UNIVERSITY OF CALCUTTA

NotificationNo.CSR/13/21

It is notified for information of all concerned that the Syndicate at its meeting held on 25.01.2021 (vide Item No.27) approved some amendments made in the DSE papers along with inclusion of Project Work in Group - B, of DSE paper taught at the semester-5 and semester-6 of Microbiology (Honours) courses of studies under CBCS, under this University, as laid down in the accompanying pamphlet.

The above shall be applicable for Semester-5 and Semester -6 and will take effect from the Semester-6 Examination, 2021.

05/7/21

Prof.(Dr.) Debasis Das
Registrar

SENATE HOUSE
KOLKATA-700 073
The 5th July, 2021.

Semester Wise Microbiology Courses for B. Sc. (Honours)

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6
Core Courses (CC)	CC1 & 2 2Th+2P (2X4+2X2=12 Credits) **CC1:** Introduction to microbiology and microbial diversity **CC2:** Bacteriology	CC3 & 4 2Th+2P (2X4+2X2=12 Credits) **CC3:** Biochemistry **CC4:** Cell Biology	CC5,6 & 7 3Th+3P (3X4+3X2=18 Credits) **CC5:** Virology **CC6:** Microbial physiology and metabolism **CC7:**Molecular Biology	CC-8,9 &10 3Th+3P (3X4+3X2=18 Credits) **CC8:**Microbial Genetics **CC9:**Environmental Microbiology **CC10:**Recombinant DNA Technology	CC11 & 12 2T+2P (2X4+2X2=12 Credits) **CC11:**Food and Dairy Microbiology **CC12:**Industrial Microbiology	CC-13 & 14 2T+2P (2X4+2X2=12 Credits) **CC13:**Immunology **CC14:**Medical Microbiology
Elective Courses:						
i) Generic Elective (GE)	1Th+1P **GE1** (1X4+1X2=6 Credits)	1Th+1P **GE2** (1X4+1X2=6 Credits)	1Th+1P **GE3** (1X4+1X2=6 Credits)	1Th+1P **GE4** (1X4+1X2=6 Credits)		
ii) Discipline Specific Elective Courses					**DSE-A*** 2Th+2P **Any two:** (2X4+2X2=12 Credits) A1. Microbial Biotechnology A2. Advances in Microbiology **DSE-B*** B1. Inheritance Biology B2. Microbes in Sustainable Agriculture and Development	**DSE-A*** 2Th+2P **Any two:** (2X4+2X2=12 Credits) A3. Plant Pathology A4. Biomathematics and Biostatistics **DSE-B*** B3. Instrumentation and Biotechniques B4. Project Work

Ability Enhance-ment Compulsory Course (AECC)	1Th+0P AECC-1: Communicative English (2 Credits)	1Th+0P AECC-2: Environmental Studies (2 Credits)				
Skill Enhance-ment Courses (SEC)			1Th+0P SEC-A (1X2=2 Credits) Any one 1.Microbial Quality Control in Food and Pharmaceutical Industries 2. Biofertilizers and Biopesticides	1Th+0P SEC-B (1X2=2Credits) Any one 1. Food Fermentation Techniques 2. Microbiological Analysis of Air and Water		
Total No. of Courses and Marks	4 X 100=400	4 X 100=400	5 X 100=500	5 X 100=500	4 X 100=400	4 X 100=400
Total Credit 140	20 Credits	20 Credits	26 Credits	26 Credits	24 Credits	24 Credits

*DSE-A: Any one to be chosen in the 5th Semester and another one to be chosen in the 6th Semester.

*DSE-B: Any one to be chosen in the 5th Semester and another one to be chosen in the 6th Semester.

These choices must be made by the students before 5th Semester begins.

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)

DSE-A:

1. MICROBIAL BIOTECHNOLOGY (THEORY)

SEMESTER –5

MCB-A-DSE-A-5-1-TH

CREDITS: 4

TOTAL HOURS: 50

Unit 1 Microbial Biotechnology and its Applications **No. of Hours: 8**

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

Unit 2 Therapeutic and Industrial Biotechnology **No. of Hours: 8**

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

Unit 3 Applications of Microbes in Biotransformations **No. of Hours: 6**

Microbial based transformation of steroids and sterols

Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute

Unit 4 Microbial Products and their Recovery **No. of Hours: 8**

Microbial product purification: filtration, ion exchange & affinity chromatography techniques

Immobilization methods and their application: Whole cell immobilization

Unit 5 Microbes for Bio-energy and Environment **No. of Hours: 10**

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

Unit 6 RNAi No. of Hours: 6

RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions

Unit 7 Intellectual Property Rights **No. of Hours: 4**

Patents, Copyrights, Trademarks

DSE-A: 1. MICROBIAL BIOTECHNOLOGY (PRACTICAL)

SEMESTER –5

MCB-A-DSE-A-5-1-P

CREDITS: 2

TOTAL HOURS: 60

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

SUGGESTED READING

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A; Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE) DSE-A:
2. ADVANCES IN MICROBIOLOGY (THEORY)
SEMESTER –5

MCB-A-DSE-A-5-2-TH

TOTAL HOURS: 50 CREDITS: 4

Unit 1 Evolution of Microbial Genomes **No. of Hours: 10**

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

Unit 2 Metagenomics **No. of Hours: 15**

Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3 Molecular Basis of Host-Microbe Interactions **No. of Hours: 15**

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

Unit 4 Systems and Synthetic Biology **No. of Hours: 10**

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

DSE-A: 2.ADVANCES IN MICROBIOLOGY (PRACTICAL)
SEMESTER –5
MCB-A-DSE-A-5-2-P

TOTAL HOURS: 60 CREDITS: 2

1. Extraction of metagenomic DNA from soil
2. Understand the impediments in extracting metagenomic DNA from soil
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers
4. Case study to understand how the poliovirus genome was synthesized in the laboratory
5. Case study to understand how networking of metabolic pathways in bacteria takes place

SUGGESTED READING

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press
5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag
6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons
7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings
8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011)Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International
10. Voit EO (2012) A First Course in Systems Biology, Istedition,Garland Science

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)
DSE-A:
3. PLANT PATHOLOGY (THEORY)
SEMESTER –6

MCB-A-DSE-A-6-3-TH

TOTAL HOURS: 50 CREDITS: 4

Unit 1 Introduction and History of plant pathology No. of Hours: 5

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

Unit 2 Stages in development of a disease No. of Hours: 2

Infection, invasion, colonization, dissemination of pathogens and perennation.

Unit 3 Plant disease epidemiology No. of Hours: 5

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit 4 Host Pathogen Interaction No. of Hours: 15

A. *Microbial Pathogenicity*
Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction). B. *Genetics of Plant Diseases*
Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance. C. *Defense Mechanisms in Plants*
Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 5 Control of Plant Diseases No. of Hours: 8

Principles & practices involved in the management of plant diseases by different methods, *viz.*
regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material
cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.
biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants
genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes

Unit 6 Specific Plant diseases No. of Hours: 15

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control
A. Important diseases caused by fungi
White rust of crucifers - *Albugo candida*
Downy mildew of onion - *Peronospora destructor*
Late blight of potato - *Phytophthora infestans*
Powdery mildew of wheat - *Erysiphe graminis*
Ergot of rye - *Claviceps purpurea*

Black stem rust of wheat - *Puccinia graministritici*
Loose smut of wheat - *Ustilago nuda*
Wilt of tomato - *Fusarium oxysporum*f.sp. *lycopersici*
Red rot of sugarcane - *Colletotrichum falcatum*
Early blight of potato - *Alternaria solani*
B. Important diseases caused by phytopathogenic bacteria: Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus
C. Important diseases caused by phytoplasmas: Aster yellow, citrus stubborn
D. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro
E. Important diseases caused by viroids: Potato spindle tuber, coconut cadangcadang

DSE-A:
3.PLANT PATHOLOGY (PRACTICAL)
SEMESTER –6
MCB-A-DSE-A-6-3-P

TOTAL HOURS: 60 **CREDITS: 2**

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
2. Study of important diseases of crop plants by cutting sections of infected plant material - *Albugo,Puccinia,Ustilago, Fusarium, Colletotrichum.*

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)
DSE-A:
4. BIOMATHEMATICS AND BIOSTATISTICS (THEORY)
SEMESTER –6

MCB-A-DSE-A-6-4-TH

TOTAL HOURS: 50 **CREDITS: 4**

Unit 1 Biomathematics **No of Hours: 25**

Sets. Functions and their graphs : polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc.
Simple observations about these functions like increasing, decreasing and, periodicity.
Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Intuitive idea of algebraic relationships and convergence.
Infinite Geometric Series. Series formulas for ex, log (1+x), sin x, cos x. Step function. Intuitive idea of discontinuity, continuity and limits.
Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation.
Integrals of the functions introduced above. Differential Equations of first order, Linear Differential Equations.
Points in plane and space and coordinate form. Examples of matrices arising in Biological Sciences and Biological networks. Sum and Produce of matrices upto order 3.

Unit 2 Biostatistics **No of Hours: 25**

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;
Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors,Censoring, difference between parametric and non-parametric statistics;
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; Confidence Interval; Distribution-free test - Chi-square test;Basic introduction to Multivariate statistics, etc.

DSE-A:

4. BIOMATHEMATICS AND BIOSTATISTICS (PRACTICAL)

SEMESTER –6

MCB-A-DSE-A-6-4-P

TOTAL HOURS: 60 **CREDITS: 2**

1. Word Problems based on Differential Equations
2. Mean, Median, Mode from grouped and ungrouped Data set
3. Standard Deviation and Coefficient of Variation
4. Skewness and Kurtosis
5. Curve fitting
6. Correlation
7. Regression
8. Finding area under the curve using normal probability
9. Testing of Hypothesis- Normal Distribution, t-test and Chi-Square-test
10. Confidence Interval

SUGGESTED READINGS

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : Introduction to Mathematics for Life Scientists,Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE) DSE-B:
1. INHERITANCE BIOLOGY (THEORY)
SEMESTER 5

MCB-A-DSE-B-5-1-TH

TOTAL HOURS: 50 **CREDITS: 4**

Unit 1 Introduction to Genetics **No. of Hours: 5**
Historical developments
Model organisms in genetic analyses and experimentation: *Escherichia coli, Saccharomycescerevisiae, Neurospora crassa, Caenorhabditis elegans Drosophila melanogaster, Arabidopsis thaliana*

Unit 2 Mendelian Principles **No. of Hours: 8**
Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity

Unit 3 Linkage and Crossing over **No. of Hours: 6**
Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping

Unit 4 Extra-Chromosomal Inheritance **No. of Hours: 7**
Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in *Chlamydomonas*, mitochondrial, mutations in *Saccharomyces,* Maternal effects – Shell coiling in *Limnaeaperegra* Infectious heredity - Kappa particles in *Paramecium*

Unit 5 Characteristics of Chromosomes **No. of Hours: 15**
Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome

Unit 6 Recombination **No. of Hours: 3**
Homologous and non-homologous recombination, including transposition, site-specific recombination.

Unit 7 Human genetics **No. of Hours: 3**
Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit 8 Quantitative genetics **No. of Hours: 3**
Polygenic inheritance, heritability and its measurements, QTL mapping.

DSE-B:

1. INHERITANCE BIOLOGY (PRACTICAL)

SEMESTER –5

MCB-A-DSE-B-5-1-P

TOTAL HOURS: 60 **CREDITS: 2**

1. Mendelian deviations in dihybrid crosses
2. Studying Barr Body with the temporary mount of human cheek cells
3. Studying *Rhoeo* translocation with the help of photographs
4. Karyotyping with the help of photographs
5. Chi-Square Analysis
6. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas /Drosophila* larvae
7. Study of pedigree analysis
8. Analysis of a representative quantitative trait

SUGGESTED READING

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)
DSE-B:
2. MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (THEORY)
SEMESTER –5

MCB-A-DSE-B-5-2-TH

TOTAL HOURS: 50 **CREDITS: 4**

Unit 1 Soil Microbiology **No of Hours: 6**
Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

Unit 2 Mineralization of Organic & Inorganic Matter in Soil **No of Hours: 6**
Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Unit 3 Microbial Activity in Soil and Green House Gases **No of Hours: 5**
Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 4 Microbial Control of Soil Borne Plant Pathogens **No of Hours: 7**
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds

Unit 5 Biofertilization, Phytostimulation, Bioinsecticides **No of Hours: 12**
Plant growth promoting bateria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs

Unit 6 Secondary Agriculture Biotechnology **No of Hours: 8**
Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters

Unit 7 GM crops No of Hours: 6
Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.

DSE-B:
2.MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (PRACTICAL)
SEMESTER –5

MCB-A-DSE-B-5-2-P

TOTAL HOURS: 60 **CREDITS: 2**

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

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,

4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)
DSE-B:
3. INSTRUMENTATION AND BIOTECHNIQUES (THEORY)
SEMESTER-6

MCB-A-DSE-B-6-3-TH

TOTAL HOURS: 50 CREDITS: 4

Unit 1 Microscopy **No. of Hours: 10**

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Unit 2 Chromatography **No. of Hours: 10**

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis **No. of Hours: 10**

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 4 Spectrophotometry **No. of Hours: 10**

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Unit 5 Centrifugation **No. of Hours: 10**

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

DSE-B:

3. INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL)

SEMESTER –6

MCB-A-DSE-B-6-3-P

TOTAL HOURS: 60 **CREDITS: 2**

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Determination of λ_{max} for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Understanding density gradient centrifugation with the help of pictures.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

DSE-B:
4. Project
SEMESTER –6

MCB-A-DSE-B-6-4-T

Credit 2

Total hours 60

1. Any topic can be chosen which is within the curriculum Sem I to Sem VI
2, Project work can be done in dry laboratory or in wet laboratory
3. A project report needs to be compiled which must contain the following sections
(i) Literature Survey or review literature
(ii) Objectives of the study
(iii) Tools and techniques used in the study
(iv) Results
(v) Discussion
(vi) Significance of the study
(vii) Future prospect

Marks Distribution: Project work 25 Marks, Project Report: 25 Marks,; Total =50 Marks

MCB-A-DSE-B-6-4-P

Project Defense: 30 Marks