linkers. Adapters.
- c) Transformation of rDNA into target host organisms: Calcium chloride mediated gene transfer, Agrobacterium mediated DNA transfer. Electroporation and Microinjection.
- d) Screening and selection of recombinant host cells: Insertional inactivation, *In situ* colony/DNA hybridization and in immunological techniques.
- e) Gene libraries: Genomic DNA and cDNA cloning techniques.
- f) DNA finger printing (10hrs)

7. **Merits and Demerits of Genetic Engineering**

Applications of Genetic Engineering

- a) Medicine - Gene therapy
 - b) Agriculture - Golden Rice
 - c) Industry – Alcohol, Biofuel.
- Potential hazards and safe guards of genetic engineering (10 hrs)

8. **Biotechnology programmes and regulations**

Role of international organizations in Biotechnology, Governmental regulations of recombinant DNA research regulation for disposal of Bio hazardous material, patenting of Bio-technological processes and products and patent laws.

(3 hrs)

PRACTICAL III

MB 3.1 – MOLECULAR BIOLOGY AND GENETIC ENGINEERING
(4 hrs/week)

1. Preparation of buffers - Citrate and Phosphate buffers.
2. Extraction and estimation of DNA by Diphenylamine method
3. Estimation of RNA by Orcinol method
4. Extraction and estimation of protein from animal/plant source by salt precipitation and organic solvent method.
5. Effect of UV light and chemicals on microbial load
6. Preparation of Master and Replica Plates
7. Restriction digestion of DNA
8. *In vitro* DNA ligation
9. Study of DNA finger printing (chart)
10. Study of gene cloning (chart)
 - a) PBR322
 - b) PUC 18 and 19
 - c) SV40

- d) Bacteriophages
- e) Selection of recombinants by replica plate technique
- f) Ames test

References:

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

- ❖ Brown, T. A. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
- ❖ Brown. T.A. 1998 "Genetics - A molecular **Approach**" 3rd edn. Stanely Thornes Ltd. U.K.
- ❖ Clark, D. P. and Pazdernik, N. J. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
- ❖ Colwod, D 1999 "Microbial Diversity" Academic Press.
- ❖ Davis R.W. Botstein, D. and Roth, J.R. (1980): "A manual for Genetic Engineering" Coldspring Harbor Laboratory. Cold spring Horbor New York.
- ❖ De Robertis. E.D.P. and De Robertis E.M.S 1988 "Cell and Molecular Biology"¹¹ Lea and Jeliger Philadelphiae K.M. Vakghese Co.
- ❖ Glick, B.R. and Pasternak, JJ. 1994 "Molecular Biotechnology Principles and Applications of Recombinant DNA" American Society for Microbiology, Washington D.C.
- ❖ Nicholl. D.S.T. 1994 "An Introduction to Genetic Engineering" Cambridge University Press.
- ❖ Peters. P 1993 "A Guide to Genetic Engineering" Dubuque Iowa WMC Brown.
- ❖ Rigbu, P.W.J 1987 "Genetic Engineering - VI" Academic Press Inc. Florids. USA.
- ❖ Russell, P. J. (2009). Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings.
- ❖ Sambrook, J. and Russell, D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
- ❖ Sandhya Mitra 1988 "Elements of molecular Biology"" MacMillian publications
- ❖ Watson, J. D., Baker, T. A., Bell, S. P. *et al.* (2008). Molecular Biology of the Gene, 6th Ed., Benjamin Cummings.

SEMESTER –IV

CORE COURSE: MICROBIOLOGY

PAPER MB 4.1DSC 1D -ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. Introduction

Soil, water and air as habitats for microorganisms and concept of environment, microbial populations in the above habitats. **(2 hrs)**

2. Microbiology of air

a) Microbes and atmosphere: Atmospheric layers, sources of microorganisms, air microflora of indoor and outdoor environment, factors affecting air microflora, significance and management of airborne microbes.

b) Techniques of trapping airborne microorganisms: Gravity slide, Petri plate exposure, liquid impingement, sieve device and filtration.

c) Air borne diseases: allergens, pathogens, significance of microorganisms in air. Control of air borne microorganisms. **(8 hrs)**

3. **Microbiology of water**
 - a) **Sources of water:** surface and ground water and their microflora.
 - b) **Water pollution** - sources, water borne diseases-viral (Jaundice), bacterial (Cholera) and protozoan (amoebic dysentery), biological indicators of water pollution.
 - c) **Determination of sanitary quality of water:** SPC tests for coliform. MPN. IMViC reactions, membrane filter technique.
 - d) **Water purification in municipal water supply.** (9 hrs)

4. **Microbiology of waste water**
 - a) **Introduction:** Source of waste water - domestic, agricultural and industrial, physical, chemical and microbiological characteristics of waste water.
 - b) **Waste water treatment:** Single dwelling unit - Septic tank; municipal waste water treatment - **primary** (Screening, coagulation and Sedimentation). **Secondary** (trickling filter, activated sludge process, Osmosis, oxidation pond), **Tertiary** (reverse Ion exchange method and dialysis), reclamation of waste water and solid waste recycling.
 - c) **Waste as Resource (organic compost):** Biogas production and composting (8hrs)

5. **Bioremediation and Bioleaching**
 Introduction, types, scope and applications of Bioremediation. Factors affecting the microbes in heavy metal tolerance Different microbial groups in bioremediation of environment pollution. Biodegradation of Petroleum (Hydrocarbons), pesticides (2,4-D and DDT), different microbial groups in bioremediation of environment. Scope, organisms involved, economic importance, mechanism of bioleaching of Cu and Fe. (4hrs)

6. **Microbiology of soil**
 - a) **Introduction:** Type, soil profile, physical and chemical characters.
 - b) **Soil Microorganisms:** Bacteria, fungi, actinomycetes. algae, protozoa and viruses.
 - c) **Role of Microbes in soil process:** Biogeochemical cycles - Carbon, Nitrogen, Sulphur and Phosphorous. Biodegradation: Pectin. Cellulose and lignin.
 - d) **Rhizosphere Microorganisms:** Rhizosphere and rhizoplane, Interactions among microorganisms - Neutralism, Mutualism, Commensalism. Antagonism and Parasitism
 - e) **Plant-microbe interaction:** Mycorrhizae (10 hrs)

7. **Microorganisms in Agriculture**
 - a) **Bio-fertilizers:** Types (Bacterial, fungal, phosphate solubilizers. BGA. Plants-Azolla).
 - b) **Mechanism of Nitrogen fixation:** Phosphate solubilizing and Cellulolytic micro organisms, Mass production, mode of applications, advantages and limitations of bacterial inoculants (*Rhizobium*, *Azotobacter*, *Azospirillum* and Cyanobacteria).
 - c) **Bio-pesticides:** Types (Bacterial *Bacillus thuringiensis*, viral- NPV. *Fungal (Trichoderma)*, mode of action, factors influencing and target pests. (10 hrs)

8. **Microbes as plant pathogens**
 A brief account of the causative agent. Symptoms and control of the following plant diseases: Fungal (*Puccinia*, *Plasmopara*, *Cercospora*, *Pyricularia*) Bacterial (*Xanthomonas oryzae*), Mycoplasma - Sandal spike. Grassyshoot. Viruses (TMV. Tomato leaf curl). Brief account of post harvest pathology and Integrated Pest Management. (9 hrs)

PRACTICAL IV

MB 4.1 - ENVIRONMENTAL and AGRICULTURAL MICROBIOLOGY (4 hrs/week)

1. Isolation of microorganisms from soil, air and water.
2. Demonstration of air samplers - vertical cylinder spore trap. Rotorod samples, Hirst spore trap. Anderson samples liquid impingement method (Bead Bubbler).
3. Isolation and enumeration of microorganisms from different water samples.
4. Determination of quality of potable water by MPN test.
5. Display of photographs of water purification process (Flocculator. Clarifier, Sand filter, back wash chlorinometer and chloroscope).
6. Estimation of TDS (Total Suspended Solids) and TDS (Total Dissolved Solids) in sewage samples.
7. Demonstration of sewage treatment plants - Trickling filter, Imhoff tank, Septic tank and sewage treatment.
8. Estimation of dissolved oxygen, BOD, COD, chloride, phosphate and nitrate in water sample.
9. Measurement of ammonia, nitrate and nitrite uptake by microorganisms.
10. Isolation and enumeration of bacteria and fungi from rhizosphere and rhizoplane. Study of Antagonism between soil microorganisms by plate method.
11. Study of Rhizobium from Legume root nodules (gram staining) and Isolation of *Rhizobium* (Using yeast extract Mannitol Agar) and *Azotobacter* (using Ashby's Mannitol Agar) from soil.
12. Isolation of actinomycetes from soil using glucose Aspergin Agar.
13. Plant Pathology : Study of plant pathogens (Two diseases each from Bacteria, Fungi and Virus) . Demonstration of caking of grains.

Note: Visit to water treatment plant / sewage treatment plant. Report should be written and submitted along with practical record

References:

ENVIRONMENTAL and AGRICULTURAL MICROBIOLOGY

- ❖ Alexander, A.M. (1987). Introduction to soil Microbiology, 5th ed., John Wiley and sons.
- ❖ Atlas, R. M. and Bartha, R. (1993). Microbial Ecology: Fundamentals and applications, 3rd ed., Benjamin and Cummings Pub. Co., New York.
- ❖ Brock, T.D "Principles and Microbial Ecology" Prentice Hall Publishing Co Philadelphia.
- ❖ Clowd, D 1999 "Microbial Diversity" Academic Press. Co. New Delhi.
- ❖ Grant, W.D. and P.E, Long: (1981). Environmental Microbiology, Thomson Litho Ltd.
- ❖ Hurst, G.H. "Environmental Microbiology" ASM Press Washington D.C.
- ❖ Mehrotra, R.S., Plant Pathology, Tata Mc Graw Hill Publications Limited, New Delhi.
- ❖ Michael, J. Pelczar, Jr.E.C.S. Chan, Moel: Microbiology, Mc Graw Hill Book Company, New York).
- ❖ Mitchell, R. (1992). Introduction to Environmental Microbiology, Prentice Hall Inc, Englewood Cliffs.
- ❖ Powar and Daginwala (1996). General Microbiology, Vol 1. Himalaya Publishing House, Bombay.
- ❖ Powar and Daginwala (1996). General Microbiology, Vol 2. Himalaya Publishing House, Bombay.
- ❖ Prescott. Lansing, M., Harley John P and KJain Donald. A "Microbiology" WCB. McGraw Hill New York

- ❖ Ralph Mitchell 1995 "Environmental Microbiology" Wiley and Sons. New York.
- ❖ Rangaswamy, G. 1996 Diseases of crop in India. 3rd edn.. prentice Hall of India Pvt. Ltd. New Delhi.
- ❖ Rangaswamy, G. and Bagyaraj, D.J. (2001), Agricultural Microbiology, 2nd ed., Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Rao, M.N. and Datta, A.K. (1987). Waste Water Treatment. Oxford and I.B.H.
- ❖ Rheinhermer, G. (1986). Aquatic Microbiology Jhon Wiely and sons, New York.
- ❖ Salle, A.J. "Fundamental Principles of Bacteriology" Tata McGraw Mill Publishing Company Ltd., New Delhi.
- ❖ Singh. D.P. and S.K.. Dwivedi "Environment Microbiology and Biotechnology, New Age Industrial Publishers.
- ❖ Stanier. R.Y. Ingraham J.L 'General Microbiology" Prentice Hail of India Pvt Ltd., New Delhi.
- ❖ Steward W.D.P. Nitrogen fixation in plants, The Alhione Press, London.
- ❖ Subba Rao, N.S. (2002). Soil Microorganisms and Plant Growth 4th ed., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- ❖ Subbarao, MS. 1986 "Soil Microorganisms and Plant Growth" 3rd edn. Oxford and IBM publication Co. New Delhi.
- ❖ Subba Rao, N.S. (1988). Biofertilizers in Agriculture, 2nd ed.Oxford and IBH Pub. Co., New Delhi.

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE-DSE

PAPER MB 5.1 DSE 1E - FOOD AND INDUSTRIAL MICROBIOLOGY

(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 hrs (4 hrs/week)

1. Food and microorganisms

Food as a substrate for microorganisms, sources of contamination of food. **(4 hrs)**

2. Food spoilage and preservation

Spoilage of canned foods, cereals, fruits, vegetables. Meat, fish and fermented foods (Soya sauce, olives, idli. butter milk and yoghurt, cheese and Kefir)

Principles of food preservation- physical and chemical methods, food sanitation and control **(10 hrs)**

3. Microbiology of milk

Sources of milk contamination, Methods to detect microbial spoilage by SPC. Reductase test.

Biochemical changes of milk souring. Gassy fermentation. Proteolysis. Lipolysis. Ropiness, Phosphatase test, Clot on boiling test. Starter culture and its role. Methods of Preservation of milk and milk products (Pasteurization and sterilization). **(8 hrs)**

4. Food Infections and Intoxications:

Endotoxin. Food infection (Salmonellosis) Food intoxication- (Staphylococcal food poisoning, Botulism). Mycotoxins produced by Fungi: Aflatoxins in stored food and grains. Food safety and quality control- brief account of HACCP, FSSAI and Food safety and standard act 2006.

(8 hrs)

5. Introduction to Industrial Microbiology

History, scope and development of industrial microbiology. Isolation and screening of industrially important microorganisms and Strain improvement methods. (4 hrs)

6. **Fermentation and Fermentation media**

Basic structure, construction and various types of fermentors - Typical stirred aerated fermentor. Tower fermentor and Bubble cap fermentor Types of fermentation (Batch. Continuous, surface, submerged and solid state fermentation). Inoculum preparation. Media components and formulation (Crude media components, anti foam agents, precursors, inducers, Inhibitors and buffering agents). Sterilization of media and raw materials and maintenance of sterility at critical points during fermentation (8 hrs)

7. **Process parameters**

Aeration, Agitation, Temperature regulation, Foam regulation and pH Regulation. Down stream processing- Precipitation, filtration, centrifugation. distillation, cell disruption, solvent recovery, drying, crystallization. (8 hrs)

8. **Industrial production of chemicals by Microorganisms**

Microbial production of Alcohol, Lactic acid, Penicillin, Cephalosporin, Protease and Insulin. Immobilization of cells and enzymes –Types, advantages and applications, Role of microorganisms for production and recovery of minerals and petroleum. (10 hrs)

PRACTICAL V

MB 5.1 DSE 1E - FOOD AND INDUSTRIAL MICROBIOLOGY (4 hrs/week)

1. Isolation and identification of microbes from infected fruits, vegetables and cereals.
2. Isolation and identification of microorganisms from curd, idli. butter and stored foods —jams, jellies, sauce and pickles.
3. Bacterial examination of milk by SPC and DMC methods.
4. Methylene Blue Reduction Test (MBRT) for quality assessment of milk.
5. Estimation of fat content in milk by Gerber's method.
6. Estimation of Lactic acid from curd samples.
7. Estimation of lactose in milk
8. Observations of industrially important microorganisms.
9. Production of Wine from grapes,
10. Estimation of alcohol content.
11. Preparation of banana juice by pectinase.
12. Production and estimation of citric acid by titrimetric method.
13. Isolation and study of antibiotic producing microorganisms from soil
14. Study of different types of fermentation (charts).

Note: Visit to Industries / Research laboratories. Dairy industries. Distilleries, Pharmaceuticals and pathological laboratories. A report on the visit should be written and submitted along with practical record.

References:

FOOD AND INDUSTRIAL MICROBIOLOGY

- ❖ Adams, M. R. and Moss, M. O. (1995). Food Microbiology. Royal Society of Chemistry, Cambridge University Press.

- ❖ Anathanarayanan, C and Paniker, C.K.J. (2009). Text Book of Microbiology, 9th ed. Orinet Longman Ltd., Chennai.
- ❖ Banwart, G. J. (1987). Basic Food Microbiology. CBS Publishers and distributors, New Delhi.
- ❖ Betty C. Hobbs "Food Microbiology" Arnold-Heinamann Publishing Private Ltd. New Delhi.
- ❖ Casida, Jr. L.E. (1996) Industrial Microbiology New Age International Publishers New Delhi.
- ❖ Frazier & Westhoff, D. C. (1995). Food Microbiology Tata McGraw Hill Pub. Company Ltd., New Dehli.
- ❖ Hammer B.W. and Babal "Dairy Microbiology" Prentice Hall Incorporated London.
- ❖ Jagadish Chandra (1996). Text Book of Medical Mycology. Oreint Longman.
- ❖ Jawetz, Melnick and Adelberg (2007). Medical Microbiology, Prentice Hall Inc, London.
- ❖ Jay, J. M. (1985). Modern Food Microbiology.CBS Publishers and distributors, New Delhi.
- ❖ Reed. G. 1982 "Industrial Microbiology" MacMillan Publications Ltd. Wisconsin.
- ❖ Ribonson R.t.C. 1990 "Dairy microbiology" Elsevier Application Dieness London.
- ❖ Stanbury, P. T. and Whitaker, (1984). Principles of Fermentation Technology, PergamongPress, New York.
- ❖ Stanier, R.Y. Ingraham J.L (2001)"General Microbiology" Prentice Hall of India Pvt Ltd.. New Delhi.
- ❖ Varnam A.H. and Evans M.G. (1998) "Food borne Pathogens" Wolfe Publishing House. London.

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE-DSE

PAPER-MB 5.2 DSE-2E: MICROBIAL BIOTECHNOLOGY AND BIOINFORMATICS

(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 hrs (4 hrs/week)

1. Introduction to Microbial Biotechnology

Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications. Genetically engineered microbes for industrial application: Bacteria and yeast. (8 hrs)

2. Applications of Microbial Biotechnology

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors. (8 hrs)

3. Microbial Products and their Recovery

Microbial product purification, filtration, ion exchange & affinity chromatography techniques. Immobilization methods and their application: Whole cell immobilization. (6 hrs)

4. Microbes for Bio-energy and Environment

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents. (8 hrs)

5. Introduction to Computer Fundamentals

RDBMS - Definition of relational database. Mode of data transfer (FTP, SFTP SCP), advantage of encrypted data transfer. (6 hrs)

6. Introduction to Bioinformatics and Biological Databases: Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB
(8 hrs).

7. Applications of bioinformatics

Sequence Alignments, Phylogeny and Phylogenetic trees: Local and Global Sequence alignment, pairwise and multiple sequence alignment. Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood. Genome organization and analysis. (8 hrs)

8. Protein Structure Predictions

Hierarchy of protein structure - primary, secondary and tertiary structures, modelling Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template. (8 hrs)

PRACTICAL V

MB 5.2 DSE 2E-MICROBIAL BIOTECHNOLOGY AND BIOINFORMATICS

(4 hrs/week)

1. Study yeast cell immobilization in calcium alginate gels.
2. Study enzyme immobilization by sodium alginate method.
3. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*).
4. Isolation of xylanase or lipase producing bacteria.
5. Study of algal Single Cell Proteins.
6. Introduction to different operating systems - UNIX, LINUX and Windows.
7. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB.
8. Sequence retrieval using BLAST.
9. Sequence alignment & phylogenetic analysis using clustalW & phylip.
10. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool.
11. Protein structure prediction: primary structure analysis, secondary structure prediction using psipred, homology modeling using Swissmodel. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK).
12. Prediction of different features of a functional gene.

References MICROBIAL BIOTECHNOLOGY AND BIOINFORMATICS

- ❖ Glazer, A. N. and Nikaido, H. (2007). Microbial Biotechnology, 2nd edition, Cambridge University Press.
- ❖ Glick, B. R., Pasternak, J. J. and Patten, C. L. (2010). Molecular Biotechnology 4th edition, ASM Press.
- ❖ Gupta, P. K. (2009). Elements of Biotechnology 2nd edition, Rastogi Publications.
- ❖ Lesk, M.A. (2008). Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition.

- ❖ Pradeep and Sinha Preeti, (2007). Foundations of Computing, 4th ed., BPB Publications.
- ❖ Prescott, Harley and Klein's Microbiology by Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2014). 9th edition, Mc Graw Hill Publishers.
- ❖ Primrose and Twyman, (2003). Principles of Genome Analysis & Genomics. Blackwell.
- ❖ Rastogi, S.C., Mendiratta, N. and Rastogi P. (2007). Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication.
- ❖ Ratledge, C. and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
- ❖ Saxena Sanjay, (2003). A First Course in Computers, Vikas Publishing House.
- ❖ Swartz, J. R. (2001). Advances in *Escherichia coli* production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

**SEMESTER V
SKILL ENHANCEMENT COURSE**

**PAPER – MB SEC-1E: MICROBIAL QUALITY CONTROL IN FOOD AND INDUSTRIES
(Credits: Theory-2)**

Theory

Total hours allotted 30 hrs (2 hrs/week)

Unit I: Biosafety

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.

Determining Microbes in Samples: 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.

(14 hrs)

Unit II: Microbiological quality analysis of Food and Water

Pathogenic Microorganisms of Importance in Food & Water: Enrichment culture technique, Detection of specific microorganisms- on XLD agar, Salmonella Shigella agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

Food safety and Standard: HACCP for Food Safety and Microbial Standards. 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.

(16 hrs)

References

- ❖ Baird, R. M., Hodges, N. A. and Denyer, S. P. (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
- ❖ Garg, N., Garg, K. L. and Mukerji, K. G. (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
- ❖ Harrigan, W. F. (1998). Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
- ❖ Jay, J. M., Loessner, M. J., Golden, D. A. (2005). Modern Food Microbiology, 7th edition. Springer.

SEMESTER V

SKILL ENHANCEMENT COURSE

PAPER – MB SEC-2E: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

(Credits: Theory-2)

Theory

Total hours allotted 30 hrs (2 hrs/week)

Unit I: Analytical Aeromicrobiology

Microflora of Air: Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens.

Collection of air sample and Analysis: Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics. Control Measures: Fate of bioaerosols, inactivation mechanisms- UV light, HEPA filters, desiccation, Incineration.

(14 hrs)

Unit II: Water Microbiology

Microbiological analysis of water sample: Microbiological analysis of water sample collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) Standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

Control of microbes in water: Water borne pathogens, water borne diseases, Control of water borne pathogens- Precipitation, chemical disinfection, filtration, high temperature, UV light.

(16 hrs)

References

- ❖ da Silva, N., Taniwaki, M. H., Junqueira, V. C., Silveira, N., Nascimento, M. S. and Gomes, R. A. R. (2012). Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press.
- ❖ Atlas, R. M. and Bartha, R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
- ❖ Maier, R. M., Pepper, I. L. and Gerba, C. P. (2009). Environmental Microbiology. 2nd edition, Academic Press.
- ❖ Hurst, C. J, Crawford, R. L., Garland, J. L. and Lipson, D. A. (2007). Manual of Environmental Microbiology, 3rd edition, ASM Press.

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER MB 6.1 DSE-1F - IMMUNOLOGY AND MEDICAL MICROBIOLOGY
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 (4 hrs/week)

1. Immunity and Immune system

History and scope of Immunology, Types of Immunity - Natural, Acquired, Active and Passiv, Antigens-Nature and types, Factors influencing antigenicity, Antibodies - Structure, types, properties and functions of immunoglobulins., Cells, tissues and organs involved in immune system, Complement system - Properties, components, pathways and functions. **(10hrs)**

2. Immune response- CML MHC. AMI. immunological memory and immunological tolerance, Hypersensitivity - Type I, Type II, Type III and Type IV

(6 hrs)

3. Antigen and Antibody reactions

Definition, Salient features Agglutination, Precipitation, Complement fixation test Neutralization test, Opsonization. Gel-diffusion techniques. Immuno electrophoresis. Labelled Antibodies - RIA, ELISA, Immuno fluorescent techniques. Serotyping. **(6 hrs)**

4. Immunoprophylaxis and Immonotherapy - Vaccines types and Significance- Killed, Live attenuated and Toxoid with an example each. National Immunization Schedule, Mission Indradhanush. Immunotherapy- Anti Tetanus Serum (ATS). Hybridoma Technology: Monoclonal Antibodies.

(8 hrs)

5. Introduction to Medical Microbiology

History and development of medical microbiology. Normal flora of human body-skin, oral cavity, respiratory tract and urogenital tract. **(4 hrs)**

6. Infection

Types and sources of infection, modes of disease transmission, portal of entry of pathogen. Pathogenesis, Virulence, attenuation and exaltation with an example each. Collection, transport and culturing of clinical samples. **(6 hrs)**

7. Study of Pathogens

Morphology, cultural and biochemical characteristics, classification, resistance, pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following.

a) **Bacterial diseases-**Tuberculosis. Cholera, Typhoid and Syphilis.

b) **Viral diseases -** Hepatitis, Poliomyelitis. AIDS. Covid 19

c) **Fungal diseases-**Candidiosis, Dermatomycosis (Tinea —Ringworm infection)

d) **Protozoan diseases -** Malaria. Trichomoniasis and Amoebiasis. **(14 hrs)**

8. Antimicrobial agents

General characteristics and types of antibiotics, mode of action of Antibacterial agents (Penicillin, Streptomycin, and Chloramphenicol). Antifungal and antiviral agents. Antibiotic resistance, MDR, XDR, MRSA, NDM-1. **(6 hrs)**

PRACTICAL VI

MB 6.1 DSE-1F - IMMUNOLOGY AND MEDICAL MICROBIOLOGY

1. Isolation and identification of microorganisms from ear, nose, throat and sputum (Growth on blood agar, chocolate agar, Braid parker, MacConkey agar, Nutrient agar).
2. Isolation and identification of microorganisms from clinical samples - urine (Growth in alkaline peptone water, blood agar, macConkey agar)
 - a) Semi quantitative estimation of C+V
 - b) Chemical analysis of urine - crystal identification, determination of sugar and protein.
3. Blood grouping and calculation of allelic frequencies.
4. Differential count of WBC
5. Coagulase test
6. WIDAL test
7. VDRL test
8. Spot ELISA
9. ODD-Ouchterlony, Double diffusion.
10. Study of AFB
11. Study of pathogenic microorganisms-Material/Microscopic observation/display of photographs of human pathogens as per theory syllabus.

References:

IMMUNOLOGY AND MEDICAL MICROBIOLOGY

- ❖ Abbas, A. K., Lichtman, A. H. and Pillai, S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
- ❖ Ananthanarayan, R. and Paniker, C.K.J. (2018). Textbook of Microbiology. 8th edition, University Press Publication.
- ❖ Delves, P., Martin, S., Burton, D. and Roitt, I. M. (2006). Roitt's Essential Immunology. 11th edition WileyBlackwell Scientific Publication, Oxford.
- ❖ Glodsby Richard A., Kindt Thomas J. and Osborne Barbara A., Kuby, (2005) Immunology, W. H. Freeman and Company New York.
- ❖ Goering, R., Dockrell, H., Zuckerman, M. and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- ❖ Gupte, S.M.D 1986 "The short text book of Medical Microbiology"⁷ Jaypee Brothers Medical Publishers New Delhi.
- ❖ Jagadish Chandra, (1996). Text Book of Medical Mycology. Oreint Longman.
- ❖ Jayaram Panicker, C.K. (1993). Text Book of Medical Parsitology Jaypee Brothers, Medical Publishers, New Delhi.
- ❖ Kenneth Jr. "Medical Microbiology-Introduction to Infection Diseases" Prentice Hall International.
- ❖ Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
- ❖ Murphy, K., Travers. P. and Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
- ❖ Nandhini Shetty 1993. Immunology: Inductory Text Book. New Age International Ltd.
- ❖ Peakman, M. and Vergani, D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg..
- ❖ Richard, C. and Geiffrey, S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
- ❖ Roitt, I.M., (2016) Essentials of Immunology, ELBS, Blackwell Scientific Publishers, London.
- ❖ Sengupta, J. 1988 "Synopsis of Clinical Pathology and Microbiology" Hilton and Co. Culcatta.
- ❖ Topley and Wilson (2001) "Principles of Bacteriology. Virology and Immunity" Idward Arnold. Greenwood. David, Richards. C and Slack B. "Medical Microbiology".

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER MB 6.2 DSE -2F: ADVANCES IN MICROBIOLOGY AND BIostatISTICS
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 (4 hrs/week)

1. Evolution of Microbial Genomes

Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics. **(8 hrs)**

2. Pharmaceutical Microbiology

Introduction and application of pharmaceutical microbiology, GMP, GLP, SOP regulations. Laboratory management and design in the pharmaceutical sector. Principles and applications of selective/differential culture media, Different methods of microbial identification. Preservation and subculture techniques. Clean rooms and environment monitoring methods, microbiological challenge to the pharmaceuticals and health care.

(8 hrs)

3. Molecular Basis of Host-Microbe Interactions: Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance.

(8 hrs)

4. Systems and Synthetic Biology: Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses.

(8 hrs)

5. Introduction to biostatistics: Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences; Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions.

(8 hrs)

6. Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom; Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test.

(8 hrs)

7. Intellectual Property rights: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications, importance of IPR, patentable and non patentables, patenting life-legal protection of biotechnological inventions, World Intellectual Property Rights Organization (WIPO).

(6 hrs)

- 8. Grant of Patent and Patenting Authorities:** Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner. (6 hrs)

PRACTICAL – VI

MB 6.2 DSE -2F: ADVANCES IN MICROBIOLOGY AND BIostatISTICS

(4 hrs/week)

1. Laboratory instruments validation
2. Chart based study of different BSL cabinets
3. Bioburden test
4. Growth Promotion test (GPT) assay
5. Sterility testing
6. Agar plate diffusion assay
7. Total Bacterial count(TBC), Total yeast and mould count (TYMC)
8. Assay of antibiotics by Turbidometer (or Nephelometric) methods
9. Extraction of DNA from soil.
10. Study of PCR
11. Mean, Median, Mode from grouped and ungrouped Data set.
12. Standard Deviation and Coefficient of Variation.
13. Skewness and Kurtosis.
14. Correlation.
15. Regression.
16. Filing primary applications for patents.
17. Study of steps of a patenting process 5.

REFERENCES

- ❖ Bare Act, (2007). Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
- ❖ Bouarab, K., Brisson, and Daayf, F. (2009). Molecular Plant-Microbe interaction CAB International.
- ❖ Caetano-Anolles, G. (2010). Evolutionary Genomics and Systems Biology, , John Wiley and Sons.
- ❖ Danial, D (2004). Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
- ❖ Edmondson. A. and Druce, D. (1996). Advanced Biology Statistics, Oxford University Press.
- ❖ Fraser, C. M., Read, T. D. and Nelson K. E. (2004). Microbial Genomes, Humana Press.
- ❖ Goel, D. and Prashar, S. (2013). IPR, Biosafety and Bioethics. Pearson.
- ❖ Kankanala, C. (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
- ❖ Klipp, E., Liebermeister, W. (2009). Systems Biology – A Textbook, Wiley –VCH Verlag.
- ❖ Madigan, M. T., Martink, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brook’s Biology of Microorganisms, 14th edition, Pearson-Benjamin Cummings.

- ❖ Miller, R. V. and Day, M. J. (2004). Microbial Evolution- Gene establishment, survival and exchange, ASM Press 3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press.
- ❖ Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services Pvt. Ltd.
- ❖ Sangdun, C. (2007). Introduction to Systems Biology, Humana Press.
- ❖ Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. (2008). IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.
- ❖ Singh, K. K. (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
- ❖ Singh, B.D. 2000: Biotechnology, Kalyani Publishers. Ludhiana.
- ❖ Voit, E. O. (2012). A First Course in Systems Biology, 1st edition, Garland Science.
- ❖ 17. Wilson, B. A., Salyers, A. A., Whitt, D. D. and Winkler, M. E. (2011). Bacterial Pathogenesis- A Molecular Approach, 3rd edition, ASM Press.

**SEMESTER VI
SKILL ENHANCEMENT COURSE**

Paper – MB SEC-1F: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

(Credits: Theory-2)

Theory

Total hours allotted 30 (2 hrs/week)

Unit I: Sample collection and Examination

Collection of clinical samples: Importance of Diagnosis of Diseases Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis. Collection of Clinical Samples. How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage. **(15 hrs)**

Microscopic examination and culture: Direct Microscopic Examination and Culture. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Unit II: Pathogens detection and Antibiotic sensitivity test

Detection of pathogens: Serological and Molecular Methods: Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Kits for Rapid Detection of Pathogens- Typhoid, Dengue and HIV, Swine flu.

Antibiotic sensitivity test: Testing for Antibiotic Sensitivity in Bacteria- Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method. **(15 hrs)**

SUGGESTED READINGS

- ❖ Ananthanarayan, R. and Paniker, C. K. J. (2009). Textbook of Microbiology, 8th edition, Universities Press Pvt. Ltd.
- ❖ Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013).

- ❖ Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
- ❖ Randhawa, V. S., Mehta, G. and Sharma, K. B. (2009). Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt. Ltd.
- ❖ Tille, P. (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.
- ❖ Collee, J. G., Fraser, A. G., Marmion, B. P. and Simmons, A. (2007). Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

SEMESTER VI
SKILL ENHANCEMENT COURSE
PAPER – MB SEC-2F : MICROBIAL INFECTIONS AND TREATMENT
(Credits: Theory-2)
Theory

Total hours allotted 30 (2 hrs/week)

Unit I: Human diseases

Human diseases types: Infectious and non infectious diseases, microbial and non microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections.

Microbial diseases: Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/ Ebola/Corona)- causes, spread and control, Mosquito borne disease- Types and prevention. **(16 hrs)**

Unit II: Therapeutics and Prophylaxis of Microbial diseases

Treatments for Microbial diseases: Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.

Prevention of Microbial Diseases: General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. Vaccines: Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context. **(14 hrs)**

REFERENCES

1. Ananthanarayan, R. and Paniker, C.K.J. (2018). Textbook of Microbiology. 8th edition, University Press Publication.
2. Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013). Jawetz,
3. Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.

4. Goering, R., Dockrell, H., Zuckerman, M. and Wakelin, D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
5. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
6. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

KARNATAK UNIVERSITY, DHARWAD
GENERAL PATTERN OF THEORY EXAMINATION (for DSC and DSE)
B.Sc MICROBIOLOGY

Duration: 3 Hours

Maximum: 80 Marks

All questions are compulsory
Draw diagrams wherever necessary

Q.I. Answer any ten of the following

10X2=20
Marks

- | | |
|-----|-----|
| 1) | 2) |
| 3) | 4) |
| 5) | 6) |
| 7) | 8) |
| 9) | 10) |
| 11) | 12) |

Q.II Write short notes on any six of the following:

6x5=30Marks

- | | |
|-----|-----|
| 13) | 14) |
| 15) | 16) |
| 17) | 18) |
| 19) | 20) |

Q.III Answer the following

- | | | |
|----|----------|---------------|
| 21 | a) Or b) | 10x1=10 Marks |
| 22 | a) Or b) | 10x1=10 Marks |
| 23 | a) Or b) | 10x1=10 Marks |

GENERAL PATTERN OF THEORY QUESTION PAPER FOR ALL SEC PAPERS (1.5 hrs)

1. Question number 1-6 carries 2marks to answer any 5 questions : 10 marks
2. Question number 7-14 carries 4marks to answer any 5 questions : 20 marks
3. Question number 15-17 carries 5marks to answer any 2 questions : 10marks
40 marks

KARNATAK UNIVERSITY, DHARWAD

GENERAL PATTERN OF THEORY EXAMINATION (for SEC)

B.Sc MICROBIOLOGY

Duration: 1.5 Hours

Maximum: 40 Marks

All questions are compulsory

Draw neat labelled diagrams wherever necessary

QNo. I Answer any FIVE of the following 2X5=10

- | | |
|-----|-----|
| (1) | (2) |
| (3) | (4) |
| (5) | (6) |

QNo. II Answer any FIVE of the following 4X5=20

- | | |
|------|------|
| (7) | (8) |
| (9) | (10) |
| (11) | (12) |
| (13) | (14) |

QNo. III Answer any TWO the following 5X2=10

- | |
|------|
| (15) |
| (16) |
| (17) |



KARNATAK UNIVERSITY, DHARWAD
PATTERN OF PRACTICAL EXAMINATION
Practical examination – B. Sc MICROBIOLOGY

Duration: 3 hours

Max. Marks: 40

Q. 1	Major question	12 Marks
Q. 2	Minor question	08 Marks
Q. 3	Identify and comment	5X2 = 10 marks
Q. 4	Record / Tour report	05 Marks
Q. 5	Viva – Voce	05 Marks



KARNATAK UNIVERSITY, DHARWAD

Syllabus and Structure

For

B. Sc. INDUSTRIAL MICROBIOLOGY

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. 2020 - 2021 onwards

Karnatak University, Dharwad

CBCS syllabus for Under Graduate Programme in Industrial Microbiology (opt.)

DISCIPLINE SPECIFIC COURSE (DSC) and DISCIPLINE SPECIFIC ELECTIVE (DSE)

Effective from 2020-21

Sem ester	Theory/ Practical	Paper	Subject Code	Instruction hour per week	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
I	Theory	DSC	MB-1.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-1.1	04 hrs	03 hrs	10	40	50	02
II	Theory	DSC	MB-2.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-2.1	04 hrs	03 hrs	10	40	50	02
III	Theory	DSC	MB-3.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-3.1)	04 hrs	03 hrs	10	40	50	02
IV	Theory	DSC	MB-4.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	MB-4.1	04 hrs	03 hrs	10	40	50	02
V	*Theory P-I /P- II	DSE	MB-5.1 / MB-5.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	MB-5.1 / MB-5.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
VI	*Theory P-I /P- II	DSE	MB-6.1 / MB-6.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	MB-6.1 / MB-6.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
Total						180	720	900	36

*Candidate shall choose either paper –I or P-II but not both in DSE Papers

SKILL ENHANCEMENT COURSE (SEC) for Industrial Microbiology

Sem ester	Theory	Subject Code	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
V	Theory	(SEC-1.1)	02 hrs	30	1.5 hrs	10	40	50	02
V	Theory	(SEC-1.2)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.1)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.2)	02 hrs	30	1.5 hrs	10	40	50	02
Total						40	160	200	08

B.Sc. Industrial Microbiology
Proposed Semester-wise distribution of the course structure

Effective from 2020-21

Sl. No.	Code No.	Type of the Paper	Title of the Paper	Credit Pattern in L:T:P	Credit Value	Hours /Week L:T:P
Semester – I						
1	MB-1.1	DSC	Basic Microbiology and Microbiological Techniques	4:0:2	6	4:0:4
Semester – II						
1	MB-2.1	DSC	Microbial Physiology and Genetics	4:0:2	6	4:0:4
Semester – III						
1	MB-3.1	DSC	Molecular Biology and Genetic Engineering	4:0:2	6	4:0:4
Semester – IV						
1	MB-4.1	DSC	Food and Agricultural Microbiology	4:0:2	6	4:0:4
Semester – V						
Any one of following						
1	MB-5.1	DSE 1.1	Environmental Microbiology	4:0:2	6	4:0:4
2	MB-5.2	DSE 1.2	Microbial Biotechnology and Bioinformatics	4:0:2	6	4:0:4
Any one of following						
1	SEC-1.1	Discipline specialization	Microbial Quality Control in Food and Industries	2:0:0	2	2:0:0
2	SEC-1.2	Discipline specialization	Microbiological analysis of air and water	2:0:0	2	2:0:0
Semester – VI						
Any one of following						
1	MB-6.1	DSE 1.1	Industrial Microbiology	4:0:2	6	4:0:4
2	MB-6.2	DSE 1.2	ImmunoTechnology and Tissue Culture	4:0:2	6	4:0:4
Any one of following						
1	SEC-2.1	Discipline specialization	Microbial diagnosis in Health Clinics	2:0:0	2	2:0:0
2	SEC-2.2	Discipline specialization	Microbial Infections and Treatment	2:0:0	2	2:0:0

- DISCIPLINE SPECIFIC COURSE- DSC
- DISCIPLINE SPECIFIC ELECTIVE-DSE
- SKILL ENHANCEMENT COURSE –SEC
- L=Lecture, T-Tutorial, P-Practical

SEMESTER-I
CORE COURSE: INDUSTRIAL MICROBIOLOGY
PAPER MB - 1.1 DSC 1A – Basic Microbiology and Microbiological Techniques
(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. Introduction to Microbiology

History of microbiology, contributions of Antony Von Leewenhoek, Redi, Needham Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming, Iwanowsky & Edward Jenner. Theory of spontaneous generation. Milestones in industrial microbiology, scope and importance of microbiology. Distribution and significance of microorganisms in air water and soil **(8 hrs)**

- 2. Microscopy:** Principles of microscopy, Resolving power, numerical aperture, chromosomal aberrations, magnification, working principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescence, electron microscopy (SEM and TEM) and stereo microscope. **(8 hrs)**

3. Microbial Taxonomy

Different kingdom system of classification of Monera. Protista. Fungi. Plantae and Animalia. Comparison of 3 domains of organisms Archaea, Bacteria and Eukarya General principles of classification and nomenclature of microorganisms. **(4 hrs)**

4. Structure and organization of Microorganisms

Comparative study of typical cells of prokaryotes and eukaryotes in detail and their cellular organization

- a) **Viruses:** Structure, classification, plant, animal, bacterial and algal viruses.
b) **Bacteria:** Classification (According to Bergey's manual upto the levels of section). Structure and reproduction of bacteria. Mycoplasma. Rickettsias. Actinomycetes and Cyanobacteria.
c) **Algae:** Structure and reproduction of *Chlorella* and Diatoms.
d) **Fungi:** Outlines of classification, structure and reproduction - *Pythium*, *Saccharomyces*, *Aspergillus*, *Fusarium* and *Penicillium*.
e) **Protozoa:** General characters, classification, structure and reproduction (*Entamoeba*, *Trichomonas*, *Plasmodium* and *Paramecium*)

(15hrs)

5. Sterilization

B) Physical Methods and their mode of action

- i) Heat** - a) Dry heat - Hot air oven.
b) Incineration.
c) Moist heat - Autoclave.
d) Tyndallizations (Fractional sterilizations)

ii) Filtrations - Types of filters, laminar air flow.

iii) Radiations Methods - UV radiation, Y-rays and cathode rays.

B) Chemical methods :

a) Definition of terms - disinfectants, antiseptics. Sanitizers, Microbicides -Bactericides, Virucide, Fungicide and Sporicide. Microbiostatic – bacteriostatic and fungistatic agents.

b) Use and mode of action - Alcohols, aldehydes, halogens, phenols, heavy metals. Detergents: Quaternary ammonium compounds. **(9 hrs)**

6. **Culturing of Micro Organisms**

Culture media: Types - Solid, semisolid and broth; Natural, Synthetic, Semi synthetic, Enriched, Differential and selective media, Nutrient agar (NA), Nutrient broth, Potato Dextrose Agar (PDA), Yeast mannitol agar (YEMA), Sabour's agar (SDA), MacConkey Agar (MA), Blood Agar (BA), Chocolate Agar. **(6 hrs)**

7. **Stains and Staining Techniques**

Principles and types of stains, staining of specimens - simple staining, differential staining, negative staining, structural staining. **(6 hrs)**

8. **Instruments**

Principles and applications of colorimeter Spectrophotometer. Atomic Absorption spectroscopy, Incubator, pH meter and centrifuge.

Chromatographic Techniques: Working principles of paper, thin layer, column and ion exchange chromatography. **(4 hrs)**

PRACTICAL I

MB - 1.1 - BASIC MICROBIOLOGY AND MICROBIOLOGICAL TECHNIQUES

(4 hrs/week)

1. Laboratory safety: General rules and regulations.
2. Sterilization of glass wares.
3. Demonstration of laboratory equipments - Microscope, autoclave. Hoi air Oven, Laminar air flow, Incubator, Inoculation loop, Membrane filter and pH meter
4. Preparation of Media - Nutrient broth. Nutrient agar, MacConkey Agar, Potato Dextrose Agar, Glucose Agar and Sabourds Agar.
5. Preparations of physiological saline and serial dilution
6. Microscopic observations of prokaryotes and eukaryotes. bacteria, protozoa, Algae and fungi.
7. Isolation of microorganisms from air, water and soil and studying their characteristics.
8. Study of bacterial motility by hanging drop technique.
9. Micrometry and camera Lucida.
10. Counting of yeast cells and fungal spores using Haemocytometre.
11. Preparation of stains and staining reagents: Safranin, Nigrosine, Cotton blue, Malachite green, Methylene blue, Carbol fuschin, acid alcohol mixture and grams iodine.
12. Staining Techniques - Staining of bacteria - a) Simple staining b) Negative staining, c) Grams staining.
13. Demonstration of chromatographic techniques.
14. Students have to submit 5 microorganisms. Slides (Permanent) for the examination

References:

- ❖ Aneja K.R. (2018) Experiments in Microbiology, plant pathology Tissue culture and Mushroom Cultivation. New Age International. New Delhi.
- ❖ Atlas, R. M. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers
- ❖ Bhattacharya "Experiments with microorganisms" - Emkay Publishers.
- ❖ Cappucino. J. and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

- ❖ Carter, J. and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
- ❖ Colwod, D 1999 "Microbial Diversity" Academic Press..
- ❖ Cooper T.G. (1997): "The tools of Biochemistry" John Wiley and sons.
- ❖ Dubey, R. C. and Maheshawari, D.K, (2013). Text book of Microbiology, S Chand and company limited, Ramnagar, New Delhi.
- ❖ Edward Alcamo T. 1997 "Fundamental of Microbiology - 5th edn., Adlison Wesley Longman Inc. New York.
- ❖ Gunashekar, P. "Laboratory Manual in Microbiology" New Age Intl Ltd.
- ❖ Madigan, M.T. Martinko, J.M and Parker, J - 1997 "Biology of Microorganisms-8th edn., McGraw Hill Inc. New York.
- ❖ Nelson David, L and Cox Michael, M., Lehninger, (2008). Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
- ❖ Norris J.R. and Ribbons. D.W. (2009) "Methods in Microbiology" Academic Press.
- ❖ Peleczar, M.J.. Chan. E.C.S and Krieg, N.R. (2016) "Microbiology" Tata MaGraw Hill Book Co. New York.
- ❖ Powar and Daginwala - 1994 "Microbiology - Vol I and II. Himalaya Publication, New York.
- ❖ Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott's Microbiology, 11th edition WCB Mc Graw Hill, New york.
- ❖ Salle, A.J. "Fundamental Principles of Bacteriology" Tata McGraw Hill Publishing Company Ltd., New Delhi.
- ❖ Srivastava, S. and Srivastava, P. S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.
- ❖ Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (2005). General Microbiology. 5th edition McMillan.
- ❖ Sullia S. Band Shantaram. S. 1998 -General Microbiology" Oxford and IBH Publishing Co Pvt Ltd. New Delhi.
- ❖ Sundara R. Rajan "Tools and Techniques of Microbiology" - Anmol Publications.
- ❖ Tortora, G. J., Funke, B. R. and Case, C. L. (2016). Microbiology: An Introduction. 9th edition. Pearson Education.

SEMESTER-II

CORE COURSE: INDUSTRIAL MICROBIOLOGY

PAPER MB 2.1 DSC 1B - Microbial Physiology and Genetics

(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. Biomolecules

A brief account of the properties, classification and importance of carbohydrates, proteins and lipids. **(8hrs)**

2. Enzymes

Physical and chemical properties of enzymes, nomenclature mechanism of enzyme action, (Lock and key and induced fit theory) Factor influencing enzyme activity, Inhibition of enzymes, Iso enzymes and industrial applications of enzymes. **(6 hrs)**

3. **Microbial nutrition Photosynthesis and growth**

Nutritional requirements. Modes of nutrition-Phototrophs. Chemotrophs, Methanotrophs, Organotrophs and saprotrophs. Classification of photosynthetic bacteria (Purple sulphur, green and purple lion sulphur bacteria). Photosynthetic pigments in bacteria, Mechanism of photosynthesis - light and dark reactions. A brief comparative account of photosynthetic process in bacteria and blue green algae. Growth rate, Generation time and growth curve-phases of growth and their significance, Physical and chemical factors influencing microbial growth, Growth curve of bacterial population in batch, continuous and synchronous growth, chemostat and Turbidostat measurement of growth.

(10 hrs)

4. **Bio energetics and Energy yielding process**

Laws of Thermodynamics, Free energy, ATP and its production, other high energy compounds, Oxidation and Reduction reactions. Glycolysis, outline of TCA cycle, electron transport chain, Oxidative phosphorylation, p-Oxidation (Alpha and Omega Oxidation Pathway) Amino acid degradation (Transamination, deamination and decarboxylation) and (Anaerobic Respiration - alcoholic, lactic acid and acetic acid fermentation.

(7 hrs)

5. **Basis of heredity**

Mendelian concepts, principles and classical genetics Experimental basis of evidences contributions of Griffith. Avery, Harshey and chase. Genomic organization in prokaryotes and eukaryotes.

(9 hrs)

6. **Nucleic acids and Genetic Code**

Chemical composition of" DNA and RNA. Watson and Crick model of DNA Nucleosome model. Types of DNA (A. B. Z and H), super coiling of DNA, Extra chromosomal DNA. Features, triplet code, wobble hypothesis, codons and evolution of genetic code

(8 hrs)

7. **DNA Replication and Genetic recombination in Prokaryotes**

Semi conservation method. Rolling circle model, origin of replication, primers and template, replication fork. Unidirectional and bi-directional replication . Study of Transformation, Conjugation and Transduction.

(8 hrs)

8. **Transposable Genetics Elements and Transposon.**

Prokaryotic transposable elements - Insertion Sequences, composite and non-composite transposons, Mu transposon. Mutagenesis, Detection and isolations Or mutants - replica plate method.

(4 hrs)

PRACTICAL II

MB 2.1 - MICROBIAL PHYSIOLOGY AND GENETICS

(4 hrs/week)

1. Qualitative tests for Carbohydrates

Glucose - Benedicts test, Molisch's test, Fehlings test and Picric acid test.

2. Qualitative tests for Proteins

Protein - Biurette test, Ninhydrin test, Millons test and Xanthoprotein test.

3. Qualitative tests for Lipids

Lipids - Acroline test, Sudan III test, Emulsification test and Solubility test.

4. Determination of growth curve for fungi by colony diameter method.
5. Biochemical test used for the identification of Bacteria.
 - a) IMViC
 - b) Fermentation of Glucose, Sucrose and Lactose - Acid and gas production
 - c) Starch hydrolysis"
 - d) Gelatin hydrolysis
 - e) Catalase test.
6. Colorimetric estimation of sugar by DNS method
7. Colorimetric estimation of protein by Biurette method
8. Effect of pH and temperature on bacterial growth.
9. Demonstration of paper chromatographic separation of amino acid.
10. Demonstration of thin layer chromatographic separation of ammo acid.
11. Study of genetic recombination in bacteria using Charts - Conjugation, Transformation and Transduction.
12. Demonstration of protoplast isolation and fusion techniques.

References:

- ❖ Becker, W. M., Kleinsmith, L. J., Hardin, J. and Bertoni, G. P. (2009). The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
- ❖ Caldwell 1995. "Microbial Physiology and Metabolism" Brown Publisher.
- ❖ De Robertis, E. D. P. and De Robertis, E. M. F. (2006). Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- ❖ Gerald Karp (2008)"Cell Biology" McGraw Hill Book Co. New York.
- ❖ Gottschalk, G. (1986). Bacterial Metabolism. 2nd edition, Springer Verlag.
- ❖ Jain J.L. (2015) "Fundamentals of Biochemistry" S.C. Chand publisher.
- ❖ Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
- ❖ Moat. A.G. and Foster S.W. (2010)"Microbial Physiology" John Wiley and Sons New York.
- ❖ Nelson David, L and Cox Michael, M., Lehninger, (2008). Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
- ❖ Peleczar. M.J.. Chan. E.C.S and Krieg, N.R. – (2016) "Microbiology" Tata MaGraw Hill Book Co. New York.
- ❖ Reddy, S. R. and Reddy, S. M. (2005). Microbial Physiology. Scientific Publishers India.
- ❖ Sambrook, J. and Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory Press.
- ❖ Voet D and Voel J.G.(2017) "Biochemistry" John Wilev and Sons New York.
- ❖ Dale J.W. (1994); Molecular Genetics of Bacteria II edition John Wiley and sons. New York.
- ❖ Freifelder David. "Microbial Genetics". (2009) Narosa Publishing House, New Delhi. Gupta P.K. "Cytology and Genetics" Rastogi Publications.
- ❖ Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). Principles of Genetics. 8th Ed. Wiley-India.
- ❖ Hariwell L. H et.al. 2000 "'Genetics - from Gene to Genomes "'McGraw Hill Publications New York.
- ❖ Krebs, J., Goldstein. E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
- ❖ Snustad. P.D. and Simmons. M.J. 2000 : "Principles of Genetics" 2^{IK1} edit.. John Wiley and Sons Inc. New York.
- ❖ Strickberger, M.W. 1995 "Genetics" prentice Hall of India Pvt. Ltd. New Delhi. Watson.

J.D. *et. al*, 1987 "Molecular Biology of Genes".

SEMESTER – III

CORE COURSE : INDUSTRIAL MICROBIOLOGY

**PAPER MB 3.1 DSC 1 C - MOLECULAR BIOLOGY AND GENETIC
ENGINEERING**

(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

1. **Molecular basis of life**
An introduction, Experimental proof of DNA and RNA as genetic material. **(4hrs)**
2. **Transcription and Translation**
Transcription in prokaryotes and eukaryotes, transcription factors, promoters and RNA polymerases in prokaryotes, event in mRNA transcription and processing. Initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. **(11 hrs)**
3. **Regulation of gene expression**
Regulation of gene expression in prokaryotes (operon concept) and eukaryotes (Galactose metabolism in yeast) Gene organization and expression in mitochondria and chloroplasts **(7 hrs)**
6. **Mutations and repair mechanisms**
Nature and types: Induced, Spontaneous. Biochemical basis of mutations, point mutation and Frame shift mutations. DNA damage and repair mechanism (SOS and Excision). **(7 hrs)**
9. **Introduction to genetic engineering**
Introduction, Historical prospects of genetic engineering **(4 hrs)**
10. **Tools and Techniques of genetic engineering**
DNA manipulative enzymes - Restriction enzymes, Ligases and other DNA modifying enzymes.
***In vitro* construction of r-DNA molecules**
Isolation of passenger DNA from bacteria (gene of interest) and isolation of vector DNA (Bacteria). Cutting of DNA molecules-physical methods, enzymatic methods and joining of DNA molecules- Homopolymer tails, Linkers, Adapters. **Transformation of r-DNA into target host organisms**
Calcium chloride mediated gene transfer. Agro bacterium mediated DNA transfer, Electro poration, Micro-injection. Liposome fusion. Micro projectile bombardment. **(13hrs)**
11. **Gene cloning vectors**
Salient features, plasmids - properties, types pBR 322 and PUC 18 series vectors, phage DNA - Insertional and replacement vectors, cosmids properties.
Screening and selection of recombinant host cells
Insertional inactivation. *In situ* hybridization (colony / DNA) and Immunological techniques. Construction of gene libraries: Genomic and cDNA libraries. Polymerase chain reaction (PCR) and its applications. **(8 hrs)**
12. **Applications of genetic engineering**
Medicine - Gene therapy
Agriculture- nif gene cloning
Industry - Alcohol

(6 hrs)

PRACTICAL III

MB 3.1 – MOLECULAR BIOLOGY AND GENETIC ENGINEERING (4 hrs/week)

1. Preparation of buffers -citrate and phosphate buffers.
2. Preparation of DNA model
3. Estimation of RNA by Orcinol method
4. Extraction and estimation of DNA by Diphenylamine method
5. Isolation of genomic DNA from bacteria
6. Isolation of plasmid
7. Extraction and estimation of protein from yeast cell / animal / plant source by salt precipitation and organic solvent method.
8. Restriction digestion of DNA
9. *In vitro* DNA ligation
10. Study of DNA finger printing (Chart)
11. Study of gene cloning (Chart)

References:

- ❖ Brown, T. A. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
- ❖ Brown, T.A. 1998 "Genetics - A molecular **Approach**" 3rd edn. Stanely Thornes Ltd. U.K.
- ❖ Clark, D. P. and Pazdernik, N. J. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
- ❖ Colwod, D 1999 "**Microbial** Diversity" Academic Press.
- ❖ Davis R.W. Botstein, D. and Roth, J.R. (1980): A manual for Genetic Engineering" Coldspring Harbor Laboratory. Cold spring Horbor New York.
- ❖ De Robertis. E.D.P. and De Robertis E.M.S 1988 "Cell and Molecular Biology"¹¹ Lea and Jeliger Philadelphiae K.M. Vakghese Co.
- ❖ Glick, B.R. and Pasternak, JJ. 1994 "Molecular Biotechnology Principles and Applications of Recombinant DNA" American Society for Microbiology, Washington D.C.
- ❖ Nicholl. D.S.T. 1994 "An Introduction to Genetic Engineering" Cambridge University Press.
- ❖ Peters. P 1993 "A Guide to Genetic Engineering" Dubuque Iowa WMC Brown.
- ❖ Rigbu, P.W.J 1987 "Genetic Engineering - VI" Academic Press Inc. Florids. USA.
- ❖ Russell, P. J. (2009). Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings.
- ❖ Sambrook, J. and Russell, D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
- ❖ Sandhya Mitra 1988 "Elements of molecular Biology"" MacMillian publications
- ❖ Watson, J. D., Baker, T. A., Bell, S. P. *et al.* (2008). Molecular Biology of the Gene, 6th Ed., Benjamin Cummings.

SEMESTER –IV
CORE COURSE: INDUSTRIAL MICROBIOLOGY
PAPER MB 4.1 DSC 1D –FOOD and AGRICULTURAL MICROBIOLOGY
(Credits: Theory-4, Practicals-2)

THEORY

Total hours allotted: 60 hrs (4 hrs/week)

9. Food and microorganisms

Food as a substrate for microorganisms, sources of contamination of food. **(4 hrs)**

10. Food spoilage and preservation

Spoilage of canned foods, cereals, fruits, vegetables. Meat, fish and fermented foods (Soya sauce, olives, idli. butter milk and yoghurt, cheese and Kefir)

Principles of food preservation- physical and chemical methods, food sanitation and control.

(9 hrs)

11. Microbiology of milk

Sources of milk contamination, Methods to detect microbial spoilage by SPC. Reductase test. Biochemical changes of milk souring. Gassy fermentation. Proteolysis. Lipolysis. Ropiness, Phosphatase test, Clot on boiling test. Starter culture and its role. Methods of Preservation of milk and milk products (Pasteurization and sterilization). **(9 hrs)**

12. Food Infections and Intoxications:

Endotoxin. Food infection (Salmonellosis) Food intoxication- (Staphylococcal food poisoning, Botulism). Mycotoxins produced by Fungi: Aflatoxins in stored food and grains. Food safety and quality control- brief account of HACCP, FSSAI and Food safety and standard act. **(8 hrs)**

13. Introduction

Introduction to Agriculture Microbiology, Types of soil, soil profile, physical and chemical characters of soil. Soil management's practices and crop rotation. **(4 hrs)**

14. Microbiology of soil

f) **Soil Microorganisms:** Bacteria, fungi, actinomycetes. algae, protozoa and viruses.

g) **Role of Microbes in soil process:** Biogeochemical cycles - Carbon, Nitrogen, Sulphur and Phosphorous. Biodegradation: Pectin. Cellulose and lignin.

h) **Rhizosphere Microorganisms:** Rhizosphere and rhizoplane, Interactions among microorganisms - Neutralism, Mutualism, Commensalism. Antagonism and Parasitism

i) **Plant-microbe interaction:** Mycorrhizae **(9 hrs)**

15. Microorganisms in Agriculture

a. **Biofertilizers:** Types (Bacterial, fungal, phosphate solubilizers. BGA, Plants-Azolla); kinds of association, mode of application and merits.

b. **Mechanism of nitrogen fixation :** Biochemistry, Genetics and physiology of nitrogen fixation, symbiotic - Rhizobium, Non symbiotic - Azotobacter BGA and Associative - Azospirillum Associations

c) **Biopesticides:** Types (Bacterial - Bacillus Thuringiensis, Viral-NPV. Fungal Trichoderma), Mode of action, Factors influencing: genes involved and target pest. **(9 hrs)**

16. **Microbes as plant pathogens:**

A brief account of the causative agent, symptoms, and control of the following plant diseases: Viral diseases (TMV. Katte diseases of Cardomam) Bacterial diseases (Blight of Paddy, Citrus canker. Soft root of Potato). Fungal diseases (Tikka of ground nut, Rust of wheat). Brief account post harvest pathology and Integrated Pest Management. **(8 hrs)**

PRACTICAL IV

MB 4.1 - FOOD AND AGRICULTURAL MICROBIOLOGY

(4 hrs/week)

1. Isolation and identification of microbes from infected fruits vegetables and cereals.
2. Isolation and identification of microorganisms from curd. Idli. butter and stored foods - Jams. Jellies, Sauce and Pickles.
3. Bacterial examination of milk by SPC and DMC methods.
4. Methylene blue reduction test for quality assessment of milk.
5. Estimation of fat content in milk Gerber's method.
6. Estimation of lactose in milk.
7. Estimation of lactic acid from curd sample.
8. Isolation and identification of microbes from Rhizosphere and Rhizoplane.
9. Study of Rhizobium from legume root nodules (Gram staining) and isolation of Rhizobium (using yeast extract Mannitol Agar) and Azotobacter (using Ashby's Mannitol agar)
10. Isolation of actinomycetes from soil using Glucose Aspergin Agar by plate method.
11. Study of antagonism between soil microorganisms by plate method.
12. Study of Aflatoxin by *Aspergillus flavus*.
13. Study of plant pathogens based on theory (through charts).

References:

- ❖ Alexander, A.M. (1987). Introduction to soil Microbiology, 5th ed., John Wiley and sons.
- ❖ Banwart, G.J. 1987 "Basic Food Microbiology" CBS Publishers and Distributors New Delhi.
- ❖ Betty C. Hobbs (2006) "Food Microbiology" Arnold-Heinamann Publishing Private Ltd. New Delhi.
- ❖ Casida. Jr. L.E. (2010) Industrial Microbiology New Age International Publishers New Delhi.
- ❖ Frazier and Westhoif (2016) "Food Microbiology" Tata McGraw Hill Publication Co. Ltd. New Delhi.
- ❖ Hammer B.W. and Babai "Dairy Microbiology" Prentice Hall Incorporated London.
- ❖ Jay, J.M. "Modern Food Microbiology" CBS Publishers and Distributors. New York.
- ❖ Rangaswamy, G. 1996 Diseases of crop in India. 3rd edn.. Prentice Hall of India Pvt. Ltd. New Delhi.
- ❖ Rangaswamy, G. and Bagyaraj, D.J. (2001), Agricultural Microbiology, 2nd ed., Prentice Hall of India Pvt. Ltd., New Delhi.
- ❖ Reed. G. 1982 'Industrial Microbiology' MacMillan Publications Ltd. Wisconsin.
- ❖ Ribonson R.K. 1990 "Dairy microbiology" Elsevier Application Dieness London.
- ❖ Salle. A.J. "Fundamental Principles of Bacteriology" Tata McGraw Hill Publishing Company Ltd.. New Delhi.
- ❖ Stanier, R.Y. Ingraham J.L (2009) "General Microbiology" Prentice Hall of India Pvt Ltd.,

New Delhi.

- ❖ Varnam A.H. and Evans M.G.(2015) "Food borne Pathogens" Wolfe Publishing House. London.
- ❖ Waites Michael J. Morgan Neil L. Rockey John S. and Gray Higton (2008). "Industrial Microbiology - An Introduction" Blackwell Science. Delhi.

SEMESTER V
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER MB 5.1 DSE 1E - ENVIRONMENTAL MICROBIOLOGY
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 hrs (4 hrs/week)

1. Introduction

Soil, water and air as habitats for micro organisms and concept of environment, microbial populations in the above habitats. **(4 hrs)**

2. Microbiology of soil

- a) **Introduction** : Soil types, profile, physical and chemical characters.
- b) **Soil microorganisms**: Bacteria, fungi, actinomycetes, algae, protozoa and viruses.
- c) **Role of microorganisms in soil processes**: Biogeochemical cycles - Carbon, Nitrogen, Sulphur, and Phosphorous.
- d) **Rhizosphere microorganisms**: Rhizosphere and Rhizoplane.
- e) **Plant - microbe interaction**: Mycorrhizae.
- f) **Soil pollution**: Sources, effects and control measures. **(12 hrs)**

3. Microbiology of air

- a) **Microbes and atmosphere**: Atmosphere layers, sources of microorganisms, air micro-flora of indoor and outdoors, factors affecting air micro-flora (nutrition, radiation, pH and temperature). Significance of air borne microbes - their control and management.
- b) **Techniques of trapping air borne microorganisms**: Impingement in liquids and impacting solids (Bead bubbler device, Petri plate exposure, Hirst spore trap, Rotorod sampler). Air borne diseases. Biohazards in occupational environment.
- c) **Air borne diseases**: allergens, pathogens, significance of microorganisms in air. Control of air borne microorganisms. **(12 hrs)**

4. Microbiology of water

- a) **Sources of water**: Surface and ground water and their microbial contents.
- b) **Water pollution**: Sources and water borne diseases - viral, bacterial and protozoan. Biological indicators of water pollution,
- c) Determination of sanitary quality of water: SPC, tests for coliform, MPN, IMViC reactions, membrane filter technique.
- d) Water purification in municipal water supply. **(12 hrs)**

5. Microbiology of waste water

- a) Introduction: Sources of waste water (domestic, agricultural and industrial). Physical, chemical and microbiological characteristics of wastewater.

- b) Wastewater treatment: Single dwelling unit - septic tank, municipal wastewater treatment - primary, secondary, tertiary and reclamation of wastewater.
- c) Solid waste recycling; Anaerobic digestion process, waste as resource (organic compost): biogas production and composting **(12 hrs)**

6. Bioleaching : Scope, organisms involved, economic importance, mechanism of bioleaching of Cu and Fe. **(2 hrs)**

7. Biodegradation and Bioremediation:

Introduction, types, scope and applications of Bioremediation. Biodegradation of Petroleum (Hydrocarbons), pesticides (2, 4-D and DDT) (in brief). Microbes in abatement of heavy metal pollution, heavy metal tolerance in microbes, different microbial groups in bioremediation of environment. **(6 hrs)**

PRACTICAL V

MB 5.1 DSE 1E - ENVIRONMENTAL MICROBIOLOGY

1. Isolation of microorganisms from soil, air and water.
2. Enumeration of bacterial number by turbidometry.
3. Total count and MPN of bacteria from water sample.
4. Measurement of chloride, phosphate and nitrate in water sample.
5. Estimation of total and dissolved solids in sewage
6. Estimation of BOD, COD and dissolved O₂ from water samples.
7. Measurement of ammonia, nitrate and nitrite uptake by microorganisms.
8. Demonstration of air samplers-Gravity slide technique, equipment/photographs of vertical cylinder spore trap, Rotarod sampler, Hirst spore trap, Andersen sampler, bead bubbler, Membrane filter
9. Demonstration of sewage treatment plants.
10. Display of photographs-Septic tank, Trickling filter, activated sludge process, oxidation pond, sedimentation tank, anaerobic digester.

References:

- ❖ Alexander, A.M. (1987). Introduction to soil Microbiology, 5th ed., John Wiley and sons. Wiley Eastern Ltd., New Delhi.
- ❖ Atlas, R. M. and Bartha, R. (1993). Microbial Ecology: Fundamentals and applications, 3rd ed., Benjamin and Cummings Pub. Co., New York.
- ❖ Colwold, D 1999 "Microbial Diversity" Academic Press.
- ❖ Grant, W.D. and P.E, Long: (1981). Environmental Microbiology, Thomson Litho Ltd.
- ❖ Hurst, G.H. (2001)"Environmental Microbiology" ASM Press Washington D.C.
- ❖ Mitchell, R. (1992). Introduction to Environmental Microbiology, Prentice Hall Inc, Englewood Cliffs.
- ❖ Peleczar, M.J., Chan, E.C.S and Krieg, N.R. – (2014) "Microbiology" Tata MaGraw HillBook Co. New York.

- ❖ Powar and Daginwala (1996). General Microbiology, Vol 1. Himalaya Publishing House, Bombay.
- ❖ Powar and Daginwala (1996). General Microbiology, Vol 2. Himalaya Publishing House, Bombay.
- ❖ Ralph Mitchell 1995 "Environmental Microbiology" Wiley and Sons. New York.
- ❖ Rao, M.N. and Datta, A.K. (1987). Waste Water Treatment. Oxford and I.B.H.
- ❖ Rheinhermer, G. (1986). Aquatic Microbiology Jhon Wiely and sons, New York.
- ❖ Singh, D.P. and S.K. Dwivedi (2000) 'Environment Microbiology and Biotechnology, New Age Industrial Publishers.
- ❖ Subba Rao, N.S. (2012). Soil Microorganisms and Plant Growth 4th ed., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- ❖ Subha Rao, N.S. (1988). Biofertilizers in Agriculture, 2nd ed. Oxford and IBH Pub. Co., New Delhi.

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE-DSE

PAPER-MB 5.2 DSE-2E: MICROBIAL BIOTECHNOLOGY AND BIOINFORMATICS

(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 hrs (4 hrs/week)

1. Introduction to Microbial Biotechnology

Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications. Genetically engineered microbes for industrial application: Bacteria and yeast. **(8 hrs)**

2. Applications of Microbial Biotechnology

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors. **(8 hrs)**

3. Microbial Products and their Recovery

Microbial product purification, filtration, ion exchange & affinity chromatography techniques. Immobilization methods and their application: Whole cell immobilization. **(6 hrs)**

4. Microbes for Bio-energy and Environment

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents. **(8 hrs)**

5. Introduction to Computer Fundamentals

RDBMS - Definition of relational database. Mode of data transfer (FTP, SFTP SCP), advantage of encrypted data transfer. **(6 hrs)**

6. Introduction to Bioinformatics and Biological Databases: Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB
(8 hrs).

7. Applications of bioinformatics

Sequence Alignments, Phylogeny and Phylogenetic trees: Local and Global Sequence alignment, pairwise and multiple sequence alignment. Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood. Genome organization and analysis. (8 hrs)

8. Protein Structure Predictions

Hierarchy of protein structure - primary, secondary and tertiary structures, modeling Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template. (8 hrs)

PRACTICAL V

MB 5.2 DSE 2E-MICROBIAL BIOTECHNOLOGY AND BIOINFORMATICS

(4 hrs/week)

13. Study yeast cell immobilization in calcium alginate gels.
14. Study enzyme immobilization by sodium alginate method.
15. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*).
16. Isolation of xylanase or lipase producing bacteria.
17. Study of algal Single Cell Proteins.
18. Introduction to different operating systems - UNIX, LINUX and Windows.
19. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB.
20. Sequence retrieval using BLAST.
21. Sequence alignment & phylogenetic analysis using clustalW & phylip.
22. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool.
23. Protein structure prediction: primary structure analysis, secondary structure prediction using psipred, homology modeling using Swiss model. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK).
24. Prediction of different features of a functional gene.

References:

- ❖ Glazer, A. N. and Nikaido, H. (2007). Microbial Biotechnology, 2nd edition, Cambridge University Press.
- ❖ Glick, B. R., Pasternak, J. J. and Patten, C. L. (2010). Molecular Biotechnology 4th edition, ASM Press.
- ❖ Gupta, P. K. (2009). Elements of Biotechnology 2nd edition, Rastogi Publications.
- ❖ Lesk, M.A. (2008). Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition.
- ❖ Pradeep and Sinha Preeti, (2007). Foundations of Computing, 4th ed., BPB Publications.

- ❖ Prescott, Harley and Klein's Microbiology by Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2014). 9th edition, Mc Graw Hill Publishers.
- ❖ Primrose and Twyman, (2003). Principles of Genome Analysis & Genomics. Blackwell.
- ❖ Rastogi, S.C., Mendiratta, N. and Rastogi P. (2007). Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication.
- ❖ Ratledge, C. and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
- ❖ Saxena Sanjay, (2003). A First Course in Computers, Vikas Publishing House.
- ❖ Swartz, J. R. (2001). Advances in *Escherichia coli* production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

**SEMESTER V
SKILL ENHANCEMENT COURSE**

**PAPER – MB SEC-1E: MICROBIAL QUALITY CONTROL IN FOOD AND INDUSTRIES
(Credits: Theory-2)**

Theory

Total hours allotted 30 hrs (2 hrs/week)

Unit I: Biosafety

Good laboratory practices: Good laboratory practices, Good microbiological practices Biosafety cabinets; Working of biosafety cabinets, using protective clothing, specification for BSL1, BSL-2, BSL-3. Discarding biohazardous waste-Methodology of Disinfection, Autoclaving & Incineration.

Determining Microbes in Samples: 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.

(14 hrs)

Unit II: Microbiological quality analysis of Food and Water

Pathogenic Microorganisms of Importance in Food & Water: Enrichment culture technique, Detection of specific microorganisms- on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

Food safety and Standard: HACCP for Food Safety and Microbial Standards. 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.

(16 hrs)

References:

- ❖ Baird, R. M., Hodges, N. A. and Denyer, S. P. (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
- ❖ Garg, N., Garg, K. L. and Mukerji, K. G. (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
- ❖ Harrigan, W. F. (1998). Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
- ❖ Jay, J. M. (2013). Modern Food Microbiology. United States: Springer US.
- ❖ Solis, A. (2018). Food Microbiology. United Kingdom: EDTECH.

SEMESTER V

SKILL ENHANCEMENT COURSE

PAPER – MB SEC-2E: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

(Credits: Theory-2)

Theory

Total hours allotted 30 hrs (2 hrs/week)

Unit I: Analytical Aeromicrobiology

Microflora of Air: Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens.

Collection of air sample and Analysis: Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics. Control Measures: Fate of bioaerosols, inactivation mechanisms- UV light, HEPA filters, desiccation, Incineration.

(14 hrs)

Unit II: Water Microbiology

Microbiological analysis of water sample: Microbiological analysis of water sample collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (b) Standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

Control of microbes in water: Water borne pathogens, water borne diseases, Control of water borne pathogens- Precipitation, chemical disinfection, filtration, high temperature, UV light.

(16 hrs)

References:

- ❖ da Silva, N., Taniwaki, M. H., Junqueira, V. C., Silveira, N., Nascimento, M. S. and Gomes, R. A. R. (2012). Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press.
- ❖ Atlas, R. M. and Bartha, R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
- ❖ Maier, R. M., Pepper, I. L. and Gerba, C. P. (2009). Environmental Microbiology. 2nd edition, Academic Press.
- ❖ Hurst, C. J, Crawford, R. L., Garland, J. L. and Lipson, D. A. (2007). Manual of Environmental Microbiology, 3rd edition, ASM Press.

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER MB 6.1 DSE-1F - INDUSTRIAL MICROBIOLOGY
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 (4 hrs/week)

1. Introduction to Industrial Microbiology

History, scope and development of industrial microbiology. Isolation and screening of industrially important microorganisms and Strain improvement methods.

(6 hrs)

2. Fermentation

Basic structures, construction and types of fermenters - Air lift, Tower. Bubble cap and Roto fermenter and Types of industrial fermentation process: Batch, continuous, surface, submerged and solid state fermentation.

(8 hrs)

3. Fermentation media

Media components and formulation, Crude media components, Anti foam agents, Precursors, Inducers, Inhibitors and Buffering agents. Sterilization of media and raw materials, maintenance of sterility at critical points during fermentation. Inoculum preparation, Immobilization of cells and enzymes: Types, advantages and applications

(10 hrs)

4. Process Parameters

Parameters used in scale up and problems associated with scale up. Control of process parameters – pH, temperature. O/R potential, Foam regulation aeration, agitation and contamination. Aeration,

(6 hrs)

5. Down stream processing

Precipitation, filtration, centrifugation. distillation, cell disruption, solvent recovery, drying, crystallization.. Recovery of fermented broth, filtration. Disintegration of cells, purification and concentration methods and by products.

(8 hrs)

6. Industrial production of chemicals by microorganisms

Alcohol, beer, lactic acid, vinegar generation. protease, Penicillin, cephalosporin and insulin. Single Cell Proteins and Single Cell Oils production and their applications. Vaccines- Polio. BCG. and DNA vaccines. Role of microorganisms in production and recovery of minerals and petroleum

(10 hrs)

7. Diagnostic trends

Recent trends in diagnostics, biosensors and biochips. Role of national and international organizations in Biotechnology,

(6 hrs)

8. Quality Assurance and IPR

Quality control assurance programs, Governmental regulations of recombinant DNA research regulation for disposal of Bio hazardous material, Intellectual property rights patenting of Bio-technological processes and products and patent laws.

(6 hrs)

PRACTICAL VI

MB 6.1 DSE-1F - INDUSTRIAL MICROBIOLOGY

1. Isolation and identification of microorganisms from industrial effluents.
2. Production of IAA by soil fungi
3. Production of amino acids by soil fungi
4. Production and detection Aflatoxin from fungi.
5. Production of wine from grapes.
6. Estimation of alcohol content by specific gravity method.
7. Production of citric acid from fungi
8. Estimation of citric acid by titrimetric method.
9. Study of different types of Fermenters and fermentation (Charts).
10. Visit to research centers / Institutions / Industries.

Note: A report on the Project/ Industrial visit should be written and submitted along with Practical record.

References:

- ❖ Casida, Jr. L.E. (1996) Industrial Microbiology New Age International Publishers New Delhi.
- ❖ Colwod. D (1999) "Microbial Diversity" Academic Press.
- ❖ Kalaichevan P T (2011)- Bioprocess Technology, Panama Book Distributors, New Delhi
- ❖ Prescott. Lansing, M., Harley John P and Klein Donald. "Microbiology" WCB. McGraw Hill New York.
- ❖ Prescott's Microbiology 2020 Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition. New York, NY : McGraw-Hill Education
- ❖ Reed. G. 1982 "Industrial Microbiology" MacMillan Publications Ltd. Wisconsin.
- ❖ Salle, A.J. "Fundamental Principles of Bacteriology" Tata McGraw Hill Publishing Company Ltd., New Delhi.
- ❖ Stanbury, P. T. and Whitaker, (1984). Principles of Fermentation Technology, Pergamomg Press, New York.
- ❖ Stanier, R.Y. Ingraham J.L (2001)"General Microbiology" Prentice Hall of India Pvt Ltd.. New Delhi.
- ❖ Tortora, G. J., Funke, B. R. and Case, C. L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
- ❖ Varnam A.H. and Evans M.G. (1998) "Food borne Pathogens" Wolfe Publishing House. London.

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE-DSE

PAPER MB 6.2 DSE -2F: - IMMUNO TECHNOLOGY AND TISSUE CULTURE

(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted: 60 (4 hrs/week)

1. **Immunity and Immune system**

History and scope of Immunology, Types of Immunity - Natural, Acquired, Active and Passiv, Antigens-Nature and types, Factors influencing antigenicity, Antibodies-Structure, types, properties and functions of immunoglobulins., Cells, tissues and organs of immune system, Complement system - Properties, components, pathways and functions. **(10 hrs)**

2. **Immune response-** CML MHC. AMI. immunological memory and immunological tolerance, Hypersensitivity - Type I, Type II, Type III and Type IV **(4 hrs)**

3. **Immunotechniques**

Definition, Salient features Agglutination, Precipitation, Complement fixation test Neutralization test, Opsonization. Gel-diffusion techniques. Immuno electrophoresis. Labelled Antibodies - RIA, ELISA, Immuno fluorescent techniques. Serological diagnosis and Serotyping. **(6 hrs)**

4. **Immunoprophylaxis and Immonotherapy** – Brief study of diseases and defense against bacteria, fungi, viruses and parasites. Vaccines types and Significance- Killed, Live attenuated and Toxoid with an example each. General characteristics and types of antibiotics, mode of action of Antibacterial agents (Penicillin, Streptomycin, and Chloramphenicol). Antifungal and antiviral agents. Antibiotic resistance, National Immunization Schedule, Mission Indradhanush. Immunotherapy– Anti Tetanus Serum (ATS). Hybridoma Technology: Monoclonal Antibodies. **(10 hrs)**

5. **Introduction to Tissue culture**

Definition, principles, types and significance of tissue culture, Plant and Animal cell culture **(2 hrs)**

6. **Media compositions and types of cell culture**

Plant cell growth medium compositions, Use of growth regulators and their effect on cell growth, differentiations and organizations. Callus- Cell suspension and embryo Culture Regeneration of shoots and roots. Ovary and endosperm culture. Auxiliary bud, Shoot tip and meristem culture **(2 hrs)**

7. **Tissue culture Techniques**

Basic techniques of animal cell culture Micro propagation, clonal propagation of allied species, *In vitro* haploids and their applications, soma clonal variations and applications. Protoplast fusion, somatic hybridization and its applications. and their applications. applications of micro propagation. **(4 hrs)**

8. **Applications of Tissue culture**

Applications of plant tissue culture, Applications of animal cell culture in production of proteins, regenerative medicine and vaccines. Biotechnology programmes and regulations, disposal of Bio hazardous material, Intellectual property rights patenting of Biotechnological processes and products and patent laws. **(4 hrs)**

PRACTICAL – VI

MB 6.2 DSE -2F: IMMUNO TECHNOLOGY AND TISSUE CULTURE

1. Isolation of lymphocytes from blood samples. Precipitation of serum proteins.
2. Detection of Blood groups.
3. Detective interaction of Antigen and Antibody (WIDAL, VDRL test)
4. Titration of Antigen and Antibody
5. Total RBC and WBC count.
6. Estimation of hemoglobin content of blood.
7. Demonstration of RIA and ELISA.
8. Preparation of plant and animal tissue culture media.
9. Callus induction using plant explains
10. Demonstration of organ cultures, Micro-propagation, organogenesis and anther culture. Protoplast isolation using enzymatic methods.
11. Study of cell suspension culture and its growth (Haemocytometre method and pocked cell volume)
12. Preparation of synthetic seeds from plant material. Demonstration of culture of lymphocytes from blood samples.
13. Demonstration of cloning of animal cell by cell and colony purification.
14. Demonstration of Fusion of cultured cells with myeloma cells.

References:

- ❖ Abbas Abdul K. Lightman Andrew K and Pober Jordan S. "Cellular and Molecular Immunology" VB Saunders Co. Philadelphia.
- ❖ Bhan 1998, "Tissue culture", Mittal publication, New Delhi.
- ❖ Douglas.J. and Slekh "Medical Bacteriology" Churchill Livingstone.
- ❖ Goldsby Richard A, Kindt Thomas J and Osborne Barbara A. "Kuby Immunology" WH Freeman and Co. New York.
- ❖ Greenwood, David. Richards,C and Slack B. (2005)"Medical Microbiology" ELBS Churchill Livingstone.
- ❖ Ian Freshney 2001 "Culture of animal cells" 3rd edition Wiley Lis.
- ❖ Jawetz, Mehick. Adelberg. Brooks, Butel and Orston (2003)"Medical Microbiology" PrenticeHall Inc. London.
- ❖ Kenneth Jr. "Medical Microbiology - Introduction to Infection Diseases" Prentice Hall International.
- ❖ Lydiane Kyte and Jhon Kleyn, 1996. Plants from test tubes - An Introduction to Micro propagation III edition, Timber press Portland.
- ❖ M.K. Sateesh 2003. Biotechnology 5. New age international publishers Patel, A.H. 1984, Industrial Microbiology.
- ❖ Peleczar, M.I. Chan. ECS. and Krieg N.R. "Microbiology" McGraw Hill Book Co. New

- York,
- ❖ Roitt, I.M. (2011) "Essentials of Immunology" ELBS Blackwell Scientific Publishers London.
 - ❖ Shetty, N (1994) "Immunology - Introductory Text Book New Agra.
 - ❖ Shetty, N (2004) "Immunology - introductory Text Book New Agra.
 - ❖ Shrivastava P.S. "Plant Tissue Culture and Molecular Biology" Application and prospects. Narosa publishing house, New Delhi.
 - ❖ Topley and Willie-principles of Bacteriology, Virology and Immunity" Edward Arnold.

SEMESTER VI
SKILL ENHANCEMENT COURSE
Paper – MB SEC-1F: MICROBIAL DIAGNOSIS IN HEALTH CLINICS
(Credits: Theory-2)
Theory

Total hours allotted 30 (2 hrs/week)

Unit I: Sample collection and Examination

Collection of clinical samples: Importance of Diagnosis of Diseases Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis. Collection of Clinical Samples. How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage. **(15 hrs)**

Microscopic examination and culture: Direct Microscopic Examination and Culture. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Unit II: Pathogens detection and Antibiotic sensitivity test

Detection of pathogens: Serological and Molecular Methods: Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes. Kits for Rapid Detection of Pathogens- Typhoid, Dengue and HIV, Swine flu.

Antibiotic sensitivity test: Testing for Antibiotic Sensitivity in Bacteria- Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

(15 hrs)

References:

- ❖ Ananthanarayan, R. and Paniker, C. K. J. (2009). Textbook of Microbiology, 8th edition, Universities Press Pvt. Ltd.
- ❖ Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013).
- ❖ Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
- ❖ Randhawa, V. S., Mehta, G. and Sharma, K. B. (2009). Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt. Ltd.
- ❖ Tille, P. (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.
- ❖ Collee, J. G., Fraser, A. G., Marmion, B. P. and Simmons, A. (2007). Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.

SEMESTER VI
SKILL ENHANCEMENT COURSE
PAPER – MB SEC-2F: MICROBIAL INFECTIONS AND TREATMENT
(Credits: Theory-2)
Theory

Total hours allotted 30 (2 hrs/week)

Unit I: Human diseases

Human diseases types: Infectious and non infectious diseases, microbial and non microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections.

Microbial diseases: Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/ Ebola/Corona)- causes, spread and control, Mosquito borne disease- Types and prevention. **(16 hrs)**

Unit II: Therapeutics and Prophylaxis of Microbial diseases

Treatments for Microbial diseases: Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.

Prevention of Microbial Diseases: General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. Vaccines: Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context. **(14 hrs)**

References:

- ❖ Ananthanarayan, R. and Paniker, C.K.J. (2018). Textbook of Microbiology. 8th edition, University Press Publication.
- ❖ Brooks, G.F., Carroll, K.C., Butel, J.S., Morse, S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
- ❖ Goering, R., Dockrell, H., Zuckerman, M. and Wakelin, D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- ❖ Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.
- ❖ Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

KARNATAK UNIVERSITY, DHARWAD
GENERAL PATTERN OF THEORY EXAMINATION (for DSC and DSE)
B.Sc INDUSTRIAL MICROBIOLOGY

Duration: 3 Hours

Maximum: 80 Marks

All questions are compulsory
Draw diagrams wherever necessary

Q.I. Answer any ten of the following

10X2=20
Marks

- | | |
|-----|-----|
| 21) | 22) |
| 23) | 24) |
| 25) | 26) |
| 27) | 28) |
| 29) | 30) |
| 31) | 32) |

Q.II Write short notes on any six of the following:

6x5=30Marks

- | | |
|-----|-----|
| 33) | 34) |
| 35) | 36) |
| 37) | 38) |
| 39) | 40) |

Q.III Answer the following

- | | | |
|----|----------|---------------|
| 21 | b) Or b) | 10x1=10 Marks |
| 22 | b) Or b) | 10x1=10 Marks |
| 23 | b) Or b) | 10x1=10 Marks |

GENERAL PATTERN OF THEORY QUESTION PAPER FOR ALL SEC PAPERS (1.5 hrs)

4. Question number 1-6 carries 2marks to answer any 5 questions : 10 marks
5. Question number 7-14 carries 4marks to answer any 5 questions : 20 marks
6. Question number 15-17 carries 5marks to answer any 2 questions : 10marks
40 marks

KARNATAK UNIVERSITY, DHARWAD

GENERAL PATTERN OF THEORY EXAMINATION (for SEC)

B.Sc INDUSTRIAL MICROBIOLOGY

Duration: 1.5 Hours

Maximum: 40 Marks

All questions are compulsory

Draw neat labelled diagrams wherever necessary

QNo. I Answer any FIVE of the following 2X5=10

(18)

(19)

(20)

(21)

(22)

(23)

QNo. II Answer any FIVE of the following 4X5=20

(24)

(25)

(26)

(27)

(28)

(29)

(30)

(31)

QNo. III Answer any TWO the following 5X2=10

(32)

(33)

(34)

KARNATAK UNIVERSITY, DHARWAD
PATTERN OF PRACTICAL EXAMINATION

Practical examination – B. Sc INDUSTRIAL MICROBIOLOGY

Duration: 3 hours

Max. Marks: 40

Q. 1	Major question	12 Marks
Q. 2	Minor question	08 Marks
Q. 3	Identify and comment	5X2 = 10 marks
Q. 4	Record + Tour Report	05 Marks
Q. 5	Viva – Voce	05 Marks