Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Microbiology

Name of the Course: B.Sc. I (Sem–I & II)

(To be effective from the academic year June-2019).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science

Choice Based Credit System (CBCS)
(W.e.f. June 2019)

- **Choice Based Credit System:** With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate degree, Solapur University has implemented Choice Based Credit System (CBCS) at Undergraduate level.

  The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

- **Outline of Choice Based Credit System:**
  1. ***Core Course:*** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
  2. ***Elective Course:*** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

     Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.
  3. ***Ability Enhancement Courses (AEC):*** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; (i) Environmental Science and (ii) English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

- **Credit:** Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. The contact hours are transformed into credits.

  Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 20 marks and University Evaluation for 80 marks. It is 80+20 pattern of evaluation. It is applicable for theory and practical as well. The details regarding this evaluation system are as under.

- **Conversion of marks into Grades:**

  A table for the conversion of the marks obtained by a student in each paper (out of 100) to grade and grade point is as given below:

Sr. No.	Range of Marks	Grade	Grade Point
1	80 – 100	O	10
2	70 – 79	A+	9
3	60 – 69	A	8
4	55 – 59	B+	7
5	50 – 54	B	6
6	45 – 49	C+	5
7	40 – 44	C	4
8	<39	FC	0 (Failed in Term Exam)
9	<39	FR	0 (Failed in Internal Assessment)

1. **Grade Point Average at the end of the Semester (SGPA)**

$$SGPA = \frac{(G_1 \times C_1) + (G_2 + C_2) + \dots}{\sum C_i}$$

(ΣC_i = the total number of credits offered by the student during a semester)

2. **Cumulative Grade Point Average (CGPA)**

$$CGPA = \frac{(G_1 \times C_1) + (G_2 + C_2) + \dots}{\sum C_i}$$

(ΣC_i = the total number of credits offered by the student upto and including the semester for which CGPA is calculated.)

3. **Final Grade Point Average (FGPA)**

It will be calculated in the similar manner for the total number of credits offered for the completion of the said course.

Where: C_i = Credits allocated for the i^{th} course.

G_i = Grade point scored in the i^{th} paper (subject)

4. **Conversion of average grade points into grades:**

SGPA/CGPA/FGPA	Letter Grade
9.5 – 10	O
8.5 – 9.49	A+
7.5 – 8.49	A
6.5 – 7.49	B+
5.5 – 6.49	B
4.5 – 5.49	C+
4.0 – 4.49	C
<3.99	FC / F
	FR

- **General guidelines for syllabus Structure:**
  - The University follows semester system.
  - An academic year shall consist of two semesters.
  - Each B.Sc. course shall consist of three years i.e. six semesters.
  - B.Sc. Part-I Microbiology shall consist of two semesters: Semester I and Semester II.

    In semester I, there will be two core papers. Each paper is having of 100 marks. Similarly in Semester II there will be two core papers. Each paper has 100 marks weightage. English will be as Ability Enhancement Course (AECC) in both Semester I and II. English paper carries 100 marks in each semester.

    The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B.Sc. Part-I Microbiology semester I & II the internal assessment will be based on Internal tests, Home assignment, Tutorials, Seminars, Group discussion, Brain storming sessions etc. as given below. Practical course examination is of 100 marks shall be conducted at the end of II semester. The practical examination of 100 marks shall also consist of 80 marks for University practical assessment and 20 marks for college internal assessment.

    For University practical examination out of two examiners, both examiner will be internal. Both examiners will be appointed by the College. The internal practical assessment shall be done as per scheme given below.
- **Scheme of Evaluation**

  As per the norms of the grading system of evaluation, out of 100 marks, the candidate has to appear for college internal assessment of 20 marks and external evaluation (University assessment) of 80 marks.

Semester – I

Theory: (100 marks)

University Examination (80 marks): No. of theory papers: 2

Internal Continuous Assessment: (20 marks)

Scheme of marking: 10 marks – Internal test
10 marks – Home assignment / tutorials / seminars / viva/

Semester – II

Theory: (100 marks)

University Examination (80 marks): No. of theory papers: 2

Internal Continuous Assessment: (20 marks)

Scheme of marking: 10 marks – Internal test
10 marks – Home assignment / tutorials / seminars / viva/

P**ractical Examination: (100 marks)**

College Internal Examination (100 marks): No. of practical course: 1

Internal Continuous Assessment: (20 marks)

Scheme of marking: 10 marks – Internal test on any two practicals
10 marks – Lab Journal / Viva/attendance, / attitude/sincerity/ field Visits etc.

- **Passing Standard**

  The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear for University Examination only. A student who fails in internal assessment and passed in University examination (theory) shall be given FR Grade. Such student will have to reappear for both University examination as well as internal assessment. In case of Annual pattern/old semester pattern students/candidates from the mark scheme the candidates shall appear for the same 70 marks of external examination and his performance shall be scaled to 100 marks.

- **ATKT**

  Candidate passed in all papers, except 5 (five) papers combined together of semester I and II of B.Sc. Part-I Microbiology examination shall be permitted to enter upon the course of Semester III of B.Sc. Part-II Microbiology .

Solapur University, Solapur: Faculty of Science
Choice Based Credit System (CBCS), (w.e.f.2019-20)
Structure for B. Sc-I: Microbiology

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
	Type	Name		L	T	P				
Class :	**B.Sc.- I Semester – I**									
	English	Paper- I		4.0			100	80	20	4.0
	DSC 1A	Paper-I		2.5	--	--	50	40	10	4.0
		Paper-II		2.5	--	--	50	40	10	
	DSC 2A	Paper-I		2.5	--	--	50	40	10	4.0
		Paper-II		2.5	--	--	50	40	10	
	DSC 3A	Paper-I		2.5	--	--	50	40	10	4.0
		Paper-II		2.5	--	--	50	40	10	
	DSC 4 A	Paper-I: Fundamentals of Microbiology		2.5	--	--	50	40	10	4.0
		Paper-II: Basic Techniques in Microbiology s		2.5	--	--	50	40	10	
Total				**24**	--	--	**500**	**400**	**100**	**20**
Class :	**B.Sc.- I Semester II**									
	English	Paper- II		4.0			100	80	20	4.0
	DSC 1B	Paper-III		2.5	--	--	50	40	10	4.0
		Paper-IV		2.5	--	--	50	40	10	
	DSC 2B	Paper-III		2.5	--	--	50	40	10	4.0
		Paper-IV		2.5	--	--	50	40	10	
	DSC 3B	Paper-III		2.5	--	--	50	40	10	4.0
		Paper-IV		2.5	--	--	50	40	10	
	DSC 4B	Paper-III: Microbial Physiology		2.5	--	--	50	40	10	4.0
		Paper-IV: Applied Microbiology		2.5	--	--	50	40	10	
	Democracy, Elections and Good Governance			3.0			50	40	10	NC
Total (Theory)				**27**	--	--	**550**	**440**	**110**	**20**
	DSC 1 A & 1B	Practical I and II		--	--	4	100	80	20	4.0
	DSC 2 A & 2B	Practical I and II		--	--	4	100	80	20	4.0
	DSC 3 A & 3B	Practical I and II		--	--	4	100	80	20	4.0
	DSC 4 A & 4B	Practical I and II		--	--	4	100	80	20	4.0
Total (Practical)						**16**	**400**	**320**	**80**	**16**
Grand Total				**51**		**16**	**1450**	**1160**	**290**	**56**

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

SYLLABUS FOR B.Sc – I (MICROBIOLOGY) (C.B.C.S)
THEORY SEMESTER I

DSC 4 A: PAPER –I (Fundamentals of Microbiology)

Total Contact hrs: 45
Total credits 2.5

UNIT–I: History and Scope of Microbiology (10)

A) History

1. Development of microbiology as a discipline, Spontaneous generation *vs*. biogenesis.
2. Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming ,John Tyndall
3. Role of microorganisms in fermentation, Germ theory of disease,
4. Contributions of Martinus W. Beijerinck and Sergei N. Winogradsky in soil microbiology.

B) Scope:

1. Introduction to types of microorganisms – Bacteria, viruses, algae, protozoa, fungi
2. Various branches of Microbiology.
3. Beneficial and harmful activities of microorganisms.

UNIT –II: Diversity of microbial world (08)

A) Taxonomy, Morphology & Cytology of Bacteria

I) Bacterial Taxonomy:-

1. General principles of Bacterial nomenclature
2. Criteria for bacterial classification – Morphological, Cultural and Biochemical Characters

II) Difference between Prokaryotic & Eukaryotic cell.

UNIT III: General characters of different groups of microorganisms – Cellular and acellular. (20)

1. Size, Shape, arrangement of bacteria
2. Structure of typical Bacterial cell
3. Structure and function of Cell Wall, Cell Membrane, Capsule & Slime layer, and Flagella.

UNIT – IV: General characteristics of various microorganisms. (07)

1. General characters, structure and economic importance of – Fungi and protozoa.
2. Archaebacteria, Rickettsia and Actinomycetes,
3. Acellular- Definition, General properties of Viruses. viroids and prions.

DSC 4 A: PAPER-II: Basic Techniques in Microbiology

Total Contact hrs: 45
Total credits 2.5

Unit I Microscopy (08)

1. Basic concepts in Microscopy - magnification, Numerical aperture, resolving power and working distance.
2. Principle, working and ray diagram of compound microscope,
3. Introduction to electron microscope.
4. Comparative study of compound and electron microscope.

Unit II - Staining Techniques (10)

1. Definition of Stains and dyes.
2. Classification of stains – Acidic, Basic & Neutral with examples
3. Principle, procedure, mechanism and applications of following staining procedures – Simple, Negative, Differential: - Gram Staining, Acid fast staining.
4. Special staining methods-
   a) Cell wall: - Chance's Method
   b) Capsule: - Maneval's method.
   c) Volutine granules – Albert's method
   d) Lipid granule staining – Burdon's method

Unit III : Sterilization Techniques (12)

1. Definitions:-Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Sanitization
   a) Sterilization by Physical agents –Temperature – Dry heat, moist heat, Desiccation
   b) Osmotic Pressure
   c) Radiation – U. V.rays and –γ rays
   d) Filtration – Asbestos, membrane Filtration.
2. Sterilization by chemical agents –
   a) Phenol & Phenolic compounds
   b) Ethyl alcohol
   c) Halogens – Cl and Iodide.
   d) Heavy Metals - Copper & Mercury,
   e) Gaseous agents – Ethylene oxide, β-Propiolactone, Formaldehyde

UNIT–IV: Cultivation techniques of microorganisms (15)

A) Culture Media: -

1. In vivo -Living – Embryonated egg, Animal Tissue Culture
2. In vitro – Non-living media,- Natural, Synthetic, Semi synthetic, Differential, Enriched, Selective

B) Methods of Pure culture: -

1. Streak Plate
2. Serial dilution: - Spread Plate and Pour Plate

SEMESTER II
DSC4B: PAPER III
Microbial Physiology

Total Contact hrs: 45
Total credits 2.5

UNIT: - I Macromolecules **(12)**

1) Structure & Functions of -

a) Carbohydrates b) Proteins c) Lipids d) DNA e) RNA

UNIT- II- Microbial Enzymes **(8)**

a) Definition, basic structure-apoenzyme, coenzymes, cofactors & prosthetic groups

b) Types of Enzymes – Extra & Intracellular, Constitutive & Induced Enzymes – with example.

c) Mechanism of action –active site, Lock and key hypothesis, induced fit hypothesis.

UNIT- III -

Microbial Metabolism:- **(10)**

a) Definition – Anabolism, Catabolism, Metabolism, and High energy compounds.

b) Structure & energy content of ATP

c) Catabolism of Glucose – EMP, Fate of Pyruvate, TCA Cycle

UNIT- IV - Microbial Nutrition and Growth **(15)**

A) Microbial Nutrition

a) Nutritional requirements of microorganisms

b) Common components-

Peptone, Meat extract, NaCl, Agar-agar

c) Selective and differential components

Vitamins, Sugar, Sodium taurocholate, milk, starch, Blood and Serum.

c) Common indicators & their functions:-Andrade's, Neutral Red, Bromothymol Blue, Brilliant green, Phenol red and Methylene blue.

d) Nutritional types of Microorganisms based on Carbon & Energy Source

DSC 4B: PAPER IV

Applied Microbiology

Total Contact hrs: 45
Total credits 2.5

UNIT -I- WATER MICROBIOLOGY (12)

i) Sources of microorganisms in water

ii) Fecal pollution of water & its indicator

iii) Routine bacteriological analysis of water

Tests for coliforms – Qualitative (Presumptive, Confirmed & Completed)

Differentiation of coliforms – IMViC & Eijkman test Quantitative – MPN

iv) Municipal Water purification – Sedimentation, Filtration, Disinfection

UNIT II- SEWAGE MICROBIOLOGY (12)

Definition, Different types of sewage, Microbial flora, Definition of B.O.D and C.O.D, Treatment of sewage – primary, secondary and tertiary

UNIT III - MILK MICROBIOLOGY (06)

a) Definition and Composition of Milk

b) Sources of contamination

c) Microbiological examination of Milk: -DMC, SPC , MBRT test

d) Pasteurization –Definition and types of pasteurization, Phosphatase test.

UNIT – IV: MEDICAL MICROBIOLOGY (15)

A) Definitions:-

Infections, etiology, etiological agents, disease, pathogen, incubation period, fomite pathogenecity, virulence, morbidity rate, mortality rate, opportunistic pathogen, epidemiology, prophylaxis, carriers, host

B) Types of diseases:-

Epidemic, endemic, pandemic & sporadic

C) Types of infections:-

Primary, Secondary, acute, chronic, reinfection, cross infection, Mixed infection, congenital, local, and generalized

D) Mode of transmission of diseases –

1. Inoculation 2. Ingestion 3. Contact 4. Inhalation

E) Preventive and control measures for

1. Water and food borne diseases.

2) Air borne diseases.

3) Vector borne diseases

4) Diseases transmitted through physical contact

Suggested reading

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.
3. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
4. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
6. General Microbiology Vol I and II –Pawar and Daginawala.

Practical Course
B.Sc. – I Microbiology

Marks: 100

1. Good microbiology laboratory practices and Biosafety
2. Principle, working and applications of Common laboratory instruments
   a) Autoclave
   b) Hot Air Oven
   c) Incubator
   d) Colony Counter
   e) Seitz filter
   f) Laminar Air flow
3. Handling and Care of compound Microscope
4. Preparation of Saline and culture media
   a) Peptone Water
   b) Nutrient Broth
   c) Nutrient agar
   d) MacConkey's agar
   e) Starch Agar
   f) Milk agar,
   g) Sabouraud's agar
5. Staining Procedures
   (a) Monochrome
   (b) Negative
   (c) Gram
6. Special Staining Procedures (a)Cell Wall (Chance's Method) b) Capsule (Maneval's Method) c) Volutine granules (Albert's method d) Lipid granule staining (Burdon's method)
7. Isolation of microorganisms from natural sources- soil,Water/Sewage by four quadrant method by studying Colony Characters, Gram Staining and Motility of
   (a) Bacillus Spp.
   (b) Escherichia coli
8. Microbial examination of milk
   Standard plate count (SPC)(by spread plate)
   MBRT
9. Mounting of Fungi
   (a) Aspergillus
   (b) Rhizopus
   (c) Penicillium
   (d) Mucor
10. Study of biochemical and enzymatic activity of microorganisms by
    (a) Indole production test.
    (b) Methyl red test
    (c) Voges Proskauer's test
    (d) Citrate utilization test (Simmon's citrate)
    (e) Hydrogen sulphide production test
    (f) Glucose fermentation.
    Study of enzyme activity of microorganisms
    (g) Amylase activity
    (h) Caseinase activity

B.Sc.Part I Microbiology

Practical Question Paper **Total Marks: 100 (80+20)**

	Marks
Q. 1. Isolation, Colony Characters, Gram Staining and Motility of *Bacillus spp / E.coli* Or Standard plate count of Milk	25
Q.2 Staining Cell wall/ Capsule/ lipid / volutine granules.	20
Q. 3 Biochemical Test/ Enzymatic activity Indol/ Methyl Red/ Voges proskauer/ Citrate Utilization/ H_2S/ Amylase/ Caseinase/ Glucose fermentation/MBRT	20
Q. 4 Spotting (A) Identify and give its Use (Microscope Part) (B) Identify and give Significance of Mounted Fungus (C) In which Staining Method it is used and give its significance (Stain) (D) In which Medium it is used and give its significance (Media Component) (E) In which Test it is used and give its significance (Indicator/Reagent)	10
Q. 5. Journal	5

Internal practical examination	**(20 marks)**
Isolation by studying colony characters/staining techniques	10
Spotting	05
Viva,Journal,Attendance	05