Academic Council Meeting No. and Date : 8 / September 04, 2023
Agenda Number : 2 Resolution Number : 34, 35 / 2.8, 2.29

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme : Bachelor of Science

Specific Programme : Biotechnology

[F.Y.B.Sc. Biotechnology]

Level 4.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2023 - 2024

This page is intentionally left blank

Preamble

Biotechnology is an applied branch of biology that includes the study that utilizes biological systems, to develop or create different products for betterment of society. Microbiology, biochemistry, immunology, genetics, molecular biology, medicine (drug development and personalized therapies), agriculture, marine, industrial biotechnology are among many other fields that form beautiful collage of Biotechnology. With the Goal of engaging the learners in biotechnological studies in the laboratory, and *in silico*, harnessing experimental approaches that can be correlated better with the theoretical learning, the syllabus was re-framed under autonomy. Continuing the Choice Based Credit System (CBCS) implemented by the esteemed University from the academic year 2016-2017, the restructured syllabus F.Y.B.Sc. Biotechnology has been implemented since 2021-22; with a purpose of maintaining the pace in concept building for better hierarchical learning as well as updation.

The present revision is related to restructuring of syllabus under the National Education Policy 2020, which aims at the holistic development of learner. With Biotechnology and Microbiology as major and minor subjects respectively, the students would also learn fundamental genetics, biostatistics and immunology as generic courses. To improve communication skills and scientific expression of the learner, a module covering English communication has been introduced. The syllabus has also included basics of yog, ayurved, meditation, traditional Indian diet and stress management as part of Indian Knowledge System. Role of Biotechnology on environment management would be dealt with as a part of ‘Value education’.

BOS Chairman: Dr. Jayashree Pawar

Eligibility: Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board withMathematics as one of the subjects.

Discipline/Subject: Biotechnology

Name of the Degree Program: B.Sc.

Duration: 1 Year (includes SEM I and SEM II)

Level: 4.5

Mode of Conduct: Offline

Laboratory Practicals / Offline lectures / Online lectures

Total Credits for the Program: 132 Starting year of implementation: 2023- 24

Specific Programme: F.Y.B.Sc. (Subject (Major) Credits: 06

Eligibility For certificate if exit at level 4.5
Program Specific Outcome:

By the end of the program, the students will be able to:

- Study basis of biological world by knowing biochemistry, genetics, immunology, cell structureand functions, along with various biophysical techniques

- Apply knowledge to make positive use of biological systems for betterment of community and for sustainable development

VPM's B.N.Bandodkar College of Science (Autonomous), Thane
F.Y.B.Sc. (Biotechnology)

Structure of Programme

	Course Code	Course Title	No. of lectures	Credits
Semester I				
Major	23BUBT1T1	Fundamentals of Life Sciences-I	30	2
	23BUBT1T2	Fundamental Chemistry – I	30	2
	23BUBT1P1	Practicals Based on 23BUBT1T1 & 23BUBT1T2	60	2
Minor	23BUBT1T3	Fundamental Microbiology-I	30	2
	23BUBT1T4	Fundamental Microbiology-II	30	2
	23BUBT1P2	Practicals Based on 23BUBT1T3 & 23BUBT1T4	60	2
Generic	23BUBT1T5	Fundamental Genetics and Evolution	30	2
	23BUBT1T6	Fundamental Biostatistics and Immunology	30	2
SEC	23BU1SEC7	Environmental Biotechnology-I	15	1
	23BU1SEC7	Practicals Based on 23BU1SEC7	30	1
AEC	23BUEN1T8	Communication skills-I	30	2
IKS	23BUIK1T9	Principles of Yoga for Body and Mind Management	30	2
	Total		405	22

	Course Code	Course Title	No. of lectures	Credits
Semester II				
Major	23BUBT2T1	Fundamentals of Life Sciences-II	30	2
	23BUBT2T2	Fundamental Chemistry – II	30	2
	23BUBT2P1	Practicals Based on 23BUBT2T1 & 23BUBT2T2	60	2
Minor	23BUBT2T3	Industrial Microbiology-I	30	2
	23BUBT2T4	Fundamental Microbiology-III	30	2
	23BUBT2P2	Practicals Based on 23BUBT2T3 & 23BUBT2T4	60	2
Generic	23BUBT2T5	Microbial Genetics and Cytoskeleton	30	2
	23BUBT2T6	Cytogenetics and Immunological Weapons	30	2
FP	23BU2FP07	Field Work	60	2
AEC	23BUEN2T8	Communication skills-II	30	2
IKS	23BUIK2T9	Ayurveda for Healthy Lifestyle	30	2
	Total		420	22

Semester I

Course Code 23BUBT1T1	Course Title Fundamentals of Life Sciences-I	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Understand levels of classification • Comprehend structure, characteristics and classification of different microorganisms • Describe the phenomena of photosynthesis and respiration in plants, composition, structure and function of blood and other body fluids			
Unit I: Biodiversity	**1.1 General classification:** Seven levels of classification 1L Kingdoms: 6 kingdom classification (Plant, Animal, Protists, Fungi, Archaebacteria, Eubacteria; properties in brief 2L **1.2 Introduction to Microbial diversity:** 12L a. Rickettsia, Coxiella, Chlamydia, Mycoplasma: general features, medical significance b. Actinomycetes: General features; Importance: ecological, commercial and medical c. Archaea: Introduction- major Archaeal physiological groups, Ecological importance d. Eumycota (Fungi): Characteristics: Structure, reproduction, Cultivation of fungi, Biological and economic importance e. Protozoa: Ecology and Morphology of Protozoa; Major categories of Protozoa based on motility, reproduction; Medical importance of Protozoa f. Viruses: General properties and structure g. Algae – Characteristics of algae: morphology, Pigments, Reproduction; Cultivation of algae, Major groups of Algae –an overview, Differences between Algae and Cyanobacteria h. Fungi and Yeast- Characteristics: structure, Reproduction. Major fungal divisions- overview i. Slime molds and Myxomycetes		**15**
Unit II: Plant and animal physiology	**2.1 Plant Physiology**: a. Photosynthesis b. Intracellular Organization of Photosynthetic Systems c. Fundamental Reactions of Photosynthesis d. Photosynthetic Pigments e. Role of light, Hill reaction and its Significance, Light Reactions f. Cyclic and Non-Cyclic Photo-induced electron flow, Energetics of Photosynthesis g. Photorespiration h. Dark phase of Photosynthesis, Calvin Cycle, C-3, C-4 pathways **2.2 Animal Physiology:** Blood composition, Structure, Function, Coagulation (Hemophilia), Anti-coagulants, body fluids and buffers		**15**

Course Code 23BUBT1T2	Course Title Fundamental Chemistry – I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Get acquainted with basic concepts of chemistry • Learn concepts of titrimetric analysis and acquire hands-on skills in preparation of buffers and solutions • Understand the principles of oxidation & reduction reactions and understand basic concepts of titrimetric analysis			
Unit I: Nomenclature, catalysts and chemical bonds	**1.1 Nomenclature and Classification of Inorganic Compounds:** Acids, bases and salts **1.2 Nomenclature and Classification of Organic Compounds:** a. Cyclic Hydrocarbons b. Alcohols and Ethers c. Carbonyl compounds and their derivatives d. Amines e. Amides f. Heterocyclic Compounds (Quinolines and isoquinolines) **1.3 Catalysts for hydrogenation:** a. Raney nickel, Pt and PtO_2 (C=C, C=N, NO2 aromatic compounds) b. Pd /C: COCl→ CHO (Rosenmund) c. Lindlar catalyst: alkynes **1.4 Chemical bonds:** **(A) Ionic Bond:** a. Nature of Ionic Bond b. Structure of NaCl c. Factors influencing the formation of Ionic Bond **(B) Covalent Bond:** a. Nature of Covalent Bond b. Structure of CH4, NH3 c. Shapes of BeCl2, BF3 **(C) Coordinate Bond:** Nature of Coordinate Bond **(D) Non-covalent Bonds:** Vander Waals force: dipole - dipole, dipole – induced dipole **(E) Hydrogen Bond:** Theory of Hydrogen Bonding and Types of Hydrogen Bonding (with example of RCOOH).		**15**

Unit II: Basic concepts of physical chemistry and titrimetric analysis	**2.1 Preparation of solutions:** Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (concepts to be taught, problem solving during practical) **2.2 Acids and Bases:** a. Lowry-Bronsted and Lewis Concept b. Strong and Weak Acids and Bases - Ionic Product of Water - pH, pKa, pKb. Hydrolysis of Salts **2.3 Buffer solution:** a. Concept of Buffer b. Types of Buffers c. Derivation of Henderson equation for Acidic and Basic buffers, Buffer action, Buffer capacity (Numericals expected) d. pH of Buffer Solution **2.4 Principles of Oxidation & Reduction Reactions**: a. Oxidizing and Reducing Agents b. Oxidation Number c. Oxidation d. Reduction e. Addition, Substitution & Elimination Reactions **2.5 Principles of Titrimetric Analysis:** a. Significance of Terms in Titrimetric Analysis b. Types of titrations: Acid-Base, Redox; Precipitation; Complexometric Titration; Strong Acid Vs Strong Base c. Theoretical aspects of Titration Curve and End Point Evaluation d. Theory of Acid –Base Indicators, Choice and Suitability of Indicators	**15**

Course Code 23BUBT1T3	Course Title Fundamental Microbiology-I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Obtain knowledge about the structural details of prokaryotic cell and their functions • Understand difference between structure of eubacterial, archaebacterial and eukaryotic cell • Comprehend knowledge about the structural and functional details of eukaryotic cell			
Unit I: **Ultra structure Of prokaryotic cells**	**1.1 Bacterial cell shape, size and arrangement** **1.2 Detailed structure** of: a. Slime Layer, Capsule b. Flagella, pili and fimbriae c. Bacterial motility d. Cell Wall (Gram Positive and Gram Negative) e. Cell Membrane, mesosomes: structure and functions f. Cytoplasm, ribosomes g. Genetic Material h. Storage Bodies i. Endospores: structure and formation j. Magnetosomes, gas vesicles **1.2 Difference between eubacterial and Archaeal cell wall, lipids membranes and ribosomes**		**15**
Unit II: **Ultrastructure of eukaryotic cells**	**2.1 Ultra structure of Eukaryotic cells:** a. Plasma Membrane, The fluid mosaic model b. Cytoplasmic Matrix, Microfilaments, Intermediate Filaments andMicrotubules c. Organelles of biosynthesis: Endoplasmic reticulum (SER, RER) & Golgi apparatus: origin and significance in the cell d. Lysosomes, peroxisomes and glyoxysomes e. Endocytosis, Phagocytosis, Autophagy, Proteasomes f. Eukaryotic Ribosomes, Mitochondria and plastids, The endosymbiont hypothesis g. Nucleus- Nuclear structure, Nucleolus h. Cilia and flagella, difference between prokaryotic and eukaryotic flagella i. Centrioles and basal bodies **2.2 Comparison of Prokaryotic and Eukaryotic cells**		**15**

Course Code 23BUBT1T4	Course Title Fundamental Microbiology-II	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Know different methods for control of microbes • Understand the nutritional requirements of bacteria and their nutritional types • Be accomplished in pure culture techniques & have basic understanding of preservation and collection of microbial cultures			
Unit I: Microbial Nutrition	**1.1** Nutritional Requirements: Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulphur and Growth Factors (definition only) **1.2** Classification of Different Nutritional Types of Organisms **1.3** Design and Types of Culture Media **1.4** Simple Medium, Differential, Selective & Enriched Media (with examples) **1.5** Concept of Isolation & Methods of Isolation & Pure Culture Techniques **1.6** Study of colony characteristics **1.7** Culture of anaerobic microorganisms **1.8** Preservation of microorganisms **1.9** Culture Collection Centers		**15**
Unit II: Sterilization techniques	**2.1 Definition of frequently used terms** Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant **2.2 Physical methods of microbial control** a. Dry & moist heat – mechanisms, instruments used & their operations b. Electromagnetic radiations – Ionizing radiations, mechanisms – advantages & disadvantages c. Bacteria proof filters d. Low temperature e. Osmotic pressure f. Desiccation **2.3 Chemical methods of microbial control-mechanism & advantages & disadvantages (if any) applications** a. Phenolics b. Alcohols c. Heavy metals and their compounds d. Halogens e. Quaternary ammonium compounds f. Halogens g. Dyes h. Surfaces active agents/Detergents i. Aldehydes j. Peroxygens k. Sterilizing gases **2.4 Evaluation of a disinfectant** –Tube dilution & Agar plate techniques, Phenol coefficient, Tissue toxicity index		**15**

Course Code 23BUBT1T5	Course Title Fundamental Genetics and Evolution	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Firm the pillar of basic genetics, right from Mendelian genetics to its modifications • Acquire knowledge on concepts of evolution and origin of life • Understand the methods for and significance of conservation of biodiversity			
Unit I: Fundamental Genetics	**1.1 Mendel: The Father of Genetics:** a. Mendel's success b. Genetic terminology **1.2 Monohybrid and Dihybrid crosses:** a. What does monohybrid crosses reveal? (Principle of segregation and concept of dominance) b. Punnett square c. Testcross d. Genetic symbols e. Dihybrid crosses f. Principle of independent assortment g. Applying probability and branch diagram to dihybrid cross h. Dihybrid testcross **1.3 Modifications of Dominance relationships:** a. Incomplete dominance b. Codominance c. Molecular explanations of incomplete dominance and codominance **1.4 Genes and the environment:** a. Penetrance and expressivity b. Effects of the environment (Age of onset, sex, temperature, chemicals) **1.5 Gene interactions and modified mendelian ratios:** a. Gene interactions that produce new phenotypes b. Epistasis (Recessive epistasis, dominant epistasis, epistasis involving duplicate genes) **1.6 Multiple alleles**		**15**

Unit II: Evolution and Conservation of Biodiversity	**3.1 Evolution:** a. Concept, time line of evolution b. Origin of Life: Earliest life on Earth, RNA world Hypothesis, Endosymbiont theory, Unicellular to Multi cellular, Diversification of life. c. Concept of Species, Origin of Species (Speciation): Allopatric, Sympatric, Parapetric, Peripatric d. Concept of Molecular Evolution in brief e. Evolution and Biogeography of Islands – Dispersal, establishment and extinction, adaptive radiation **3.2 Conservation of Biodiversity:** a. Biodiversity Hot Spots b. Seed Banks & Artificial seeds in conservation Significance of gene banks and germplasm conservation	**15**

Course Code 23BUBT1T6	Course Title Fundamental Biostatistics and Immunology	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Know important role played by different lymphoid cells and organs the learner would gain the knowledge about basic properties and types of antigen and antibody. • Have basic understanding of biostatistics			
Unit I: Fundamental Biostatistics	**1.1** Introduction to biostatistics **1.2** Types of data **1.3** Population and sample **1.4** Frequency distribution **1.5** Visualizing data **1.6** Central tendency **1.7** Measures of variation **1.8** Standard error of mean		**15**
Unit II: Fundamental Immunology	**2.1** Overview of immune system **2.2** Cells (T, B and NK cells) **2.3** Organs - primary and secondary and their functional significance **2.4** Innate immunity, acquired immunity **2.5** Local and herd immunity **2.6** Humoral and cell mediated immunity, factors influencing and mechanisms of each **2.7** Antigens: Types and general properties **2.8** Antibody: basic Structure, classes antibodies, Ig superfamily **2.9** Complement: Nomenclature, activation pathways (Classical, alternative, lectin), biological function and regulation overview		**15**

Course Code 23BU1SEC7	Course Title Environmental Biotechnology I	Credits 1	No. of lectures
Learning Outcomes: Learners will be able to: • Know about bio-aerosols and their properties, control and biosafety • Get introduced to various organisms in soil, their role, their association with vascular plants that can be beneficial			
Unit I: Microbes in the environment	**1.1 Air microbiology** a. Important Airborne Pathogens, b. Important Toxins released by Airborne bacteria, c. Nature of Bioaerosols, d. Microbial survival in the air, e. Extramural and Intramural aeromicrobiology, f. Bioaerosol Control, g. Gravity sedimentation and air sampler (comparison of semi-quantitative and quantitative method for air sampling) h. Biosafety in the Laboratory **1.2 Soil Microbiology** a. Soil- definition, composition, textural triangle, Physicochemical characters of earth environment b. Types of soil organisms c. Microorganisms in soil d. Microorganism associations with vascular plants: e. Phyllosphere f. Rhizosphere & Rhizoplane g. Mycorrhizae h. Nitrogen Cycle; nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating Rhizobia i. Fungal & Bacterial endophytes *Agrobacterium*& other plant pathogens		**15**

Course Code 23BUEN1T8	Course Title Communication Skills-I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • acquire practical command of English • develop a set of core vocabulary and expressions for use in scientific communication			
Unit I: **Basic English**	1.1 Sentence, kind of Sentence 1.2 Parts of speech 1.3 Infinitive and participles 1.4 Commands, Requests and questions 1.5 Punctuation: Full stop, comma, colon, semicolon, dash Verbs, Kind of verbs 1.6 Articles, prepositions, conjunctions 1.7 Tenses, Kinds of senses, Use of correct verb forms		**15**
Unit II: **Speech, Communication and Comprehension**	2.1 Transformation, Antonyms, Synonyms 2.2 Homophones, Homonyms, Collocation 2.3 Active and passive voices, Degree of comparison 2.4 Reading, Vocabulary learning, Conversation, Essay writing, Short speeches, Dialogue writing, Mock interview		**15**

Course Code 23BUIK1T9	Course Title Principles of Yoga for Body and Mind Management	Credits 2	No. of Lectures
Learning Outcomes: Learners will be able to: • Learn basic concepts in Ayurveda related to human body • Understand the importance of Meditation & Stress Management			
Unit I: **Know Your Body**	1.1 Three Gunas & Mental Nature 1.2 The Three Doshas 1.3 The Seven Dhatus 1.4 The Five Pranas		**15**
Unit II: **Meditation & Stress Management**	2.1 Concept of Stress 2.2 Stimulation - Relaxation for Stress Management 2.3 Dinacharya 2.4 Balancing the female cycle 2.5 Pranayama & Its forms 2.6 Meditation & The Mind 2.7 Resolving inner conflict & limiting beliefs 'The Enquiry', Accomplishing goals		**15**

Course Code 23BUBT1P1	Course Title Practicals Based on 23BUBT1T1 & 23BUBT1T2	Credits 2	No. of lectures in hrs.
Practical 1	Construction and working of simple and compound microscope		**2**
Practical 2	Study of fungi by staining using lactophenol cotton blue		**3**
Practical 3	Study of Permanent slides of Protozoa		**2**
Practical 4	Study of microalgae and cyanobacteria using permanent slides		**2**
Practical 5	Wet mount of lichens		**2**
Practical 6	Slide Culture technique to study Actinomycetes (demonstration)		**3**
Practical 7	Study of Hill reaction		**3**
Practical 8	Colorimetric study of Absorption Spectrum of Photosynthetic Pigments		**3**
Practical 9	Determination of RBC count using hemocytometer		**4**
Practical 10	Differential staining of WBCs using Romanowsky Stains: Field's staining		**2**
Practical 11	Study of human blood groups		**4**
Practical 12	Safety Measures and Practices in Chemistry Laboratory, Working and use of a Digital Balance, Functioning and Standardization of pH Meter		**2**
Practical 13	Qualitative Analysis of Inorganic Compounds		**4**
Practical 14	Preparation of 0.1 N succinic acid and standardize the NaOH of two different concentrations		**3**
Practical 15	Preparation of Standard (Molar, Molal and Normal solutions) and Buffer Solutions		**5**
Practical 16	Characterization of Organic Compounds containing only C, H, O, N, S elements (element tests to be done)- Compounds belonging to the following classes: Carboxylic Acid, Phenol, Aldehyde/Ketone, Alcohol and Haloalkane		**13**
Practical 17	Dissociation Constant of Weak Acids by Incomplete Titration Method using *pH* Meter and determination of Acetic acid in Vinegar by Titrimetric Method		**3**

Course Code 23BUBT1P2	Course Title Practicals Based on 23BUBT1T3 & 23BUBT1T4	Credits 2	No. of lectures in hrs.
Practical 1	Study of shape of different bacteria by monochrome staining		**4**
Practical 2	Study of Gram nature of different bacteria by Gram staining		**4**
Practical 3	Cell wall staining		**4**
Practical 4	Capsule staining		**4**
Practical 5	Study of bacterial motility: Hanging drop method (demonstration); TTC agar		**5**
Practical 6	Vital staining of mitochondria using Janus green B		**4**
Practical 7	Aseptic transfer		**3**
Practical 8	Sterilization equipment: Principle, Construction and Working of Autoclave & Hot Air Oven		**4**
Practical 9	Methods of preparation of glassware for Sterilization (Pipettes, Petri Plates, Flasks)		**1**
Practical 10	Effect of UV light on micro-organisms (Qualitative)		**4**
Practical 11	Study of antimicrobial effect of dyes, phenolics and heavy metals		**4**
Practical 12	Preparation of culture media: liquid and solid		**2**
Practical 13	Preparation of slant, butts and plates		**3**
Practical 14	Study of general-purpose medium		**2**
Practical 15	Study of selective and differential media (MacConkeys and Sabourauds' media)		**2**
Practical 16	Isolation of organism and study of colony characteristics		**4**
Practical 17	Study of enriched media: superimposed blood agar		**2**
Practical 18	Study of enrichment media: Enrichment and isolation of *Azotobacter*		**4**

Course Code 23BU1SEC7	Course Title Practicals Based on 23BU1SEC7	Credit 1	No. of lectures in hrs.
Practical 1	Study of air microflora by Gravity Sedimentation Method		**3**
Practical 2	Determination of soil pH and moisture content		**3**
Practical 3	Visualizing soil micro-organisms using contact slide method		**3**
Practical 4	Study of following organisms from soil Nitrifying bacteria (enrichment) qualitative detection Cellulolytic bacteria (enrichment and isolation) qualitative detection		**5**
Practical 5	Enrichment and Isolation of *Rhizobium*		**3**
Practical 6	Winogradsky's column to study soil ecosystem		**6**
Practical 7	Visit to and report of biogas plant		**4**
Practical 8	Effect of heavy metals on growth of bacteria		**3**

Semester II

Course Code 23BUBT2T1	Course Title Fundamentals of Life Sciences - II	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Learn the chemical foundations of cell • Characterize and classify Biomolecules and know their structures • Understand about the different aspects of chromosomes viz., its structural details, variation in number and structure. • Obtain knowledge about the different ways of sex determination and concept of Barr body			
	3.1 Water- Structure, properties in brief **3.2 Carbohydrates:** a. Definition, Classification, Biological role b. Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) c. Polysaccharides (starch, glycogen, peptidoglycan, cellulose) **3.3 Amino acids & Proteins:** a. General structure and features of amino acids (emphasis on amphoteric nature) Classification by R-group, b. Uncommon amino acids and their functions c. Peptides & proteins- Definition; general features & examples with biological role d. Primary, secondary, tertiary, quaternary structures - Brief outline **3.4 Nucleic acids:** a. Nitrogenous bases- Purines, Pyrimidines, Pentoses - Ribose, Deoxyribose b. Nomenclature of Nucleosides and nucleotides, N-β-glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds) c. Basic structure of RNA and DNA **3.5 Lipids:** Classification, Properties of Saturated & Unsaturated Fatty Acids		**15**
Unit II: Chromosome structure and variations	**2.1 Eukaryotic chromosomes**: Structure of chromatin; Euchromatin and Heterochromatin **2.2 Variations in chromosome structure:** a. Deletion (Details of Drosophila not required) b. Duplication c. Inversion d. Translocation **2.3 Variations in chromosome number:** a. Changes in one or a few chromosomes b. Changes in complete sets of chromosomes **2.4 Sex chromosomes and sex determination:** Genotypic sex determination (mammals, *Drosophila* and *Caenorhabditis*, other organisms); Genetic sex determination		**15**

Course Code 23BUBT2T2	Course Title Fundamental Chemistry – II	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn basic organic reactions and name reactions • Understand the concepts and significance of green chemistry • Know the fundamentals of chemical kinetics			
Unit I: Name Reactions & Green Chemistry	**1.1 Basic Organic reactions** a. Nucleophilic substitution reaction: SN1 and SN2 b. Elimination reactions (E1 and E2 mechanism) **1.2 Name reactions** a. Aldol condensation b. Cross- Aldol Condensation c. Wolf kishner reduction d. Clemmensen reduction e. Perkin reaction f. Hydroboration g. Friedal Craft's Reaction h. Knoevenagel reaction, Witting reaction i. Cannizzaroreaction **1.3 Introduction to Green Chemistry** a. Need and Relevance b. Principles of Green Chemistry c. Use of the following in green synthesis with suitable examples: • Green reagents: dimethylcarbonate, polymer supported reagents • Green catalysts: Acid catalysts, oxidation catalysts, basic catalysts • Green solvents: water, ionic liquids, deep eutectic solvents, supercritical carbon dioxide • Comparison of traditional processes versus green processes: Synthesis of Adipic acid		**15**
Unit II: Chemical Kinetics	**2.1** Order & Molecularity of Reaction **2.2** Integrated Rate Equation of First and Second order reactions (with equal initial concentration of reactants). (Numericals expected) **2.3** Determination of Order of Reaction by a. Integration Method b. Graphical Method c. Ostwald's Isolation Method d. Half Time Method (Numericals expected) **2.4** Transition state theory: Collision theory, Transition state theory (Derivation not expected) Arrhenius equation and calculation of activation energy		**15**

Course Code 23BUBT2T3	Course Title Industrial Microbiology-I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Develop an understanding of the various aspects of Bioprocess Technology • Develop skills associated with screening of Industrially Important Strains			
Unit I: An Introduction to Fermentation	**1.1 An introduction to fermentation processes:** a. The range of fermentation processes b. The components of a fermentation process **1.2 Screening methods:** a. Primary and secondary screening b. High throughput screening methods **1.3 Strain improvement:** a. Selection of induced mutants synthesizing improved levels of primary metabolites b. The isolation of induced mutants producing improved yields of secondary metabolites c. The improvement of strains by modifying properties other than the yield of product **1.4 Preservation of cultures and Quality control of preserved stock** **1.5 Types of fermentations:** Surface and Submerged; Batch and Continuous, Aerobic and anaerobic		**15**
Unit II: Fermenter, fermentation media and sterilization	**2.1 Design of a fermenter:** Stirred Tank Fermenter- Basic Design; Parts of a Typical Industrial Fermenter. **2.2 Composition of Media for industrial fermentations** **2.3 Sterilization:** Batch and continuous sterilization **2.4 Study of Representative Fermentation Processes:** Penicillin production and Ethanol Production by Fermentation along with a flow-diagram (study with respect to Inoculum development, downstream processing extraction and purification).		**15**

Course Code 23BUBT2T4	Course Title Fundamental Microbiology-III	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Have basic understanding of microbial growth. • Enumeration of microorganisms using appropriate techniques. • Comprehend the effect of various environmental parameters on the growth of microorganisms			
Unit I: Microbial growth	**1.1** Definition of growth, Mathematical Expression, Growth curve **1.2** Measurement of growth **1.3** Direct microscopic count – Breed's count, Petroff –Hausser counting chamber- Haemocytometer **1.4** Viable count – Spread plate and Pour plate technique **1.5** Measurements of cell constituents **1.6** Turbidity measurements – Nephelometer & spectrophotometer techniques **1.7** Synchronous growth, Continuous growth (Chemostat and Turbidostat) **1.8** Influence of environmental factors on growth: Solutes and Water Activity, pH, Temperature, Oxygen Concentration, Pressure, Radiation **1.9** Biofilm formation and quorum sensing		**15**
Unit II: Food Microbiology	**2.1 Microbial growth in foods**: intrinsic factors and extrinsic factors **2.2 Microbial growth and food spoilage:** a. Controlling food spoilage: Homeostasis and hurdle technology b. Antimicrobial chemicals: organic acids, nitrites, parabenzoic acid, sodium chloride, phosphates, sulfites c. Naturally occurring antimicrobials: lysozyme, lactoferrin and other Fe binding proteins, avidin, spices and essential oils, onions and garlic, isothiocyanates, phenolic compounds **2.3 Bio preservation:** controlled acidification, bacteriocins, probiotics, prebiotics and symbiotic **2.4 Physical methods of food preservation:** a. Drying, freeze-drying, cold storage (Overview) b. Heat treatment: concept of TDP and TDT c. Preservation by irradiation: UV and ionizing radiations (Overview) **2.5 Microbiology of fermented foods:** a. Overview of fermented foods: importance & major chemical conversions b. Chocolate: The sweet side of fermentation! c. Fermented Milks: Lactic Acid Bacilli; mesophilic and thermophilic milk fermentations d. Yeast lactic fermentation: Kefir e. Meat and fish fermentation f. Production of bread g. Other fermented foods Alkaline fermentation: alkali-fermented vegetables		**15**

Course Code 23BUBT2T5	Course Title Microbial genetics and Cytoskeleton	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Get familiar with basic terminologies related to microbial genetics. • Be well versed with the concept of conjugation, transformation, transduction and transposition • Understand the role of cytoskeleton.			
Unit I: **Microbial genetics**	**1.1 The search for genetic material:** a. Griffith's transformation experiment b. Avery's transformation experiment c. Hershey and Chase Bacteriophage experiment **1.2 Genetic analysis of Bacteria:** a. Minimal medium, complete medium, auxotroph, prototroph b. Conjugation: Discovery of conjugation in bacteria, Thesex factor F, High frequency recombination strains of *E. coli*, F' factors, Natural gene transfer and antibiotic resistance, concept of horizontal and vertical gene transfer c. Transformation (Only process) d. Transduction: Bacteriophages, Generalized transduction (Only process), Specialized transduction **1.1 Transposable elements in bacteria:** Insertion sequences and transposons		**15**
Unit II: **Cytoskeleton**	**2.1 Overview of Major Functions of Cytoskeleton** **2.2 Microtubule:** structure and composition, MAPs Function- Role in Mitosis, Structural support and Cytoskeleton Intracellular motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic properties of Microtubule. Microtubules in Flagella and Cilia **2.3 Microfilament:** Structure, Composition, Assembly and Disassembly Motor Protein: Myosin, Muscle contractility: Sliding Filament. Actin Binding Proteins: Examples of Non-Muscle Motility **2.4 Intermediate Filament:** Structure and composition; Assembly and Disassembly; Types and Functions		**15**

Course Code 23BUBT2T6	Course Title Cytogenetics and Immunological Weapons	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Obtain knowledge about mapping and cytogenetics • Understand the role of different types of Cells, Effector Molecules and Effector immune mechanisms			
Unit I: Cytogenetics	**1.1 Genetic linkage, Crossing Over and Mapping:** a. Conjugation, transformation, transduction mapping. b. Two-point testcross c. Tetrad analysis **1.2 Conventional karyotyping e.g., CML** **1.3 Pedigree** **1.4 Legal and ethical issues**		**15**
Unit II: Immunological Weapons	**2.1** Hematopoiesis; Cells of the Immune System: T, B, NK, DC, Granulocytes. **2.2** TCR CD3 Complex. **2.3** Cytokines and its receptors **2.4** B cell Receptor **2.5** MHC Classes - General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism **2.6** Antigen Presentation - Endocytic and Exocytic Pathways **2.7** MHC Restriction		**15**

FP	23BU2FP07	Field Work	60	2
		Students will select subjective filed project	60	2
		Total	60	2

Course Code 23BUEN2T8	Course Title Communication Skills-II	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • acquire basic information of scientific writing • develop ability to interpret data, express it as a scientific report and use appropriate ICT tools for the same			
Unit I: **Scientific Writing**	**1.1 Types of research articles:** 8L 1.Review article 2. Original research article 3. Book chapter 4. Book review 5. Conference abstract 6. Short communications/note 7. case study **1.1 Organization of original research article:** writing Abstract, Introduction, Materials **1.2** & Methods, Results, Discussion and Conclusion 3L **1.3 Importance of tables, figures and schematics in a research article** 1L **1.3 Review of Literature** 2L **1.4 Bibliography and different citation formats** 1L **1.5 Importance of statistics in research** 1L		**15**
Unit II: Interpretation, Report writing and use of IT in research	**2.1 Interpretation:** Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in interpretation. **2.2 Report writing:** Different steps in writing report, Layout of research report, Types of reports, Plagiarism, Poster & Oral Presentation. **2.3 Use of ICT in research:** List of software available for Pre-data, data and post data analysis **2.4 Demonstration of Use of websites and software useful in Research:** Google scholar, Shodhganga, Mendeley, NDLI, JSTOR, working with Microsoft excel, introduction to SPSS, use of software for plagiarism check		**15**

Course Code 23BUIK2T9	Course Title Ayurveda for Healthy Lifestyle	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn about Indian Diet & its Impact on Health • Understand the importance of Ayurveda & Ancient Indian Drugs in day – to -day life			
Unit I: **Indian Diet & its Impact on Health**	1.1 Ayurvedic detox programs 1.2 Yogic & Ayurvedic Diets 1.3 A balanced diet, the six tastes & Vipaka		**15**
Unit II: **Ayurveda & Ancient Indian Drugs**	**2.1 Ayurvedic Herbs:** Amla, Ginger, Ritha, Maka, Behada, Bell, Tondali, Brahmi, Anar, Corriander seeds, Durva, Erand, Papita, Gulvel, Haldi, Hirada, Hing, Jamun, Hibiscus, nutmeg, Cumin seeds, Banana,Karanja, Karela, Karpur, Khajur, Khaskhas, Kulith, Aloevera, Kesar, Lajalu, Lasun, Laung, Pepper, Methi, Saunf, Mula, Pan, coconut, Kadunimb, Onion, Fig, Sadafuli, Rai, Shatavari, Kadipatta, Shivga, Eliachi, Chandan, Chakraful, teel, Tulasi, Dalchini, Tamalpatra, Almond, Yashtimadhu, Ajwain, Ghee, Honey **2.2 The Five Main Methods of Herbal Preparation**		**15**

Course Code 23BUBT2P1	Course Title Practicals Based on 23BUBT2T1 & 23BUBT2T2	Credits 2	No. of lectures in hrs.
Practical 1	Spot test for Carbohydrates, Fats, Proteins, Amino Acids and Nucleic Acids		**3**
Practical 2	Estimation of Reducing sugar by DNSA method		**4**
Practical 3	Estimation of Protein by Biuret method and Lowry method		**4**
Practical 4	Study of Saponification of Fats & Determination of Saponification Value of Oil or Fat		**3**
Practical 5	Determination of Iodine value of Oil		**3**
Practical 6	Study of polytene chromosomes in *Drosophila*		**3**
Practical 7	Study of karyotype of normal male and normal female		**2**
Practical 8	Study of Trisomy-21, Trisomy-18, Trisomy-13, Turner syndrome, Klinefelter syndrome and Cri-du-chat		**2**
Practical 9	Study of Barr body		**3**
Practical 10	Use of PDB/ colchicine for induction of polyploidy		**3**
Practical 11	Determine the rate constant for hydrolysis of ester using HCl as a catalyst		**3**
Practical 12	Study the kinetics of reaction between Thiosulphate ion and HCl		**3**
Practical 13	Study reaction between potassium Persulphate and Potassium Iodide kinetically and hence to determine order of reaction		**3**
Practical 14	Study the reaction between NaHSO3 and KMnO4 and balancing the reaction in acidic, alkaline and neutral medium		**3**
Practical 15	Study transfer of electrons (Titration of sodium thiosulphate with potassium dichromate		**3**
Practical 16	Investigation of the reaction between cooper sulphate and sodium hydroxide (Standard EDTA Solution to be provided to the learner)		**4**
Practical 17	Estimate the amount of nickel present in the given nickel chloride/nickel sulphate solution (Estimation of Nickel (II) as Ni-dmg)		**4**
Practical 18	Organic Preparation: Base catalyzed aldol Condensation (synthesis of Dibenzalpropanone)		**4**
Practical 19	Microwave synthesis: Synthesis of coumarin by Knoevenagel reaction using Salicylaldehyde, and ethyl acetate		**3**

Course Code 23BUBT2P2	Course Title Practicals Based on 23BUBT2T3 & 23BUBT2T4	Credits 2	No. of lectures in hrs.
Practical 1	Enumeration of microorganisms by • Spread plate technique • Pour plate technique • Hemocytometer, Brown's opacity tubes		**13**
Practical 2	Study of bacterial Growth Curve		**4**
Practical 4	Study of growth pattern in liquid media		**2**
Practical 5	Effect of temperature, pH, Solute concentration on growth of micro-organisms		**4**
Practical 6	Analysis of milk keeping quality by MBRT		**3**
Practical 7	Analysis of milk keeping quality by RRT		**3**
Practical 8	Determination of TDP and TDT (Demonstration)		**6**
Practical 9	Determination of MIC of salt/ sugar (Demonstration)		**3**
Practical 10	Study of Lactic acid bacteria – Homofermentative and heterofermentative		**3**
Practical 11	Primary screening of antibiotic producers		**5**
Practical 12	Amylase production by surface and submerged fermentations		**3**
Practical 13	Ethanol production		**3**
Practical 14	Estimation of ethanol using Dichromate method		**4**
Practical 15	Chemical estimation of Penicillin		**4**

REFERENCES
SEMESTER-I
BNBUSBT1T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood &Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	Cell Biology, genetic, Molecular Biology, Evolution and Ecology	Verma &Agarwal	S Chand	1st	2004
4.	Brock Biology of Microorganisms	Madigan, Martinko, Stahl & Clark	Benjamin Cummings	13th	2012
5.	Textbook of Plant Physiology	V. Verma	ANE Books	Ane's Student edition	-
6.	Textbook of Medical Physiology	Guyton and Hall	Elsevier Saunders	11th	2006

BNBUSBT1T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	F.Y.B.Sc Organic chemistry, F.Y.B.Sc Inorganic chemistry & S.Y.B.Sc Organic chemistry textbooks	Puniyani , Parulekar, Upadhyay , Mukherjee &Turakhai ,Dixit ,Arora	Himalaya	5th 5th	2018
2.	F.Y.B.Sc Physical chemistry & S.Y.B.Sc Analytical chemistry Textbooks	Dr.Yogesh V. Ghalsasi, Deepak Teckchandani, Padma Sathe	Himalaya	5th 19th	2018 & 2017

BNBUSmb1T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood &Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	Cell Biology, genetic, Molecular Biology, Evolution and Ecology	Verma&Agarwal	S Chand	1st	2004

BNBUSmb1T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	Fundamentals of Microbiology	Martin Frobisher Ronald Hinsdill Koby Crabtree Clyde GoodHeart	Thomson Learning	6th	1957
4.	Fundamental Principles of Bacteriology	A J Salle	McGraw-Hill	2nd	1943
5.	General Microbiology	Stanier, Ingraham, Wheelis& Painter	McMillan Press Ltd.	5th	1987
6.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016

BNBUSBTGE1T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Strickberger's Evolution	Brian K. Hall &BenediktHallgrimsson	Jones & Bartlett	5th	2013
2.	Evolutionary biology handbook	Richard Arber	Callisto reference	-	2015
3.	The biology of biodiversity	M.Kato	Springer	-	2012
4.	iGenetics: A Molecular Approach	Peter Russel	Benjamin Cummings	3rd	2010
5.	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007

BNBUSBTGE1T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Introduction to Bio-Statistics: A Textbook of Biometry	Dr. Pranab Kumar Banerjee	S.Chand	3rd Rev. Edition	2007
2.	Principles and application of Statistics in Biosciences	Dr. D.V.Kamat	MananPrakashan	-	2012
3.	Biostatistics for the Biological and Health Sciences with Statdisk	Marc M. Triola and Mario F. Triola	Pearson	1st	2014
4.	Kuby Immunology	Kindt, Goldsby, Osborne	W.H. Freeman	6th	2006

5.	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007

BNBUSBT1VEC

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Environmental Biotechnology	M H Fulekar	Science Publishers	1st	2010
2.	Environmental Biotechnology	Indu Shekhar Thakur	Dreamtech Press	2nd	2019
3.	Environmental Biotechnology	Alan Scragg	Oxford Press	2nd	2005

BNBUSBT1IKS

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Yoga and Ayurveda: Self-Healing and Self-Realization	David Frawley	Motilal Banarsidass Publishing House	5th Reprint edition	2022
2.	Everyday Ayurveda – a practical guide to healthy living	Danny Cavanagh & Carol Willis	Ayurveda UK	1st	2004
3.	The Yoga of Herbs	Dr David Frawley & Dr Vasant Lad	Lotus Press	2nd	1993
4.	New Perspectives in Stress Management	H. R. Nagendra & Dr.R. Nagarathna	Swami Vivekananda Yoga Prakashana	3rd	1986

SEMESTER-II

BNBUSBT2T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Lehninger, principles of biochemistry	David Nelson and Michael Cox	*W.H. Freeman* and Company, New York.	4th	2005
2.	Fundamentals of Biochemistry	D. Voet and J. Voet	Wiley plus	5th	2011
3.	iGenetics: A Molecular Approach	Peter Russel	Benjamin Cummings	3rd	2010
4.	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007

BNBUSBT2T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	S.Y.B.Sc Organic chemistry T .Y B.Sc Organic chemistry Green Chemistry Textbooks	V.K.Ahluwalia	Ane Books	5th 2nd	2012
2.	F.Y.B.Sc Physical chemistry	D. Teckchandani K.B.Baliga	Himalaya	5th	2018

BNBUSmb2T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Industrial Microbiology	L.E Casida, Jr	New Age International Publishers	2nd Edition	2019
2.	Principles of Fermentation Technology	P.F. Stanbury, A. Whitaker, S.J. Hall	Butterworth Heinemann, oxford	2nd Edition	2000
3.	Industrial Microbiology	A.H Patel	Macmillan	1st Edition	1984

BNBUSmb2T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Food Microbiology- An introduction	Mointville and Matthews	ASM Press	4th	2019
2.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016
3.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood &Woolverton	McGraw-Hill	7th	2008
4.	Microbiology	Michael J Pelczar Jr., E. C. S Chan &Noel R. Krieg	Tata McGraw-Hill	5th	1993
5.	Fundamentals of Microbiology	Martin Frobisher, Ronald Hinsdill, Koby Crabtree &Clyde GoodHeart	Thomson Learning	6th	1957

BNBUSBTGE2T1

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Cell Biology	Gerald Karp	John Wiley	6th Edition	2010
2.	iGenetics: A Molecular Approach	Peter Russel	Benjamin Cummings	3rd	2010
3.	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007

BNBUSBTGE1T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Kuby Immunology	Kindt, Goldsby, Osborne	W.H. Freeman	6th	2006
2.	Genetics: A Conceptual Approach	Benjamin A. Pierce	WH Freeman	3rd	2007

BNBUSBTGE2T2

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Immunology	Kuby	W.H. Freeman	6th Edition	2006
2.	Immunology: essential and Fundamental	Palan and Pathak	Science Publishers	2nd Edition	2005
3.	The Elements of Immunology	Fahim Khan	Pearson Education	-	2009
4.	Igenetics	Peter Russell	Pearson Education India	3rd Edition	2009

BNBUSBT2IKS

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Yoga and Ayurveda: Self-Healing and Self-Realization	David Frawley	Motilal Banarsidass Publishing House	5th Reprint edition	2022
2.	Everyday Ayurveda – a practical guide to healthy living	Danny Cavanagh & Carol Willis	Ayurveda UK	1st	2004
3.	The Yoga of Herbs	Dr David Frawley & Dr Vasant Lad	Lotus Press	2nd	1993

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Sem.	Faculty-DSC		Any Faculty		Vocational & Skill Enhancement Courses (VSC), SEC (VSEC)	Ability Enhancement Courses (AEC)/ Value Education Courses/ Indian Knowledge System (IKS)			Field Project/ Apprenticeship/ Community Engagement & Services	Credit	Cumulative Credits
		Subject	Subject	Subject			Subject					
		Major	Minor	GE & OE			AEC	VEC	IKS			
		CREDITS	CREDITS	CREDITS	CREDITS		CREDITS	CREDITS	CREDITS			
				GE	ID							
4.5	I.	06	06	02	02	02	02	-	02	-	22	44
	II.	06	06	02	02	-	02	-	02	02	22	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF courses/ internship or continue with Major and Minor												
Transforming F.Y.B.Sc. curriculum into NEP 2020 structure provided by the Government of Maharashtra												
Cum cr.		6*2 = 12	6*2 = 12	4*2 = 08		02	4*2 = 08			02	44	44

Level	Sem.	Faculty - DSC						Any Faculty		Vocational & Skill Enhancement Courses (VSC)	Ability Enhancement Courses (AEC)/Indian Knowledge System (IKS)		Field Project/ Apprenticeship/ Community Engagement & Services		Credit	Cumulative Credits
		Subject			Subject			Subject								
		Major - credits 6 (4T+2P)			Minor- credits 6 (4T+2P)			GE & OE								
		Course-I	Course-II	Course-III	Course- I	Course-II	Course-III	Course-I	Course-II		AEC	VEC	IKS			
Level4.5	I.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (1T+1P)	02 (2T)	-	02 (2T)	-	22	44
	II.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	0 2 (2T)	02 (2T)	-	02 (2T)	-	02 (2T)	02	22	

Note: Students will get a choice of **VSC, SEC VSEC for credits- 2**

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Faculty – DSC	Theory					Practical		
		Internal	Min. Marks for passing	Theory Examination	Min. Marks for passing	Total	Practical Examination	Min. Marks for passing	Total
Sem I	**1. Major (Credits 06)**								
	Course – I	20	08	30	12	50	50	20	150
	Course – II	20	08	30	12	50			
	2. Minor (Credits 06)								
	Course – I	20	08	30	12	50	50	20	150
	Course – II	20	08	30	12	50			
	3. GE/ OE (Credits 04)								
	GE	20	08	30	12	50	-	-	100
	OE/CS	20	08	30	12	50			
	4. Vocational & Skill Enhancement Courses (VSC) (Credits 02)	-	-	25	10	25	25	10	50
	5. Ability Enhancement Courses (AEC)/ Value Education Courses/ Indian Knowledge System (IKS)								
	IKS (Credits 02)	20	08	30	12	50	-	-	50
	AEC (Credits 02) Sem I	20	08	30	12	50	-	-	50 Sem I
	6. Field Project/ Apprenticeship/ Community Engagement & Services (Credits 02) Sem II								
		20	08	30	12	50	-	-	50 Sem II
	SEM I TOTAL					425	125		550
	SEM I TOTAL					425	125		550
	FYBSC/ Certificate Total Marks								1100