PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

NAAC Accredited-2022
'B++'Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Biotechnology

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

(Syllabus to be implemented from June 2023)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Choice Based Credit System (CBCS)
B.Sc.-II Biotechnology (w. e. f. June 2023)

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.

Programme Outcome (POs):

Students having an academic background of science at 10+2 level can pursue B.Sc programme invarious branches. After the completion of the B.Sc degree there are various options available for the science students, they can pursue master degree in Science i.e. M.Sc, work in research relatedfields and can even look for professional job oriented courses. Often, in some reputed universities or colleges the students are recruited directly by big MNC's after the completion of the course. The student is also eligible for the job of a Medical Representative. The student after graduating will be eligible for various government exams conducted by UPSC, SSC etc

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Choice Based Credit System (CBCS): (June 2023):
B. Sc-IIBiotechnology

Class : B.Sc.- II Semester – III							
Subject/ Core Course	**Name and Type of the Paper**	**No. of papers/ Practical**	**Hrs/ week**	**Total Marks Per Paper**	**UA**	**CA**	**Credits**
(*Students can opt any Three subjects among the Four Subjects offered atB.Sc.I. Out of Three Subjects offered One Subject will be the Core Subject)	DSC 1C Genetics	Paper-I: Genetics-I	3.0	50	40	10	4.0
		Paper-II: Genetics-II	3.0	50	40	10	
	DSC 2C General Microbiology	Paper-I: General Microbiology-I	3.0	50	40	10	4.0
		Paper-II: General Microbiology-II	3.0	50	40	10	
	DSC 3C Plant Biotechnology	Paper-I: Plant Biotechnology-I	3.0	50	40	10	4.0
		Paper-II: Plant Biotechnology-II	3.0	50	40	10	
Total (Theory)			**18.0**	**300**	**240**	**60**	**12**

Class :B.Sc.- II Semester – IV								
Subject/ Core Course		**Name and Type of the Paper**	**No. of papers/ Practical**	**Hrs/ week**	**Total Marks Per Paper**	**UA**	**CA**	**Credits**
(*Students can opt any Three subjects among the Four Subjects offered at B.Sc.I. Out of Three Subjects offered One Subject will be the Core Subject OR Students can opt any Two subjects among the Four Subjects offered at B.Sc.I. Out of Two Subjects One Subject will be the Core Subject and any One Subject among the other willbe Elective Subject)		DSC 1D Molecular Biology	Molecular Biology-I	3.0	50	40	10	4.0
			Paper-II: Molecular Biology-II	3.0	50	40	10	
		DSC 2D Immunology	Paper-I: Immunology-I	3.0	50	40	10	4.0
			Paper-II: Immunology-II	3.0	50	40	10	
		DSC 3D Animal Biotechnology	Paper-I: Animal Biotechnology-I	3.0	50	40	10	4.0
			Paper-II: Animal Biotechnology-II	3.0	50	40	10	
AECC - EnvironmentalStudies					--			NC
			Total (Theory)	**18.0**	**300**	**240**	**60**	**12**
DSE (Practical)	DSC 1C & 1D		Paper-I & II	8.0	100	80	20	4.0
	DSC 2C & 2D		Paper-I & II	8.0	100	80	20	4.0
	DSC 3C & 3D		Paper-I & II	8.0	100	80	20	4.0
			Total (Practical)	**24.0**	**300**	**240**	**60**	**12**
			Grand Total		**900**	**720**	**180**	**36**

Summary of the Structure of B. Sc. Biotechnology Programme as per CBCS pattern

Class	Semester	Marks-Theory	Credits-Theory	Marks-Practical	Credits-Practicals	Total – credits
B.Sc.-I Biotechnology	I	450	18	--	--	18
	II	450	18	400	16	34
B.Sc.-II Biotechnology	III	300	12	--	--	12
	IV	300	12	300	12	24
B.Sc.-III Biotechnology	V	500	24	--	--	22
	VI	500	24	400	16	38
Total		2500	108	1100	44	148

B. Sc. Programme:

Total Marks : Theory + Practical's = 2500 +1100 =3600
Credits : Theory + Practical's = 108 + 44 = 152
Numbers of Papers Theory: Ability Enhancement Course (AECC) 05
Theory: Discipline Specific Elective Paper (DSE) 08
Theory: Discipline Specific Core Paper (DSC) 28

Total: Theory Papers 41 (28 Core + 8 elective + 5 AECC)
Practical Papers 11
Skill Enhancement Courses 01

Abbreviations:
L: Lectures
T: Tutorials
P: Practicals
UA : University Assessment
CA : College Assessment
DSC / CC: Core Course
AEC: Ability Enhancement Course
DSE: Discipline Specific Elective Paper
SEC: Skill Enhancement Course
GE: Generic Elective
CA: Continuous Assessment
ESE: End Semester Examination

PAH SOLAPUR UNIVERSITY, SOLAPUR
Faculty of Science & Technology
Choice Based Credit System (CBCS)
(June 2023)

• Title of the Course: B.Sc. Part-II

• Subject: Biotechnology

• **Introduction**: This course provides a broad overview of Biotechnology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using Biotechnology. The course structure is basic science centric where students learn core science and are taught necessary fundamental subject for that purpose.

• **Objectives of the course: The objectives of B. Sc. Biotechnology course are:**
To provide an intensive and in depth learning to the students in field of Biotechnology. Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing world. To develop awareness & knowledge of different organization requirement and subject knowledge through varied branches and research methodology in students. To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

- **Course outcome and Advantages:** Biotechnology has tremendous job potential. The successful students will be able to establish research organizations with the help of agriculture, environment protection and also their own industry for transgenic animals, clinical pathology, genetic counseling, human karyotyping etc. Scientific Research Organizations. Universities in India & aboard.

• Medium of Instruction: **English**

• Syllabus Structure:
• The University follows semester system.
• An academic year shall consist of two semesters.
• B.Sc. Part-II Biotechnology shall consist of two semesters: Semester III and Semester IV

In semester III: there will be two DSC papers having paper V and paper VI of 100 marks. There will be additional **SEC-I Paper** of 50 marks. There will a **Compulsory paper on "Ability Enhancement Compulsory Course (AECC)" on** Environmental Studies

In Semester IV: there will be two DSC papers having paper VII and paper VIII of 100 marks. There will be additional **SEC-II Paper** of 50 marks.

The scheme of evaluation of performance of candidates shall be based on **University Assessment (UA**) as well as **College Internal Assessment (CA)** as given below.

For B.Sc.Part-II Biotechnology Sem III & IV the "internal assessment" will be based on Internal tests, Home assignment, Tutorials, Open Book Examination, Seminars, Group discussion, Brain storming sessions etc. as given below.

- **Practical course examination** is of 100 marks shall be conducted at the end of semester II. The practical examination of 100 marks shall also consist of **80 marks for University practical assessment** and **20 marks for college internal assessment (CA)**.

• **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 – III: Theory: (100 marks): Comprising DSC-

a) University Examination (UA) (80 marks): No. of theory papers: 2 (paper V and paper VI of 40 marks each)
b) Internal Continuous Assessment (CA) (20 marks) No. of theory papers: 2 (paper V and paper VI of 10 marks each)
c) SEC-I: Total Marks =50 Marks;) No. of theory papers: 01 (UA=40 Marks & CA=10 Marks
d) Compulsory paper on "Ability Enhancement Compulsory Course (AECC)" on Environmental Studies

Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

Semester – IV: Theory: (100 marks): Comprising DSC-

a) University Examination (UA) (80 marks): No. of theory papers: 2 (paper VII and paper VIII of 40 marks each)

b) Internal Continuous Assessment (CA) (20 marks) No. of theory papers: 2 (paper VII and paper VIII of 10 marks each)

c) SEC-II: Total Marks =50 Marks;) No. of theory papers: 01 (UA=40 Marks & CA=10 Marks

Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

Practical Examination: (100 marks)

University Examination (80 marks): No. of practicals': 02

Pactical-I: Based on papers V & VI : (40 UA + 10 CA)
Pactical-II: Based on papers VII & VIII : (40 UA + 10 CA)

Internal Continuous Assessment: (20 marks): Practical-I (10) + Practical-II (10)

(a) Internal practical test and
(b) Viva/group discussion/model or chart/attitude/attendance/overall behavior
(c) University practical examination of 80 marks (Practical I & II for two separate days) will be conducted at the end of semester IV

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 Biotechnology examination shall be permitted to enter upon the course of Semester III of B.Sc. Part-II Biotechnology

B. Sc. II BIOTECHNOLOGY
SEMESTER-III & IV
CHOICE BASED CREDIT SYSTEM (CBCS) STRUCTURE (June 2023)

SEMESTER- III (THEORY)

Paper	Title	Marks
DSC 1C	Genetics: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)
DSC 2C	General Microbiology: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)
DSC 3C	Plant Biotechnology: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)

SEMESTER- IV (THEORY)

Paper	Title	Marks
DSC 1D	Molecular Biology: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)
DSC 2D	Immunology: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)
DSC 3D	Animal Biotechnology: Paper I and II	50 (40- UA and 10-CA) + 50 (40- UA and 10-CA)
AECC	Environmental Studies	NC

PRACTICALS

PRACTICAL	Title	Marks
DSC 1C & 1D	Genetics and Molecular Biology	100 (80UA and 20 CA)
DSC 2C & 2D	General microbiology and Immunology	100 (80UA and 20 CA)
DSC 3C & 3D	Plant Biotechnology and Animal Biotechnology	100 (80UA and 20 CA)
	Total Marks (Practicals)	**300 (240 UA and 60CA)**

B. Sc. II BIOTECHNOLOGY
SEMESTER III

SEMESTER III - DSC 1C
GENETICS (PAPER-I)

Total Credits :2 **Contact hours:30**

On completion of this course, students will have the knowledge and skills to explain the key concepts in gene mapping, inheritance and linkage.

- Outcome 1.The course also provides comprehensive knowledge gene transfer in bacteria.
- Outcome 2. The student understands how alteration in genes results in various sex linked disorders.

	UNIT - I	
01	**Mendelism** Introduction, Mendel's experiment, Monohybrid and Dihybrid crosses, Genotypic and phenotypic ratio, Law of Dominance, Law of segregation and Law of independent Assortment, Back cross and test cross. Modifications of Mendelian ratios: Co-dominance, Incomplete dominance, Interaction of complementary genes, supplementary gene, inhibitory gene, epistasis.	**5**
02	**Modifications of Mendelian ratios**: Co-dominance, Incomplete dominance, Interaction of complementary genes, supplementary gene, inhibitory gene, epistasis.	**5**
03	**Genetic Linkage and Chromosome Mapping** Linkage – Definition, types of linkage, significance of linkage. Crossing over– theories, types and mechanism. Gene Mapping – physical map and genetic map (by three-point test crosses), Mapping by tetrad analysis – the analysis of unordered and ordered Tetrads.	**5**
	UNIT - II	
01	**Extra chromosomal inheritance and alleles** Genetic system in mitochondria, chloroplast, and plasmid. Definition of Alleles. Multiple alleles – ABO blood groups in human, fur colour in rabbit, self- incompatibility in plants, and eye colour in *Drosophila*. Pseudo alleles, Complementation test.	**5**
02	**Sex linked Inheritance** Structure of Sex Chromosomes. Complete and incomplete sex linked genes. Inheritance of XY linked genes, Y linked genes, X linked genes. Sex determination with examples. X and Y linked Disorders.	**5**
03	**The Genetics of Bacteria** The Genetic Organization of Bacteria (folded fiber model), Bacterial Recombination – transformation, conjugation and transduction. F Plasmids	**5**

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References

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlet Publishers.
2. Experiments in Plant Hybridization – G. Mendel; Prentice Hall, New Jersey.
3. Genetics – B. D. Singh; Kalyani Publication
4. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
5. Molecular Biology – P. K. Gupta
6. Genetics – M. W. Strickberger; Macmillan Publication
7. Heterochromatin Science – S. W. Brown
8. The Theory of Gene – T. H. Morgan; Yale University press; New Haven, Conn.
9. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
10. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London

SEMESTER III - DSC 1C
GENETICS (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Course learning outcomes: By the conclusion of this course, the students-

- Outcome 1. Has acquired knowledge of population and quantitative genetics.
- Outcome 2. Has acquired a fairly good understanding mechanisms of transposition, mutations and their implications.
- Outcome 3. Has developed practical skill for isolation of bacteria/plasmid DNA and its visualization in gel after separation by electrophoresis.

	UNIT - I	
01	**Chromosome** Structure, Morphology, Organization, Heterochromatin and euchromatin, Lampbrush chromosome, polytene chromosome, Sex chromosomes, Role of chromosome in heredity. Mitosis, Meiosis. Karyotyping	**5**
02	**Mutation** Spontaneous and induced mutation. Chemical, physical and biological mutagenic agents. Effect of mutation and detection of mutants.	**5**
03	**Chromosomal abrasion**s – deletion, duplication, inversion, translocation. Numerical alteration in chromosome – polyploidy, aneuploidy, euploidy	**5**
	UNIT – II	
01	**Transposable elements** Terminology, insertion sequences, types of bacterial transposons. Transposition – structure of transposons and target sites, replicative and nonreplicative transposition. Eukaryotic trasnsposable elements – DNA transposases, retroposes (LINES, SINES), Satellite DNA (mini & micro).	**5**
02	**Population Genetics** Introduction, Hardy-Weinberg law, gene frequency, factors affecting gene frequency- migration, selection, genetic drift, inbreeding and Mutations. Significance of population genetics. Genetic basis of evolution, evolutions in some crop plants and animals	**5**
03	**Quantitative Genetics** Introduction, Multiple factor hypothesis, Transgressive segregation, Handling of quantitative data: mean, range, Variance, Standard deviation, Coefficient of Variation. Effects of the environment on quantitative traits.	**5**

References

1. Genetics: Principles and Analysis; Fourth Edition; Daniel L. Hartl; Jones Bartlet Publishers.
2. Genetics – B. D. Singh; Kalyani Publication
3. Principles of Genetics – E. J. Gardner; John Willey & Sons, New York.
4. Molecular Biology – P. K. Gupta
5. Genetics – M. W. Strickberger; Macmillan Publication
6. Heterochromatin Science – S. W. Brown
7. Plant Breeding – Principles and Methods: B. D. Singh: Kalyani Publication.
8. Experimental studies in Physiology of Hereditary; Bateson & Punnet; Harrison's & Sons, London
9. Gene VII; Benjamin Lewin; W. H. Freeman & Company.

SEMESTER III - DSC 2C
GENERAL MICROBIOLOGY (PAPER-I)

Total Credits: 2 **Contact hours: 30**

Course learning outcomes:

1. Have developed a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
3. Are able to explain the useful and harmful activities of the microorganisms.
4. Are able to perform basic experiments to grow and study microorganisms in the laboratory.

	UNIT - I	
01	**History and Development of Microbiology:** Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming,Paul Ehrlich, ElieMetchnikoff, Edward Jenner, Martinus W. Beijerinck, Sergei N. Winogradsky,Selman A.Waksman.Germ theory of disease, Hargovind Khorana.	**5**
02	**An overview of Scope of Microbiology** a) Environment b) industry c) medical and pharmaceuticals d) genetic engineering e) immunology and vaccines f) agriculture	**5**
03	**Taxonomy:** Systems of classification, Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems.Aim and principles of Bacterial classification, systematics and taxonomy, concept of species,taxa, strain;Differences between: prokaryotic-eukaryotic microorganisms, eubacteria-Archaebacteria.	**5**
	UNIT – II	
01	**General characteristics of different groups:** Acellular microorganisms (Viruses,Viroids, Prions) and Cellular microorganisms (Algae, Fungi andProtozoa) withemphasis on distribution and occurrence, morphology, mode ofreproduction andeconomic importance. Study of bacteria-Size,Shape, Arrangement, Cellwall, Cell membrane, Flagella, Nuclear equivalent,Ribosome, Capsule with functions,Slime layer. Mesosomes, Pili	**5**
02	**Microbial Nutrition and growth:** Nutritional requirement of microorganisms,Classification of microorganisms in response to Nutrition and Energy.Definitions of growth, Growth curve,Batch culture,Continuous culture, Synchronous growth,Diauxic growth,Microbial growth in response to environment(definition with one example) –Temperature, pH, soluteand water activity,Oxygen.	**5**
03	**Control of micro-organisms:** Definition of sterilization, disinfectant, antiseptic,germicide, antimicrobial agents. Physical agent of sterilization– Temperature (Dryheat, moist heat, incineration & boiling), Desiccation, Filtration, Radiation Chemical agents of Sterilization – Alcohols, Phenols, Halogens, gaseous agents(ethylene oxide, formaldehyde, Nitrous oxide, Ozone).	**5**

References

Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9thedition. Pearson Education

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology ofMicroorganisms.14th edition. Pearson International Edition

3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9thedition. Pearson Education Limited

4. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology.9th Edition. McGraw Hill International.

5. Atlas RM. (1997).Principles of Microbiology.2nd edition.WM.T.BrownPublishers.

6. Pelczar MJ, Chan ECS and Krieg NR.(1993). Microbiology.5th edition. McGraw Hill Book Company.

7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005).GeneralMicrobiology.5th edition. McMillan.

SEMESTER III - DSC 2C
GENERAL MICROBIOLOGY (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Course learning outcomes: At the conclusion of this course the students –
Outcome 1. Have developed a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
Outcome 2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
Outcome 3. Are able to explain the useful and harmful activities of the microorganisms.
Outcome 4. Are able to perform basic experiments to grow and study microorganisms in the laboratory.

	UNIT – I	
01	**Microscopy:** Construction, Working, Principles & Application of- Bright FieldMicroscopy, Dark Field Microscopy, Phase Contrast Microscopy, Fluorescent Microscopy, Confocal microscopy, Scanning and Transmission Electron Microscopy.	**6**
02	**Nutrition and Culture media:** components of media, natural and synthetic media,chemically defined media, complex media, selective, differential, indicator, enriched andenrichment media. Living media- Eggs, cell lines, animals.	**6**
03	**Cultivation and Isolation Techniques:** Serial dilution, Streak plate, Pour plate,Spreadplate. Cell Enumeration Techniques- Direct methods, DMC, Neubauer chamber, IndirectMethods- SPC/TVC, Membrane filter technique. Maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria.	**6**
	UNIT - II	
01	**Stains and staining procedures:** Difference between dye and stain.ClassificationofStains – acidic, basic and neutral. Theories, Procedures and mechanisms of – Simplestaining, Differential staining, Gram staining, Acid fast staining, Negative staining,special staining- Capsule, Cell wall, Metachromatic granules.	**6**
02	**Microbial Biochemical Tests:** Media composition, mechanism and significance- IMViCtest, Catalase test, Starch hydrolysis test, casein hydrolysis test, urea hydrolysis test,sugar utilization test, nitrate reduction test, triple sugar iron agar test, Oxidase test,Coagulase test etc.	**6**

References:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9thedition. Pearson Education

2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology ofMicroorganisms.14th edition. Pearson International Edition

3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

SEMESTER III - DSC 3C
PLANT BIOTECHNOLOGY (PAPER-I)

Total Credits: 2 **Contact hours: 30**

Learning outcomes On the completion of the course the students will be able to

- Understand the core concepts and fundamentals of plant biotechnology and green house
- Develop their competency on different types of plant tissue culture
- Evaluate different methods production of haploids
- Understand the method of germ plasm storage and cryopreservation
- Critically analyze the major concerns and applications of plant biotechnology in sustainableagriculture.

	UNIT - I	
01	**Introduction To Plant Biotechnology:** Introduction, Conventional Plant Breeding And Plant Tissue Culture, Terms Used In Plant Tissue Culture, Basic Techniques In Plant Tissue Culture. Aseptic manipulation.	**6**
02	**Embryo Culture:** History And Methodology In Seed Culture, Embryo Culture, Categories Of Embryo Culture, Objectives, Embryo Rescue, Application Of Embryo Culture In Plant Biotechnology**.**	**6**
03	**Production Of Haploids:** Invitro Haploid Production, Androgenic Methods, Anther Culture, Microspore Culture, Androgenesis, Significance And Use Of Haploids, Gynogenic Haploids, Factors Affecting Gynogenesis. Chromosome elimination techniques for production of haploids in cereals: Hordeum bulbosum method.	**6**
	UNIT - II	
01	**Germ Plasm Storage And Cryopreservation:** Cryopreservation, Cryoprotectant, Pretreatment Method-Freezing, Storage, Thawing. Viability Methods- TTC Method Of Staining, Evan's Blue Stain. Plant Growth And Regeneration, Slow Growth Method, Applications.	**6**
02	**Greenhouse Management:** Greenhouse Technology, Advantages Of Greenhouse, Classification Of Greenhouse, Types Of Greenhouse Based On Shape, Utility, Material And Constructions.	**6**

References:

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA.
2. Textbook of plant biotechnology, Chawala P.K.2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
6. Verpoorte, R. and A.W. Alfermann (Eds) 2000.Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
7. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
8. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 Blackwell Publ)
9. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the 21th century (Academic press).
10. Bhojwani SS. &Razdan MK (1996). - Plant Tissue Culture: Theory & Practice (Elsevier)
11. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology (CRC Press)
12. Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
13. Vasil IK, Thorpe TA (1994) – Plant cell and tissue culture (Springer)
14. H K Das Textbook of Biotechnology 4th edition

SEMESTER III - DSC 3C
PLANT BIOTECHNOLOGY (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Learning outcomes On the completion of the course the students will be able to

- Outcome 1 Understand the core concepts and fundamentals of plant transformation technology
- Outcome 2 Develop their competency on development different types of GM plants
- Outcome 3 Understand the key concepts in plant development.

	UNIT - I	
01	**Plant Transformation Technology-** Mechanism of DNA transfer:- Indirect method- (*Agrobacterium* - mediated gene transfer, Ti plasmid, Ri plasmids as vector) role of virulence genes; Direct method of gene transfer- Particle bombardment , electroporation and microinjection.	**6**
02	**Metabolic engineering of plants:-** Plant cell culture for production of useful chemicals and secondary metabolites (Hairy roots culture, Biotransformation, Elicitation) pigments, flavonoids, alkaloids.	**6**
03	**Plant Development:-** Plant growth promoting bacteria (PGPB): Nitrogen fixation, Nitrogenase, hydrogenase, nodulation; vermicomposting technology. Biofertilizers- types, production, VAM, Rhizobium, Azobactor. Biocontrol of pathogens	**6**
	UNIT - II	
01	**Applications of plant technology:-** Single cell protein, Mushroom cultivation, Hydroponic culture and Nutrient Film Technology, floriculture and horticulture	**6**
02	**Advances in plant Biotechnology:** Edible vaccines and plantibodies using transgenic technology, molecular pharming, development of stress resistant varieties	**6**

References:

1. An introduction to Plant Tissue Culture 2nd edn. Razdan, M. K, Science Publishers, USA.
2. Textbook of plant biotechnology, Chawala P.K.2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and M. K. Razdan 1996.Plant Tissue Culture:Theory and Practice, Elsevier Pub.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
   Verpoorte, R. and A.W. Alfermann (Eds) 2000.Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
7. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
8. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 Blackwell Publ)
9. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the 21th century (Academic press).
10. Bhojwani SS. &Razdan MK (1996). - Plant Tissue Culture: Theory & Practice (Elsevier)
11. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology (CRC Press)
12. Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
13. Vasil IK, Thorpe TA (1994) – Plant cell and tissue culture (Springer)
14. H K Das Textbook of Biotechnology 4th edition

B. Sc. II BIOTECHNOLOGY
SEMESTER IV

SEMESTER IV - DSC 1D

MOLECULAR BIOLOGY (PAPER-I)

Total Credits: 2 **Contact hours: 30**

Learning outcomes on the completion of the course the students will be able to

- Outcome 1Understand the core concepts and fundamentals of central dogma and various repair mechanisms.
- Outcome 2 Thorough learning of the key concepts in molecular biology.
- Outcome 3 Students will able explain role of different proteins and enzymes in DNA replication and repair mechanisms.

	UNIT - I	
01	**Central Dogma:** The Central Dogma, Miescher to Watson and Crick historic perspective; Nucleic acids- structure, properties and function; Types of DNA, Types of RNA, Organelle DNA – mitochondria and chloroplast DNA.	**6**
02	**Structure of Genetic Elements:** DNA as genetic material: - Griffith's experiment, Hershey and Chase warring blender experiment, Molecular nature of Gene, Genetic code –evidences and properties. Denaturation and renaturation of DNA; cot curves; DNA topology-linking number, topoisomerases; Organization of DNA in Prokaryotes, Eukaryotes, Viruses.	**6**
03	**Replication of DNA in Prokaryotes**: General principles - bidirectional replication, Semiconservative, RNA priming; Enzyme involved in DNA replication of prokaryotes– DNA polymerases, Mechanism of DNA replication, Various models of DNA replication including rolling circle, Ɵ (theta) mode of replication, replication of linear ds-DNA.	**6**
	UNIT - II	
01	**Replication of DNA in Eukaryotes:** D-loop(mitochondrial) replication model; DNA polymerases of eukaryotes; Enzymes involved in DNA replication, Mechanism of DNA replication in eukaryotes.	**6**
02	**DNA damage & repair:** DNA damage: - Mutagenic agents; DNA Repair-Photoreactivation, Mismatch, Excision Recombination, SOS repair mechanisms and disorders.	**6**

References

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication

SEMESTER IV - DSC 1D
MOLECULAR BIOLOGY (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Learning outcomes on the completion of the course the students will be able to

- Outcome 1 Understand the core concepts and fundamentals of gene expression mechanisms.
- Outcome 2 Thorough learning of the key concepts in transcription and translation.
- Outcome 3 Students will able explain role of different proteins and enzymes in transcription and translation mechanisms.

	UNIT - I	
01	**Transcription** Structure of RNA polymerase, Sigma factor and the transcription unit; Mechanism- Initiation, Elongation: - Processing of pre-mRNA and Termination of transcription in Prokaryotes and Eukaryote.	**6**
02	**Transcription Regulation in Prokaryotes** Principles of transcriptional regulation; Operon concept; Repression and induction of genes; Regulation of operon: Lac operon and Trpoperon.	**6**
03	**Transcription Regulation in Eukaryotes** Regulatory Sequences- Promotors and Enhancers, Eukaryotic Activators, Repressors, Transcriptional Regulatory Protein, Regulation of Transcription by Non-Encoding RNA, Hormonal control of gene expression.	**6**
	UNIT - II	
01	**RNA Modification** Split genes, concept of introns and exons, Splicing Mechanism: - Structure of spliceosome, splicing pathways, alternative splicing, Splicing of tRNA precursor & rRNA precursor exon shuffling, RNA editing, and mRNA transport.	**6**
02	**Translation** Genetic code, Components of translation, Mechanism of Translation in Prokaryote & Eukaryote; translational proofreading, protein folding, protein splicing, (PTM) Post translation modification, Regulation of translation.	**6**

References

1. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
2. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
3. Gene VII; Benjamin Lewin; Pearson Education.
4. Genetics; B.D. Singh; Kalyani Publication
5. Life-The Science of Biology; David Sadava; 9th Edition; W. H. Freeman & Company

SEMESTER IV - DSC 2D
IMMUNOLOGY (PAPER-I)

Total Credits: 2 **Contact hours: 30**

Learning outcomes on the completion of the course the students will be able to

- Outcome 1 Understand the core concepts and fundamentals of innate and cognate immunity.
- Outcome 2 Thorough learning of the key concepts in antigen, antibody, cells & organ system Students will able explain role of different cells & organs involved in immune system and major histocompatibility complex.

	UNIT - I	
01	**Native or Innate immunity**: Introduction, First line of Defense – Physical and Chemical barriers at the portal of entry. Second line of Defense –Cellular Processes in nonspecific defense mechanism **Haematopoisis**: Introduction, factors involved in hematopoisis, programmed cell death and Homeostasis	**5**
02	**Cells of immune system**: B lymphocytes, T lymphocytes, Natural Killer Cells, Mononuclear phagocytes, Dendritic cells, Follicular dendritic cells. **Organs of immune system**: Structure and functions of primary lymphoid organs (Thymus, Bone marrow, and Lymphatic system), secondary lymphoid organs (Lymph nodes, Spleen, Mucosa Associated Lymphoid Tissue and Cutaneous Associated Lymphoid Tissue).	**5**
03	**Antigen**: Introduction, immunogenicity, antigenicity, types of antigens, properties of immunogen, role of biological system in immunogenicity (genotype of animal, immunogen dosage, route of Administration), adjuvant, epitope.	**5**
	UNIT – II	
01	**Antibody**: Introduction, History of Antibody invention(*Instructive and selective theories of antibody production)*, basic structure and biological function of antibody classes, antigenic determinants, Antibody diversity	**5**
02	**Major Histocompatibility Complex**: Introduction, classes-structure and function. **Cytokines**: Introduction, properties, function, Cytokine receptors	**5**
03	**Complement system**: Introduction, functions, components, general account on complement activation – classical and alternative pathways	**5**

References

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.
6. Basic and Clinical Immunology- Fundenberg H.
7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard
10. TextText book of Medical laboratory technology,Vol.1&2 -PrafulGodkar and DarshanGodkar

SEMESTER IV - DSC 2D
IMMUNOLOGY (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Learning outcomes on the completion of the course the students will be able to

- Outcome 1 Understand the core concepts and fundamentals of humoral and cell mediated immunity, autoimmunity, vaccines and antigen-antibody interactions.
- Outcome 2 Thorough learning of the key concepts in humoral and cell mediated immunity, autoimmunity, vaccines and antigen-antibody interactions.
- Outcome 3 Students will able explain type of immune response, processing of antigen, types of autoimmune diseases and antigen and antibody interactions.

	UNIT - I	
01	**Humoral immunity**: Components of Humoral Immunity, Primary and secondary immune response, B cell – maturation, activation, differentiation. Antibody production against T cell dependent and independent antigens, Processing of Exogenous Antigens – The Endocytic Pathway.	**5**
02	**Cell mediated Immunity:** Processing of Endogenous Antigens by the Cytosolic Pathway, T cell – maturation, activation, differentiation. Mechanism of CTL mediated cytotoxicity	**5**
03	**Autoimmunity**: Introduction, general mechanism, classification of autoimmune diseases Hemolytic, organspecific (Hashimoto's disease, Grave's disease, Myasthenia Gravis) and non-organ specific (RA). Introduction to Hypersensitivity. Immunodeficiency disease: AIDS	**5**
	UNIT - II	
01	**Vaccines**: Introduction active and passive immunization, Types of vaccines – Live-attenuated, killed, subunit, conjugate, DNA vaccines, recombinant Vector vaccines, Vaccination Schedule.	**5**
02	**Antigen antibody interactions**: Principles and applications of interaction, strength of interactions, crossreactivity, features of interactions, and measurement of antigen-antibody. Reactions of antigen-antibody complex – precipitation, flocculation, agglutination, complement fixation. Immunodiffussion, Immuno- electrophoresis, Complement FixationTest, Immunofluorescence Test, Radioimmunoassay, ELISA.	**5**
03	**Immunity to infections:** Specific and Nonspecific immunity to Bacteria, Fungi, Virus and Protozoa infections.	**5**

References

1. Immunology - Kuby
2. Essential Immunology- Roitt
3. Cellular and Molecular Immunology- Abbas
4. Immunology and Serology- Philip Carpenter
5. Textbook of Immunology- Barrette J.T.
6. Basic and Clinical Immunology- Fundenberg H.
7. Biology of Immune response- Abramoff and Lavice
8. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul
9. Immunology an Introduction- Tizard
10. TextText book of Medical laboratory technology,Vol.1&2 –Praful Godkar and Darshan Godkar

SEMESTER IV - DSC 3D
ANIMAL BIOTECHNOLOGY (PAPER-I)

Total Credits: 2 **Contact hours: 30**

Upon completion of the course, students should be able to:

- Outcome 1 Use or demonstrate the basic techniques of biotechnology like DNA isolation, PCR,transformation, restriction digestion etc.
- Outcome 2 Make a strategy to manipulate genetic structure of an organism for the improvement inany trait or its well-being based on the techniques learned during this course.
- Outcome 3 Understand better the ethical and social issues raised regarding GMOs.
- Outcome 4 Use the knowledge for designing a project for research and execute it.

UNIT - I		
01	**Animal Cell Culture:** Culture and maintenance of primary and established cell lines; Biology of cultured cells – culture environment, cell adhesion, cell proliferation and differentiation; Characterization of cultured cells, cell viability and cytotoxicity and expression of culture efficiency	**6**
02	**Stem cells technology:** Introduction and scope, Types of Stem cells, Stem cell culture techniques and their applications;	**6**
03	**Genetic manipulation of animals:** Introduction to transgenesis, Genetic manipulation of animals by Pronuclear microinjection, Recombinant retroviruses and Transfection of Embryonic Stem Cells;	**6**
UNIT – II		
01	**Animal propagation:** Cloning livestock by nuclear transfer and In Vitro Fertilization (IVF) technology for livestock, Conservation Biology – Embryo transfer techniques.	**6**
02	**Biosafety:** The Cartagena protocol on biosafety, levels of containment, Good Manufacturing Practice and Good Laboratory Practice (GMP and GLP), Use of genetically modified organisms and their release to environment	**6**

References:

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA
4. Molecular Biotechnology – S. B. Primerose
5. Principals of Gene Manipulation – Primerose
6. Culture of animal cell 3rd edition-R Ian Freshney
7. M. K. Sateesh (2010) Bioethics and Biosafety; I. K. International Publishing House Pvt. Ltd.
8. LIFE SCIENCES PROTOCOL MANUAL (2018) Compiled by Dr. P. Hemalatha Reddy, Dr. Suman Govil, Department of Biotechnology, Ministry of Science & Technology, Government of India
9. P.M. Swami (2008) Laboratory Manual on Biotechnology; Rastogi Publications

SEMESTER IV - DSC 3D: ANIMAL BIOTECHNOLOGY (PAPER-II)

Total Credits: 2 **Contact hours: 30**

Upon completion of the course, students will be able to: Get a clear concept of the basic principles and applications of biotechnology.

- Know the basic techniques used in genetic manipulation helping them continue with higher studies in this field.
- Acquire knowledge of the basic principles, preparations and handling required for animal cell culture.
- Understand principles underlying the design of fermenter and fermentation process and its immense use in the industry.
- Design small experiments for successful implementation of the ideas and develop solutions to solve problems related to biotechnology keeping in mind safety factor for environment and society.
- Apply knowledge and skills gained in the course to develop new diagnostic kits and to innovate new technologies further in their career.
- Enhance their understanding of the various aspects and applications of biotechnology as well as the importance of bio-safety and ethical issues related to it.

UNIT - I		
01	**Transgenic Animals** –Cow, Pig, Sheep, Goat, Bird. Transgenic mice model for tackling human diseases	**6**
02	**Importance of Biotechnology in Animal diseases –** Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.	**6**
03	**Genetic modification in Medicine:** Gene therapy – use of genes to prevent, treat or cure disease; vectors in gene therapy Gene augmentation therapy – transferring a functional copy of the gene into the genome	**6**
UNIT – II		
01	**Applications of Animal Biotechnology:** Improvement of biomass, livestock-pharming products, pharmaceutical products produced by mammalian cells, cell culture based vaccines, monoclonal antibodies production	**6**
02	**Bioethics:** Use of animals for research and testing, Use of cell cultures as alternative for animal models for research, Ethical issues associated with consumptions of genetically modified foods, animal and human genetic engineering/cloning – ethical and social issues	**6**

References:

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA
4. Molecular Biotechnology – S. B. Primerose
5. Principals of Gene Manipulation – Primerose
6. Culture of animal cell 3rd edition-R Ian Freshney
7. M. K. Sateesh (2010) Bioethics and Biosafety; I. K. International Publishing House Pvt. Ltd.
8. LIFE SCIENCES PROTOCOL MANUAL (2018) Compiled by Dr. P. Hemalatha Reddy, Dr. Suman Govil, Department of Biotechnology, Ministry of Science & Technology, Government of India
9. P.M. Swami (2008) Laboratory Manual on Biotechnology; Rastogi Publications

PRACTICAL COURSE: DSC 1C & 1D
GENETICS AND MOLECULAR BIOLOGY

Sr. No	Practical Title
1.	Study of Mendelian Traits
2.	Problem sets in Mendelian inheritance, test cross, back cross and gene interaction.
3.	Study of Mitosis and Meiosis
4.	Induction of Polyploidy
5.	Identification of mutant phenotypes- Body shape / nature of wings / eye colour in Drosophila.
6.	Sex-Linked Inheritance in Drosophila melanogaster
7.	Culture maintenance of Drosophila
8.	Preparation of Salivary Gland Chromosomes
9.	Spontaneous mutation: Fluctuation test – StrR
10.	Examples based on Hardy Weinberg Equilibrium
11.	Isolation of bacterial DNA
12.	Isolation of Plasmid DNA
13.	Isolation of DNA from animal cell / plant cell / yeast cells
14.	Isolation of DNA from yeast cells
15.	Isolation of RNA from yeast
16.	Isolation of RNA from plant cells / tissue
17.	Isolation of coli phages
18.	Transfer of genetic material – Transformation
19.	Transfer of genetic material – Conjugation
20.	Transfer of genetic material – Transduction
21.	Visit to Molecular Biology Laboratory OR Review of recent advances in Molecular Biology or Molecular Genetics thereby submitting a brief report

PRACTICAL COURSE: DSC 2C & 2D
GENERAL MICROBIOLOGY AND IMMUNOLOGY

1	Introduction to Microbiology laboratory **Glassware**: petriplates, slants, incubation flasks, glass spreader, suspension tube and **Equipment**: Microscope, Autoclave, Incubator, Hot Air Oven, Laminar Air flow, Rotary Shaker
2	Introduction to Microbiology **Culture media** – Nutrient broth, selective medium, differential medium, minimal medium, concept of sterilization.
3	Microbiology **Culture techniques**: Preparation of suspension, smear, inoculation, and streaking, spreading, concept of aseptic technique.
4	Gram staining and motility test by Hanging drop technique
5	Mounting & Identification of Fungi
6	Isolation of *E. coli* on differential media (Streak plate technique)
7	IMViC test
8	Enumeration of microorganisms from Soil by SPC (Pour Plate technique)
9	Enumeration of microorganisms from Soil by SPC (Spread plate technique)
10	To determine the MIC of given antibiotic
11	Growth curve
12	Latex agglutination test
14	Coomb's test
15	Ouchterlony procedure
16	Counter current immunoelectrophoresis
17	Rocket immunoelectrophoresis
18	Widal Test (Qualitative)
19	VDRL Test
20	Visit to any recognized Serology and/or Microbiology and/or Pathology laboratory OR Review of recent advances in Techniques in Microbiology/Immunology/Pathology thereby submitting a brief report

PRACTICAL COURSE: DSC 3C & 3D
PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Sr. No	Practical Title
1.	Isolation of Rhizobium from soil or root nodules
2.	Initiation and establishment of cell suspension culture.
3.	Protoplast fusions and culture by calcium ion or polyethylene glycol (**PEG**) method.
4.	Isolation of Ti plasmid from *Agrobacterium tumefaciens*.
5.	Anther culture and production of haploids.
6.	Synthetic seed production.
7.	Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, laboratory fumigation
8.	Demonstration of hydroponics technique
9.	Demonstration of vermicomposting
10.	Preparation of Hanks Balanced salt solution
11.	Preparation of Minimal Essential Growth medium
12.	Isolation of lymphocytes for culturing
13.	DNA isolation from animal tissue
14.	Quantification of isolated DNA
15.	Resolving DNA on Agarose Gel
16.	Establishment of primary cell culture: mouse splenocyte culture or any other suitable animal tisuue
17.	Cell Viability test by dye uptake assay
18.	Cell Viability test by dye exclusion assay
19.	Visit to Biotechnology or tissue culture lab.

NATURE OF QUESTION PAPER

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.Sc.-II Biotechnology (June 2023)

Time: - 2 hrs. **Total Marks-40**

Instructions:

1. All questions are compulsory.
2. Draw **neat diagrams** and give **equations** wherever necessary.
3. Figures to the **right** indicate **full marks**.
4. Use of logarithmic table and calculator is allowed.

Q. No.1) Multiple choice questions (08)

1) ..... a) b) c) d)
2)
3)
4)
5)
6)
7)
8)

Q.No.2) Answer any four of the following (08)

i)
ii)
iii)
iv)
v)
vi)

Q.No.3 A) Write short notes on any two of the following (08)

i)
ii)
iii)

Q. No.4) Answer any Two of the following (08)

i)
ii)
iii)

Q.No.5) Answer any one of the following (08)

i)
ii)

For,Science faculty:

CA- INTERNAL EXAMINATIONS. **Total Marks-10**

Pattern/Examination nature may be as follows-

One Internal Examination of 10 marks or two examinations of 5 marks each.

Open book examination/Home Assignment/class room test/Seminar/Field work report/Project report etc.

ENVIRONMENT STUDIES (AECC)

Syllabus As Per UGC Guidelines

UGC Letter – File No. 13-01/2000 (EA/ENV/COS-01 Dated 14th May, 2019)

Theory Lectures - (45)

Unit 1 : Introduction to environmental studies (2 lectures)

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development

Unit 2 : Ecosystems (6 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
  a) Forest ecosystem b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3 : Natural Resources : Renewable and Non-renewable Resources (8 lectures)

Land resources and land use change; Land degradation, soil erosion and desertification.

- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and overexploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation (8 lectures)

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-•-wildlife conflicts, biological invasions; Conservation of biodiversity: In-•-situ and Ex-•-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5 : Environmental Pollution (8 lectures)

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

Unit 6: Environmental Policies & Practices (7 lectures)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act, Air (Prevention, & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 7 : Human Communities and the Environment (6 lectures)

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8 : Field work (Equal to 3 lectures)

- Visit to an area to document environmental assets: river/ forest/flora/fauna etc.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, dam, pond, ocean / marine etc.

Suggested Readings:

1. Environmental Studies E - Text Book (Marathi and English Medium) Solapur University Solapur (2017).
2. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
3. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
4. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
5. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
6. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of ConservationBiology. Sunderland: Sinauer Associates, 2006.
7. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
8. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
9. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
10. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
11. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
12. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
13. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
14. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
15. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
16. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
17. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
18. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
19. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
20. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
21. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.