

SOLAPUR UNIVERSITY, SOLAPUR



Faculty of Science

CBCS Pattern

B.Sc.II (Sem-III&IV)-Microbiology

With effect from –June-2017

Solapur University, Solapur

Faculty of Science Choice Based Credit System (CBCS)

(w.e.f.2017-18)

Structure for B. Sc-II Microbiology

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credit s	
	Type	Name		L	T	P					
Class :→	B.Sc.- II Semester – III										
	Core	Microbiology	Paper V-Cytology and Physiology of Microorganisms	3	--	--	100	70	30	3	
			Paper VI-Bacterial Genetics	3	--	--	100	70	30	3	
	Core	Subject 2		Paper V	3	--	--	100	70	30	3
				Paper VI	3	--	--	100	70	30	3
	Core	Subject 3		Paper V	3	--	--	100	70	30	3
				Paper VI	3	--	--	100	70	30	3
Grand Total				18	--	--	600	420	180	18	
Class :→	B.Sc.- II Semester – IV										
	Abilit y Enha nceme nt Cours e(AE CC)	Environ mental Science		4			100	70	30	4	
	Core	Microbiology		Paper VII- Immunology and Medical Microbiology	3	--	--	100	70	30	3
				Paper VIII- Industrial Microbiology-I	3	--	--	100	70	30	3
	Core	Subject 2		Paper VII	3	--	--	100	70	30	3
				Paper VIII	3	--	--	100	70	30	3
	Core	Subject 3		Paper VII	3	--	--	100	70	30	3
				Paper VIII	3	--	--	100	70	30	3
	Total (Theory)				22	--	--	700	490	210	22
	Core	Microbiology	Pr. II&III	--	--	8	200	140	60	8	
	Core	Subject 2	Pr. II&III	--	--	8	200	140	60	8	
	Core	Subject 3	Pr. II&III	--	--	8	200	140	60	8	
Total (Practicals)						24	600	420	180	24	
Grand Total				22		24	1300	910	390	46	

Preamble:

Ministry of Human Resource Development (HRD), Govt. of India, has already initiated the process for developing New Education Policy (NEP) in our country to bring out reforms in Indian education system. University Grants Commission (UGC) participates more actively in developing National Education Policy, its execution and promotion of higher education in our country. The UGC has already initiated several steps to bring equity, efficiency and academic excellence in National Higher Education System. The important ones include innovation and improvement in course- curricula, introduction of paradigm shift in learning and teaching pedagogy, examination and education system. The education plays enormously significant role in building of a nation

The present alarming situation necessitates transformation and/or redesigning of education system, not only by introducing innovations but developing “learner-centric approach in the entire education delivery mechanism and globally followed evaluation system as well. Majority of Indian higher education institutions have been following marks or percentage based evaluation system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests and aims can choose interdisciplinary, intra-disciplinary and skill-based courses. This can only be possible when choice based credit system (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also exploring additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate us bench mark our courses with best international academic practices.

OBJECTIVES/Advantages

The objectives of the choice based credit system:

- Shift in focus from the teacher-centric to student-centric education.
- Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).
- CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students).
- CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations.
- CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students).
- Credits earned at one institution can be transferred.

Semester III
Paper V- Cytology and Physiology of Microorganisms

45L
Credits - 03

- Unit I: Ultra structure and Functions** (14)
1. **Bacterial Cell wall:** chemical composition, structure of cell wall of Gram Positive and Gram Negative bacteria and functions
 2. **Cell Membrane:** Chemical Composition, structure and functions. Transport across cell membrane – simple diffusion, facilitated diffusion, active transport & group translocation.
 3. **Flagella:** Structure and functions, Mechanism of movement, Tactic behavior
 4. **Pili:** Structure and functions
 5. **Cytoplasmic inclusions:** Chlorobium vesicles. Gas vacuoles, Magnetosomes and carboxysomes and their functions
 6. **Reserve Food Materials:** Nitrogenous and Non nitrogenous and their role
 7. **Bacterial Endospore:** Ultrastructure and functions, sporulation as an example of cell differentiation, Germination of endospore
- Unit II: Bacterial Growth** (6)
- i) Definition of growth, generation time and growth rate,
 - ii) Growth phases
 - iii) Measurement of growth,
 - iv) Batch and Continuous growth,
 - v) Synchronous and Diauxic growth.
- Unit III: Effect of Environmental factors on Bacterial growth** (8)
- Temperature, pH, Oxygen, Osmotic pressure, Hydrostatic Pressure, Surface Tension, Heavy metals, UV light & Antibiotics [Penicillin, Streptomycin]
- Unit IV: Metabolism** (12)
- 1) ED pathway and glyoxylate cycle
 - 2) Modes of ATP generation
 - a. Substrate Level Phosphorylation, Fermentation - Homolactic and Heterolactic.
 - b. Oxidative Phosphorylation: Respiratory electron transport chain, components of ETC, aerobic and anaerobic respiration
 - c. Photophosphorylation: photosynthetic ETC [cyclic & noncyclic]
- Unit V Virology** (5)
- 1) Structural properties of viruses- T4, TMV and HIV
 - 2) Cultivation of viruses: Animal, plant viruses and bacteriophages

Reference Books:

- 1] Powar C.B. and Dagainawala H.F. (1986). General Microbiology Vol. I & II (2nd Edition), 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.
- 5] Biswas – Introduction to viruses.

Semester III
Paper-VI: Bacterial Genetics

(45L)
Credits - 03
(10)

Unit – I: Structure of nucleic acids & Replication of Bacterial DNA

1. DNA as a genetic material experimental proof
 - Griffith and Avery, MacLeod and McCarty's experiment
 - Hershey and Chase's experiment
2. Types and forms of DNA, Structure of DNA: Watson and Crick's Model
3. DNA replication:
 - Semi conservative mode (Meselson and Stahl's experiment),
 - Mechanism and steps with enzymes involved in DNA replication, Rolling circle and Theta (θ) model

Unit – II: Gene, Genetic code and Transcription **(10)**

1. Gene- Basic concept of Genome, genotype, phenotype, Recon, Muton, Cistron & interrupted genes.
2. Genetic code – Basic concept & Properties of genetic code.
3. Transcription in Prokaryotes :Definition, RNA Polymerase, transcription unit and Process

Unit III: Bacterial Mutation **(10)**

Mutations and mutagenesis: Basic concepts, Definition and types of Mutations; Physical and chemical mutagens;

1. Types of mutations-Base pair substitutions ,missense, nonsense, silent, neutral and Frame shift.
2. Types of Mutations on the basis of Molecular Mechanism:
 - a) Spontaneous mutations - Fluctuation Test, Replica plate technique
 - b) Induced Mutations – Mechanism of Mutagenesis by 5- Bromouracil, 2-aminopurine, Hydroxylamine, Nitrous acid, Alkylating agents, Acridine dyes and U.V. rays.
3. DNA repair – i) Photo reactivation ii) Dark Repair Mechanism

Unit – IV Plasmids **(06)**

1. Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, Yeast- 2 μ plasmid.
2. Plasmid replication and its applications

Unit – V Bacterial Recombination **(09)**

1. Transformation (experimental proof, Competence, Process)
2. Conjugation (Leaderberg and Tatum's experiment, Davis U tube experiment, F- factors – F⁺, HFr, F', Process of conjugation)
3. Transduction (Zinder & Lederberg 's experiment, Generalized, Specialized, High frequency transduction)

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 Upadhyay: 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 (45 L)
Credits - 03

- Unit I: Immunity** (12)
1. **Immunity** – Definition and concept
 - a. Innate immunity – Definition, Types of innate immunity – Individual, racial and species immunity
 - b. Acquired immunity – Active & passive
 2. **Defense Mechanism of body**
 - a. First Line of defense: Physico-chemical Barriers
 - b. Second Line of defense: Significance of fever, inflammation and role phagocytic cells
 - c. Third Line of defense: Components of immune system
 - i. Cells – Types and functions
 - ii. Organs – primary & secondary & their functions
 - d. Primary and Secondary immune response
- Unit II: Antigen and Antibody** (11)
1. **Antigen** – Types & factors affecting antigenicity
 2. **Antibody** – Basic structure, types, biological properties and functions of Immunoglobulins.
 3. Antigen antibody reactions: general features and mechanism.
 4. **Types of antigen – antibody reactions:** Agglutination test, precipitation test, flocculation test, complement fixation test, Immunofluorescence test
- Unit III: Clinical Microbiology** (04)
1. Basic concept
 2. Collection, handling & transportation of specimen
 3. **Methods of diagnosis of diseases:** Microscopic, cultural, biochemical and serological.
- Unit IV Pathogenicity** (06)
1. Definition and concept of pathogenicity and virulence.
 2. **Microbial adhesion** – Basic concept.
 3. **Microbial invasion** – basic concept and mechanism.
 4. **Bacterial toxins** – Endotoxins, exotoxins and their comparison with examples.
- Unit V – Microbial Diseases** (12)
1. **Bacterial Infections** - Enteric fever, Staphylococcal wound infections and Urinary tract infections.
 2. **Fungal infections:** Candidiasis
 3. **Viral infection:** Dengue fever
- Reference Books:**
1. Ananthanarayana, R. and Panicker, C.K.S. (2000). Text Book of Microbiology, 6th 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 VIII : Industrial Microbiology – I

45L

Credits - 03
(10)

Unit I: Industrial Microbiology

1. Definition and scope of Industrial microbiology, Industrially important Microorganisms With products (List)
2. Fermentations: Basic concept, Types- Surface culture, submerged culture, Batch, Continuous, Dual and Multiple
3. Design of typical Fermentor/Bioreactor : Parts & their functions

Unit II: Fermentation Media

(12)

1. Media for industrial fermentation
2. Media Components and Optimzation
3. Use of waste as a fermentation media
4. Inoculum and Production media

Unit III: Screening, Inoculum Development and Scale Up

(10)

1. Screening: Primary and Secondary
2. Strain Improvement
3. Preservation of industrially important microorganisms
4. Inoculum Development
5. Scale up of fermentation

Unit IV: Microbiological assays :

(05)

Diffusion, turbidometric, metabolic response, enzymatic assay

Unit V Specific fermentations

(08)

1. Penicillin (*P.chrysogenium*), 2. Alcohol (*S.cerevisiae*)
3. SCP (*S. cerevisiae*), 4. Probiotics

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]
 - iv. Lipid Staining[Burdon's method]
 - v) Metachromatic granule staining (Albert'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
 - c. Protease Producers [gelatinase] – Replica Plate Technique
7. Isolation & Identification of Pathogenic Microorganisms from Clinical Samples
 - a. *Salmonella* spp.
 - b. *Candida* spp.
 - c. *Proteus* spp.
9. Determination of Blood Groups – ABO & Rh

10. Widal test (slide test): Qualitative
11. Glucose Estimation (Benedict's Method).
12. Protein Estimation (Biuret Method).
13. Study of Growth phases of *E.coli* by optical density method.
14. Isolation of DNA

Practical Question Paper for University Practical Examination

Total Marks: 140

Q.1 Identification of Pathogen	25
Q.2 Biochemical Tests	20
Q.3 Staining / Screening	25
Q.4 Effects/ Growth Curve [lag phase]	20
Q.5 Glucose /Protein / Widal test/ Blood Groups	10
.6 Spotting on Media components, reagents and stains	20
Q.7 Journal	10
Q.8 Tour Report	10

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: 60

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 Goodhart, 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

Equivalent Subject for Old Syllabus

Sr No	Name of the old Paper	Name of the New Paper
1	Cytology and Physiology of Microorganisms	Cytology and Physiology of Microorganisms
2	Bacterial Genetics	Bacterial Genetics
3	Immunology and Medical Microbiology	Immunology and Medical Microbiology
4	Applied Microbiology - II	Industrial Microbiology- I