DEBRAJ ROY COLLEGE (AUTONOMOUS)

FOUR YEARS UNDER GRADUATE PROGRAM (F.Y.U.G.P.)

SYLLABUS FOR

Undergraduate Program in Biotechnology (NEP)

FYUGP 2024-25

Department of Biotechnology

Debraj Roy College

(An Autonomous College under Dibrugarh University)

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PREAMBLE

Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents, to provide goods and services. This field has resulted in significant advances in areas such as genetic engineering, drug discovery, and personalized medicine. Biotechnology has also played a crucial role in addressing global challenges, such as food and energy security, environmental sustainability, and the development of new diagnostic and therapeutic tools for diseases.
The B.Sc. Biotechnology is a four year under graduate Programme (FYUGP) comprising eight semesters, which encompasses theory and practical in different areas of Biotechnology and allied disciplines of life-sciences.

When designing the fundamental structure of the Under Graduate (UG) program, the following factors were taken into consideration:

1. The ability to switch between different fields of study
2. The opportunity for learners to choose courses of interest across all disciplines
3. Flexible options for entry and exit with UG certificates, UG diplomas, or Bachelor's degrees depending on the credits earned
4. The possibility for students to transfer between institutions to participate in interdisciplinary learning
5. The ability to switch to alternative modes of learning
6. Providing the necessary knowledge and mindset for self-employment initiatives and entrepreneurship
7. Fostering the ability for complex critical thinking and solving real-life problems
8. Developing a capacity to comprehend global issues, cultural competency, and digital literacy
9. Equipping students with research skills, communication skills, community engagement, environmental awareness, responsibility, and accountability.

To ensure that the curriculum for Biotechnology at the undergraduate level remains relevant to contemporary society and modern practices, new components of learning have been integrated. The resulting Learning Outcome-based Curriculum Framework (LOCF) for Biotechnology, as well as the FYUGP, is expected to be highly valuable to prospective graduates interested in Biotechnology, Bioinformatics, and Applied Biological Sciences as a whole.

The curriculum for Biotechnology aims to improve students' skills, making them more versatile and adaptable, which will in turn enhance their employability. Additionally, the discipline will aid in shaping students' personalities to enable them to confront the challenges of a competitive society and in doing so, promote the development of bio-entrepreneurs and enhance capacity-building efforts. Moreover, the curriculum's incremental learning experiences will benefit students from a wide range of backgrounds, providing opportunities to develop individual potential and produce a pool of better-trained professionals each year.

INTRODUCTION

Higher Education is a vital component of India's development and growth strategy, as it is considered critical to the country's progress. As per the New Education Policy (NEP) 2020, the focus of Higher Education should be on identifying and nurturing each student's unique strengths by educating teachers and parents about the need to encourage holistic development in both curricular and co-curricular areas. The curriculum should be flexible enough to allow students to choose their own learning paths and programs based on their talents and interests, enabling them to make informed life choices. To promote unity and integrity of all knowledge in a pluralistic world, there should be an emphasis on multidisciplinary and comprehensive education in the sciences, social sciences, arts, humanities, and sports.

The Under Graduate (UG) syllabus of Biotechnology in light of New Education Policy (NEP), 2020 consists of Major (Core) disciplines, Minor disciplines, Multi- Disciplinary
Generic Elective Courses (MDGEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Based Engagement (NCC/NSS/Adult Education/Student Mentoring/NGO/Govt. institutions, etc.), Digital and Technological Solutions/Digital Fluency (DTS/DF), Internship, Project, Research Ethics and Methodology, Research Project (Development of Project/Research Proposal, Review of related literature), Dissertation (Collection of Data, Analysis and Preparation of Report) and Discipline Specific Electives (DSE).

The UG degree Programme offers certificates, diplomas and degrees as follows:

UG Certificate: Students who opt to exit after completion of the first year (Two Semesters) and have secured 44 credits will be awarded a UG certificate. These students are allowed to re-enter within three years and complete the degree Programme within the stipulated maximum period of seven years.

Certificate course consists of two Major disciplines, two Minor disciplines, two MDGEC, two AEC, two VAC, two SEC, YOGA and Environmental Education with emphasis on community-based activities.

UG Diploma: Students who opt to exit after completion of the second year (Four Semesters) and have secured 88 credits will be awarded the UG diploma. These students are allowed to re-enter within a period of three years and complete the degree Programme within the maximum period of seven years.

Diploma course consists of six Major disciplines, four Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities and Digital and Technological Solutions/Digital Fluency and Community engagement.

3-year UG Degree: Students who wish to undergo a 3-year (Six Semesters) UG Programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 132 credits.
3-year UG degree course consists of fourteen Major disciplines, six Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis

on community based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship and Project.

4-year UG Degree (Honours with Research): Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year (Two Semesters). They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students, who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

4-year UG degree course consists of twenty Major disciplines, eight Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship, Project, Research Ethics and Methodology, Research Project or one DSE and Dissertation or two DSE.

UG Degree Programmes with Single Major: A student has to secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major.

UG Degree Programmes with Double Major: A student has to secure a minimum of 40% credits from the second major discipline for the 3-year/4-year UG degree to be awarded a double major Interdisciplinary UG Programmes: The credits for core courses shall be distributed among the constituent disciplines/subjects so as to get core competence in the interdisciplinary Programme.

Multidisciplinary UG Programmes: In the case of students pursuing a multidisciplinary Programme of study, the credits to core courses will be distributed among the broad disciplines such as Life sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc.

The statutory bodies of the Universities and Colleges such as the Board of Studies and Academic Council will decide on the list of courses under major category and credit distribution for double major, interdisciplinary and multidisciplinary programmes.

AIMS OF FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN BIOTECHNOLOGY:

1. The Four Year Under-Graduate Programme (FYUGP) in Biotechnology has several aims that are designed to prepare students for a career in the field and develop their understanding of the principles and applications of Biotechnology, and Applied Biological Sciences as a whole. The program aims to provide students with a comprehensive understanding of the fundamental principles of Biotechnology, including the latest advancements in the field. It also focuses on enabling students to develop critical thinking and problem-solving skills, which are essential for a successful career in this field.
2. Another aim of the FYUGP is to prepare students for a career in the field of Biotechnology by providing them with practical experience and exposure to the latest

industry trends and practices. The program also aims to foster students' research skills and promote innovation and entrepreneurship in the field. This will help to create a Pool of skilled professionals who can contribute to the growth and development of the Biotechnology industry.

3. In addition to these, the program aims to promote ethical and social responsibility among students, ensuring that they are aware of the impact their work can have on society and the environment. The program also focuses on developing students' communication skills, multicultural competence, and digital literacy, which are increasingly important in today's globalized world.
4. Ultimately, the goal of the FYUGP in Biotechnology is to produce competent and skilled professionals who can contribute to the growth and development of the Biotechnology industry in India and globally. By providing students with a well-rounded education that includes practical experience, research skills, and exposure to the latest industry trends, the program aims to prepare them for a successful career in this field.

□ GRADUATE ATTRIBUTES OF THE FYUGP IN BIOTECHNOLOGY

The Four Year Under-Graduate Programme (FYUGP) in Biotechnology aims to produce graduates with a range of attributes that will enable them to succeed in their professional and personal lives. Some of the comprehensive graduate attributes of the FYUGP in Biotechnology are:

Knowledge and skills: Graduates of the FYUGP in Biotechnology are expected to have a strong foundation of knowledge and skills in the areas of Biotechnology, Bioinformatics, and Applied Biological Sciences. They should be able to apply this knowledge to solve complex biological problems and make informed decisions in their professional lives.

Critical thinking and problem-solving: Graduates should be able to think critically and creatively to identify, analyze, and solve problems related to Biotechnology. They should be able to evaluate information, make sound judgments, and communicate their findings effectively.

Research skills: Graduates should be equipped with research skills that will enable them to conduct independent research in the field of Biotechnology. They should be able to design experiments, analyze data, and interpret findings.

Innovation and entrepreneurship: Graduates should be innovative and entrepreneurial, with the ability to identify new opportunities and develop novel solutions to problems in the field of Biotechnology. They should be able to work in interdisciplinary teams and collaborate with others to bring their ideas to fruition.

Ethical and social responsibility: Graduates should be aware of the ethical and social implications of their work in the field of Biotechnology. They should be able to integrate ethical considerations into their decision-making and be socially responsible in their actions.

Communication and interpersonal skills: Graduates should have strong communication and interpersonal skills, with the ability to work effectively in a team, present their findings to

different audiences, and engage in constructive dialogue with colleagues and stakeholders. Multicultural competence and digital literacy: Graduates should be able to work effectively in a multicultural environment and demonstrate proficiency in digital literacy. They should be able to adapt to new technologies and communicate using digital media.

Overall, the FYUGP in Biotechnology aims to produce graduates who are well-rounded, competent, and skilled professionals with a deep understanding of the principles and applications of Biotechnology, and who are prepared to make meaningful contributions to the growth and development of the industry in India and globally.

PROGRAMME LEARNING OUTCOMES

The Objectives of the Undergraduate Programme in Biotechnology are listed in the following. After completing the Programme an undergraduate student in biotechnology will be able to-

PO1: Demonstrate familiarity with the major concepts, theoretical perspectives and latest trends in the field of biotechnology.

PO2: Apply Biotechnology as a tool to solve problems of other disciplines viz., Natural Sciences, Commerce and Management, Humanities, Soft computing etc.

PO3: Develop new techniques/methods for solving the unsolved problems in terms of global welfare.

PO4: Use scientific approach to address issues related to problems of learning.

Teaching Learning Process

The Programme allows using varied pedagogical methods and techniques both within classroom and beyond.

- Lecture
- Tutorial
- Power point presentation
- Project Work/Dissertation
- Group Discussion and debate
- Seminars/workshops/conferences
- Field visits and Report/Excursions
- Mentor/Mentee

Teaching Leaning Tools

- Projector
- Smart Television for Documentary related topic
- LCD Monitor
- WLAN
- White/Green/Black Board

Assessment

- Home assignment
- Project Report

- Class Presentation: Oral/Poster/Power point
- Group Discussions
- In semester examinations
- End Semester examinations

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	:	BIOCHEMISTRY
Course Code	:	BTNC101
Nature of the Course	:	Major
Total Credits	:	04 = 3 (Theory, 45 hours of teaching)+ 1(Practical, 30 hours of lab)
Distribution of Marks	:	60 (End Sem) + 40 (In-Sem)

Objective(s):

- To identify the basic the structure and function of biomolecules, their chemical and physical properties and catalysis.
- To explain the biological catalysts, their mechanisms of action, kinetics and provides an overview of the major metabolic pathways.
- To analyze the role of enzymes in the various metabolism in-vivo.

Module I: Fundamentals of Biochemistry: (8 hours)
Composition of living matter, ionization of water, pH, pKa, buffer system and their application; Henderson-Hasselbalch equation, Bio-energetics: Concept of entropy, free energy, high energy compounds, membrane potential, electron transport chain, chemiosmotic hypothesis.

Module II: Introduction to Biomolecules (10 hours)
Classification, structure and functions of Biomolecules; **Carbohydrate**: Structure, general properties and functions; **Proteins**: Chemistry of amino acids and proteins, Hierarchy of protein structure, Ramachandran Plot; **Nucleic acids**: Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiment.; **Lipids**: Chemistry and functions of fatty acids, essential fatty acids, phospholipids, sphingolipids, prostaglandins, cerebrocides, steroids

Module III: Introduction to Enzymes (14 hours)
General characteristics, nomenclature, IUB enzyme classification, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, biological roles, measurement and expression of enzyme activity, Enzyme Kinetics: enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Michaelis-Menten equation, Line weaver Burk plot, Enzyme inhibitions, Vitamins and its types.

Module IV: Metabolism (13 hours)
General concept of metabolism (catabolism and anabolism), Types of metabolism; Carbohydrates: Glycolysis- pathway, regulation & energetic, feeder pathway of glycolysis, citric acid cycle- reactions and regulation, pentose phosphate pathway and its significance,

gluconeogenesis, glycogenesis and glycogenolysis, Cori cycle, Hormonal regulation of carbohydrate metabolism; Amino Acids: General reactions of amino acid metabolism – transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids. Urea cycle and its regulation; Lipids: Importance of fats, types of fatty acid, beta oxidation of fatty acids.

PRACTICAL (30 hours of lab)

1. Numerical problems based on the preparation of standard solutions of different molarity, normality, strength and percentage.
2. Estimation of proteins by Lowry and Bradford assays.
3. Estimation of total carbohydrates by Anthrone method.
4. Isolation and purification of enzymes from microbial/plant/animal source.
5. Estimation of DNA by diphenylamine method.
6. Quantification of RNA by orcinol method.

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

- Comprehend the role and significance of biomolecules and is anticipated to develop an understanding of working of enzyme.
- In addition, the student is expected to develop an understanding of biochemical pathways and their significance in the sustenance of life.

SUGGESTED READINGS:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition, W.H Freeman and Co.
2. Bowden Athel Cornish, 2004. Fundamentals of Enzyme Kinetics, Portland Press
3. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Jayaraman J, 1988. Laboratory manual of Biochemistry, Wiley East.
6. Jo Keith Willson, 2000. Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press.
7. Murray R K et al., 2005. Harper's Biochemistry, Prentice Hall International
8. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
9. Plummer M & Plummer DT, 2017.Introduction to Practical Biochemistry, McGraw Hill Education
10. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	:	BIOCHEMISTRY AND BIOINSTRUMENTATION
Course Code	:	BTNM102
Nature of the Course	:	Minor Course
Total Credits	:	04 = 3 (Theory, 45 hours of teaching)+ 1(Practical, 30 hours of lab)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

Objective(s):

- To identify the basic the structure and function of biomolecules, their chemical and physical properties and catalysis.
- To explain the biological catalysts, their mechanisms of action, kinetics and provides an overview of the major metabolic pathways.
- To analyze the role of enzymes in the various metabolism in-vivo.

Module I: Foundation of Biochemistry (8 hours)
Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.), Fundamentals of thermodynamic principles applicable to biological processes, Significance of water in biochemistry; acid-base concept, buffers, pH and pK Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins) and their metabolism.

Module II: Enzymology (10 hours)
Introduction to enzymes: General characteristics, IUB enzyme classification, biological roles; Definitions of IU, Katal, enzyme turnover and specific activity. Allosteric enzymes, Isoenzymes, Ribozymes, Restriction enzymes; Cofactors and coenzymes: Nomenclature and classification, role in enzyme catalysis; Vitamins: classification, their coenzyme forms and functions.

Module III: Biophysical Method (14 hours)
Spectroscopy: Theory, instrumentation & applications of- UV-VIS spectrophotometry, IR spectroscopy, Mass Spectrometry and NMR; Microscopic techniques: Principle, working and applications. Light, electron and Confocal Microscopy, Electron Microscopy

Module IV: Separation technique (8 hours)
Chromatography: Principle, types and applications of different chromatographic methods. Partition and Adsorption chromatography, Ion-exchange chromatography, Size exclusion and affinity chromatography; Basic principles of centrifugal force; RCF and RPM; Types of Centrifugation; applications of different centrifuges; Theory, instrumentation and applications.

Native PAGE, SDS PAGE, Agarose gel electrophoresis. Centrifugation: Working principle, types and applications.

PRACTICAL (30 hours of lab)

1. Numerical problems based on the preparation of standard solutions of different molarity, normality, strength and percentage.
2. Hands-on training on setting up and running gel electrophoresis experiments (e.g., agarose gel electrophoresis)
3. Demonstration of centrifugation protocols for isolating cellular components and biomolecules from biological samples.
4. Estimation of proteins by Lowry and Bradford assays.
5. Estimation of total carbohydrates by Anthrone method.
6. Estimation of DNA by diphenylamine method.

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:

- Comprehend the role and significance of biomolecules and is anticipated to develop an understanding of working of enzyme.
- In addition, the student is expected to develop an understanding of biochemical pathways and their significance in the sustenance of life.
- Acquire in-depth knowledge of the theory, instrumentation, and applications of various microscopy and spectrophotometry techniques.
- Compare working principles and application of different chromatographic & centrifugation techniques.

SUGGESTED READINGS:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition, W.H Freeman and Co.
2. Bowden Athel Cornish, 2004. Fundamentals of Enzyme Kinetics, Portland Press
3. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Jayaraman J, 1988. Laboratory manual of Biochemistry, Wiley East.
6. Jo Keith Willson, 2000. Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press.
7. Murray R K et al., 2005. Harper's Biochemistry, Prentice Hall International
8. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
9. Plummer M & Plummer DT, 2017.Introduction to Practical Biochemistry, McGraw Hill Education
10. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	:	GOOD LAB PRACTICES
Course Code	:	BTNS-103
Nature of the Course		: Skill Enhancement Course
Total Credits	:	03 = 2 (Theory, 30 hours of teaching)+ 1(Practical, 30 hours of lab)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

MODULE I: Introduction to GLP (7 hours)
History, Scope, Fundamental points of GLP (Resources Characterization, Rules, Results); General Rules/Protocols for Lab Safety measures, Precaution and Safety in handling of chemicals, Laboratory tools, Glassware and instruments; Internal and External Audit.

MODULE II: Levels of Laboratories (8 hours)
Log Book Maintenance; Basic SOPs for instrument handling and Maintenance; Keeping data records, its analysis by using statistical and mathematical tools; Result analysis and its interpretation.

MODULE III: Biosafety (8 hours)
Definition and requirement; International Legal Instruments on Biosafety- Cartagena Protocol on Biosafety, Nagoya Protocol; Laws relating to Biosafety in India: The Biological Diversity Act, 2002, Biosafety procedures, rules and guidelines under Environment (Protection) Act 1986 and Rules 1989; Biosafety Regulation: Principles and Practices in Microbial and Biomedical Labs for Infectious agents.

MODULE IV: Good Manufacturing Practices (7 hours)
Quality Control and Quality Assurance, Concept, Function and Advantages OECD Guidelines.

PRACTICALS (30 hours):
1. Standard Operating Procedures
2. Demonstration of Laboratory Safety Wear
3. Demo and Maintenance of Internal and External Audit
4. Calibration of Basic Instruments such as pH meter, water bath, Distillation assembly, Burette, Pipette etc.
5. Use of Microsoft word, Excel. (For Data entry, calculation and graphical representation)

LEARNING OUTCOMES:
- Students will be able to safely practice basic laboratory procedures and protocols in future lab situations.
- Maintain laboratory records compliant with current industry standards.

SUGGESTED READINGS:

1. Handbook on Good Laboratory Practices-World health organization (WHO)
2. Life science protocol manual (2018)-DBT star college scheme
3. Guidelines for good laboratory practices-Indian council of medical research, New Delhi (2008).

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	:	BIOTECHNOLOGICAL INNOVATION IN FOOD PRESERVATION TECHNOLOGY
Course Code	:	BTNG-104
Nature of the Course	:	Generic Elective Course
Total Credits	:	03 (Theory, 45 hours of teaching)
Distribution of Marks	:	60 (End Sem) + 40 (In-Sem)

Objectives

- Understand the principles and mechanisms of traditional and biotechnological methods of food preservation.
- Explore the applications of biotechnological innovations such as fermentation, probiotics, and genetic modification in food preservation.
- Evaluate the impact of biotechnological food preservation techniques on food safety, quality, and sustainability.
- Develop critical thinking skills to assess the ethical, social, and environmental implications of biotechnological innovations in food preservation.

Module I: Introduction to Food Preservation (9 hours)
Overview of food preservation methods: traditional vs. biotechnological approaches, Principles of food spoilage and factors influencing shelf life, Regulatory frameworks and safety considerations in food preservation

Module II: Fermentation in Food Preservation (9 hours)
Fundamentals of fermentation: microbial metabolism and product formation, Applications of fermentation in food preservation: yogurt, cheese, sauerkraut, and kimchi, Fermentation techniques and microbial cultures used in food fermentation.

Module III: Biopreservation Techniques (9 hours)
Principles of biopreservation: inhibition of spoilage and pathogenic microorganisms; Biopreservation methods: bacteriocins, lactic acid bacteria, and protective cultures; Application of biopreservation in meat, fish, dairy, and bakery products.

Module IV: Genetic Modification in Food Preservation (9 hours)
Genetic engineering techniques for food preservation: transgenic crops, Case studies of genetically modified organisms (GMOs) in food preservation: pest resistance, shelf-life extension, and nutrient enhancement; Regulatory issues and public perceptions of GMOs in food.

Module V: Novel Approaches in Food Preservation (9 hours)

Emerging biotechnological innovations in food preservation: nanotechnology, edible coatings, and antimicrobial peptides; Applications of novel approaches in extending shelf life, reducing food waste, and improving food safety.

PRACTICALS

1. Isolate microbes from preserved or fermented food
2. Isolate microbes from spoiled food
3. Stain microbes isolated from different foods (simple and gram staining in bacteria and yeast/ lactophenol cotton blue staining in filamentous fungi or mold)
4. Compare the nutritional content of fermented (curd) vs. non-fermented products (paneer)

LEARNING OUTCOMES:

At the end of the course, the student would be able to

- Adhere to the ethical practices appropriate to the various scientific disciplines at all times
- Adopt safe working practices relevant to the different biotech industries & fields of research

SUGGESTED READINGS:

1. Jay. J.M., Loessner. M.J. and Golden. D.A. (2005). Modern Food Microbiology. 7thedition, CBS Publishers and Distributors, Delhi, India.
2. Currell. B.C., Dam-Mieras. R.C.E. (1991). Biotechnological Innovations in Food Processing. Elsivier.
3. Verma D.K., Ami R. Patel A.R., Sandhu K.S., Baldi A., Garcia S. (2021). Biotechnical Processing in the Food Industry: New Methods, Techniques, and Applications. Apple Academic Press
4. Barbosa J, Teixeira P. (2022). Biotechnology Approaches in Food Preservation and Food Safety. Foods.
5. Bicas J.M.,Maróstica Jr.M.R., Pastore G.M. (2016). Biotechnological production of natural ingredients for food industry: First edition. Bentham Books.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	:	CELL BIOLOGY
Course Code	:	BTNC-201
Nature of the Course	:	Major
Total Credits	:	04 = 3 (Theory)+ 1(Practical)
Distribution of Marks	:	60 (End Sem) + 20 (In-Sem)

Course objectives:

- To identify the basic understanding of the fundamentals of cell structure and function.
- To explain the mechanisms of the cellular processes of signaling and transport of biomolecules.
- To analyze the specific methodologies used in the study of modern cell biology, through lab experiments and exercises.

Module I: Membrane structure and function (12 hours)

Basic concept of a cell: Prokaryotic & Eukaryotic cell; Cell Theory and its modification, Cell size, Surface area by volume ratio, Structure of Cell wall (Plant, Bacteria, Fungi), Structure and function of Plasma Membrane, Different models on plasma membrane, Molecular transport across the membrane: Passive and Active transport, ABC transporter, Cell organelles –Structure and function of Nucleus, Chloroplast, Mitochondria; Endomembrane system; Structure & function of the cytoskeleton and their role in motility.

Module II: Cell-cell interactions (10 hours)

Structural components of extracellular matrix, Interaction of cells with ECM, Cell Adhesion Molecules (CAM) - Selectin, Integrin, Ig superfamily, Cadherin; Tight junctions, Gap junctions and Plasmodesmata.

Module III: Cell communications and signal transduction (12 hours)

Mechanisms of cell communication: Cell signaling and mechanism of signal transduction and receptors, Types of signaling molecules, Classification of receptors, GPCR and RTK Signal transduction pathways, Regulation of signaling pathways, Secondary messengers.

Module IV: Cell cycle (11 hours)

Cell division-Mitosis and meiosis, Steps in cell cycle & their regulation, Molecular basis of cell cycle- Cellular checkpoints of the cell cycle, Regulation and control of cell cycle, Cell death, Apoptosis and other cell death processes, Biochemical changes in Apoptosis, Molecular basis of Apoptosis, An overview of polytene chromosome.

PRACTICAL (30 hours of lab)

1. Study of mitosis in onion root tips
2. Study of mitosis in Chick pea root tips

3. Study of meiosis in onion flower bud.
4. Study of polytene chromosome in Drosophila larvae.

LEARNING OUTCOMES:

The students will have

- Strong underpinning of fundamentals of cell structure and function.
- lucid understanding of the cellular processes of signaling and transport
- a comprehensive understanding of the cellular changes that lead to malignancy
- strong underpinning of fundamentals of the different developmental pathways that lead to both morphogenesis and organogenesis in both animals and plants

RECOMMENDED READINGS:

1. Cell and Molecular Biology, Phillip Sheeler and Donald E. Bianchi.
2. Molecular Biology of the Cell. Alberts et al. Garland Science, 18-Nov-2014
3. Molecular Cell Biology, Harvey Lodish, W. H. Freeman, 2008
4. Schaum's Outline of Molecular and Cell Biology, William Stansfield, Jaime S. Colomé, Raúl J. Cano, McGraw Hill Professional, 22-Sep-1996
5. Essential Cell Biology. Bruce Alberts. Garland Pub., 1998
6. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, 8th edition, Wiley.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	:	CELL BIOLOGY AND MICROBIOLOGY
Course Code	:	BTNM-202
Nature of the Course	:	Minor Course
Total Credits	:	04 = 3 (Theory)+ 1(Practical)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

Course objectives

- To identify the basic understanding of the fundamentals of cell structure and function.
- To explain the mechanisms of the cellular processes of signaling and transport of biomolecules.
- To analyze the specific methodologies used in the study of modern cell biology, through lab experiments and exercises.
- To have an in-depth knowledge about the diversity of microorganisms and a comprehensive understanding of the basic techniques employed for their isolation, characterization and culture.

Module I: Membrane structure and function (12 hours)
Cell: Prokaryotic & Eukaryotic cell, Cell Theory (Scleiden and Schwann), Cell wall , Structure and function of Plasma Membrane, Different models on plasma membrane, Passive and Active transport, ABC transporter, Cell organelles –Structure and function of Nucleus, Chloroplast, Mitochondria; Endomembrane system; Structure & function of the cytoskeleton and their role in motility.

Module II: Cell division and cell cycle (10 hours)
Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle. Concept of Polytene chromosome.

Module III: Structure of bacteria; nutrition, growth medium. Methods of sterilization**:** pure culture, isolation, selective method of isolation, cultivation, preservation **(8 hours)**

Module IV: Metabolic diversity among microorganisms: Heterotrophs, autotrophs, phototrophs; chemolithotrophs; (iron, sulfur utilizing microbes). **Host parasite interaction:** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells-pathogen-induced diseases in animals and plants. **(10 hours)**

PRACTICAL (30 hours of lab)

1. Study of mitosis in onion root tips
2. Study of mitosis in Chick pea root tips.
3. Study of meiosis in flower bud.
4. Starch hydrolysis test.
5. Catalase test
6. Study of polytene chromosome in Drosophila larvae.

LEARNING OUTCOMES:

The students will have

- Strong underpinning of fundamentals of cell structure and function.
- lucid understanding of the cellular processes of signaling and transport
- a comprehensive understanding of the cellular changes that lead to malignancy
- strong underpinning of fundamentals of the different developmental pathways that lead to both morphogenesis and organogenesis in both animals and plants

RECOMMENDED READINGS:

1. Cell and Molecular Biology, Phillip Sheeler and Donald E. Bianchi.
2. Molecular Biology of the Cell. .Alberts et al. Garland Science, 18-Nov-2014
3. Molecular Cell Biology, Harvey Lodish, W. H. Freeman, 2008
4. Schaum's Outline of Molecular and Cell Biology, William Stansfield, Jaime S. Colomé, Raúl J. Cano, McGraw Hill Professional, 22-Sep-1996
5. Essential Cell Biology. Bruce Alberts. Garland Pub., 1998
6. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, 8th edition, Wiley.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP) DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	:	VERMICOMPOSTING
Course Code	:	BTNS-203
Nature of the Course	:	Skill Enhancement Course
Total Credits	:	03 = 2 (Theory)+ 1(Practical)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

COURSE OBJECTIVES:

1. To have a basic understanding of vermicomposting
2. To develop skills, through lab experiments and exercises, in specific methodologies used in the contemporary vermicomposting.
3. To elucidate the impact of different vermicomposting practices and its economic importance.
4. To understand the scope, prospect and challenges in vermi-technology and its application.

MODULE I (7 hours)

Vermicompost: Definition and its types, Elements of Vermicompost, Importance of Vermicompost in Agri-horticultural practices; Vermicomposting for Organic Farming - an Eco-Friendly approach; Vermicomposting for Rural Development

MODULE II (8 hours)

Waste materials: Classification, disposal techniques & their impact on environment; Earthworms: Types, identification & usefulness; Anaerobic (Pit) & Aerobic (Heap) composting: techniques & their comparison.

MODULE III (8 hours)

Vermiculturing: Techniques & importance; Vermicomposting techniques, standard composition of Vermicompost; Vermi-wash production techniques, standard; composition of vermiwash.

MODULE IV (7 hours)

Economics on Vermiculture and Vermicomposting; Problems & prospects of Vermicomposting in India

PRACTICALS (30 hours)

1. **Preparation of Vermicompost pit**
    - Collection of wastes & their segregation & processing
    - Bed preparation for Anaerobic & Aerobic composting. Fortnightly mixing of beds
    - Bed preparation for Vermicomposting. Four chambered tank/pit system, etc.
    - Earthworm collection & application on beds. Inspection of beds & watering 2.

2. Vermicompost and vermin-wash collection.

- Vermicompost collection, Earthworms Separation, Air drying of vermicompost, Sieving & storing
- Vermi-wash collection & processing

LEARNING OUTCOMES:

The students will

- have a basic understanding of vermicomposting
- Develop skills in specific methodologies used in the contemporary vermicomposting.
- Have a comprehensive understanding of the impact of different vermicomposting practices and its economic importance.
- Have strong underpinning of fundamentals of the scope, prospect and challenges associated with vermi-technology, along with its application.

SUGGESTED READINGS:

1. Verms & Vermitechnology, Arvind Kumar (2005) APH Publishing (New Delhi). Reference Books
2. Vermitechnology, A. Mary Violet Christy (2014) MJP Publisher (India).
3. Vermitechnology, M. Seetha Lekshmy and R. Santhi Saras (2012) Publication (New Delhi)

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP) DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	:	**BIOTECHNOLOGICAL INNOVATIONS IN HORTICULTURE**
Course Code	:	BTNG-204
Nature of the Course	:	Generic Elective Course
Total Credits	:	04 = 3 (Theory)+ 1(Practical)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

Objectives:

- Understand the principles and techniques of biotechnology as applied to horticulture.
- Explore the applications of genetic engineering in modifying plant traits for improved productivity, quality, and resilience.
- Learn tissue culture techniques for mass propagation of horticultural crops and conservation of genetic resources.
- Gain insights into molecular breeding strategies for developing new plant varieties with desirable traits.
- Examine the ethical, social, and environmental implications of biotechnological innovations in horticulture.
- Develop critical thinking and problem-solving skills through hands-on laboratory experiments and case studies.

Module I: **Introduction to Biotechnological Innovations in Horticulture (10 hours)**
Overview of biotechnology and its applications in horticulture, Historical perspectives and current trends in biotechnological innovations, Ethical considerations and regulatory frameworks in biotechnology**.**
Genetic Engineering in Horticulture: Principles of genetic engineering: gene cloning, gene editing, and transgenic technologies, Applications of genetic engineering in horticulture: pest resistance, herbicide tolerance, and nutritional enhancement, Case studies of genetically modified crops and their impact on agriculture.

Module II: Tissue Culture Techniques for Horticultural Crops (10 hours)
Introduction to tissue culture and micro propagation, Techniques for in vitro culture of plant tissues: explant selection, sterilization, and culture media preparation
Molecular Breeding for Crop Improvement: Principles of molecular breeding: marker-assisted selection, genomic selection, and gene pyramiding, Applications of molecular breeding in horticulture: disease resistance, abiotic stress tolerance, and yield improvement, Case studies of successful molecular breeding programs in horticultural crops.

Module III: Biotechnological Approaches to Crop Protection (10 hours)

Biotechnological strategies for pest and disease management in horticulture, Use of biopesticide, plant-derived compounds, and RNA interference (RNAi) technologies

Bioremediation and Phytoremediation Techniques

Biotechnological approaches for soil and water remediation using plants, Use of horticultural crops for phytoremediation of heavy metals, organic pollutants, and contaminants, Case studies of successful phytoremediation projects and their implications for sustainable agriculture.

Module IV: Precision Agriculture and Remote Sensing Technologies (10 hours)

Integration of biotechnology with precision agriculture techniques for optimal crop management, Use of remote sensing technologies, GIS (Geographic Information System), and drones in horticulture

Future Directions and Challenges in Biotechnological Innovations

Emerging trends in biotechnology and their potential impact on horticulture, Challenges and opportunities in translating biotechnological innovations into practical solutions for agriculture, Final project presentations and discussions on innovative biotechnological applications in horticulture.

PRACTICALS (30 hours of lab)

1. Preparation of Immobilized Seeds
2. Isolation and visualization of protoplast under microscope
3. Establishment of tissue culture cultures
4. Preparation of explants
5. Preparation of biopesticide extracts
6. Testing the efficacy of *Trichoderma* against fungal pathogen

SUGGESTED READINGS:

1. Suza. W. and Lee. D.(2021). Genetics, Agriculture, and Biotechnology. Iowa State University.
2. Ratledge. C. and Kristiansen. H. (2006). Basic Biotechnology. 3rd Edition. Cambridge University Press.
3. Peter. K.V. (2013). Biotechnology in Horticulture: Methods and Applications. New India Publishing Agency, New Delhi
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : FUNDAMENTALS OF MICROBIOLOGY
Course Code : BTNC-301
Nature of the Course : Major
Total Credits : 04= 3(Theory, 45 hour) + 1 (Practical, 30hours)
Distribution of Marks : 60 (End Sem) + 40 (In-Sem)

Course objectives:

- To identify the diversity of microorganisms and a comprehensive understanding of the basic techniques employed for their isolation, characterization and culture.
- To analyze the specific methodologies used in the study of microbiology through lab experiments and exercises.

Module I: Basics of microbiology (8 hours)

History of Microbiology, Basic bacterial growth kinetics, Bacterial growth curve, Nutrition, Microbial culture medium, pure culture; Methods of sterilization, isolation, Selective method of isolation, cultivation; Cryopreservation.

Module II: Diversity (9 hours)

Metabolic diversity among microorganisms: Heterotrophs, organotrophs (methane utilization, hydrocarbon transformation); autotrophs, phototrophs; chemolithotrophs; (iron, sulfur utilizing microbes) and their importance in biotechnology. Microbial diversity, New approaches to bacterial taxonomy (ribotyping).

Module III: Bacterial kingdom (14 hours)

Classification (Bergy's Manual for Systematic Bacteriology), General characters, Model organism: *Escherichia coli*, *Staphylococcus* spp., *Streptococcus spp*., *Bacillus*, *Spirullina*, *Clostridium* spp, Archaea: General characters, chemical nature, Phyllum: Crenarchaeota, Euryarchaeota; Classification and properties: acidophilic, alkalophilic, thermophilic, barophilic and osmophilic microbes, methanogens, methane production; Biotechnological potential of extremophiles; Economic & ecological importance of bacteria.

Module IV: Viruses and other infectious agents (14 hours)

General characters, Chemical nature, and structure of TMV, HIV, bacteriophages, Lytic and lysogenic cycles, Viroids and Prions; Fungi and molds: General characters, structure, reproduction, and model organism: *Saccharomyces, Aspergillus* spp, Penicillum spp. *Neurospora* spp. Protozoa: General characters, structure, reproduction. Model protozoan: *Plasmodium* spp., *Amoeba, Paramecium.*

PRACTICAL (30 hours of lab)

1. Cleaning and sterilization of glass wares.
2. Preparation of liquid and solid media for growth of microorganism and pure culture technique.
3. Isolation and enumeration microorganisms from mixed population.
4. Microbial colony characterization in different media.
5. Microbial sub-culturing and preservation techniques.

6. Staining techniques (Gram's staining and Lactophenol cotton blue staining)
7. IMViC test.
8. Starch hydrolysis test.
9. Catalase test

LEARNING OUTCOMES

The students will have

- Thorough knowledge and understanding of the core concepts in the disciplines of Microbiology.
- Knowledge on how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.

RECOMMENDED READINGS

1. Microbiology- A Lab Manual, Cappuccino and Sherman.
2. Experiment in Microbiology, Plant pathology and Biotechnology, K.R. Aneja.
3. Microbiology: A Text Book of Microorganisms, General and Applied, Charles Edward Marshall, F.T. Bioletti Published P. P.Blakiston's son &co.
4. Microbiology, M.J. Pelczer and R.D. Reid.
5. General Microbiology, R. Y. Stanier *.et.al*.
6. Soil Microbiology, S. A. Walman.
7. Microbiology, by Prescott, Tata MacGrawHill.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	: MOLECULAR BIOLOGY
Course Code	: BTNC-302
Nature of the Course	: Major
Total Credits	: 04= 3 (Theory, 45 hour) + 1(Practical, 30 hours)
Distribution of Marks	: 60 (End Sem) + 40 (In-Sem)

Course objectives

- To identify the concepts of biomolecules viz. DNA and RNA, its maintenance and processing inside a cell.
- To explain in-depth knowledge about the different mechanism involved in replication of DNA in prokaryotes and eukaryotes.
- To explain transcription of DNA to RNA in prokaryotes and eukaryotes and translation of protein from RNA in prokaryotes and eukaryotes.
- To analyze and conceptualize the fundamental principles behind the expression of gene.

Module I: Genetic material and its packaging (8 hours)
Nucleic acid as genetic material, Griffith transforming principle, Hershey and Chase experiment, Genome organization in prokaryotes and eukaryotes, Chromatin structure and function. Heterochromatin, euchromatin, Histones and non-histone proteins, Histone modification, general properties of histone, nucleosomes, solenoid structure, packaging of DNA, satellite DNA.

Module II: Replication (11hours)
DNA replication: mechanism, the replicons, origin, primosome & replisomes, Properties of prokaryotic and eukaryotic DNA polymerases, Enzymes involved in DNA replication, Synthesis of leading and lagging strand. Difference between prokaryotic and eukaryotic replication.

Module III: Transcription and Translation (14 hours)
Prokaryotic transcription; promoters, Transcription unit, properties of bacterial RNA polymerase; Steps: initiation, elongation and termination, TATA Box, Properties of RNA polymerase I, II and III; RNA processing and RNA editing. Inhibitors of transcription; Translation: Ribosomes structure and function, genetic code, aminoacyl tRNA synthases, Formation of translation initiation complex, chain elongation, translocation & termination and the role of respective factors involved therein; Post-translational modifications- Proteolytic cleavage, covalent modifications, glycosylation of proteins.

Module IV: **Regulation of gene expression (12 hours)**
Positive and negative control. Repressor & Inducer, Concept of operon- lac/ trp operons, Attenuation and catabolite repression; Nucleases and restriction enzymes, C-value paradox.

PRACTICAL (30 hours of lab)

1. Extraction of DNA from bacterial/plant/ animal source.
2. Extraction of RNA from bacteria.
3. Quantification of DNA/RNA.
4. Quality assessment of DNA.
5. Restriction Digestion.

LEARNING OUTCOMES:

The students will be able to develop

- An understanding of the concepts of replication, transcription, translation and other concepts of molecular biology.
- Practical knowledge on isolation, screening and visualization of biomolecules viz., DNA, RNA and Protein.

RECOMMENDED READINGS

1. Genomes, T. A. Brown.
2. Gene cloning and Data analysis- An introduction, T.A. Brown.
3. Molecular Biology of the Gene, James D. Watson, Pearson/Benjamin Cummings, 2008.
4. Molecular Biology, Robert Weaver, McGraw-Hill Education, 11-Feb 2011.
5. Molecular Biology of the Cell. Alberts et al. Garland Science, 18-Nov 2014.
6. Molecular Cell Biology, Harvey Lodish, W. H. Freeman, 2008.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	:	GENETICS AND BIOSTATISTICS
Course Code	:	BTNM-303
Nature of the Course	:	MINOR COURSE
Total Credits	:	04 = 3 (Theory)+ 1(Practical)
Distribution of Marks	:	60(End Sem) + 40 (In-Sem)

Course objectives

- To identify the fundamentals of genetics and principles of Mendelian genetics.
- To explain the condition relating to mutation and chromosomal disorder.
- To explain the impact of different practices in cultivation of mushroom
- To analyze and develop problems relating to genetics and other biological data using statistics.

Module I: Mendelian principles (12 hours)

Dominance, segregation, independent assortment, Concept of gene: Allele, Structure of chromosome and its types; multiple alleles. Extensions of Mendelian principles; Codominance, incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, phenocopy, linkage and crossing over.

Module II: Mutations and Chromosomal aberration (8 hours)

Molecular basis of mutation—types, spontaneous mutation, induced mutations, transition & transversion; point mutation, frameshift mutation; Mutagens-physical & chemical mutagens; mechanism of action of different mutagens.

Module III: Descriptive Statistics (10 hours)

Introduction to data types; mean, median, mode, Measures of central tendency and dispersion; Probability distributions: Binomial, Poisson and normal.

Module IV: Test of significance (10 hours)

Students t-test (one and two), Chi-square test, non-parametric tests, Analysis of variance (one way and two way classifications).

PRACTICALS (30 hours of lab)

1. Solving Problems related to Mendelian Genetics
2. Solving Problems related to deviation Mendelian Genetics
3. Solving Problems related to linkage analysis and chromosome mapping
4. Solving Problems related to population genetics
5. Solving Problems related to quantitative genetics
6. Solving of statistical problem using Excel
7. Solving of statistical problem using SPSS

SUGGESTED READINGS

1. Genetics: The continuity of life, D. J. Fairbanks and W. H. Andersen, Brooks/Cole Pub., 1999
2. Introduction to Genetic Analysis- Vol. 10, Anthony J.F. Griffiths, W. H. Freeman, 2008
3. Applied Statistics Process , B. Biswas, New Central Book Agency, Kolkata
4. Genetics of Population, J.P Jain and V.T Pravakaran South Asian Publishers (P) Ltd. New Delhi.
5. Statistical techniques for studying genotype-environment introduction, V.T Pravakaran and J.P. Jain.
6. A Biostatistical and population oriented Approach, South Asian Publisher (P) Ltd. New Delhi.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	: MUSHROOM CULTIVATION
Course Code	: BTNS-304
Nature of the Course	: Skill Enhancement Course
Total Credits	: 03 = 2 (Theory) + 1(Practical)
Distribution of Marks	: 60(End Sem) + 40 (In-Sem)

COURSE OBJECTIVES:

- To identify and differentiate edible mushrooms from poisonous one.
- To explain the impact of different practices in cultivation of mushroom.
- To explain the impact of different practices in cultivation of mushroom
- To analyze and develop the develop skills, through lab experiments and exercises, in specific methodologies identification of edible mushroom.

MODULE I: INTRODUCTION TO EDIBLE MUSHROOM (7 hours) Edible Mushroom: Different parts of a typical mushroom & variations in mushroom morphology; Key to differentiate Edible from Poisonous mushrooms.

MODULE II: NUTRIENT PROFILE OF MUSHROOM (7 hours)
Protein, Amino acids, Calorific values, Carbohydrates, Fats, Vitamins & minerals

MODULE III: HEALTH BENEFITS OF MUSHROOM (8 hours)
Antiviral value, Antibacterial effect, Antifungal effect, Anti-tumor effect, Haematological value Cardiovascular & renal effect, Therapeutic diets for adolescence, aged persons & diabetes mellitus.

MODULE IV: Cultivation of Button, Oyster and Straw Mushrooms (8 hours) Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing; Economic importance of mushroom and their uses.

PRACTICALS (30 hours)

1. Cultivation of Mushroom (Oyster Mushroom/Button Mushroom and other locally available edible mushroom).
   a. Mushroom bed preparation
   b. Spawning and Spawn maintenance
   c. Harvesting of Mushroom
2. Nutrients content analysis in mushroom.
   a. Protein and amino acid analysis in mushroom
   b. Lipid analysis in mushroom

LEARNING OUTCOMES:

The students will

· have a basic understanding and identifying edible mushroom

· be able to identify and differentiate edible mushroom from poisonous mushroom · be able to cultivate edible mushroom and understand its nutritive and economic importance.

SUGGESTED READINGS:

1. Mushroom Cultivation, Tripathi, D.P. (2005) Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
2. Mushroom Production and Processing Technology, Pathak Yadav Gour (2010) Published by Agrobios (India).
3. A hand book of edible mushroom, S.Kannaiyan& K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi.
4. Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co.

B.Sc. IN BIOTECHNOLOGY AND BIOINFORMATICS (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course	: BIOTECHNOLOGY AND HUMAN WELFARE
Course Code	: BTNG-305
Nature of the Course	: Generic Elective Course
Total Credits	: 03 = 2 (Theory) + 1(Practical)
Distribution of Marks	: 60(End Sem) + 40 (In-Sem)

Course objectives

- This course is an introduction to the students on the ethical aspects of conducting research and safety aspects to be adhered in a research setting.
- This course also introduces the students to effective management of available resources and footprint of research activities.

Module I: Industrial Biotechnology (8 hours)

Scope and importance of Biotechnology in human welfare; Protein engineering, Enzyme and polysaccharide synthesis, Activity and secretion of enzyme, Alcohol and antibiotic formation.

Module II: Agriculture Biotechnology (7 hours)

N2 fixation, Nod and Nif gene, Transfer of pest resistance genes to plants, Interaction between plants and microbes, Qualitative improvement of livestock.

Module III: Environments (8 hours)

Chlorinated and non-chlorinated organ pollutant degradation, Degradation of hydrocarbons and agricultural wastes, Wastes management, Development of biodegradable polymers such as PHB.

Module IV: Health (7 hours)

Development of non-toxic therapeutic agents, Recombinant live vaccines, Gene therapy, Diagnostics, Monoclonal antibodies production, production of human insulin, Human genome project.

PRACTICALS (30 hours of lab)

1. Perform of ethanolic fermentation using Baker's yeast.
2. Study of a plant part infected with a microbe.
3. To perform quantitative estimation of residual chlorine in water samples.
4. Isolation and analysis of DNA from minimal available biological samples.

LEARNING OUTCOMES:

At the end of the course, the student would have gained sufficient knowledge to act as a responsible scientist and environmentally conscious.

SUGGESTED READINGS

1. Microbiological Examination of Water and Wastewater By Maria Csuros; CRC Publishing House
2. Textbook of Environmental Microbiology by Pradipta K. Mohapatra; I. K. International Pvt Ltd.
3. Environmental Microbiology (Second Edition) Edited by: Ian L. Pepper, Charles P. Gerba, Terry Gentry and Raina M. Maier; Elsevier LLC.
4. Agricultural Microbiology by Rangaswami G; MT Publishers.
5. Atlas RM (1997). Principles of Microbiology. McGraw Hill.