



**Vivekanand Education Society's
College of Arts, Science and Commerce
(Autonomous)**

Sindhi Society, Chembur, Mumbai, Maharashtra – 400 071.

Re-accredited by NAAC "A Grade" in 3rd Cycle (CGPA 3.26)

Best College Award – Urban Area, University of Mumbai (2012-13)

Recipient of FIST Grant (DST) , STAR College Grant (DBT) , and

Recipient of Pradhan Mantri Uchchatar Shiksha Abhiyan (PM-USHA) grant (2023-26)

Affiliated to the

University of Mumbai

Syllabus for

Program: B.Sc. (Biotechnology)

(Program code: VESUSBT)

**As per Choice Based Credit System (CBCS)
with effect from Academic Year 2026 - 2027**

The NEP-2020 presents a chance for India's higher education system to change teaching focus from one that is very unilateral to one that is holistic. It offers skill-based education, where the programmes, courses, and supplemental activities are designed backwards in order to achieve the graduation qualities and learning attributes. The learning outcomes-based curriculum framework for a B.Sc. in Biotechnology is designed to give students a thorough grounding in the field and to support them as they successfully pursue further education and research in it while being equipped with the necessary skills at various stages. An effort has been made to incorporate the usage of gradual build up of knowledge and contemporary technologies to aid the teaching-learning process for students. The curriculum framework takes into account the need to uphold knowledge and skill standards that are globally competitive in biotechnology and related courses, as well as the development of scientific orientation, an inquiring spirit, problem-solving abilities, and human and professional values that encourage rational and critical thinking in the students. This degree offers a wide range of prospects in several disciplines, including both traditional and applied parts of biotechnology.

Program Outcomes (PO):

A learner completing B.Sc. (Biotechnology) will be able to:

- PO1 Demonstrate analytical skills in applying appropriate science principles and methodologies to solve a wide range of problems.
- PO2 Design, carry out experiments and analyze results by accounting uncertainties in different quantities measured using various scientific instruments.
- PO3 Acquire the ability to correlate and draw various inferences.
- PO4 Be able to apply the learnings in the academic course to an industrial setup

Program Specific Outcomes (PSO's)

On completion of B.Sc. (Biotechnology)

- PSO1 Apply the basics of biotechnology to build a strong foundation that will allow them to comprehend emerging and advanced engineering concepts in life sciences.
- PSO2 Acquire expertise in the field of biotechnology so that it may be used in industry and research.
- PSO3 By integrating disciplinary and interdisciplinary components of biotechnology, students will be able to gain technological knowledge.
- PSO4 Recognize the significance of bioethics, intellectual property rights, entrepreneurship, communication, and managerial skills in the development of the future generation of Indian industrialists.

F.Y.B.Sc. (BIOTECHNOLOGY)**(SEMESTER I)**

Course Code	Types of Courses	Subject Name	Credits	Subject Type
UMMBTS1-101	MAJOR	Fundamentals of Biotechnology I	2	Theory
UMMBTS1-102	MAJOR	Fundamentals of Chemistry	2	Theory
UMMBTS1-103	MAJOR	Practicals Based on UMMBTS1-101 and UMMBTS1-102	2	Practical
UIKBTS1-125	IKS	Ayurveda and Lifestyle	2	Theory
UVSBTS1-126	VSC	Introduction to Microscopy	2	Practical
USEBTS1-131	SEC	Cell Biology and Virology	2	Theory
UAEBTS1-141	AEC	Business Communication I	2	Theory
UVEBTS1-146	VEC	Environmental Management & Sustainable Development I	2	Theory
UOEBTS1-152	OE	Lifestyle Related Disorders	2	Theory
UOEBTS1-166	OE	Poisons in Food	2	Theory
UCCBTS1-176	CC	Music/Health and Wellness/Sunday School/Outreach Activity/Sports	2	
		Total Credits	22	

F.Y.B.Sc. (BIOTECHNOLOGY)**(SEMESTER II)**

Course Code	Types of Courses	Subject Name	Credits	Subject Type
UMMBTS2-101	MAJOR	Bioprocess Technology	2	Theory
UMMBTS2-102	MAJOR	Immunology I	2	Theory
UMMBTS2-103	MAJOR	Practicals Based on UMMBTS2-101 and UMMBTS2-102	2	Practical
UMNBTS2-116	MINOR	Biochemistry I	2	Theory
UVSBTS2-126	VSC	Introduction to Microbiology	2	Practical
USEBTS2-131	SEC	DNA Replication, Mutation and Repair	2	Theory
UAEBTS2-141	AEC	Business Communication II	2	Theory
UVEBTS2-146	VEC	Environmental Management & Sustainable Development II	2	Theory
UOEBTS2-152	OE	Lifestyle Related Disorders	2	Theory
UOEBTS2-166	OE	Poisons in Food	2	Theory
UCCBTS2-176	CC	Music/Health and Wellness/Sunday School/Outreach Activity/Sports	2	
		Total Credits	22	

SEMESTER I

Course Code	Title	Credits	No. of lectures
UMMBTS1-101	Fundamentals of Biotechnology I	02	30
Course Objectives: To familiarize the students with the potential and different applications of biotechnology Learning Outcomes: By the end of the course the student will: 1. Have an understanding of developments in various fields of Biotechnology 2. Be able to relate to applications and benefits of Biotechnology in the fields of agriculture, livestock, human health and environment 3. Discuss the basics of fermentation			
Unit I- Introduction and Application of Biotechnology	What is biotechnology? Biotechnology –an interdisciplinary biological science; Biotechnology – definition; History & Introduction to Biotechnology; Traditional and Modern Biotechnology; Scope and importance of biotechnology; World of Biotechnology- Pharmaceutical Biotechnology, Plant Biotechnology, Industrial Biotechnology, Marine Biotechnology, Animal Biotechnology, Medical biotechnology, Environmental Biotechnology. Biotechnology in India – Bio-business in India, booming biotech market, success story of biotech market, policy initiatives; and global trends; Biotechnology research in India; Applications of biotechnology: - Agriculture: GM fruits- GM papaya, GM tomato, Insect resistant transgenic plants – Bt cotton, Bt brinjal, Modifications in nutrient quality – starch, oilseed protein, golden rice Livestock: Growth, disease resistance, product quality, pharmaceuticals and nutritional supplements, industrial applications Human welfare: Cloned genes for production of -Insulin; recombinant vaccine for Hepatitis B virus. Molecular farming, Edible vaccines and their advantages Environment- Pollution abatement through GMOs Bioethics Case study: Genetically modified microbes for bioremediation of oil spills in marine environment		15
Unit II- Fermentation Technology	Introduction to fermentation processes: Microbial biomass, Microbial enzymes, Microbial metabolites, recombinant products, transformation processes.		15

	Development of fermentation Industry Fermentation medium: Basic requirements of industrial media, Criteria for use of raw materials in media, Examples of raw materials used, Growth factors, Water, Carbohydrate sources, Protein sources Fermenter design: Definition of a fermenter, aerated stirred tank batch fermenter-Typical design, Construction materials used, aeration and agitation Basic introduction to process parameters: Temperature control, Foam production and control, pH measurement and control, CO₂ and O₂ control		
References	1. Dubey, R. C. (1993). A textbook of Biotechnology. S. Chand Publishing. 2. Dubey, R. C. (2014). Advanced biotechnology. S. Chand Publishing. 3. Singh, B. D., & Singh, B. D. (2007). Biotechnology expanding horizons. Kalyani publishers. 4. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). Principles of fermentation technology. Elsevier. 5. Casida, L. E. (1968). Industrial microbiology. Industrial microbiology. 6. Okafor, N., & Okeke, B. C. (2017). Modern industrial microbiology and biotechnology. CRC Press.		

Course Code	Title	Credits	No. of lectures
UMMBTS1-102	Fundamentals of Chemistry	02	30
Course Objectives: 1. To acquaint the students with the basic concepts of chemical analysis like gravimetry and titrimetry 2. To introduce the concepts of stereoisomerism Learning Outcomes: 1. Develop skills towards the use of titrimetric and gravimetric analysis 2. Differentiate between chiral and achiral compounds and various enantiomers.			
Unit I- Titrimetry and Gravimetry	Titrimetric Analysis: Titration, Titrant, Titrand, End Point, Equivalence Point, Titration Error, Indicator, Primary and Secondary Standards, Characteristics and examples. Types of Titrations – Acid –Base, Redox. Precipitation, Complexometric Titration. Acid – Base Titration - Strong Acid Vs Strong Base. Theoretical aspects of Titration Curve and End Point Evaluation. Theory of Acid –Base Indicators, Choice and Suitability of Indicators. Gravimetric Analysis: Solubility and Precipitation, Factors affecting Solubility, Nucleation, Particle Size, Crystal Growth, Colloidal State, Ageing/Digestion of Precipitate. Co-Precipitation and Post-Precipitation. Washing, Drying and Ignition of Precipitate.		15
Unit II- Stereochemistry	Isomerism: Types of Isomerism: Constitutional Isomerism (Chain, Position and Functional) and Stereoisomerism, Chirality. Geometric Isomerism and Optical Isomerism:		15

	Enantiomers, Diastereomers, and Racemic mixtures Cis-Trans, Threo, Erythro and Meso isomers. Diastereomerism (Cis-Trans Isomerism) in Alkenes and Cycloalkanes (3 and 4 membered ring) Conformation: Conformations of Ethane. Difference between Configuration and Conformation. Configuration: Asymmetric Carbon Atom, Stereogenic/ Chiral Centers, Chirality Representation of Configuration by —Flying Wedge Formula, Projection formulae: Fischer, Newman and Sawhorse. The Interconversion of the Formulae.		
References	1. Bahl, B. S., & Bahl, A. (2017). A textbook of organic chemistry. S. Chand Publishing. 2. Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons. 3. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2013). Fundamentals of analytical chemistry. Cengage learning. 4. Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. Wiley.		

Course Code	Title	Credits
UMMBTS1-103	Practicals Based on UMMBTS1-101 and UMMBTS1-102	02
- Qualitative Enzyme detection - amylase, lipase, protease, catalase - Alcohol production- organoleptic detection - Yeast Isolation from sugarcane juice - Lactic Acid Bacillus isolation from curd - Methods of sterilization - Vitamin C estimation - titrimetric - Problems on molarity, normality, molality, mole fraction, ppm and dilution methods. - Titrimetric estimation of acetic acid using NaOH as a standard solution - Iodometric Titration - Redox Titration - Gravimetric analysis I - Gravimetric analysis II		

Course Code	Title	Credits	No. of lectures
UIKBTS1-125	Ayurveda and Lifestyle	02	30
Course objectives : - Introduce to the students the overall organization of IKS - Develop an appreciation among the students the role and importance of Veda, Vedāṅgas, Upa Vedas and Purāṇas in food and medicine. - Motivate the students to take up a detailed study of some of these topics and explore their application potential. Learning outcomes : - Inculcate ayurvedic practices in food. - Apply traditional knowledge for sustainability. - Follow <i>dincharya</i> or daily regime and appropriate food for the maintenance of good health.			

4. Understand the importance of Ayurvedic pharmacopeia.			
Unit I- Introduction to IKS, Ayurveda and Food	Introduction to Indian knowledge system (IKS) Nature, Philosophy and Character Ayurvedic Concept of Food and Nutrition Ayurvedic nutrition, taste, ayurvedic diet, role of spices in ayurvedic diet, Influence of food over mind and emotions, food source, incompatible food and diet, hunger and nutrition, thirst, and water intake. Quantitative Understanding of Food in Ayurveda Food required for an individual wrt time, gender, and age. Factors determining the requirements of food in a person, consumer related factors, food related factors in the determination of quantity. Traditional and ayurvedic foods of Indian origin Indian view about health foods, grain-based traditional health food, Fruit and vegetable-based traditional health food, Milk-based health food, Ayurvedic health foods, Miscellaneous health foods, Ayurvedic diet in diseases, Weaning foods in Indian tradition.		15
Unit II- Ancient Indian Science and Practices	Ayurveda: a knowledge system Ayurveda to understand and preserve life, meaning of Ayurveda for concept building, analysis and experience. Ayurveda as a trans-scientific system of knowledge Vedas and medical science Ayurvedic medicine as the most ancient of the Indian systems of medicine. Other Vedas for a systematic discussion on medicine. Leeds of nanotechnology in Ayurveda (e.g. Bhasma's are nanomaterials) used for treatment History of Medicine in India From Vedic to modern times. Evidence of earliest textbooks of Ayurveda like Caraka Samhita (General Medicine), Sushruta Samhita (Surgery), and Kāśyapa Samhita (Paediatrics) Ancient Indian Bacteriology The knowledge of microorganisms (pathogenic and non-pathogenic) is traced to descriptions in various texts of Ayurveda and also in non-medical literature of ancient India (Krimi or Jeevanu). Ancient Indian practices and Microbiology Antimicrobial properties of havan ash and smoke. Impact of the rhythmic chanting of mantras. Use of panchagavya for eco-friendly management of plant diseases.		15
References	1. Kapil Kapoor (2005). Indian Knowledge Systems. D.K. Print World Ltd 2. Guha, Amala, "Ayurvedic Concept of Food and Nutrition" (2006). SoM Articles. 25. 3. Preetam Sarkar et.al, "Traditional and ayurvedic foods of Indian origin". J Ethn Foods 2015; 2: 97-109 4. Payyappallimana U and Venkatasubramanian P (2016) Exploring Ayurvedic Knowledge on Food and Health for Providing Innovative Solutions to Contemporary Healthcare. Front. Public Health 4:57. doi: 10.3389/fpubh.2016.00057 5. Sanjeev Rastogi (2014). Ayurvedic Science of Food and Nutrition. Springer New York Heidelberg Dordrecht London. 6. R.C. Dubey (2021) Vedic Microbiology: A Scientific Approach Motilal Banarsidass (Publisher), India		

	7. Panda, C. K. Natural Medicines prescribed in the vedas (2021) IJCRT; Vol 9 (3) ISSN: 2320-2882 8. Kuhad, U., Goel, G., Maurya, P. K., & Kuhad, R. C. (2021). Sukshma Jeevanu in Vedas: The Forgotten Past of Microbiology in Indian Vedic Knowledge. Indian Journal of Microbiology, 61, 108-110. 9. Pawar, A., & Waghmode, S. (2021). Ayurveda and nanotechnology: an integrative approach. medicine, 1, 3. DOI: http://doi.org/10.5281/zenodo.5118434 10. Chandorkar, S., Dagade-Gadale, S., & Waghmode, S. (2021). Nanotechnology in Ayurveda perspective. DOI: http://doi.org/10.5281/zenodo.5118438 11. Kumar, K., Verma, G., Veer, R., Kumar, S., & Kumar, P. (2020). Exploitation of Panchagavya, benefits and eco-friendly management of plant diseases: A review. J. Entomol. Zool. Stud, 8, 2360-2364. 12. Pathade, G., & Abhang, P. (2014). Scientific study of Vedic knowledge Agnihotra. Bharatiya Bouddhik Sampada A Quarterly Science Research Journal of Vijnana Bharati, 43rd-44th Issue.
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Course Code	Title	Credits
UVSBTS1-126	Introduction to Microscopy	02
1. Study of Compound Microscope 2. Study of Dark Field Microscope 3. Phase Contrast Microscope 4. Fluorescence Microscope 5. Monochrome Staining 6. Negative Staining 7. Gram Staining 8. Cell Wall Staining 9. Capsule Staining 10. Spore Staining 11. Flagella Staining		

Course Code	Title	Credits	No. of lectures
USEBTS1-131	Cell biology and Virology	02	30
Course objectives:- To build a firm foundation of concepts related to cell biology and virology. Learning outcomes:- 1. Discuss the ultrastructure, function and location of organelles in prokaryotic and eukaryotic cells. 2. Gain insight into the basics of virology			
Unit I Ultrastructure of cell (Prokaryotic/ Eukaryotic)	Ultrastructure of Prokaryotic Cell: Concept of Cell shape, size and arrangement Bacterial structures external to cell wall: Flagella, Pilli, Fimbriae, Capsule, Slime Layer, Sheath Cell Wall (Gram Positive and Negative) Structures internal to cell wall: Cell Membrane, nucleoid, Cytoplasm and cytoplasmic inclusion bodies and vacuoles, Genetic Material spores and cysts Ultrastructure of Eukaryotic Cell: Cell wall; Plasma membrane, Cytoplasmic Matrix, Nucleus –Nuclear		15

	Structure, nuclear envelope, nucleoplasm, Nucleolus, Chromosome Structure and Packaging; cytoplasmic structures–cytoplasmic inclusions, cytoplasmic organelles -Endoplasmic Reticulum; Golgi Apparatus; Mitochondria; Chloroplasts; Ribosomes; Lysosome - Endocytosis, Phagocytosis, Autophagy; Peroxisomes. External Cell Coverings:Cilia and Flagella Comparison of Prokaryotic and Eukaryotic Cells		
Unit II (Virology)	Introduction to virology: Historical perspective General Characteristics of Viruses: Host Range Viral Structure- Nucleic Acid, Capsid and Envelope General Morphology- Helical, Polyhedral, Enveloped, Complex. Taxonomy of Viruses Viral Multiplication: Multiplication of Bacteriophages and Animal Viruses Isolation, Cultivation, and Identification of Viruses: Growing Bacteriophages and animal viruses in the Laboratory, Viral Identification Case studies- TMV, Influenza COVID-19 (Self learning)		15
References	1. Microbiology by Prescott,Harley & Klein 6th Ed 2. Pelczar., Microbiology. (1993). India: McGraw-Hill Education. 3. Russell, P. J. (2000). Fundamentals of genetics. Longman Publishing Group		

Course Code	Title	Credits	No. of lectures
UAEBTS1-141	Business Communication 1	2	30
Course Objectives: The objective of this course is to: 1.Develop a strong foundation in communication principles by familiarizing students with the concepts, processes, channels, and barriers of communication in personal and professional contexts. 2.Enhance verbal, non-verbal, and digital communication skills to enable effective interaction in contemporary workplace and organizational settings. 3.Build professional writing competencies by training students in the preparation of business correspondence, emails, and employment-related documents. 4.Prepare students for career and workplace communication through the development of job application, resume writing, and professional letter-writing skills required for employment and organizational communication.			
Learning Outcomes: After completion of this course learner will be able to: 1. Explain key concepts, processes, channels, and barriers of communication. 2. Apply appropriate communication strategies across different professional contexts. 3. Analyze communication situations and evaluate the impact of barriers, paralanguage, and digital technology. 4. Draft clearly organized letters, emails, and resumes following appropriate formats.			
Module 1	Fundamentals of Communication		[15 L]
1.1	Concept of Communication: Definition & Meaning		(8 L)

	Process of Communication Barriers to Communication (Physical, Linguistic, Cultural, Psychological and Organizational) Need for Communication	
1.2	Dynamics of Communication: Channels of Communication (Vertical, Horizontal, Diagonal, Grapevine) Verbal and Non-verbal Communication Paralanguage Impact of Digital Technology on Communication	(7 L)
Module 2	Professional Writing Skills	[15 L]
2.1	Parts and Layout of a Letter Basics of Email Writing	(4 L)
2.2	Job Application Letter/Email Resume Writing (Structure & Types) Letter of Appointment Letter of Appreciation Letter of Resignation	(9 L)

References

1. Bovée, Courtland L., and John V. Thill. Business Communication Today. 14th ed., Pearson, 2021.
2. Guffey, Mary Ellen, and Dana Loewy. Essentials of Business Communication. 11th ed., Cengage Learning, 2019.
3. Madhukar, R. K. Business Communication. 4th ed., Vikas Publishing House, 2014.
4. Mohan, Krishna, and Meera Banerji. Developing Communication Skills. 2nd ed., Macmillan India, 2009.
5. Cunningham, Helen, and Brenda Greene. The Business Style Handbook. McGraw-Hill, 2012.
6. Murphy, Herta A., Herbert W. Hildebrandt, and Jane P. Thomas. Effective Business Communication. 7th ed., McGraw-Hill, 2008.

Course Code	Title	Credits	No. of lectures
UEBTS1-146	Environmental Management & Sustainable Development I	2	30

Course Objectives: This course attempts to –

1. Introduce the fundamental concepts and importance of environmental science and provide a comprehensive understanding of ecosystems, importance of biodiversity and its conservation measures.
2. Highlight the importance and classification of natural resources, the impacts of degradation and measures of conservation.
3. Create an in-depth understanding of various regional and global issues, principles of effective waste management as well highlights the need for Environmental Management for achieving sustainable development.
4. Sensitize students towards environmental concerns, issues, and impacts of the human population.
5. Prepare students for successful careers in environmental departments, research institutes, industries, consultancy, and NGOs, etc.

Learning Outcomes: By the end of the course a learner will be able to-

1. Explain the structure and functions of ecosystems, and differentiate biodiversity at genetic, species, and ecosystem levels.
2. Evaluate various biodiversity conservation strategies and justify their ecological, economic, and ethical significance.
3. Identify, classify, and propose management plans for natural resources, including renewable and

non-conventional energy sources.

4. Analyse sustainable development strategies through real-world case studies in agriculture, green buildings, and related sectors.

5. Examine causes, impacts, and mitigation measures for global and regional environmental issues such as climate change, air pollution, and noise pollution.

6. Critically appraise environmental movements and ethics, integrating cultural perspectives into conservation practices.

Module 1	Ecosystems, Biodiversity and Conservation	10L
	1.1 Introduction, structure, and function of ecosystems: Energy flow: food chains, food webs, Bio-geochemical cycles, Case studies on a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems 1.2 Biodiversity & Levels of biological diversity: genetic, species and ecosystem diversity, Biogeographic zones of India 1.3 India as a mega-biodiversity nation: Endangered and endemic species of India 1.4 Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic, and Informational value. 1.5 Threats to biodiversity, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	
Module 2	Natural resources and Sustainable Development	10L
	2.1 Natural Resources: Definition, Importance and Classification 2.2 Factors influencing Resource utilization: Socio-cultural, Economic, Technological and Environmental factors. 2.3 Resources: Water, Forest, and Energy Resources- Resource Degradation and conservation, Non-conventional energy sources: Solar Energy, Green Hydrogen and Biofuels 2.4 Sustainable development: Meaning and Need, Sustainable Development Goals, Strategies for achieving Sustainable Development Goals, Case studies on Sustainable Buildings / Green buildings and Sustainable Agriculture	
Module 3	Environmental Issues and Environment Movements	10L
	3.1 Global Issue: Climate Change and impacts on environment, Case studies 3.2 Regional Issues: Air pollution, Hazards on environment, AQI standards, Noise pollution, adverse impacts of noise on human health, Noise Standards, Case studies. 3.3 Environmental movements: Narmada Bachao Andolan (NBA), Save Aarey, Chipko Movement 3.4 Environmental ethics: Role of Indian cultures in environmental conservation	
References:	1. Singh, Savindra, (2011) : Environmental Geography, Prayag Pustak Bhavan, Allahabad, India 2. Asthana, D. K. and Asthana, M. (2012): A Textbook of Environmental Studies, S. Chand & Company Ltd., New Delhi. 3. Jayamani, C. V. and Vasanthagopal, R. (2012). 'Environmental Management', New Century	

	Publications, New Delhi. 4. Erach Bharucha (2021): Text book Of Environmental Studies, University Grants Commission. 5. Odem. E.P. (1971) : Fundamental of Ecology, W.B. Saunders, Philadelphia. Down to Earth, Centre of Science and Environment. 6. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge. 7. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press. 8. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley-Blackwell. 9. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals 10. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science (No. 60457). Englewood Cliffs, NJ: Prentice Hall. 11. Central Pollution Control Board Web page for various pollution standards: https://cpcb.nic.in/standards/ 12. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
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Course Code	Title	Credits	No of lectures
UOEBS1-152	Lifestyle related Disorders	02	30
Course Objectives: 1. To introduce the relationship between lifestyle and health. 2. To introduce some disorders associated with habits and lifestyle. 3. To discuss the methods of prevention of lifestyle disorders. Learning Outcomes: 1. Understand the connection between lifestyle and health 2. Lead a healthy lifestyle to reduce the probability of occurrence of certain diseases			
Unit I	INTRODUCTION: Lifestyle diseases – Definition; Risk factors – Diet, stress, physical inactivity, sleep deficit, environmental factors, addictions- Tobacco, alcohol, drugs, technology and food.		15
Unit II	Common Lifestyle Related Disorders Obesity Diabetes Cardiovascular diseases Respiratory diseases Cancer: Causes, Symptoms, Risk factors involved, Treatment/Therapy		15
References	1. R.Kumar & Meenal Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003 2. Gary Eggar et al, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017		

Course Code	Title	Credits	No of lectures
UOEBS1-166	Poisons in Food	02	30

Course Objectives:

1. To raise the awareness of the students to intentional and unintentional additions of chemicals into everyday food items
2. To help students understand the harmful effects of food adulteration and additives
3. To enable students to find out if the food they consume is safe.

Learning Outcomes:

1. Understand intentional and unintentional food adulteration
2. Understand the different types of additives in processed food
3. Evaluate the food they consume in terms of health safety
4. Analyse food samples to check for harmful substances

Unit I Food Adulterants	Introduction to adulteration Common food adulterants PFA Act and its clauses Contamination of food: Microbial contamination, Natural toxicants in food, Metallic contaminants, Environmental/agricultural contaminants Processing Contamination Some common tests for checking adulteration (Demonstration)		15 Lectures
Unit II Food Additives	Introduction to additives Types of additives: Preservatives, colours, anti-oxidants, humectants, sequestrants, anti-caking anti-foaming agents, flavouring agents, buffering agents, leavening agents, nutritive additives, Flour improvers, sweetening agents, emulsifiers and stabilizers. Some common tests for detecting additives. (Demonstration)		15 Lectures
References	A first course in Food Analysis – A.Y.Sathe, New Age International (P) Ltd.,1999		

SEMESTER II

Course Code	Title	Credits	No of lectures
UMMBTS2-101	Bioprocess Technology	02	30
Course Objectives: To understand the basics skills applied in Fermentation Technology and build a foundation for more advanced studies in Bioprocess Technology. Learning Outcomes: By the end of the course the student will be able to: 1. Develop an understanding of the various aspects of Bioprocess Technology. 2. Develop skills associated with screening of Industrially Important Strains. 3. Understand principles underlying design of Fermentor and Fermentation Process.			
Unit I- Types of fermentors and media	Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic. Types of Fermentors 1. Continuous stirred tank fermentor 2. Airlift fermentor 3. Bubble column fermenter 4. Packed bed fermentor 5. Photobioreactor 6. Membrane bioreactor Fermentation Media - Components-Carbon, Nitrogen sources, Buffers, Antifoams, Minerals, Chelators, Growth factors, Precursors, Oxygen requirements. Types of Production media - Saccharine based (Molasses), Cellulose based media, Nitrogen based media (CSL) Sulphite liquor, Pharmamedia.		15
Unit II- Sterilization and screening	Sterilization: Sterilization of Fermentor and Fermentation Media Isolation of Industrially important organism by Screening Primary screening, Secondary screening Types of organism examples (Bacteria, Fungi, Actinomycetes, Algae) Storage and Preservation of organism Dried culture, lyophilisation, on agar slants, in dried form, in liquid Nitrogen Improvement of strains Basics and modern strain improvement strategies		15
References	1. Principles of Fermentation Technology 2nd Edn. Stanbury Whitaker 2. Industrial microbiology AH Patel 2nd Edn. 3. Industrial Microbiology L.E. Casida 2nd Edn		

Course Code	Title	Credits	No of lectures
UMMBTS2-102	Immunology I	02	30

Course Objectives: 1. To understand the concepts of immunology 2. To delineate the various mechanisms of development of immunity Learning Outcomes: 1. Give an overview of the Immune system and how it functions 2. Explain the various types of immune mechanisms 3. Enlist and understand the various cells and organs involved in the development of immunity.			
Unit I- Introduction to Immunology	Overview of Immune System Innate Immunity, Mechanisms of innate immunity, Acquired Immunity, Local and Herd Immunity Humoral and Cellular Immunity - Factors Influencing and Mechanisms of each. Antigens: Immunogenicity Versus Antigenicity, Factors That Influence Immunogenicity, Epitopes, Haptens, Superantigens Antibodies: Basic Structure of Antibodies, Antibody-Mediated Effector Functions, Antibody Classes and Biological Activities, Antigenic Determinants on Immunoglobulins.		15
Unit II- Cells and organs of the immune system	Cells of the Immune System Organs of immune system Primary and Secondary Lymphoid Organs Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System		15
References	1. Immunology - 5th edition by Goldsby, Kuby, Kindt and Osborne 2. Textbook of microbiology 9th ed Anantnarayan and Panniker		

Course Code	Title	Credits
UMMBTS2-103	Practicals of Bioprocess Technology and Immunology I	02
1. Screening for an Antibiotic Producing Strain of Microorganism. 2. Lab Scale Production of Penicillin (Static and Shaker). 3. Purification of Penicillin from Broth Culture of <i>Penicillium</i> spp. by Solvent Extraction. 4. Estimation of Penicillin from Recovered Broth by Chemical (Iodometric) Method. 5. Estimation of Penicillin from Recovered Broth by Biological (Bioassay) Method. 6. Differential Staining of White Blood Cells 7. RBC Count 8. WBC Count 9. Study of Blood groups		

Course Code	Title	Credits	No of lectures
UMMBTS1-102	Biochemistry I	02	30
Course Objectives: To acquaint the students with different concepts of biomolecules Learning Outcomes: By the end of the course the student will:			

1. Understand the role of carbohydrates and nucleic acids. 2. Discuss the basics of carbohydrate and nucleic acid biochemistry.			
Unit I- Basics of Carbohydrate chemistry	Carbohydrates: Introduction, definition and general formula. Classification of carbohydrates: Monosaccharides: Two Families of Monosaccharides. Aldo series and keto series; (Triose - Glyceraldehyde and Dihydroxyacetone, Tetrose- Erythrose and Erythrulose, Pentose- Xylose, Xylulose, Ribose, Ribulose, Hexose- Glucose, Galactose, Mannose, Heptose- sedoheptose and Sedoheptulose (structures to be taught) Concept of Enantiomers, Mutarotation, Anomeric carbon and Epimers of glucose. Chemical reactions of monosaccharides: Amination, Phosphorylation, Oxidation, glycosidic bond formation Disaccharides: Maltose, Lactose, Sucrose, Cellobiose (structures to be taught, biological significance, structure and bond type) Examples of Reducing and nonreducing carbohydrates.		15
Unit II- Basics of Nucleic acid chemistry	Nucleic Acids: Structure, Function of Nucleic Acids, Properties and Types of DNA, RNA. Structure of Purine and Pyrimidine Bases Hydrogen Bonding between Nitrogenous Bases in DNA Differences between DNA and RNA, Structure of Nucleosides, Nucleotides and Polynucleotides.		15
References	Lehninger's Principles of Biochemistry, Nelson and Cox 4th or 5th edition		

Course Code	Title	Credits
UVSBTPS2-126	Practicals of Introduction to Microbiology	02
1. Preparation of media- Nutrient broth and Agar, MacConkey Agar, Sabouraud's Agar 2. Sterilization of Laboratory Glassware and Media using Autoclave 3. Isolation techniques: T-streak, polygon method & Colony Characteristics of Microorganisms. 4. Isolation of Yeasts from the natural environment. & Study of morphology and colony characteristics of yeasts. Fungal staining – wet mount (Lactophenol cotton blue/Methylene Blue) 5. Enumeration of microorganisms- Serial dilution, Surface spread method, Pour plate method. 6. Study of Growth Curve of <i>E. coli</i> 7. Motility by hanging drop method/stab culture 8. Study of bacterial flora of skin (as a physical barrier in innate immunity) by swab method/Hand imprint method.		

Course Code	Title	Credits	No of lectures
USEBTS2-131	DNA Replication, Mutation and Repair	02	30
Course Objectives: To build a firm foundation of molecular biology Learning Outcomes:			

By the end of the course the student will: 1. Develop an understanding of structure and organization of the hereditary material 2. Discuss the different processes involved in replication of DNA 3. Understand the relevance of physical, chemical and biological factors in mutations			
Unit I- DNA replication	Models of DNA Replication Evidence of Semi-conservative DNA replication- Meselson and Stahl's experiment DNA polymerases and its role, DNA Replication in Prokaryotes: E.coli chromosome replication, Semi-discontinuous replication, Bidirectional replication of circular DNA molecules, Rolling circle replication, DNA Replication in Eukaryotes Enzymes and proteins involved in DNA replication		
Unit II- Mutation and repair	Definition and concept of Mutations: Classification of mutations Types of Point Mutations, Types of Spontaneous and induced mutations. Mutagenesis and types of mutagens. (Examples of Physical, Chemical and Biological Mutagens) DNA repair: Photo reversal, Base excision repair, Nucleotide excision repair, Mismatch repair, SOS repair.		
References	1. Russell, P. J. (2000). Fundamentals of genetics. Longman Publishing Group. 2. Strickberger M., Genetics. (1995). Australia: Deakin University.		

Course Code	Course Title	Credits	No. of Lects
UAEBTS2-141	Business Communication Skills II	2	30
Course Objectives: The objective of this course is to: 1.To develop effective group communication skills by enabling students to participate confidently in group discussions and meetings while understanding their structure, roles, and processes. 2.To enhance professional interpersonal communication skills required for various types of interviews and workplace interactions in both traditional and online environments. 3.To cultivate analytical and decision-making abilities by helping students evaluate communication situations and adopt appropriate strategies, roles, and professional etiquette. 4.To develop professional writing competence through the preparation of business documents such as notices, agendas, minutes, resolutions, letters, and reports used in organizational communication.			
Learning Outcomes: After completion of this course learner will be able to: 1. Explain key concepts, types, and processes of group discussions, meetings, interviews, and professional documents. 2. Demonstrate effective participation in discussions, meetings, and interviews. 3. Analyze communication situations in professional settings and apply appropriate strategies and roles. 4. Draft professional documents including letters, notices, agendas, minutes, and reports.			
Module 1	Group Communication	[15 L]	

1.1	Group Discussion: Meaning & Types Ingredients of a Group Discussion Role of a Group Leader Process of a Group Discussion Dos & Don'ts of a Group Discussion	(8 L)
1.2	Meetings: Meaning & Types Conduct of a Meeting Role of Chairperson, Secretary and Participants Online Meetings	(7 L)
Module 2	Professional Communication and Writing	[15 L]
2.1	Interviews: Meaning & Types Procedure of an Interview Job Interview, Appraisal Interview, Grievance Interview, Exit Interview, Online Interviews Role of Interviewer & Interviewee	(8 L)
2.2	Notice, Agenda, Minutes and Resolutions for meetings Letters: Inquiry, Complaint and Claim Letters Report writing: Investigative report, Event report	(7 L)
1. Bovée, Courtland L., and John V. Thill. Business Communication Today. 14th ed., Pearson, 2021. 2. Guffey, Mary Ellen, and Dana Loewy. Essentials of Business Communication. 11th ed., Cengage Learning, 2019. 3. Penrose, John M., et al. Advanced Business Communication. 5th ed., Thomson South-Western, 2004. 4. Lesikar, Raymond V., et al. Business Communication: Connecting in a Digital World. 13th ed., McGraw-Hill Education, 2017. 5. DiSanza, James R., and Nancy J. Legge. Business and Professional Communication: Plans, Processes, and Performance. 6th ed., Pearson, 2016. 6. Mohan, Krishna, and Meera Banerji. Developing Communication Skills. 2nd ed., Macmillan India, 2009.		

Course Code	Course Title	Credits	No. of Lecs
UVEBTS2-146	Environmental Management & Sustainable Development II	2	30
Course Outcomes: The Learners will be able to- 1. Explain the concepts, types, importance, and advantages of environmental management and related systems such as ISO 14001, LCA, and eco-labelling. 2. Analyse the process and significance of Environmental Impact Assessment (EIA) and evaluate India's key environmental initiatives for sustainable development. 3. Interpret the objectives and relevance of major international environmental treaties and conventions. 4. Examine the scope and provisions of key Indian environmental legislations and their role in environmental protection. 5. Describe the historical evolution and constitutional provisions for environmental protection in India. 6. Assess landmark judicial decisions and their influence on environmental governance and policy.			
Learning Outcomes: By the end of the course a learner will be able to- 1. Define environmental management and describe its major systems and tools for sustainability.			

2. Assess the role of EIA and national programs like NAPCC, Namami Gange, and Swachh Bharat in promoting sustainable practices
3. Summarize the purpose and impact of global environmental agreements such as the Ramsar Convention, Montreal Protocol, and Kyoto Protocol.
4. Explain the key provisions of The Water Act, The Air Act, The Environment Protection Act, and The Biological Diversity Act.
5. Interpret Articles 21, 48A, and 51A(g) in the context of environmental rights and duties.
6. Analyse the legal principles established in landmark cases such as M.C. Mehta v. Union of India and Subhash Kumar v. State of Bihar.

Module 1	Environmental Management & Importance	10 L
	1.1 Environmental Management: Introduction, Meaning, types, importance and advantages 1.2 Environment Management Systems: Aims and goals, ISO 14001, Life Cycle Analysis/ Assessment, Eco-labelling / Eco-mark scheme 1.3 Environment Impact Assessment: Meaning, Process and Importance 1.4 Role of India in managing the environment: National Action Plan on Climate Change (NAPCC), the Namami Gange program, Swachh Bharat Mission and Mission LiFE to promote sustainable lifestyles	
Module 2	Environmental Treaties and Conventions	10 L
	2.1 Major International Environmental Agreements: Ramsar Convention on Wetlands, 1971, Montreal Protocol, 1987, Basel Convention (1989), Kyoto Protocol, 1997, Earth Summit at Johannesburg, 2002. 2.2 Major Indian Environmental Legislations: The Water (Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002	
Module 3	Indian Constitution and Constitutional Provisions for Environmental Protection	10 L
	3.1 Environment and Indian Constitution: Historical background of environmental protection in India, evolution of environmental concerns in constitutional laws 3.2 Constitutional provisions- Article 21, Article 48A, Article 51A (g) and other derived environmental rights. 3.3 Judicial interpretation and Landmark cases: M.C.Mehta v.Union of India (Ganga Pollution Case), M.C. Mehta v. Kamal Nath (1997), Subhash Kumar v. State of Bihar, Kinkri Devi v. State of Himachal Pradesh	

References:

1. Singh, Savindra, (2011) : Environmental Geography, Prayag Pustak Bhavan, Allahabad, India
2. Asthana, D. K. and Asthana, M. (2012): A Textbook of Environmental Studies, S. Chand & Company Ltd.,

New Delhi.

3. Jayamani, C. V. and Vasanthagopal, R. (2012). 'Environmental Management', New Century Publications, New Delhi.

4. Erach Bharucha (2021): Text book Of Environmental Studies, University Grants Commission.

5. Oden, E.P. (1971) : Fundamental of Ecology, W.B. Saunders, Philadelphia.

6. Down to Earth, Centre of Science and Environment.

7. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.

8. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.

9. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley-Blackwell.

10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications <https://sdgs.un.org/goals>

11. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science (No. 60457). Englewood Cliffs, NJ: Prentice Hall.

12. Central Pollution Control Board Web page for various pollution standards: <https://cpcb.nic.in/standards/>

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14. <https://www.indianbarassociation.org/wp-content/uploads/2013/02/environmental-law-article.pdf>

15. Dr. Amit Kumar Singh. (2025): Indian Environmental Law: Principles, Policies and Practices

Course Code	Title	Credits	No of lectures
UOEBTS2-152	Lifestyle related Disorders	02	30
Course Objectives: 1. To introduce the relationship between lifestyle and health. 2. To introduce some disorders associated with habits and lifestyle. 3. To discuss the methods of prevention of lifestyle disorders. Learning Outcomes: 1. Understand the connection between lifestyle and health 2. Lead a healthy lifestyle to reduce the probability of occurrence of certain diseases			
Unit I	INTRODUCTION: Lifestyle diseases – Definition; Risk factors – Diet, stress, physical inactivity, sleep deficit, environmental factors, addictions- Tobacco, alcohol, drugs, technology and food.		15
Unit II	Common Lifestyle Related Disorders Obesity Diabetes Cardiovascular diseases Respiratory diseases Cancer: Causes, Symptoms, Risk factors involved, Treatment/Therapy		15
References	1. R.Kumar & Meenal Kumar, "Guide to Prevention of Lifestyle Diseases", Deep & Deep Publications, 2003 2. Gary Eggar et al, "Lifestyle Medicine", 3rd Edition, Academic Press, 2017		

Course Code	Title	Credits	No of lectures
UOEBTS2-166	Poisons in Food	02	30

Course Objectives:

- 1.To raise the awareness of the students to intentional and unintentional additions of chemicals into everyday food items
- 2,To help students understand the harmful effects of food adulteration and additives
- 3.To enable students to find out if the food they consume is safe.

Learning Outcomes:

- 1.Understand intentional and unintentional food adulteration
- 2.Understand the different types of additives in processed food
- 3.Evaluate the food they consume in terms of health safety
- 4.Analyse food samples to check for harmful substances

Unit I Food Adulterants	Introduction to adulteration Common food adulterants PFA Act and its clauses Contamination of food: Microbial contamination, Natural toxicants in food, Metallic contaminants, Environmental/agricultural contaminants Processing Contamination Some common tests for checking adulteration (Demonstration)		15 Lectures
Unit II Food Additives	Introduction to additives Types of additives: Preservatives, colours, anti-oxidants, humectants, sequestrants, anti-caking anti-foaming agents, flavouring agents, buffering agents, leavening agents, nutritive additives, Flour improvers, sweetening agents, emulsifiers and stabilizers. Some common tests for detecting additives. (Demonstration)		15 Lectures
References	A first course in Food Analysis – A.Y.Sathe, New Age International (P) Ltd.,1999		

Modality of Assessment

The performance of the learners for those exams having Semester End Examinations and Internal Assessment shall be evaluated in two parts as per the following ratio:

Semester End Examination: Internal Assessment [60:40].

The learner's performance shall be assessed by conducting the **Semester-end Examination with 60%** marks and **Continuous Internal Assessment (CIA) with 40%** marks.

Students will have to score 40% of marks INDIVIDUALLY in Internal assessment as well as Semester-end Examination to pass the course.

Internal Assessment: It is defined as the assessment of the learners on the basis of internal evaluation by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment: It is defined as the assessment of the learners on the basis of performance in the Semester-end Theory/ Practical examination.

Table-1- Mode of Assessment under NEP 2020

Name of the course	Nature of Evaluation & Mode of Assessment	Credits	Duration	Marks
Major/ Minor Subject Course	1. Internal (40%) (Table 2)	4-Credit	-	40
	2. Semester-end Examination (60%)		2 hrs	60
Major/ Minor	1. Internal (40%) (Table 2)	2- Credits	-	20

Subject Course	2. Semester-end Examination (60%)		75 min	30
Open Elective (OE)	1. Internal (40%) (Table 2)	2- Credits	-	20
	2. Semester-end Examination (60%)		75 min	30
VSC & SEC - VSEC	1. Internal (40%) (Table 2)	4-Credit	-	40
	2. Semester-end Examination (60%)		2 hrs	60
Ability Enhancement Course (AEC)	1. Internal (40%) (Table 2)	2- Credit	-	20
	2. Semester-end Examination (60%)		75 min	30
Value Education Course (VEC)	1. Internal (40%) (Table 2)	2- Credit	-	20
	2. Semester-end Examination (60%)		75 min	30
Indian Knowledge System (IKS)	1. Internal (40%) (Table 2)	2- Credit	-	20
	2. Semester-end Examination (60%)		75 min	30
On Job training (OJT) /NSS/ NCC/ Co-curricular Course(CC)/ Field project FP) /Internship/Community Engagement Program (CEP)	CIE-Tests, Essays, Articles, Group assignments/ Reports/ Journals/ Diaries/ Reviews/ Dissertations/ Observations of Students (As per the nature of the course)	2- Credit		

Note: CC-Co-curricular Courses include involvement/ participation in various areas such as Cultural Activities, Departmental activities, Fine/ Applied/ Visual/ Performing Arts, Sports and fitness, NSS/ NCC, DLLE, The Sunday School (TSS), Health & Wellness, Yoga education etc. Record of involvement /participation by students has to be documented with signatures of staff concerned in students' CC Cards.

Table - 2

Theory - Mode of assessment-Continuous Internal Assessment [40%]

Evaluation type
1. Assignments. 2. Project based learning activities (Group Discussion Research/ Case studies/ Reports / Assignments / Presentations / Skit / Poster / etc.). 3. Class Test (Objective - Multiple Choice Questions/ Subjective). 4. Active participation in class activities. 5. Overall conduct as a responsible student with respect to good behaviour, leadership qualities, interpersonal skills etc.

