GONDWANA UNIVERSITY

GADCHIROLI

SYLLABI AND COURSE OF STUDY IN

BIOTECHNOLOGY

BIOTECHNOLOGY COURSE

UG SEMESTER I

UNDER NEP-2020

From Session 2024 Onwards

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Programme Name - B.Sc. Sem I (BIOTECHNOLOGY) (Level 4.5) Revised Examination Scheme & Basket

Sr. No.	Course Category	Subject Name		Subject Code	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
									Theory					Practical				
						Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Core Subject-I	Select any Two core group subject from Annesure-1	i)Subject –I Cell Biology	STUG01 BTH001	02	02	--	02	40	10	50	20	02	--	--	--	--	50
			ii) Subject II-Major Subject from Science		02	02	-	02	40	10	50	20	02	-	-	-	-	50
			iii) Practical Based on Subject –I Cell Biology	STUG01 BTH002	02	-	04	04	-	-	-	-	-	30	20	50	25	50
			iv) Practical Based on Subject –II		02	-	04	04	-	-	-	-	-	30	20	50	25	50
2	OE	Group-A (Any one from Annexure – II) Biotechnology for Human Welfare		STUG01 BTH003	02	02	--	02	40	10	50	20	02	--	--	--	--	50
3	VSC	Mushroom Cultivation		STUG01 BTH004	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Biotechnological Skills And Analytical Techniques		STUG01 BTH005	02	02	--	02	40	10	50	20	02	--	--	-	-	50
5	VEC	Audit Course (Any one from Annexure –V)			02	02	-	02	--	50	50	20	--	--	-	-	-	50
6	AEC	English/Marathi/Hindi/Bengali/Pali/ Supplementary English, Annexure-VI			02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	IKS	Generic IKS			02	02	--	02	40	10	50	20	02	--	--	--	--	50
8	CC	NCC/NSS/Yoga/Sports (Any One)			02	--	04	04	--	--	--	--	--	--	50	50	25	50
Total					22	14	16	30	240	110	350	140	12	90	110	200	100	550

- **Shall be based on Group Subject-I**

Note(s):

1) The Students shall undertake total two subjects which shall include one each from Group Subject –I, Group Subject-II
2) From Sem-III onwards out of the above three Subjects, the Students shall select one Subject as a major and one Subject as a minor as per Government letter No.क्र. एनईपी.२०२२/प्र.क्र.०९/विशि—३ शिकानादिनांक १३ मार्च, २०२४. As per AEC is concerned, those Students Selected English as a AEC in 1st Sem, shall select Marathi/ Hindi/Bengali/Pali in the IInd Sem and Vis-a Versa
3) As per open elective (OE)is concerned, students shall opt one subject from Group-A
4) Generic IKS will be common for all Faculties in the first Semester as per Government letter No. क्र.एनईपी.२०२२/प्र.क्र.०९/विशि—३(शिकाना)दिनांक२५जानेवारी, २०२४.
5) VSC Shall be based on Group Subject

Gondwana University, Gadchiroli

FYUGP-Scheme I-VIII Semester
Bachelor of Science (Honours/Research)
(Biotechnology - Major)
Four-Year (Eight Semester Degree Course)

Programme Outcomes (POs) for UG course in Biotechnology of the Faculty of Science And Technology

1. To develop skills in graduate students to be able to acquire theoretical and practical knowledge in fundamentals of biology in respective disciplines of plants, animals, microbes and environment.
2. To inculcate ability to critically evaluate problems and apply lateral thinking and analytical skills for professional development.
3. To create awareness on ethical issues, good laboratory practices and biosafety.
4. To develop ability in youth for understanding basic scientific learning and effective communication skills.
5. To prepare youth for career in teaching, industry, government organizations and self reliant entrepreneurship.
6. To make students aware of natural resources and environment and its sustainable utilization.
7. To provide learning experience in students that instills deep interest in biological science for the benefit of society.

B.Sc. Biotechnology Semester I

Subject Title :- Cell Biology	**Course Credit:02/50 Marks**
Course Code: STUG01BTH001	**T per week : 2**
Total Contact Hours: 30 for theory	**Duration of Theory Exam: 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Course Outcomes:

After successful completion of this Course, students will be able to:

CO 1. Understand concepts of Biotechnology and demonstrate knowledge acquired in interdisciplinary skills in cell biology

CO 2. Describe the ultra structure of cells, structure and function of organelles, cytosol and cytoskeleton

CO 3. Understand phases of cell cycle, cell division,

Unit I: Introduction to Cell	Hrs
A. Discovery of cell: - Contribution of Robert Hook, Jan Evangelista, Purkyne, Matthias Jakob Schleiden and Theodor Schwann, B. Cell as a basic unit of living systems, C. The Cell theory D. Classification of cells based on Cell shape, Cell size, Cell volume and Cell Number E. Typical structure of prokaryotic and eukaryotic cell F. Structure of Plant cell, Structure of Animal cell G. Difference between plant and animal cell. H. Structure and function of Muscle and Nerve Cell	8 Hrs
Unit II: Cell Organelles	Hrs
A. Structure And Function of Nucleus and Nucleolus B. Cell Wall (Bacterial and Plant) C. Plasma Membrane (Fluid-Mosaic Model) D. Endoplasmic Reticulum (Rough, Smooth), Mitochondria, Golgi apparatus, Ribosomes and its subunits, Lysosomes, chloroplast. Centrioles (animal), Plastids (Plant), Vacuoles, Granuoles, cytosol	8 Hrs
Unit III: Cytoskeleton And Cell Locomotion	Hrs
A. Structure and function of Actin filaments (Microfilaments), Microtubules (alpha tubulin and beta tubulin), Microtubule Motor (kinesins, dyneins) and intermediate filaments (keratins, lamins, neurofilaments, vimentins) B. Dynamic instability. Tubulin synthesis and modification **C.** Cell Locomotion (amoeboid, flagellar and ciliar)	8 Hrs
Unit IV: Cell Division	Hrs
A. Cell division and cell cycle. Stages of Mitosis and Meiosis- Prophase, Metaphase, Anaphase,Telophase, Cytokinesis. B. G1, S, G2 phases of cell cycle. C. Cell synchronization and its application, Cell senescence **D.** Cell differentiation in plant and animals.	8 Hrs

Suggested Readings for theory for B.Sc. semester I Biotechnology(Cell Biology)

1. Text book of Biotechnology, R.C.Dubey, 2009, S.Chand, New Delhi
2. Cell Biology, Genetics, Mol Biology, Evolution And Ecology, P. S. Verma, 2005, S. Chand
3. Biotechnology (E.H.), B. D. Singh, 2008, Kalyani Publication
4. Cell And Molecular Biology, Gerald Karp, 2007. John Wiley And Sons Pvt.Ltd.
5. Cell Biology, C.B. Powar, 2005, Himalaya Publishing House.
6. Cell Biology, Varma And Agrawal, 2005, S. Chand, Delhi
7. Cell, B. Lewin, 2007, Jones And Bartlett Publisher , London.
8. Cytology, Varma And Agrawal, 2005, S. Chand New Delhi
9. Molecular Biology of Cell - Bruce Alberts et al, Garland publications.
10. Animal Cytology and Evolution- MJD, White Cambridge University Publications
11. Molecular Cell Biology-Daniel, Scientific American Books
12. Cell Biology - Jack d Bruke, The William Twilkins Company
13. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
14. Cell Biology-Ambrose & Dorothy M Easty, ELBS Publications
15. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
16. Cytology-Willson & Marrison, Reinform Publications
17. Molecular Biology- Christopher Smith, Faber &FaberPublications
18. Cell Biology & Molecular Biology – EDP De Robertis & EMF Robertis, Saunder College.
19. Cell Biology- C.B Powar, HimalayaPublications
20. Basic Genetics- Daniel L. Hartl, Jones &BarlettPublishersUSA
21. Human Genetics and Medicine lark Edward Arnold PLondon
22. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
23. Genes V - Benjamin Lewin, Oxford UniversityPress.
24. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
25. Genes II - Benjamin Lewin, Wiley &SonsPublications
26. Genes III- Benjamin Lewin, Wiley &SonsPublications
27. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
28. Genetics – Edgar Altenburg Oxford & IBH publications
29. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley &SonPublications
30. Genetics- P.K.Gupta, Rastogi Publication, Meerut, India

Practical Based on Subject –I Cell Biology

Subject Title :- Practical on Cell Biology	**Subject Credit:02/50 Marks**
Subject Code: STUG01BTH002	**P per week : 4**
Total Contact Hours : 60 for Practical	**Duration of Practical Exam : 04 Horus**
Practical Marks: 30	**Internal Assessment Marks : 20**

Learning Objective:
The objective of this course is to demonstrate significant cell biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology to be translated into practical understanding.

Course outcome:
CO1: Students will be able to differentiate the cells of various living organisms
CO2: Awareness of physiological processes of cell e.g., cell divisions.
CO3: Students will be able to observe and correctly identify different cell types, cellular structures

1. Operation and working principle of simple and compound microscope
2. Use of Micrometry, measurement of onion epidermal cells and yeast
3. Demonstration Stages of mitosis in onion root tips.
4. Demonstration Stages of meiosis.
5. Microscopic observation of Stomata and Root hairs.
6. Isolation and staining of Chloroplast/Mitochondria
7. Enumeration of RBC using Hemocytometer
8. Mounting of polytene chromosomes
9. Buccal smear- Barr bodies
10. Microtomy (Demo)
11. Blood typing
12. Preparation and submission of 5 permanent slides of Mitosis and Meiosis (By each students)

Distribution of Marks : Total marks : 30 Duration: 04 Hrs

1. **Major experiment ----------10**
2. **Minor Experiment (2x5)----------10**
3. **Practical Record----------04**
4. **Spotting----------03**
5. **Viva-voce----------03**

Total : 30

Internal Assessment Marks : 20 (Based on Attendance, Punctuality, Lab Assignment Submission, Tour/ Field Visit Diary Submission)

Suggested Readings for Practicals on Cell Biology for B.Sc. Semester I Biotechnology

1. Experiments in Microbiology, Plant Pathology And Biotechnology, K.R. Aneja, 2003, New Age Int.Pvt.Ltd
2. Microbiology: A Laboratory Manual by James Cappacino
3. Microbiology Pratical By R. C. Dubey
4. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi. Co. Ltd.
5. Chmielewski, Jerry & Krayesky, David. (2013). General Botany Laboratory Manual. ISBN: 978-1-4772-9653-0.
6. Manju Bala , Sunita Gupta , N.K. Gupta & M.K. Sangha (2019) Practicals in Plant Physiology and Biochemistry. ISBN 9789386102638

Open Elective (OE)

Subject Title :- Biotechnology for Human Welfare	**Subject Credit:02/50 Marks**
Subject Code: STUG01BTH003	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam : 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Course Outcomes:

After successful completion of this Course, students will be able to:

CO 1. Understand the biotechnological applications in the industry

CO 2. Appreciate application of biotechnology in environmental management

CO 3. Describe application of biotechnology to forensic science

CO 4. Comprehend contributions of biotechnology to biomedical fields, such as diagnostics, genomics and therapeutics

Unit I: Biotechnology in Industry And Environment	Hrs
Introduction, Scope, branches and applications of Biotechnology. Biotechnology in industry: Industrial production of alcoholic beverage (wine), Applications of biotechnology in food, detergent and pharmaceutical industries Application of biotechnology in environmental aspects : Bioremediation: Degradation organic pollutants, hydrocarbons and agricultural wastes, Superbug Bioplastics and Biofuels	16Hrs
Unit II: Biotechnology in Forensic and Health Sciences	Hrs
Application of biotechnology in forensic science: Solving crimes of murder and rape, paternity testing and theft using DNA finger printing techniques Application of biotechnology in health: Genetically engineered insulin, recombinant vaccines, gene therapy, diagnostics-ELISA and PCR, human genome project.	16Hrs

Suggested Readings

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook ofIndustrial Microbiology.2nd edition. Panima Publishing Co. NewDelhi.

2. Patel AH. (1996). Industrial Microbiology.1st edition, MacmillanIndia Limited.

3. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier ScienceLtd.

4. Environmental Biotechnology, Pradipta Kumar Mohapatra

5. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter 6. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

7. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi(2002).

8. S.H. James and J.J. Nordby, Forensic Science: An Introduction toScientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton(2005).

9. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences,2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton(1997).

Vocational Skill Course (VSC)

Subject Title : Mushroom Cultivation	**Subject Credit:02/50 Marks**
Subject Code: STUG01BTH004	**P per week : 4**
Total Contact Hours : 60 for Practical	**Duration of Practical Exam : 04 Horus**
Practical Marks: 30	**Internal Assessment Marks : 20**

Course Outcomes (CO)

After completing practical Students will be :

1. Students will be Orientated to a mushroom farm and able to Identify different types of edible and non edible mushrooms.

2. Prepare pure culture of mushroom by different methods and use pure culture for preparation of spawn.

3. Prepare mother spawn and multiply spawn for commercial use.

4. Will be able to prepare selective compost for cultivation of button mushroom following appropriate steps.

5. Use different methods of spawning, casing, cropping, management of temperature and carbon dioxide at different steps for cultivation of button mushroom. Perform post harvest storage of button mushroom.

Sr. No.	Practical
1.	Orientation to a Mushroom Farm
2.	Preparation of Pure Culture and Maintenance of cultures
3.	Preparation of mother spawn, commercial spawn and its storage
4.	Compositing methods
5.	Spawning, casing, cropping and post harvest handling
6.	Cultivation of oyster mushroom/ paddy straw mushroom/ cultivation of milky mushroom (any one)
7.	Market survey and cost benefit analysis

Suggested Readings

1. A text Book of Mushroom cultivation by Dr. Chand Pasha, A. Chetana & Sk. Naseeruddin
2. Saras Mushroom Cultivation by V. Kumaresan
3. Mushroom : a manual for cultivation by Subrata Datta
4. Mushroom ultivation in India by Suman B. C.& Sharma V. P.
5. Hand Book of Mushroom: Cultivation, processing and Packaging by Sudhir Gupta
6. A-Z Oyster mushroom cultivation Training Book by Harshit Lad
7. Mushroom Cultivation by Tom Gordan

Distribution of Marks : Total marks : 30 Duration: 04 Hrs

1. **Major experiment ---------- 10**
2. **Minor Experiment (2x5)---------- 10**
3. **Practical Record---------- 04**
4. **Visit to Mushroom Farm----------03**
5. **Viva-voce---------- 03**

Total 30

Internal Assessment Marks :20 (Based on Attendance, Punctuality, Lab assignment submission, Tour/ field visit diary submission)

Skill Enhancement Course (SEC)

Subject Title :- Biotechnology for Human Welfare	**Subject Credit:02/50 Marks**
Subject Code: STUG01BTH005	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam : 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

BIOTECHNOLOGICAL SKILLS AND ANALYTICAL TECHNIQUES

Course Outcomes:

After successful completion of this Course, students will demonstrate the:

CO 1. Skill enhancement as per National Occupational Standards (NOS) of "Lab Technician/ Assistant" Qualification Pack issued by Life Sciences Sector Skill Development Council – LFS/Q0509, Level 3.

CO 2. Knowledge about major activities of biotech industry, regulations, and compliance, environment, health, and safety (EHS), good laboratory practices (GLP), standard operating procedures (SOP) and GMP as per the industry standards.

CO 3. Soft skills, such as decision making, planning, organizing, problem solving, analytical thinking, critical thinking, and documentation.

1. Insights into biotechnology industry: Biotechnology Industry in Indian and Global context – organization in context of large /medium/ small enterprises, their structure and benefits.
2. Industry professional skills to be acquired: Planning and organizing skills, decision-making, problem-solving skills, analytical thinking, critical thinking, team management, risk assessment.
3. Interpersonal skills: Writing skills, reading skills, oral communication, conflict-resolution techniques, interpretation of research data, trouble shooting in work place
4. Digital skills: Basic Computer Skills (MS Office, Excel, Power point, Internet) for Workplace. Professional Email drafting skills and Powerpoint presentation skills

Analytical Skills in laboratory:

Solutions: Molarity, Molality, Normality, Mass percent % (w/w), Percent by volume (% v/v), parts per million (ppm), parts per billion (ppb), Dilution of concentrated solutions. Standard solutions, stock solution, solution of acids. Reagent bottle label reading and precautions

1. Methods and practices of cleaning and management of lab: Learning and Practice of Integrated clean-in-place (CIP) and sterilize-in-place (SIP) as per industry standards, material requirements for cleaning specific area, equipment, ventilation area, personal protective requirements
2. Procedure of cleaning and storage of Labware:

Methodology for storage area, Cleaning procedure and materials to be used for various surfaces. Sign boards, labelling do's & don'ts

Knowledge about standard procedures of cleaning or glass ware, plastic ware. Maintenance of inventory

3. Principles and practices of lab safety:

Knowledge about safety symbols and hazard signs. Personal safety gears, utility, and disposal. Equipment safety protocols, chemical safety protocols.Documentation of chemical and equipment usage records.Handling hazardous chemicals.

4. Best practices of usage and storage of chemicals:

Knowledge and practice in handling of chemicals, labelling and stock maintenance. SOP and material handling.Procedures to maintain chemicals, labelling, storage, and disposal.

5. Record maintenance as per SOP's

Labelling of samples and reagents as per SOP's. Recording detail of work done for research experiments. Importance of study of manuals, health, and safety instructions.

6. Usage and maintenance of basic equipment of biotechnology lab: Principles, calibrations, and SOPs of weighing balances, pH meters, autoclaves, laminar flows and biosafety cabinets, basic microscopes, homogenizers, stirrers, colorimeters, UV, and Visible spectrophotometers.

7. Preparation of solutions and standards: Properties and uses of chemicals commonly used in life sciences laboratories. Maintaining safety standards for handling various solutions and chemicals. Preparation of test reagents and buffers, Protocols for proper mixing of chemicals. Safety precautions while preparation and storage of incompatible chemicals and reagents.

8. Preparation of media: Maintenance and storage of purified water for media (Plant Tissue culture media, Microbiological media, and Animal cell culture media) preparation. Preparation and storage of concentrated stock solutions.Documentation and disposal of expired stocks.Collection of indents of media requirement, preparation, and storage.Media coding, documentation, and purpose of usage.

9. Practical methods for decontamination and disposal: Decontamination methods, Safe disposal practices of decontaminated media or materials.

10. Laboratory record writing: Method of record writing, data collection and recording, reporting of result, discussion of result, summary writing, effective power point presentation taking any experiment as example

11. Industry visit or Analytical laboratory visit

Suggested Readings

1. Microbiology: A Practical Manual by James Cappacino
2. Microbiology Practical by R. C. Dubey
3. Practical manual: Principle of Biotehnology-Indira Gandhi Krishi Vishwavidyalaya, Jagdalpur
4. A Plant Biotechnology Practical manual by Anjana R. & Joy P.P.
5. Laboratory Manual for Biotechnology by Ashish verma, Surjit Das & Anchal Singh
6. Practical manual of Biotechnology & Biochemistry by Alok Kumar Singh
7. A Laboratory Manual of Microbiology and Biotechnology by K. R. Aneja
8. Bergey's Manual of Systematic Bacteriology, Vol. 1-5, Springer-Verlag, New York, NY.
9. Karp G (2009). Cell and Molecular Biology: Concepts and experiments. 7th edition. John Wiley & Sons.

Sample Question Paper Pattern

F.Y. B. Sc. Semester I

BIOTECHNOLOGY (Major)

Time : 2 Hours | Max Marks : 40

Q. 1 Long answer type question from Unit I — 08 Marks

OR

a) Short answer type question from Unit I — 02 Marks
b) Short answer type question from Unit I — 02 Marks
c) Short answer type question from Unit I — 02 Marks
d) Short answer type question from Unit I — 02 Marks

Q. 2 Long answer type question from Unit II — 08 Marks

OR

a) Short answer type question from Unit II — 02 Marks
b) Short answer type question from Unit II — 02 Marks
c) Short answer type question from Unit II — 02 Marks
d) Short answer type question from Unit II — 02 Marks

Q. 3 Long answer type question from Unit III — 08 Marks

OR

a) Short answer type question from Unit III — 02 Marks
b) Short answer type question from Unit III — 02 Marks
c) Short answer type question from Unit III — 02 Marks
d) Short answer type question from Unit III — 02 Marks

Q. 4 Long answer type question from Unit IV — 08 Marks

OR

a) Short answer type question from Unit IV — 02 Marks
b) Short answer type question from Unit IV — 02 Marks
c) Short answer type question from Unit IV — 02 Marks
d) Short answer type question from Unit IV — 02 Marks

Q. 5 Solve 08 Questions (02 Question from Each Unit) — 01 Marks Each

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UG SEMESTER II

UNDER NEP-2020

From Session 2024 Onwards

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Programme Name - B.Sc. Sem II (BIOTECHNOLOGY) (Level 4.5) Revised Examination Scheme & Basket

Sr. No.	Course Category	Subject Name		Subject Code	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
									Theory					Practical				
						Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Core Subject-I	Select any Two core group subject from Annesure-VI1	i)Subject –I Fundamentals of Microbiology	STUG02 BTH001	02	02	--	02	40	10	50	20	02	--	--	--	--	50
			ii) Subject II-Major Subject from Science		02	02	-	02	40	10	50	20	02	-	-	-	-	50
			iii) Practical Based on Subject –I Fundamentals of Microbiology	STUG02 BTH002	02	-	04	04	-	-	-	-	-	30	20	50	25	50
			iv) Practical Based on Subject –II		02	-	04	04	-	-	-	-	-	30	20	50	25	50
2	OE	Group-A (Any one from Annexure – VIII) Application of Biotechnology in Agriculture		STUG02 BTH003	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		Group-B (Any one from Annexure – VIII) Biotechnology For Society		STUG02 BTH004	02	02	-	02	40	10	50	20	02	-	-			50
3	VSC	Biofertilizer & Biopesticide Production		STUG02 BTH005	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Fermentation Technology		STUG02 BTH006	02	02	--	02	40	10	50	20	02	--	--	-	-	50
5	VEC	Audit Course (Any one from Annexure –V)			02	02	-	02	--	50	50	20	--	--	-	-	-	50
6	AEC	English/Marathi/Hindi/Bengali/Pali/ Supplementary English, Annexure-VI			02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	CC	NCC/NSS/Yoga/Sports (Any One)			02	--	04	04	--	--	--	--	--	--	50	50	25	50
Total					22	14	16	30	240	110	350	140	12	90	110	200	100	550

Note(s): 1) As per open elective (OE) is concerned, students shall opt any one subject from Group-A & any one subject from Group B to be Chosen Compulsory from Faculty other than that of the core subject.

B. Sc. Biotechnology Semester II

Subject Title :- : Fundamentals of Microbiology	**Course Credit:02/50 Marks**
Course Code: STUG02BTH001	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam: 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Course Outcomes: On successful completion of the course the student will be able to

1. Illustrate the knowledge of history, scope of Microbiology.
2. Compare and characterize prokaryotic and eukaryotic cells based on morphology; different groups of microorganisms based on their structures.
3. Discover different staining procedures and microscopic techniques used to visualize microbial cells.
4. Give an account of microbial growth and their control

Unit I: History, Development And Microscopy	**Hrs**
A. History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner. B. Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance, C. Principle and application of dark field and fluorescent microscopy. D. Electron microscopy: Principle, ray diagram, applications, TEM and SEM, comparison between optical and electron microscope.	**08 Hrs**
Unit II: Bacterial Morphology And Organelles	**08 Hrs**
A. General morphology of bacteria: shapes and sizes. B. Generalized diagram of typical bacterial cell. C. Cell wall of Gram positive and Gram negative cells. D. Endospores: Study of Endospore structure and its formation, germination. E. General account of flagella and pili. F. Chromatin material, plasmids, definition and kinds of plasmids (conjugative and noncojugative) **G.** Morphology of Archae: Archaeal cell membrane (differences between bacterial and archaea cell membrane), General Characteristics.	
Unit III: Microbial Diversity and Microbial Staining Techniques	**08 Hrs**
A. General characteristics of yeast, moulds and protozoa their importance. B. Stains and staining Procedure: Definition of Dye, stain. C. Concept of simple staining, differential staining, Endospore staining, flagella staining, D. Viruses: General characteristics of viruses, difference structure, shapes and symmetries of viruses with one example of each. **E.** Brief idea of lytic cycle and lysogeny.	
Unit IV: Microbial growth, Nutrition and Control	**08 Hrs**
A. Growth: Growth rate, details of growth curve and its phases. B. Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat). C. Physical conditions required for growth: pH, Temperature. D. Pure culture: Concept, isolation methods, maintenance, preservation, E. Nutrition: Basic nutritional requirements such as water, carbon, nitrogen, sulfur and vitamins etc. F. Natural and synthetic media, Media composition. Role of Peptone, Beef extract, NaCl, Agar. G. Microbial Control: Concept of Sterilization, disinfection, antiseptic, sanitization, germicide and antimicrobial agents. H. Methods of Microbial Control- Physical method (Temperature, Radiation), Chemical method (halogens, alcohol, gaseous sterilization)	

TEXT BOOKS & REFERENCES FOR THEORY (Fundamentals of Microbiology)

1. General Microbiology-Vol-I, Powar And Daginawala, 2008, Himalaya Publishing House

2. General Microbiology ,Roger Y. Stanier, , 2008,Cover Illustration

3. A Textbook Of Microbiology, R.C.Dubey, D.K.Mheshwary, 2009, S.Chand

4. Text Book of Biotechnology, R.C.Dubey, 2009, S.Chand, Delhi

5. Infrastucture Of Cells, Butterworth, Heinemanm, 2004, Open University Publ.

6. A Text Book Of Bacteria, Subrata Bhattacharyarjee, 2009, Dominanat Publishers 6. A Text Book Of Virus, K.C.Sawant, 2009, Dominanat Publishers

7. Plant Physiology And Biochemistry, S.K.Singh,Seema Srivastava, 2009, Campus Books International

8.General Microbiology, R. Y. Stanier, 2008, Mc Millon Press Ltd

9. Biotechnology (E.H.), B. D. Singh, 2008, Kalyani Publication

10. General Microbiology-5th Edi, R. Y. Stanier, 1995, Mac Millan Press Pvt. Ltd. Landon

11. Fundamental Principles 0f Bacteriology Iied. A.J.Salle. Tata-Mcgrawhill (Pub.).

12. Text-Book 0f Microbiology- Anantnarayan, C.K. Jayram, Panikar, 2005, Orient Longman.

13. Elementary Microbiology Vol-I, Dr.H.A.Modi, 1995, Ekta Prakashan

14. Cell Biology, C.B. Powar, 2005, Himalaya Publishing House.

15. Cell Biology, Varma And Agrawal, 2005, S. Chand, Delhi

16. Cell, B. Lewin, 2007, Jones And Bartlett Publisher, London.

17. General Microbiology, Pelzar, 2005, Tata Mcgraw Hill, Delhi

18. Cytology, Verma And Argawal, 2005, S. Chand, Newdelhi

19. Fundamentals of Microbiology by Alcamo

Practical Based on Fundamentals of Microbiology

Subject Title :- Practical on Fundamentals of Microbiology	**Subject Credit:02/50 Marks**
Subject Code: STUG02BTH002	**P per week : 4**
Total Contact Hours : 60 for Practical	**Duration of Practical Exam : 04 Horus**
Practical Marks: 30	**Internal Assessment Marks : 20**

Learning Outcomes: After successful completion students will be able to

1. Handle and use instruments used in Biotechnology laboratories
2. Experiment with various methods of sterilization in microbiological work
3. Prepare different types of media, perform culture methods and staining techniques for isolation, characterization of microbes
4. Isolate bacteria from different sources and their cultivation
5. Handle and use antimicrobial agents and perform anti-microbial assays

Practicals

1. Demonstration of Common Instruments used in Biotech Laboratory.
2. Preparation of Nutrient Media.
3. Isolation of Pure Culture by SPC, Streak Plate, Pour Plate Method.
4. Staining of Bacteria: Simple Staining.
5. Gram Staining of Bacteria.
6. Endospore Staining of Bacteria.
7. Negative staining of Bacteria.
8. Demonstration of Motility of Bacteria by Hanging Drop method.
9. Anaerobic cultivation of microorganisms.
10. Cultivation of Yeast and Molds.
11. Demonstration of Antibiotic sensitivity.
12. Demonstration of Oligodynamic Action of Heavy Metals against Bacteria.
13. Demonstration of Bacteriophage Plaque Assay.

Distribution of Marks : Total marks : 30 Duration: 04 Hrs

1. **Major experiment ----------10**
2. **Minor Experiment (2x5)----------10**
3. **Practical Record----------04**
4. **Spotting----------03**
5. **Viva-voce----------03**

Total : 30

Internal Assessment Marks : 20 (Based on Attendance, Punctuality, Lab Assignment Submission, Tour/ Field Visit Diary Submission

BOOKS FOR PRACTICALS : (Practical Based on Fundamentals of Microbiology)

1. Experiments In Microbiology, Plant Pathology And Biotechnology, K.R. 13
Aneja, 2003, New Age Int.Pvt.Ltd

2. Practical Microbiology, Maheshwari D.K., R. C. Dubey, 2005, S. Chand, Delhi

3. Practical Microbiology, Vinita Kale & Kishore Bhasari, Himalaya Publication

4. Microbiology: A Practical Manual by James Cappacino

Open Elective (OE) (Group A)

Subject Title :- Applications of Biotechnology in Agriculture	**Subject Credit:02/50 Marks**
Subject Code: STUG02BTH003	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam : 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Course Outcomes : At the end of the Course, the Student will be able to:

1. To trained the students about different Tools and techniques used in agriculture biotechnology.
2. To teach about Plant tissue culture and its application in crop improvement,
3. To teach the students about Genetically modified foods and use of genetic engineering in crop improvement.

Unit I Agricultural Biotechnology	**Hrs**
Concepts and scope of biotechnology in Agriculture. Plant tissue culture, micro propagation, entrepreneurship in commercial plant tissue culture. Banana tissue culture - primary and secondary commercial setups, Small scale bio enterprises: Mushroom cultivation	**16 Hrs**
Unit II Transgenic plants	**Hrs**
The GM crop debate – safety, ethics, perception and acceptance of GM crops GM crops case study: Bt cotton, Bt brinjal, Biopesticides: Baculovirus pesticides, Mycopesticides Genetic Engineering for quality improvement: Golden rice, Seed storage proteins, Flavours– capsaicin, vanillin	**16 Hrs**

Suggested Readings

1. Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
2. Gamborg O.L. and Philips G.C.Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. NewDelhi.1998
3. Hammound J, P McGravey&Yusibov.V. Plant Biotechnology, Springerverlag.2000
4. Heldt. Plant Biochemistry and Molecular Biology.Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.1997
5. LydianeKyte and John Kleyn.Plants from test tubes. An introductionto
6. Micropropagation (3 rd. Ed.). Timber Press, Portland.1996
7. Murray D.R. Advanced methods in plant breeding and biotechnology.Panima Publishing Corporation.1996
8. NickoloffJ.A.Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana press incorp, USA.1995.
9. Sawahel W.A. Plant genetic transformation technology.Daya Publishing House, Delhi.1997
10. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004
11. Sateesh M.K. 2008. Biosafety and Bioethics. Oxford and IBH Publishers, New Delhi.

Open Elective (OE) (Group B)

Subject Title :- Biotechnology for Society	**Subject Credit:02/50 Marks**
Subject Code: STUG02BTH004	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam : 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Biotechnology For Society

Course Outcomes: At the end of the Course, the Student will be able to:

1. Identify the importance of biotechnology in different agricultural practices.
2. Appreciate the role played by microorganisms in the development of food supplements, biological fertilizers and pesticides
3. Gain knowledge about the application of biotechnology in transforming environmental pollutants

Unit I	**Hrs**
Introduction to Biotechnology- Role of biotechnology in sericulture- Rearing of silkworms- Importance and applications- Role of biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained- Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation.	**16 Hrs**
Unit II	**Hrs**
Biofertilizer- Definition- Mass production of *Rhizobium*-Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- *Bacillus thuringiensis*- Single cell protein- Introduction- history- production of *Spirulina* SCP- Applications- Advantages & disadvantages. Biodegradation- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages	**16 Hrs**

TEXT BOOKS:

1. Sathyanarayana, U., Chakrapani, U., (2008). *Biotechnology*, First edition, Books and allied (P) Ltd, Kolkata.

2. A.K. Chatterji, (2011).*Introduction to Environmental Biotechnology*, Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9

3. R.C. Dubey, (2014*). A text book of Biotechnology*, *S.Chand& Company, New Delhi.* ISBN 9788121926089

Vocational Skill Course (VSC)

Subject Title : Biofertilizer & Biopesticide Production	**Subject Credit:02/50 Marks**
Subject Code: STUG01BTH005	**P per week : 4**
Total Contact Hours : 60 for Practical	**Duration of Practical Exam : 04 Horus**
Practical Marks: 30	**Internal Assessment Marks : 20**

Course Outcomes: At the end of the Course, the Student will be able to Learn:

1. Importance of nitrogen fixing bacteria in agriculture.
2. Production of different types of Microbial fertilizers and pesticides
3. Gain knowledge about production unit for bio fertilizers and bio pesticides visiting bio fertilizer and bio pesticides production Units/ Industry

Sr. No.	Practical
1.	Isolation and Identification of Symbiotic and Non Symbiotic Nitrogen Fixing Bacteria.
2.	Mass Multiplication and Inoculums Production of Biofertilizers.
3.	Preparation of *Rhizobium* Biofertilizer
4.	Preparation of *Azotobacter* Biofertilizer
5.	Preparation of Azospirillum and PSB biofertilizers
6.	Isolation and Identification of *VAM* fungi. Production of *VAM* biofertilizer.
7.	Isolation and purification of important biopesticides: *Trichoderma Pseudomonas, Bacillus*
8.	Visit to Biofertilizer/ Biopesticide laboratory in nearby area.

Suggested Readings

1. Handbook on Biofertilizer and Biopesticides by A. M. Deshmukh, Technoscience Publications, 1998
2. Biofertilizer and Biopesticides in Sustainable Agriculture by B. D. Kaushik, Apple Academic Press
3. Biofertilizer and Biopesticides by H. C. Laxman
4. Biofertilizer and Biopesticides by Krishnendu Acharya
5. Biofertilizer Technology by Kannaiyan, K. Kumar
6. Biofertilizer and Biopesticides by Shalini Suri

Distribution of Marks : Total marks : 30 Duration: 04 Hrs

1. **Major experiment ---------- 10**
2. **Minor Experiment (2x5)---------- 10**
3. **Practical Record---------- 04**
4. **Visit to Biofertilizer & Biopesticide Production Unit-03**
5. **Viva-voce---------- 03**

Total 30

Internal Assessment Marks :20 (Based on Attendance, Punctuality, Lab assignment submission, Tour/ field visit diary submission)

Skill Enhancement Course (SEC)

Subject Title :- Fermentation Technology	**Subject Credit:02/50 Marks**
Subject Code: STUG02BTH006	**T per week : 2**
Total Contact Hours: 30 for Theory	**Duration of Theory Exam : 02 Horus**
Theory Marks: 40	**Internal Assessment Marks : 10**

Course Outcomes: At the end of the Course, the Student will be able to:

1. Gain knowledge of basic principle of fermentation.
2. To develop skills of the students in the area of downstream processing
3. To impart basic knowledge of quality control and good manufacturing practices in industries

UNIT I:	**Hrs**
Fermentation as an ancient tradition, development of fermentation microbiology: historical background. Fermenter: Main components and its uses, peripheral parts and accessories. Medium formulation, energy source, carbon sources, nitrogen sources, minerals, growth factors, buffers, inhibitors and precursors, antifoaming agents. Inoculum preparation and scale up of fermentations. Batch, fed batch and continuous fermentations. Multiple fermentation and solid substrate fermentations.	**16 Hrs.**
UNIT II:	**Hrs**
Isolation of industrially important microorganisms (Primary and secondary screening). Preservation of industrially important microorganisms. Strain improvement by genetic recombination approaches and directed screening for mutants with altered metabolism. Removal of microbial cells and solid matter, foam separation, cell disruption, precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, membrane process, drying and crystallization. Physical, chemical and biological assays for detection of fermentation products	**16 Hrs**

Suggested Readings

1. Bioprocess Engineering by Michael L.Schuler and F.Kargi .Prentice Hall of India
2. Biochemcal Engineering Fundamentals. J.E. Bailey and D.F. Ollis Mcgraw Hill International Editions
3. Process Biotehnology Fundamentals by S.N. Mukhopadhyaya. Vivi Books Pvt. Ltd.
4. Principles of Fermentation Technology by P.F. Stanbury,A. Whittaker & Hall Pergaman. McNeul & Harvey Publications.

Sample Question Paper Pattern

F.Y. B. Sc. Semester II

BIOTECHNOLOGY (Major)

Time : 2 Hours Max Marks : 40

Q. 1 Long answer type question from Unit I 08 Marks

OR

a) Short answer type question from Unit I 02 Marks
b) Short answer type question from Unit I 02 Marks
c) Short answer type question from Unit I 02 Marks
d) Short answer type question from Unit I 02 Marks

Q. 2 Long answer type question from Unit II 08 Marks

OR

a) Short answer type question from Unit II 02 Marks
b) Short answer type question from Unit II 02 Marks
c) Short answer type question from Unit II 02 Marks
d) Short answer type question from Unit II 02 Marks

Q. 3 Long answer type question from Unit III 08 Marks

OR

a) Short answer type question from Unit III 02 Marks
b) Short answer type question from Unit III 02 Marks
c) Short answer type question from Unit III 02 Marks
d) Short answer type question from Unit III 02 Marks

Q. 4 Long answer type question from Unit IV 08 Marks

OR

a) Short answer type question from Unit IV 02 Marks
b) Short answer type question from Unit IV 02 Marks
c) Short answer type question from Unit IV 02 Marks
d) Short answer type question from Unit IV 02 Marks

Q. 5 Solve 08 Questions (02 Question from Each Unit) 01 Marks Each