SILVER OAK UNIVERSITY
EDUCATION TO INNOVATION
(Established under Gujarat Private Universities Act, 2009)

SEMESTER – IV

Soil Microbiology
Bacterial Taxonomy
Microbial Physiology
Biostatistics

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Subject: - Soil Microbiology								
Program: B.Sc.				Subject Code:			Semester: IV	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

THEORY

Unit: 1 History and significant developments of Soil Microbiology

a. Contributions of Beijerinck, Winograd sky, Selman A. Waksman

b. Components of Soil, Soil Profile, Soil Microorganisms, Scope and Importance of Soil Microbiology, Factors affecting

c. Distribution, Activity and Population of Soil Microorganisms, Soil Formation.

Unit :2 Microbial Interactions in nature

a. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation

b. Microbe-Plant interaction: Mycorrhizae, Lichens

c. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Unit: 3 Biogeochemical Cycles

a. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin

b. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction

c. Phosphorus cycle: Phosphate immobilization and solubilization

d. Sulphur cycle: Microbes involved in sulphur cycle

e. Iron Cycle:

Unit 4 Introduction to Plant Pathology (Fungi and Bacteria)

a. Study of some important plant diseases giving emphasis on its etiological agent, symptoms, and control

b. Important diseases caused by fungi

(i) White rust of crucifers - *Albugo candida*
(ii) Late blight of potato - *Phytophthora infestans*
(iii) Powdery mildew of wheat - *Erysiphe graminis*
(iv) Ergot of rye - *Claviceps purpurea*
(v) Black stem rust of wheat - *Puccinia graminis tritici*
(vi) Early blight of potato - *Alternaria solani*
(vii) Loose smut of wheat - *Ustilago nuda*

c. Important diseases caused by phytopathogenic bacteria:

(i) Angular leaf spot of cotton
(ii) bacterial leaf blight of rice
(iii) crown galls
(iv) bacterial cankers of citrus

PRACTICAL

1. Identification of *Bacillus*,*Clostridium*,*Staphylococcus* from soil.
2.Cultivation and Isolation of Actinomycetes
3.Isolation of *Rhizobium/Azotobacter* from root nodules.
4.Isolation of Fungi (*Mucor*,*Rhizopus*,*Aspergillus*,*Neurospora*) from soil.

References:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition.Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition.Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, AcademicPress
4. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
5. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London

6. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education.
8. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
9. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
10.Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
11. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt.Ltd., New Delhi.
12. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi

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THEORY

Unit: 1 Microbial evolution, taxonomy and diversity

a. Introduction to Microbial Taxonomy Taxonomic ranks
b. Microbial taxonomy and phylogeny
c. Classical and molecular characteristics
d. Evolution of microbial species

Unit: 2 Archaea

a. Archaeal taxonomy
b. Archael metabolism
c. Characteristics of the major archael physiological groups

Unit: 3 Important groups of bacteria

a. Bergey's Manual of Systematic
b. Bacteriology Order *Bacillales*
c. Properties of some members of class *Mollicutes*
d. Characteristics of the major groups of gram negative
e. Photosynthetic bacteria
f. Characteristics of the Cynobacterial Subsections
g. Phylum: *Spirochetes*

Unit: 4 Phylum: proteobacteria

a. Bergey's Manual of Systematic
b. Bacteriology Order *Bacillales*
c. Properties of some members of class *Mollicutes*
d. Characteristics of the major groups of gram negative
e. Photosynthetic bacteria
f. Characteristics of the
g. Cynobacterial Subsections
h. Phylum: *Spirochetes*

PRACTICAL

1. Pure culture study of *Escherichia. coli* and *Klebseilla mobillis* (formerly *Enterobacter aerogenes)*
2. Pure culture study of *Proteus vulgaris*, *Serratia marcescens* and *Pseudomonas aeruginosa.*
3. Pure culture study of *Bacillus megaterium, Bacillus. subtilis, Bacillus. cereus.*
4. Pure culture study of *Staphylococcus aureus, Staphylococcus. epidermidis.*
5. Isolation of halophilic bacteria.

References:

- Wiley, J., & Sherwood, L. (2013). *Prescott, Harley, and Klein's Microbiology*, 9th Ed., McGraw-Hill Science/Engineering/Math, ISBN: 9780073402406
- Pelczar, Chan and Krieg, (1993), *Microbiology-Concepts and Application*, International Edition, McGraw-Hill. ISBN: 9780071129145
- Tortora G.J., and Funke B.R. (2016), *Microbiology an Introduction*, 12th Ed., Pearson, ISBN: 9781292099149
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Subject: - Microbial Physiology								
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THEORY

Unit:1 Introduction to metabolism

a. microbial metabolism
b. Catabolism
c. Anabolism
d. Types of Metabolites
e. Primary metabolism
f. Secondary metabolism
g. Intermediary metabolism
h. Precursor metabolites
i. Role of energy rich compounds and reducing power

Unit: 2 Membrane Transport

a. Introduction
b. Structure of membrane
c. Mechanism of Membrane transport
d. Secondary active transport
   (i) Symport
   (ii) Antiport
   (iii) uniport
e. Phosphate bond linked active transport
f. Group Translocation

(i) Phosphotransferase system
(ii) Acyl coA synthatase system
(iii) Phosphoribosyl transferase

g. Utilization of substrates that cannot enter the cell

Unit: 3 Energy release and conservation

a. Aerobic respiration from Glucose to pyruvate
b. TCA ETC-Oxidative phosphorylation
c. Anaerobic respiration
d. Fermentation

Unit: 4 Catabolism of organic molecules: other than glucose

a. Carbohydrates
b. Lipid catabolism
c. Protein and aminoacids catabolism

PRACTICAL

1.. Effect of pH on metabolic activity (by growth measured at 600nm)
2.Effect of Temp. On enzyme activity (by growth measured at 600nm)
3.Study of Biochemical reactions

References:

- Wiley, J., & Sherwood, L. (2013). *Prescott, Harley, and Klein's Microbiology*, 9th Ed., McGraw-Hill Science/Engineering/Math, ISBN: 9780073402406
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- Voet and Voet, (2008) *Fundamentals of biochemistry*, 3rd Ed, Johns wiley & sons, Asia ISBN: 978-0470129302
- S.C.Rastogi, Biochemistry (2015), 2nd Edi. ISBN:9788171339389

- Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2015). Harper'Biochemistry, 30th Edi.Appleton and Lange.
- Pelczar Jr, M J, Chan E C S., Krieg N R, (1986) Microbiology, 5th edn, McGraw- Hill Book Company, NY
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- P.J.Soni .Introduction to microbial Physiology,Nirav Prakashan.

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Subject: - Biostatistics								
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04	-	-	4	24/60	-	16/40	-	100

THEORY

BIOSTATISTICS

Unit 1: Basic concepts in Statistics

Terms and Definitions in Statistics, Population and Sample, Raw Data, Types of variables, Numerical variable (Continuous and discrete), Categorical variables (Nominal and ordinal), Outcome and exposure variables, Display of data for 1 variable, For categorical data: Bar Chart and Pie Chart, For numerical data: Histogram (different shapes) and Frequency Polygon

Unit 2: Central Tendency and Deviations

Measurements of central tendency: Mean, Median, quartiles, percentiles, Mode Measures of spread:
Range, Variance and Standard Deviation and its interpretation Normal deviation and its characteristics

Unit 3: Probability, Permutations and combinations

Probability: Definition and basic formula, Probability of an event not occurring, Multiplicative rule to calculate the probability of occurrence of both of two events. Independent events, Non- independent events (conditional probability), Additive rule to calculate the probability of occurrence of at least on of two events, Mutually exclusive events, Non-exclusive events, Concept of odds, Applications of probability in biology

Permutations: Definition and basic formula (${}_nP_r$ = n!/(n-r)!), Permutations with repetition, Application of permutations in biology (The genetic code), Combinations: Definition and basic formula (${}_nC_r$ = n!/r!(n-r)!), Application in biology (pedigree analysis), Problems involving Permutations, Combinations and Probability

Unit 4: Data analysis

Sampling Variation, Population mean and standard error, Concept of Hypothesis test and null- hypothesis, t-test (concept and calculation), ANOVA, One-way Anova (concept and calculation), Two-way Anova (definition only), SPSS and its application

References:

Khan and Khannum. Fundamentals of Biostatistics. Bala Rastogi. Biostatistics