



गोंय विद्यापीठ

ताळगांव पठार

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(Accredited by NAAC)

GU/Acad –PG/BoS -NEP/2023/102/11

Date: 16 .06.2023

CIRCULAR

The University has decided to implement the UGC Curriculum and Credit Framework for the Undergraduate Programme (CCFUP) of **Bachelor of Science in Biotechnology/Bachelor of Science in Biotechnology (Honours)** under the National Education Policy (NEP) 2020 from the Academic Year 2023-2024 onwards.

The approved Syllabus of Semesters I and II of the **Bachelor of Science in Biotechnology/Bachelor of Science in Biotechnology (Honours)** Programme is attached.

Principals of Affiliated Colleges offering the **Bachelor of Science in Biotechnology/Bachelor of Science in Biotechnology (Honours)** Programme are requested to take note of the above and bring the contents of this Circular to the notice of all concerned.

(Ashwin Lawande)

Assistant Registrar – Academic-PG

To,

1. The Principals of Affiliated Colleges offering the Bachelor of Science in Biotechnology /Bachelor of Science in Biotechnology (Honours) Programme.

Copy to:

1. The Director, Directorate of Higher Education, Govt. of Goa.
2. The Dean, School of Biological Sciences and Biotechnology, Goa University.
3. The Vice-Deans, School of Biological Sciences and Biotechnology, Goa University.
4. The Chairperson, BOS in Biotechnology.
5. The Controller of Examinations, Goa University.
6. The Assistant Registrar, UG Examinations, Goa University.
7. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website

Goa University
Programme Structure for Semester I to VIII Under Graduate Programme- Biotechnology

Semester	Major -Core	Minor	MC	AEC	SEC	I	D	VAC	Total Credits	Exit
I	GBT-100 - Biotechnology in Everyday Life (4)	GBT-111 Biotechnology: Insights and Progression (4)	GBT-131 - Nutrition and Dietetics (3)		GBT-141 - Laboratory Essentials (3)	-	-		20	-
II			GBT-132- Lifestyle Diseases and Management (3)		GBT-142- Bakery and Fermented Beverage Technology (3)	-	-		20	GBT- 161 Eco Friendly Bioproducts (4)
III	GBT-200 - Cell Biology (4) GBT-201- Elementary Microbiology (4)	GBT-211- Biomolecules (4)	GBT-231- Emergency Response and First Aid (3)		GBT-241- Modern Agricultural Practises and Home Gardening (3)	-	-		20	-
IV	GBT-202- Biochemical Processes and Metabolism (4) GBT-203-Genetics(4)	GBT-221 - Principles of Ecology and Evolution (4) (VET)	-		-	-	-	-	20	GBT -261 Public Healthcare (4)

	GBT-204- Mammalian Physiology (4) GBT-205- Plant Physiology (2)									
V	GBT-300- Molecular Biology (4) GBT-301- Plant tissue culture (4) GBT-302- Immunology (4) GBT-303- Virology (2)	GBT-321- Biostatistics (4) (VET)	-	-	-	Internship (2)	-	20	-	
VI	GBT-304- Industrial Biotechnology (4) GBT-305- Animal Tissue Culture(4) GBT-306- Bioanalytical Tools (4) GBT-307- Minor Project (4)	GBT- 322- Forensic Science & Toxicology (4) (VET)	-	-	-	-	-	20	-	
VII	GBT-400- Recombinant DNA technology (4)	GBT-411- Developmental Biology (4)						20	-	

Name of the Programme: Biotechnology

Course Code: GBT-100

Title of the Course: Biotechnology in Everyday Life

Number of Credits: 04

Effective from AY: 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	<ol style="list-style-type: none">1. To understand the fundamental concepts and various applications of biotechnology in different fields.2. To explore the role of microorganisms in fermentation technology, use of genetically modified organisms in agriculture, animal husbandry, and medicine, applications of diagnostic tools, biosensors and vaccines in disease prevention and diagnosis.3. To examine the role of biotechnology in waste treatment and environmental remediation, and the potential for sustainable solutions to environmental problems.4. To study the applications of biomimetic, enzymes, and bioinformatics in biotechnology, and their potential for innovation and commercialization.	
Content:	<p>MODULE I General overview and concept Biotechnology. Fermented foods (cheese, yoghurt, sauerkraut, bread), prebiotics and probiotics, Alcoholic beverages (beer, wines), Study of Microbial flora from fermented products, antimicrobial agents (antibiotics), Nutraceuticals, SCP and mushroom cultivation, genetically modified foods, Organic acids, amino acids, vitamins.</p> <p>MODULE II Genetically modified organisms: Plants (resistance to biotic and abiotic stresses, improved crop yield and quality improved nutrition (Case study of Golden rice); animals (mice, cattle, pigs, fish, sheep), microorganisms (Insulin production). Development of Vaccines. Vaccine types-recombinant vaccines, bacterial vaccines, viral vaccines (COVID), Diagnostic and molecular tools (readily available kits, molecular scissors) Biosensors.</p> <p>MODULE III Bio-fertilizers, bio-pesticides, vermicomposting. Bioethanol, Biofuels, Bioplastics. Treatment of industrial wastes, bioremediation, sewage/ waste water treatment, bioleaching, bioaugmentation. Bioindicators. Enzymes and applications in Industries (Amylase, cellulase, pectinase, protease, lipase). Introduction to Biomimetics and their applications (jellagen, tissium, greenbone). Dark Biotechnology (biowarfare, biological weapons and Bioterrorism) (Case studies: Anthrax). Concept of Bioinformatics and Databases in Biotechnology.</p>	<p>15 hours</p> <p>15 hours</p> <p>15 Hours</p>

	<p>PRACTICALS</p> <ol style="list-style-type: none"> 1. Study of Microbial flora from fermented products- Curd. 2. Preparation of Sauerkraut. 3. Preparation of Ethanol by yeast. 4. Mushroom cultivation. 5. Microbiological assay of antibiotics - Diffusion method. 6. Study of ABO blood group and Rh factor in Humans. 7. Pregnancy test using kit. 8. Biosensors - Estimation of blood glucose (Demonstration). 9. Qualitative study of Amylase. 10. Qualitative study of Protease. 11. Study of phosphate solubilizing activity of microorganisms. 12. Demonstration of bacteria as biocontrol agents of plant diseases. 13. Composting of kitchen waste. 14. Introduction to biological databases- NCBI and PDB. 15. Visit to a sewage / waste water treatment plant. 	<p>30 hours</p>
<p>Pedagogy:</p>	<p>Lectures and class discussions to introduce basic principles and concepts. Use of ICT tools. Case studies to provide real-world examples of biotechnological products and processes. Fundamental theoretical concepts will be explained by practical demonstration.</p>	
<p>References/ Readings:</p>	<ol style="list-style-type: none"> 1. R. Renneberg, V. Berkling, V. Lorocho, D. Süßbier, Biotechnology for Beginners. Elsevier Science. 2023 2. U. Satyanarayana and U. Chakrapani, Biotechnology. Books and Allied. 2021. 3. Willey, J.M., Sherwood, L.M., and C.J. Woolverton, Prescott's Microbiology (11th ed.). McGraw-Hill Education. 2021. 4. Dr. H.K Das, Textbook of Biotechnology. Wiley India. 2017. 5. B.D. Singh, Biotechnology: Expanding Horizons. Kalyani Publishers. 2014. 6. F. Mitha, "Biomimicry in Biotech: Taking Inspiration from Nature" Labiotech.eu[online document], 2021 Available: https://www.labiotech.eu/in-depth/biomimicry-biotech-nature-inspiration/ 	
<p>Course Outcomes:</p>	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic principles and techniques used in biotechnology research and development with the help of demonstrations and case studies. 2. Evaluate the impact of biotechnology on human health, agriculture, industry, and the environment. 3. Understand the principles and methods of genetic engineering in plants, animals and microorganisms. 4. Recognise the implications of biotechnology in biological weapons development. 	

Name of the Programme: Biotechnology

Course code: GBT-111

Title of the course: Biotechnology: Insights and Progression

Number of credits: 04

Effective from AY: 2023-24

Prerequisites for the Course:	Nil
Course Objectives:	<ol style="list-style-type: none">1. To gain an accurate and deep understanding in the field of biotechnology.2. To appreciate developments in biotechnology from ancient civilizations to modern times.3. To familiarize students with the applications of biotechnology in agriculture, medicine, environment, food and beverage industries and conservation of biodiversity.4. To encourage students to pursue biotechnology as a promising career.
Content:	<p>MODULE I Ancient biotechnology: Domestication of crops & livestock, traditional fermented products, preservation & storage of food. Classical biotechnology: Discovery of microscope & microorganisms, early medicinal development, pasteurisation & sterilization, discovery of penicillin. Overview of Mendelian genetics. Discovery of chromosomes, gene as carrier of hereditary: phenotype & genotype, gene theory, jumping genes. Modern biotechnology: DNA structure-Double helix model of DNA, central dogma, genetic code, first recombinant DNA molecule, sequencing technology: revolutionary breakthrough, first vaccine, DNA fingerprinting, human genome project, Dolly 'the cloned' sheep.</p> <p>MODULE II Pre-independence Indian scenario of food and agriculture (1997-1990). Green revolution, Golden rice, eugenics, improved crops, GM foods, Flavour savour tomatoes, designer milk, Cultured food products, Cereal fermentation, genetically modified fishes & meat, Role of biotechnology in managing the carbon footprint of food industry, Smart food delivery systems, way forward-policy and actions.</p> <p>MODULE III Disease outbreaks (Smallpox, Bubonic Plague, Spanish Flu, and COVID), Development of vaccines, Clinical Trials, Molecular Diagnosis (immunological kits, monoclonal antibodies and Biosensors). Recombinant DNA technology (Recombinant Insulin, Edible Vaccines, Genome editing & Gene Therapy), Biomedical Innovations – 3D Bioprinting, Stem cell therapy, Regenerative</p>
	15 hours
	15 hours
	15 hours

	<p>medicine, Biomaterials, Implants, Bionics & Scaffolding, Nanomedicine & Drug delivery, the Role of IoT in medicine.</p> <p>MODULE IV</p> <p>Environmental problems: Pollution (air, water and soil), Ozone depletion, global warming, oil spills, invasive species.</p> <p>Pollution monitoring systems using Biotechnology - Bioindicators: lichens, animal and plant test systems, biosensors, reporter genes.</p> <p>Case studies on development of genetically engineered organisms in mitigation of environmental issues. Bioremediation (microorganisms and plants; <i>Pseudomonas aeruginosa</i>, <i>Pseudomonas putida</i> and degradative plasmids). Cloning and <i>in vitro</i> techniques. Role of gene editing and AI in tackling environmental problems.</p>	15 hours
Pedagogy:	Lectures and tutorials. Seminars / term papers /assignments / presentations / or a combination of these.	
References/ Readings:	<ol style="list-style-type: none"> 1. Godbey, W.T.. An Introduction to Biotechnology: The Science, Technology and Medical Applications. Netherlands, Elsevier Science, 2014. 2. Cimpeanu, Carmen, and Pele, Maria. Biotechnology: An Introduction. United Kingdom, Wit Press, 2012. 3. Stevens, Hallam. Biotechnology and Society: An Introduction. United Kingdom, University of Chicago Press, 2016. 4. Jay, James M., Loessner, Martin J., Golden, David A. Modern Food Microbiology, 2005. 5. Casida LE. Industrial Microbiology.1st edition.Wiley Eastern Limited, 1968. 6. Indu Shekar Thakur, Environmental Biotechnology:Basic concepts and applications. .K.International Pvt.Ltd. NewDelhi, 2011. 7. Singh B.D.,Biotechnology.4th ed, KalyaniPublishers, 2010. 8. Kenneth J. Ryan and C. George Ray. Sherris Medical Microbiology: An introduction to infectious diseases. McGraw-Hill, Medical Publishing Division, 2004. 	
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Define the term ‘Biotechnology’ and appreciate its scope. 2. Discuss the national and global significance of biotechnology and the key events in the development of biotechnology. 3. Understand the multidisciplinary nature of biotechnology and the associated role that has been played by “enabling technologies” in the development of biotechnology. 4. Evaluate the issues, prospects and impact of biotechnology on the ecosystem. 	

Name of the Programme: Biotechnology

Course Code: GBT-131

Title of the Course: Nutrition and Dietetics

Number of Credits: 03

Effective from AY: 2023-24

Prerequisites for the Course:	Nil
Course Objectives:	1. To acquire knowledge of various concepts of Food Science – facts and principles 2. To understand the composition of food. 3. To understand the diet pattern for various age groups. 4. To provide a thorough knowledge of the subject and to help the learner to analyse the accurate body requirements.
Content:	<p>MODULE I Role of nutrition in health– An overview, Concept of nutrition, Current Nutritional status of India, Scope of nutrition and dietetics. Basic Nutrition: 1. Macronutrients: Carbohydrates, Proteins & Fats - Their Classification, Functions, Digestion and absorption, Sources Requirements, Deficiency, and related diseases 2. Micronutrients – Their Classification, Functions, Digestion and absorption, Sources, Requirements, Deficiency, and related diseases, & role of antioxidants I. Minerals: a) Macro: i. Calcium ii. Phosphorus iii. Sodium iv. Potassium b) Micro: i. Iron ii. Iodine iii. Zinc II. Vitamins –a) Fat soluble –A, D, E, K b) Water Soluble - B Complex Vitamin C.</p> <p>MODULE II Functional foods - Antioxidants, Probiotics & Prebiotics, Phytonutrients, emerging trends in Nutraceuticals (Nootropics and Adaptogens). Basal Metabolic Rate- Metabolism and energy requirements. Balance; underweight, overweight, obesity,</p> <p>MODULE III Meal Planning- Factors affecting meal planning, Basic steps in planning a meal, Balanced Diet, RDA and Dietary Guidelines for Indians, ICMR, 2010, Diet during different stages of life – Nutrition for infants, toddlers, adults (men & women), pregnant women, lactating mothers, and aged individuals.</p>
Pedagogy:	Lectures, Tutorials, ICT Tools.
References/ Readings:	1. Srilakshmi, B., Nutrition Science, 7th edition. New Delhi: New Age International Publishers. 2021. 2. Alex M, "Role of nutrition in maintaining health" International Journal of Physical Education, Sports and Health, vol. 7, no. 4, 2020. [Online serial]

	<p>Available https://www.kheljournal.com/archives/2020/vol7issue4/PartE/7-4-14-997.pdf. 3. Manay, N.S. Food: Facts and Principles. New Delhi, India: New Age International Publishers. 4th Edition, 2020. 4. S. Rodey, Food Science and Nutrition, Oxford University Press, Second edition. 2018 5. R., Chaddha and P., Mathur, Nutrition a lifecycle approach, The Orient Blackswan, 2015. 6. Dr. Laxmaiah, Dietary Guidelines for Indians a manual, Second edition, National Institute of Nutrition. Generic Publisher, 2011.</p>
<p>Course Outcomes:</p>	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the principles of food essential for good health and its importance in preventive health care. 2. Describe the current scope of nutrition and the importance of a healthy diet in today's world. 3. Understand the concept of RDA and its importance in meal planning. 4. Plan a meal with ideal dietary requirements for various stages of life. 5. Discuss the current trends in nutraceuticals and probiotics.

Name of the Programme: Biotechnology

Course code: GBT-132

Title of the course: Lifestyle Diseases and Management

Number of credits: 03

Effective from AY: 2023-24

Prerequisites for the course:	Nil						
Course Objectives:	<ol style="list-style-type: none">1. To understand the concept of lifestyle diseases and the significance of lifestyle factors in preventing the development of diseases.2. To analyse the components of nutrition, as well as label reading and the use of supplements.3. To examine the characteristics, causes, diagnosis, prevention, and management of various lifestyle diseases and related disorders.4. To evaluate the importance of a balanced diet and exercise in maintaining good health, reducing the risk of lifestyle diseases, and preventing obesity.						
Content:	<table border="1"><tr><td>MODULE I Concept of lifestyle diseases- importance of lifestyle factors in preventing disease development: diet, exercise, smoking, alcohol etc. The food pyramid, components of nutrition-carbohydrates, fiber, protein, fat and types of fat and label reading. Supplements.</td><td>15 hours</td></tr><tr><td>MODULE II Diabetes- Type 1 and type 2, characteristics, causes, diagnosis, prevention and management. Cancer- Characteristics, Causes, Diagnosis, Prevention, Management, basics of treatment modalities. Stress related disorders- insomnia, depression and anxiety. Eating disorders- anorexia nervosa and bulimia nervosa. PCOS and its management.</td><td>15 hours</td></tr><tr><td>MODULE III Atherosclerosis and cardiovascular diseases- Myocardial infarction, congestive heart failure, ischemic diseases-Causes, diagnosis and management. Importance of diet and exercise in health- balanced diet, BMR, calorific value, reducing cholesterol and risk of heart attack through lifestyle changes, use of medication to treat disorders. Body mass index, determination and significance. Obesity- causes, prevention and management.</td><td>15 hours</td></tr></table>	MODULE I Concept of lifestyle diseases- importance of lifestyle factors in preventing disease development: diet, exercise, smoking, alcohol etc. The food pyramid, components of nutrition-carbohydrates, fiber, protein, fat and types of fat and label reading. Supplements.	15 hours	MODULE II Diabetes- Type 1 and type 2, characteristics, causes, diagnosis, prevention and management. Cancer- Characteristics, Causes, Diagnosis, Prevention, Management, basics of treatment modalities. Stress related disorders- insomnia, depression and anxiety. Eating disorders- anorexia nervosa and bulimia nervosa. PCOS and its management.	15 hours	MODULE III Atherosclerosis and cardiovascular diseases- Myocardial infarction, congestive heart failure, ischemic diseases-Causes, diagnosis and management. Importance of diet and exercise in health- balanced diet, BMR, calorific value, reducing cholesterol and risk of heart attack through lifestyle changes, use of medication to treat disorders. Body mass index, determination and significance. Obesity- causes, prevention and management.	15 hours
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MODULE II Diabetes- Type 1 and type 2, characteristics, causes, diagnosis, prevention and management. Cancer- Characteristics, Causes, Diagnosis, Prevention, Management, basics of treatment modalities. Stress related disorders- insomnia, depression and anxiety. Eating disorders- anorexia nervosa and bulimia nervosa. PCOS and its management.	15 hours						
MODULE III Atherosclerosis and cardiovascular diseases- Myocardial infarction, congestive heart failure, ischemic diseases-Causes, diagnosis and management. Importance of diet and exercise in health- balanced diet, BMR, calorific value, reducing cholesterol and risk of heart attack through lifestyle changes, use of medication to treat disorders. Body mass index, determination and significance. Obesity- causes, prevention and management.	15 hours						
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers / assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.						
References/ Readings:	<ol style="list-style-type: none">1. George, Jesiya Susan, et al. A Holistic and Integrated Approach to Lifestyle Diseases. United Kingdom, Apple Academic Press, 2022.2. Gattani, S. G. Lifestyle Diseases. India, Nirali Prakashan, 2017.3. Hall, John E., et al. Guyton and Hall Textbook of Medical Physiology. United Kingdom, Saunders/Elsevier, 2011.						

	4. M. Kumar R. Kumar. Guide to Prevention of Lifestyle Diseases. India, Deep & Deep Publications, 2004.
Course Outcomes:	At the end of the course, students will be able to: <ol style="list-style-type: none">1. Appreciate the importance of a healthy lifestyle and nutrition.2. Rationalise nutritional habits with lifestyle management.3. Describe how personal decisions and behaviors affect health and impact the most common lifestyle diseases.4. Identify basic principles of nutrition and ways to obtain/maintain a healthy body composition.

Name of the Programme: Biotechnology

Course Code: GBT-141

Title of the Course: Laboratory Essentials

Number of Credits: 03(1T+2P)

Effective from AY: 2023-24

Prerequisites for the Course:	Nil						
Course Objectives:	<ol style="list-style-type: none">1. To study the various risks and hazards involved in a laboratory.2. To study the protective equipment and be prepared for emergency situations in the laboratory.3. To follow the general procedures for lab safety.4. To impart basic practical skills in laboratory sciences.						
Content:	<table border="0"><tr><td>MODULE I Introduction to GLP- History, scope, fundamental points of Good Laboratory Practices (GLP), levels of laboratories, infrastructure, personal, training and development, documentation of raw data and data collection, handling of specimens (seized materials, biological specimens), specimen labelling and transportation of samples.</td><td>07 hours</td></tr><tr><td>MODULE II Safety in Laboratories- Use of Personal protective equipment (PPE) and conduct in labs, waste and its disposal (recycling, general waste, non-hazardous identifiable lab waste, incineration bags, sharps, uncontaminated glassware, solvent waste, sink), general safety measures, laboratory hygiene and sanitation, electrical safety, biosafety precautions and biological safety cabinets (BSCs). Dealing with Burns, Spills, Scalds, basic working of fire extinguishers, Data safety sheets, Risk assessment, Working with Hazardous chemicals, Decontamination and Fumigation.</td><td>08 hours</td></tr><tr><td>PRACTICAL <ol style="list-style-type: none">1. Basic SOPs for instrument and equipment handling, calibration and maintenance: weighing balance, pH meter, autoclave, hot air oven, laminar air flow, water baths, incubators, fume hoods, microscopes, micro pipettes; spectrophotometer, centrifuge, rotary shaker, filter assembly, vacuum pump, desiccators, distillation unit.2. First aid in the laboratory.3. Documentation: Lab notebook & Lab report, log book maintenance.4. Math skills (conversion of metric units, determining significant figures and rounding off).5. Data analysis using Microsoft Excel - calculation and graphical representation.</td><td>60 hours</td></tr></table>	MODULE I Introduction to GLP- History, scope, fundamental points of Good Laboratory Practices (GLP), levels of laboratories, infrastructure, personal, training and development, documentation of raw data and data collection, handling of specimens (seized materials, biological specimens), specimen labelling and transportation of samples.	07 hours	MODULE II Safety in Laboratories- Use of Personal protective equipment (PPE) and conduct in labs, waste and its disposal (recycling, general waste, non-hazardous identifiable lab waste, incineration bags, sharps, uncontaminated glassware, solvent waste, sink), general safety measures, laboratory hygiene and sanitation, electrical safety, biosafety precautions and biological safety cabinets (BSCs). Dealing with Burns, Spills, Scalds, basic working of fire extinguishers, Data safety sheets, Risk assessment, Working with Hazardous chemicals, Decontamination and Fumigation.	08 hours	PRACTICAL <ol style="list-style-type: none">1. Basic SOPs for instrument and equipment handling, calibration and maintenance: weighing balance, pH meter, autoclave, hot air oven, laminar air flow, water baths, incubators, fume hoods, microscopes, micro pipettes; spectrophotometer, centrifuge, rotary shaker, filter assembly, vacuum pump, desiccators, distillation unit.2. First aid in the laboratory.3. Documentation: Lab notebook & Lab report, log book maintenance.4. Math skills (conversion of metric units, determining significant figures and rounding off).5. Data analysis using Microsoft Excel - calculation and graphical representation.	60 hours
MODULE I Introduction to GLP- History, scope, fundamental points of Good Laboratory Practices (GLP), levels of laboratories, infrastructure, personal, training and development, documentation of raw data and data collection, handling of specimens (seized materials, biological specimens), specimen labelling and transportation of samples.	07 hours						
MODULE II Safety in Laboratories- Use of Personal protective equipment (PPE) and conduct in labs, waste and its disposal (recycling, general waste, non-hazardous identifiable lab waste, incineration bags, sharps, uncontaminated glassware, solvent waste, sink), general safety measures, laboratory hygiene and sanitation, electrical safety, biosafety precautions and biological safety cabinets (BSCs). Dealing with Burns, Spills, Scalds, basic working of fire extinguishers, Data safety sheets, Risk assessment, Working with Hazardous chemicals, Decontamination and Fumigation.	08 hours						
PRACTICAL <ol style="list-style-type: none">1. Basic SOPs for instrument and equipment handling, calibration and maintenance: weighing balance, pH meter, autoclave, hot air oven, laminar air flow, water baths, incubators, fume hoods, microscopes, micro pipettes; spectrophotometer, centrifuge, rotary shaker, filter assembly, vacuum pump, desiccators, distillation unit.2. First aid in the laboratory.3. Documentation: Lab notebook & Lab report, log book maintenance.4. Math skills (conversion of metric units, determining significant figures and rounding off).5. Data analysis using Microsoft Excel - calculation and graphical representation.	60 hours						

	<ol style="list-style-type: none"> 6. Preparation of stock and working solutions (normality, molarity, molality, ppm, percentage solutions) 7. Preparations of buffers – acidic, basic, neutral pH and measurement. 8. Sterilization using physical agents (dry heat, moist heat, UV). 9. Sterilization using chemical agents (alcohol, formaldehyde, sodium hypochlorite, chromic acid). 10. Verification of Beer Lambert Law, Molar Extinction Coefficient using spectrophotometer/ colorimeter. 11. Sample collection techniques (environmental samples). 12. Disposing harmful chemicals (guidelines) and microbial decontamination. 13. Extinguishing fires in a laboratory (demonstration). 	
Pedagogy:	Lectures, Integrated Learning, Practical skill-based learning.	
References/ Readings:	<ol style="list-style-type: none"> 1. Handbook of Laboratory Safety. 1st Edition, Elsevier, 2022. 2. Clinical Laboratory Science Concepts. Procedures and Clinical Applications, 9th Edition, 2022. 3. M., Pahuja, Guidelines for good laboratory practices - Indian council of Medical Research (ICMR), New Delhi, 2021. 4. Nigam, P.K., Vijay, K. ICMR Guidelines for Good Clinical Laboratory Practices (GCLP), ICMR, New Delhi, 2021. 5. Life Science protocol manual. Reddy and Govil, 2018. 6. Laboratory Manual and Practical science. T.N Pattabiraman, 4th Edition, 2015. 7. P.H., Reddy, S. Govil, Life science protocol manual - DBT star college scheme, 2018. 8. Dubey, R.C., Maheshwari, D.K. Practical Microbiology. S Chand Publications, 2018. 9. Handbook Good Laboratory Practices - World health organization (WHO), 2009. 	
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Practice basic procedures and protocols, safely and accurately in a lab setting. 2. Understand the rationale behind laboratory procedures. 3. Handle and maintain laboratory equipment and apparatus correctly. 4. Appreciate the need of maintaining a timely, comprehensive, detailed laboratory notebook depicting experimental results in a clear and concise manner to repeat experiments, troubleshoot procedures, and analyze data. 5. Perform basic lab calculations to prepare solutions and samples for experiments. 	

Name of the Programme: Biotechnology

Course Code: GBT-142

Title of the Course: Bakery and Fermented Beverage Technology

Number of Credits: 03

Effective from AY: 2023-24

Prerequisites for the Course:	Nil
Course Objectives:	<ol style="list-style-type: none">1. To impart basic knowledge of the science and techniques of baking and fermentation.2. To familiarize the students with different types of baking tools and equipment and their use.3. To understand the fermentation process and requirements of various alcoholic and non- alcoholic fermented beverages.4. To learn to prepare different types of bread, cake, pastry and fermented beverages.
Content:	<p>MODULE I The Science of Baking- Origin and history of baking, baking v/s cooking; types of baking; Scope of Bakery and Confectionery in India and Abroad, Bakery terms, baking tools and equipment, Ingredients and their role- Flours, sweeteners, salt, leavening agents, fats, eggs, liquids. Mixing Methods- Basic steps involved in mixing ingredients – Kneading, stirring, whipping, creaming. Methods of bread making- Straight dough method, Delayed salt method, No time dough method, Sponge and dough method; Cake Making Methods- Sugar butter process, Flour butter process, Genoise method, Blending and rubbing method Pastry - basic formulation - different types – shortcrust, choux, flaky, puff and filo / phyllo pastry.</p> <p>MODULE II The Art of Brewing- Origin and history of fermented beverages. Types of fermented beverages, their properties and health benefits, Alcoholic and Non-alcoholic beverages, carbonated and non-carbonated, Fermented whey beverages, The process and principle of Brewing, ingredients and additives used in brewing, knowledge of appropriate machines/ tools - fermenter, seed germinator, vinegar generator, autoclave, bottle washer, required fermentation agents, packaging machines.</p> <p>PRACTICAL</p> <ol style="list-style-type: none">1. Simple yeast fermented products- Bread Rolls, Soft Rolls, Sour dough.2. Rich Yeast Fermented Breads- Cinnamon Rolls, Fermented Doughnuts.3. Bread loaf, French Bread.4. Flavoured Breads- Fruit Buns, Burger Buns.5. Basic Cake Making- Victoria Sponge, Fruit cake, Chocolate cake.6. Icing Cakes – Buttercream, Whipped Cream.7. Shortcrust pastry - jam tart, apple pie.8. Choux pastry - Chocolate eclairs.

	<ol style="list-style-type: none"> 9. Puff pastry- Khari Biscuits, Patties, Cheese straws. 10. Filo pastry- Baklava. 11. Preparation and maintenance of starter cultures for fermented beverages. 12. Preparation of Buttermilk. 13. Preparation of wine - Grapes, Pineapple, Beetroot, Dates 14. Preparation of milk Kefir and water Kefir. 15. Preparation of Kombucha. 16. Preparation of Sake. 17. Preparation of Apple cider. 18. Preparation of Beet Kvass 19. Preparation of Sima. 20. Preparation of Ginger ale. 21. Preparation of Mead. 	
Pedagogy:	Lectures, Integrated Learning, Practical skill-based learning.	
References/ Readings:	<ol style="list-style-type: none"> 1. Jyoti Prakash Tamang, Patricia Lappe-Oliveras, Baltasar Mayo, Insights of Fermented Foods and Beverages: Microbiology and Health-Promoting Benefits. Frontiers Media SA., 2022. 2. Ashokkumar Y., Textbook of bakery and confectionery (2nd Edition), 2019. 3. NPCS Board of Consultants & Engineers, The Complete Technology Book on Alcoholic and Non-Alcoholic Beverages, 2nd Revised Edition, 2018. 4. Rosentrater, K. A., & Evers, A. D., Kent's technology of cereals: An introduction for students of food science and agriculture. Woodhead Publishing, 2017. 5. Louise Davidson, Fermented Beverages for Healthy Guts, The Cookbook Publisher; 1st edition, 2016. 6. Kulandaivel, S., and Janarthanan, S., Practical manual on fermentation technology. IK International Publishing House Pvt. Limited., 2012. 7. Katz, S. E., The art of fermentation: an in-depth exploration of essential concepts and processes from around the world. Chelsea green publishing, 2012. 8. James Peterson, Baking. Ten Speed Press, 2009. 9. Hui, Y. H., Corke, H., De Leyn, I., Nip, W. K., and Cross, N. A. (Eds.), Bakery products: science and technology. John Wiley & Sons, 2008. 10. Khetarpaul, N., Bakery science and cereal technology. Daya Books, 2005. 11. Kulp, K., & Lorenz, K. (Eds.) Handbook of dough fermentations (Vol. 127). Crc Press., 2003. 12. Andrew G. H. Lea, John R. Piggott, Fermented Beverage Production, 2nd Edition, 2003. 	
Course Outcomes:	<p>At the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Identify and differentiate the small and large equipment used in baking. 2. Identify and indicate the use of the different types of ingredients used in baking. 3. Prepare yeast fermented products, flavoured breads, bread loaf and French bread, basic sponges and iced cakes, basic pastries and its derivatives. 4. Prepare various fermented beverages. 	

Name of the Programme: Biotechnology

Course Code: GBT -161

Title of the Course: Eco-Friendly Bioproducts

Number of credits: 04

Effective from AY: 2023-24

Prerequisites for the course	Nil	No. of hrs
Course objectives	<ol style="list-style-type: none">1. To provide an understanding of the various types of biofertilizers and their applications in agriculture.2. To explore the different types of biopesticides and their mechanism of action.3. To familiarize students with the production and properties of different biofuels.4. To introduce students to various eco-friendly bioproducts and their applications.5. To enable students to prepare and evaluate different types of biofertilizers, biopesticides	
Contents	<p><u>Module (I) Theory</u></p> <p><u>Biofertilizers:</u> Bacterial, Fungal (Endo, Ecto & VAM mycorrhizae) and Algal (Blue green algae) biofertilizers. Applications and uses of effective microorganisms [E.M.] solutions, Panchagavya, Sanjivani solutions. Problems of biofertilizers.</p> <p><u>Biopesticides:</u> Definition, mechanism of action and application of bacterial (<i>Bacillus thuringiensis</i>) fungal (<i>Neozygites floridana</i>) protozoal (<i>Malamoeba</i>) and nematode (<i>Heterorhabditis bacteriophora</i>) based biopesticides. Neem based biopesticides.</p> <p><u>Biofuels:</u> Types (Biodiesel, Bioethanol, Biomethane, Biohydrogen), Raw materials used in production, process technology, feed stocks. Advantages and limitations.</p> <p><u>Eco-Friendly Bioproducts-</u> Production and applications of Bioplastics: (PHA, PHB). Natural dyes: Curcumin (Turmeric), chlorophyll (spinach), anthocyanin (red hibiscus), carotenoids (henna), Characteristics of Biocomposites (Starch & cellulose based). Composting products: Manure and vermicompost.</p>	15hours

<u>Practicals</u>		
	<ol style="list-style-type: none"> 1. Preparation of biofertilizer: Panchagavya. 2. Demonstrate the application of Panchagavya on plant growth. 3. Preparation of biofertilizer: Sanjivani. 4. Demonstrate the application of Sanjivani on plant growth. 5. Preparation of biofertilizer: Beejamrut 6. Demonstrate the application of Beejamrut on plant growth. 7. Preparation of biofertilizer: Jeevamrut. 8. Demonstrate the application of Beejamrut on plant growth. 9. Microscopic examination of blue green algae. 10. Preparation of bacterial biofertilizer. 	30hours
	<ol style="list-style-type: none"> 11. Demonstrate the application of bacterial biofertilizer on plant growth. 12. Microscopic examination of Mycorrhizal fungi. 13. Production of fungal biofertilizer. 14. Demonstrate their application of fungal biofertilizer on plant growth. 15. Preparation of Effective Microorganisms (EM) solution. 16. Evaluating the impact of EM solution on plant growth. 17. Demonstration of different methods of biofertilizer application, such as seed treatment, root dipping, soil inoculation, foliar spraying, using suitable crops. 18. Preparation of Neem based biopesticide. 19. Preparation of Citrus Enzyme based biopesticide. 20. Preparation of Lignocellulosic biomass 	30hours
	<ol style="list-style-type: none"> 21. Production of bioethanol from lignocellulosic biomass. 22. Production of biomethane from kitchen waste. 23. Demonstration of PHA formation using Bacillus sp. 24. Extraction and preparation of natural dyes from beetroot and pomegranate peels. 25. Extraction and preparation of natural dyes from henna leaves. 26. Preparation of starch-based bio composites. 27. Preparation of biopackaging material. 28. Preparation of cocopeat from coconut husk. 29. Preparation of compost using kitchen waste. 30. Demonstration of vermicomposting technique. 	30hours
Pedagogy	Lectures and tutorials, Seminars / assignments /presentations, interactive and peer group learning sessions and use of ICT tools.	
References/ Readings	1. U. Satyanarayana and U. Chakrapani, Biotechnology. Books and Allied. 2021.	

	<ol style="list-style-type: none"> 2. Indu Shekar Thakur, Environmental Biotechnology:Basic concepts and applications. .K. International Pvt.Ltd. NewDelhi, 2011. 3. Blackburn, R.S., Sustainable textiles: Life cycle and environmental impact. Elsevier Science Publishers, The Netherland. 2009. 4. Natrajan, K. Panchagavya. Organic Farming Association of India, Mapusa- Goa, 2009. 5. Board, N., The complete technology book on vermiculture and vermicompost CRC Press. 2004. 6. Kannalyan, S. Biotechnology of Biofertilizer, Narosa Publishing House, New Delhi. 2002.
Course outcomes	<p>At the end of the course, the students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the various types of biofertilizers and their importance in agriculture. 2. Understand the mechanism of action of different types of biopesticides 3. Evaluate the suitability, effectiveness, advantages and limitations of different types of biofuels and eco-friendly bioproducts for specific applications 4. Prepare and evaluate different types of biofertilizers, biopesticides, biofuels and eco-friendly bioproducts in the laboratory. 5. Understand the environmental impact of different types of biofuels and eco- friendly bioproducts.