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**

<table>
<thead>
<tr>
<th>Subject/Core Course</th>
<th>Name and Type of the Paper</th>
<th>No. of papers/Practical</th>
<th>Hrs/week</th>
<th>Total Marks Per Paper</th>
<th>UA</th>
<th>CA</th>
<th>Credits</th>
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<td>Core</td>
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<td>Paper V-Cytology and Physiology of Microorganisms</td>
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| Core                              | Microbiology            | Pr. II&III                                    |                                      | 8         | 8         | 8         | 8         |
| Core                              | Subject 2               | Pr. II&III                                    |                                      | 8         | 8         | 8         | 8         |
| Core                              | Subject 3               | Pr. II&III                                    |                                      | 8         | 8         | 8         | 8         |
| **Total (Practicals)**            |                         |                                               |                                      | 24        | 24        | 24        | 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 inter-disciplinary, 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 benchmark 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.
Unit I: Ultra structure and Functions
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
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
Temperature, pH, Oxygen, Osmotic pressure, Hydrostatic Pressure, Surface Tension, Heavy metals, UV light & Antibiotics [Penicillin, Streptomycin]

Unit IV: Metabolism
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
1) Structural properties of viruses- T4, TMV and HIV
2) Cultivation of viruses: Animal, plant viruses and bacteriophages

Reference Books:
2] Stanier R.Y., *et al.*; General Microbiology
Semester III

Paper-VI: Bacterial Genetics

(45L)
Credits - 03

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

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

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

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

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

References:

2] R Y Stainer, Roger et.al: General Microbiology
6] Freifelder David: Microbial genetics, Jones and Bartlett Publications
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

Unit IV Pathogeneity (06)
1. Definition and concept of pathogenicity and virulence.
2. Microbial adhesion – Basic concept.
3. Microbial invasion – basic concept and mechanism.

Unit V – Microbial Diseases (12)
2. Fungal infections: Candidiasis
3. Viral infection: Dengue fever

Reference Books:
4. Dugid, J.P., Medical Microbiology
5. Kubey - Immunology
Semester – IV
Paper VIII : Industrial Microbiology – I

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
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
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 :
   Diffusion, turbidometric, metabolic response, enzymatic assay

Unit V Specific fermentations
1. Penicillin (P.chrysogenium), 2. Alcohol (S.cerevisiae)
3. SCP (S. cerevisiae), 4. Probiotics

Reference Books:
   International Ltd., New Delhi.
3. Prescott & Dunn, Industrial Microbiology
4. Purohit, Microbiology- Fundamentals and Applications, sixth edition
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
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  
Q.2 Biochemical Tests  
Q.3 Staining / Screening  
Q.4 Effects / Growth Curve [lag phase]  
Q.5 Glucose / Protein / Widal test / Blood Groups  
Q.6 Spotting on Media components, reagents and stains  
Q.7 Journal  
Q.8 Tour Report  

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**

4] Naik Sandesh, Handbook of Practical microbiology
## Equivalent Subject for Old Syllabus

<table>
<thead>
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<th>Sr No</th>
<th>Name of the old Paper</th>
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<td>Cytology and Physiology of Microorganisms</td>
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<td>2</td>
<td>Bacterial Genetics</td>
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<td>3</td>
<td>Immunology and Medical Microbiology</td>
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<tr>
<td>4</td>
<td>Applied Microbiology - II</td>
<td>Industrial Microbiology - I</td>
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