

Punyashlok Ahilyadevi Holkar Solapur University, Solapur



Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Microbiology

Name of the Course: B.Sc. II (Sem-III & IV)
(Syllabus to be implemented from w.e.f. June 2020)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Choice Based Credit System (CBCS)

(w.e.f. 2020-21)

Structure for B.Sc. II Microbiology (Semester III & IV)

Subject/ Core Course	Name and Type of the Paper		No. of Papers/ Practicals	Hrs / Week			Total Marks per paper	UA	CA	Credits
	Type	Name		L	T	P				
Class :	B.Sc. II Semester III									
	Core	C5	Paper – V Bacterial Cytology and Physiology	3.0	-	-	50	40	10	3.0
	Core	C6	Paper – VI Bacterial Genetics	3.0	-	-	50	40	10	3.0
Total				6.0			100	80	20	6.0
Class:	B.Sc. II Semester IV									
	Core	C7	Paper VII Immunology & Medical Microbiology	3.0	-	-	50	40	10	3.0
	Core	C8	Paper VIII Industrial Microbiology	3.0	-	-	50	40	10	3.0
	Ability Enhancement Course (AECC)	Environmental Studies		3.0	-	-	50	40	10	3.0
Total (Theory)				9.0	-	-	150	120	30	9.0
Practical	Core	C5 & C6	Paper V& VI	-	-	4.0	50	40	10	4.0
	Core	C7 & C8	Paper VII & VIII	-	-	4.0	50	40	10	4.0
Total Practical				-	-	8.0	100	80	20	8.0
Grand Total (Semester III & IV with Practicals)				15.0	-	8.0	350	280	70	23.0

B.Sc. II- Semester –III

Paper – V Bacterial Cytology and Physiology		
THEORY COURSE (03 Credits)		
		Total Lectures 45L
Unit No.	Content of Unit	Lectures Allotted
I	Ultra-structure and Functions <ol style="list-style-type: none"> Bacterial Cell wall: chemical composition, structure and functions of cell wall of Gram Positive and Gram Negative bacteria Cell Membrane: Chemical Composition, structure and functions. Transport across cell membrane – simple diffusion, facilitated diffusion, active transport & group translocation. Mesosome & its functions. Flagella: Structure and functions , Mechanism of movement, Tactic behaviors Pili: Types, Structure and functions Cytoplasmic inclusions: Chlorobium vesicles. Gas vacuoles, Magnetosomes and carboxysomes and their functions Reserve Food Materials: Nitrogenous and Non nitrogenous and their role Bacterial Endospore: Ultra-structure and functions, sporulation as an example of cell differentiation, Germination of endospore 	15 L
II	Bacterial Growth <ol style="list-style-type: none"> Definitions of - growth, generation time, growth rate and Synchronous Growth Growth phases Measurement of growth – Cell numbers, Cell Mass and Cell activity 	07 L
III	Effect of Environmental factors on Bacterial growth <ol style="list-style-type: none"> Temperature Psychrophiles, Mesophiles, Thermophiles, Thermodurics pH- Acidophiles, Basophiles and Neutrophiles Oxygen- Aerobic, Anaerobic, Facultative Anaerobic and Microaerophilic Osmotic pressure- Osmophilic(Halophilic) Hydrostatic Pressure- Barophiles Surface Tension 	10 L
IV	Bacterial Metabolism <ol style="list-style-type: none"> Fates of Pyruvate – a) Aerobic Tri-Carboxylic Acid Cycle b) Anaerobic – Ethanol Fermentation c) Microaerobic – Lactic Acid Fermentation Modes of ATP generation – <ol style="list-style-type: none"> Substrate Level Phosphorylation, Oxidative Phosphorylation - Respiratory electron transport chain, components of ETC, aerobic and anaerobic respiration Photophosphorylation: photosynthetic ETC [cyclic & noncyclic] 	13 L

Reference Books:

- 1] Powar C.B. and Dagainawala H.F. (1986). General Microbiology Vol. I & II (2ndEdition), Himalaya Publishing House, Mumbai.
- 2] Stanier R.Y, *et.al*; General Microbiology
- 3 Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi
- 4] Dubey, R.C and Maheswari, D.K. (2000) General Microbiology. S. Chand, New Delhi.

Paper-VI Bacterial Genetics

THEORY COURSE (03 Credits) (45 L)

Unit No.	Content of Unit	Allotted Lectures
Unit-I: Structure of nucleic acids & Replication of Bacterial DNA	1.Experimental evidences for nucleic acid as genetic material- <ul style="list-style-type: none"> • Griffith Experiment • Avery, Macleod and McCarty's experiment • Hershey and Chase experiment 2. Structure & forms or types of DNA- <ul style="list-style-type: none"> • Watson and Crick's model of DNA • A, B ,C and Z form of DNA 3.DNA replication- <ul style="list-style-type: none"> • Modes of replication (Conservative, semiconservative and Dispersive) • Messelson & Stahl's experimental proof of semiconservative replication • Enzymes involved in replication • Mechanism of DNA replication 	12
Unit –II: Gene, Genetic code and Plasmid	1. Definitions and concepts of - <ul style="list-style-type: none"> • Gene • Genome • Genotype • Phenotype • Cistron, Recon & Muton • Split gene-concept of intron and exons 2. Genetic code- <ul style="list-style-type: none"> • Definition and properties of genetic code 3. Plasmid- <ul style="list-style-type: none"> • Definition of plasmid and episome • Properties of plasmid • Types of plasmid-F plasmid, R plasmid, Col plasmid, Ti plasmid, Linear plasmid and Yeast 2μ plasmid • Applications of plasmid 	09
Unit-III: Bacterial Mutation & Repair	1.Mutations & Mutagenesis- <ul style="list-style-type: none"> • Definition of mutation • Mutagen- physical and chemical Mutagens 2. Types of mutation- <ul style="list-style-type: none"> • Base pair Substitution- Transition and Transversion • Missense mutation • Nonsense mutation • Neutral Mutation • Silent Mutation • Frame shift Mutation 	12

	<p>3. Types of mutation on the basis of molecular mechanism-</p> <ul style="list-style-type: none"> • Spontaneous Mutation- Definition, Fluctuation Test, Replica plate technique • Definition and Mechanism of Induced Mutations caused by- • Physical Mutagen- U.V.rays • Chemical mutagens- 5-Bromouracil, 2-aminopurine, Hydroxylamine, Nitrous acid, alkylating agent and Acridine dyes. <p>4. DNA repair-</p> <ul style="list-style-type: none"> • Photo reactivation • Dark repair Mechanism-Excision repair (Base and Nucleotide) 	
Unit- IV Bacterial Recombination	<p>1. Definition of recombination</p> <p>2. Fate of exogenote</p> <p>3.Types of recombination-</p> <ul style="list-style-type: none"> • Transformation- experimental proof & mechanism of transformation, Definition of transfection • Conjugation- a)Discovery, experimental evidence (Leaderberg & Tatum's & Davis U Tube) b) Mechanism of conjugation- F+ X F-, HFr X F-, F'X F- • Transduction- a) Discovery & experimental proof (Zinder & Leaderberg) b) Types of transduction- Specialized, Generalized and Abortive transduction. 	12

References:

- 1] A J Salle: Fundamentals of Bacteriology
- 2] R Y Stainer, Roger et.al: General Microbiology
- 3] Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi
- 4] Powar and Dagainawala: General microbiology Vol. I, II, Himalaya Publishing House
- 5] Avinash and Kakoli Upadhay: Molbio, Himalaya Publishing House
- 6] Freifelder David: Microbial genetics, Jones and Bartlett Publications
- 7] James D Watson: Molecular biology of the gene, W. A. Benjamin, Inc.

Semester IV

Paper-VII Immunology & Medical Microbiology		
THEORY COURSE (03 Credits)		
		Total Lectures 45L
Unit No.	Content of Unit	Lectures Allotted
Unit I: Immunity	<ol style="list-style-type: none"> 1. Immunity – Definition and concept <ol style="list-style-type: none"> a. Innate immunity – Definition, Levels of innate immunity – Individual, racial and species immunity , Mechanism of innate immunity-mechanical, chemical, biological barriers[role of normal flora, cells of innate immunity and their role], inflammation and fever b. Acquired immunity – definition, types-Active & passive 	(12)
Unit II: Antigen & Antibody	<ol style="list-style-type: none"> 1. Antigen <ol style="list-style-type: none"> a.definition,concept of hapten,antigenic determinant, b.Types of antigen c.factors affecting antigenicity 2. Antibody (immunoglobulin) <ol style="list-style-type: none"> a. Historical perspective-Immune sera and concept of immunoglobulin b. Basic structure of antibody (immunoglobulin) c. Classes of immunoglobulins, physicochemical & biological properties and functions of Immunoglobulins. 	(12)
Unit III: Antigen – antibody reactions	<ol style="list-style-type: none"> 1. Purposes of antigen antibody reactions 2. General features antigen antibody reactions 3. Measurement of antigen antibody reactions 4. Mechanism antigen antibody reactions 5. Types of antigen – antibody reactions: Agglutination test, precipitation test, flocculation test, complement fixation test, Immunofluorescence test 	(09)
Unit IV- Microbial Diseases Clinical Microbiology	<p>A. Microbial Diseases</p> <ol style="list-style-type: none"> 1.Bacterial Infections- Enteric fever, Staphylococcl wound infections and Urinary tract infections 2.Fungal Infection-Candidiaais 3.Viral Infection- Dengue fever <p>B. Clinical Microbiology</p> <ol style="list-style-type: none"> 1.Basic concepts 2.Collection, handling & transportation of specimen 3. Methods of diagnosis of diseases- Microscopic, cultural, biochemical & Serological. 	(12)

Reference Books:

1. Ananthanarayana R. and Paniker, C.K.J. (2000). Text Book of Microbiology, 9th Edition, Oriental Longman Publications, USA.
2. Roitt, I.M. (1998). Essentials of Immunology, ELBS and Black Well Scientific Publishers, England.
3. Prescott, M.J., Harley, J.P. and Klein, D.A. (2002). Microbiology. 5th Edition, WCB McGrawHill, New York.
4. Dugid,J.P.,Medical Microbiology
5. Kubey - Immunology

Semester -IV

Paper VII: Industrial Microbiology		
THEORY COURSE (03 Credits)		
		Total Lectures 45L
Unit No.	Content of Unit	Lectures Allotted
UnitI: Industrial Microbiology	1. Definition and Scope of industrial Microbiology, industrial important organisms with products (lists) 2. Fermentations: Basic Concept, Types –Surface Culture Submerged Culture. Batch, Continuous culture (Chemostat & Turbidostat) , Dual and Multiple fermentation. 3. Design of typical Fermenter / Bioreactor: Parts and their functions	(10)
UnitII: Fermentation Media	1. Media for industrial Fermentations 2. Media Components and Optimization 3. Use of Waste as a fermentation Media 4. Inoculum and Production media	(12)
Unit III: Screening, Inoculum Development and Scale up	1. Screening: Primary and Secondary 2. Strain Improvement 3. Preservation of industrially important microorganisms 4. Inoculum Development 5. Scale up of Fermentation	(09)
Unit IV: Specific Fermentations & Fermentation Product Recovery	<p style="text-align: center;">a) Specific Fermentations</p> <p style="text-align: center;">1. Penicillin fermentation (<i>P.chrysogenium</i>) 2. Alcohol (<i>S.cerevisiae</i>) 3. SCP (<i>S.cerevisiae</i>) 4. Amylase (<i>A.niger</i>)</p> <p style="text-align: center;">b) Fermentation Product Recovery</p> <p style="text-align: center;">1. Criteria for selection of recovery method 2. Filtration, Centrifugation, Precipitation, Distillation, Crystallization and Drying.</p>	(14)

Reference Books:

1. Patel, A.H. (1984). Industrial Microbiology, Mac Milan India Ltd., Hyderabad.
2. Cassida, L.E. (1968). Industrial Microbiology, Wiley Eastern Ltd. & New Age International Ltd., New Delhi.
3. Prescott & Dunn, Industrial Microbiology
4. Purohit, Microbiology- Fundamentals and Applications, sixth edition
5. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

B. Sc. II Microbiology

Practical Course (Credits - 08)

1. Stains and Staining Procedures

- i. Spore Staining [Dorner's method]
- ii. Flagella Staining [Bailey's Method]
- iii. Nuclear material Staining [Giemsa's method]

2. Preparation of culture media

- a. Wilson and Blair's medium
- b. Gelatin Agar
- c. Amino Acid Decarboxylation Medium
- d. Peptone Nitrate Broth
- e. Hugh and Leifson's Medium
- f. Amino Acid Deamination medium
- g. Christensen's urea agar

3. Preparation of Reagents and Solutions

- a. 1N NaOH
- b. 1N HCl
- c. 10% Ferric chloride
- d. Nitrate reduction test reagents (α naphthylamine & Sulphanilic acid)
- e. 1% Tannic acid
- f. Phosphate buffer solution of pH 7.0
- g. Benedict's reagent
- h. Biuret reagent

4. Biochemical Tests

- a. Gelatin Hydrolysis
- b. Amino Acid Decarboxylation
- c. Amino Acid Deamination
- d. Urea Hydrolysis
- e. Nitrate Reduction

- f. Oxidase
 - g. Hugh and Leifson's
 - h. Catalase
5. Effect of environmental factors on growth of microorganisms
- a. UV light
 - b. Heavy Metals
 - c. Salt Concentration (NaCl)
 - d. pH
 - e. Temperature
 - f. Antibiotics [Penicillin & Streptomycin]
6. Primary Screening:
- a. Antibiotic Producers – Crowded Plate Technique
 - b. Amylase Producers – Replica Plate Technique
7. Isolation & Identification of Pathogenic Microorganisms from Clinical Samples
- a. *Salmonella* spp.
 - b. *Candida* spp.
 - c. *Proteus* spp.
8. Determination of Blood Groups – ABO & Rh
9. Widal test (slide test): Qualitative
10. Glucose Estimation (Benedict's Method).
11. Protein Estimation (Biuret Method).
12. Study of Growth phases of *E.coli* by optical density method.
13. Isolation of DNA

Practical Question Paper for University Practical Examination

Total Marks: 80

Q.1 Identification of Pathogen	20
Q.2 Biochemical Tests	10
Q.3 Staining / Screening	10
Q.4 Effects/ Growth Curve [lag phase]	10
Q.5 Glucose /Protein / Widal test/ Blood Groups	10
Q.6 Spotting on Media components, reagents and stains (05 Spots)	10
Q.7 Journal	05
Q.8 Tour Report	05

The practical Examination will be conducted for two (2) successive days for 6 hours each day. There will be one batch of maximum 20 students each day.

Internal Practical examination:

Total Marks: 20

The internal practical examination shall be as per scheme given by Faculty of Science.

Practical Examination will be conducted at the end of Semester IV

References for Practical course

- 1] Cappuccino, J.G. and Sherman, N. (2005). Microbiology – A Laboratory Manual. 7th Edition. Pearson Education. Published by Dorling Kindersley (India) Pvt. Ltd.
- 2] Mukherjee, K.L. (1996). Medical Laboratory Technology. Vol II. Tata Mc GrawHill Publishing Co. Ltd., New Delhi
- 3] Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi
- 4] Naik Sandesh, Handbook of Practical microbiology
- 6] Frobisher, H., Hinsdil, R.D., Crabtree, K.T. and Goodhert, D.R. (2005) Fundamentals of Microbiology, Saunders and Company, London.
- 7] K.R.Aneja, Pranay Jain, Raman Aneja (2008). A Textbook of Basic and Applied Microbiology, New Age International Publishers