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 3rdCycle (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 2025 - 2026

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 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 buildup of knowledge and contemporary technologies to aid the teaching-learning process for students. The curriculum framework considers 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 a 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 and carry out experiments and analyze results by accounting for 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.

S.Y.B.Sc. (BIOTECHNOLOGY)

(SEMESTER III)

Course Code	Types of Courses	Subject Name	Credits	Subject Type
UMMBTS3-201	**MAJOR**	Medical Microbiology I	**2**	**Theory**
UMMBTS3-202	**MAJOR**	Molecular Biology II	**2**	**Theory**
UMMBTS3-203	**MAJOR**	Ecology	**2**	**Theory**
UMMBTS3-204	**MAJOR**	Practicals Based on UMMBTS3-201	**2**	**Practical**
UMNBTS3-216	**MIN**	Biochemistry	**2**	**Theory**
UMNBTS3-217	**MIN**	Practicals Based on UMNBTS3-216	**2**	**Practical**
UVSBTS3-226	**VSC**	Tools in Molecular Biology	**2**	**Practical**
UOEBTS3-252	**OE**	Hormones and You	**2**	**Theory**
UAEBTS3-241	**AEC**	Modern Indian Language	**2**	**Theory**
UFPBTS3-261	**FP**	Field Project	**2**	
UCCBTS3-276	**CC**	Music/Health and Wellness/Sunday School/Outreach Activity/Sports	**2**	
		Total Credits	**22**	

S.Y.B.Sc. (BIOTECHNOLOGY)

(SEMESTER IV)

Course Code	Types of Courses	Subject Name	Credits	Subject Type
UMMBTS4-201	**MAJOR**	Genetics	**2**	**Theory**
UMMBTS4-202	**MAJOR**	Immunology II	**2**	**Theory**
UMMBTS4-203	**MAJOR**	Practicals based on UMMBTS4-201	**2**	**Practical**
UMMBTS4-204	**MAJOR**	Practicals Based on UMMBTS4-202	**2**	**Practical**
UMNBTS4-216	**MIN**	Instrumentation	**2**	**Theory**
UMNBTS4-217	**MIN**	Practicals Based on UMNBTS4-216	**2**	**Practical**
USEBTS4-231	**SEC**	Cell Biology	**2**	**Theory**
UAEBTS4-241	**AEC**	Modern Indian Language	**2**	**Theory**
UOEBTS4-252	**OE**	Hormones and You	**2**	**Theory**
UCEBTS4-272	**CEP**	Community Engagement Program	**2**	
UCCBTS4-276	**CC**	Music/Health and Wellness/Sunday School/Outreach Activity/Sports	**2**	
		Total Credits	**22**	

SEMESTER III

Course Code	Title	Credits	No. of lectures
UMMBTS3-201	**Medical Microbiology I**	**02**	**30**

Course Objectives: The objective of this course is to

CO1: Explain the principles of host–parasite interactions, infection, and disease progression in humans.

CO2: Describe the morphology, virulence factors, pathogenesis, and epidemiology of clinically important bacterial pathogens.

CO3: Interpret the laboratory diagnosis, prevention, and treatment strategies for major bacterial infections.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Identify factors influencing microbial infection, transmission, and host response.

LO2: Differentiate major bacterial pathogens based on morphology, virulence factors, and pathogenic mechanisms.

LO3: Explain the clinical features and laboratory diagnostic approaches for common bacterial diseases.

Unit I- Infectious diseases General Bacteriology and Bacteria as Human Pathogen, Host-parasite Interactions	**Host-Parasite Relationship:** The Role of microorganisms in disease Acquisition of infection: Koch's Postulates. (2 Lectures) Normal flora (2 Lectures) Factors affecting the introduction (3 Lectures) Course of infection and disease. Mechanisms of infection and virulence factors (3 Lectures) Microbial growth kinetics (brief introduction) Infection: Patterns of infection; types of infections; signs and symptoms (3 Lectures) Epidemiology and markers (2 Lectures)		**15**

Unit II- Causative organisms-1	**Skin:** *Staphylococcus aureus*- Morphology, resistance, virulence factors, diseases, laboratory diagnosis, treatment in brief (3 lectures) *Streptococcus:* Morphology, classification, virulence factors, pathogenicity of skin and soft tissues, laboratory diagnosis, treatment in brief (3 lectures) **GI tract:** *Salmonella spps* -Morphology, cultural characteristics, antigenic structure, pathogenicity, clinical course, complications, carriers in brief, lab diagnosis, vaccines, and treatment (3 lectures) *Shigella:* Morphology, cultural characteristics, biochemical reactions, antigenic structure, pathogenicity, lab diagnosis, and treatment (3 lectures) **Urinary Tract:** *E. coli*—Morphology, cultural characteristics, antigenic structure, virulence factors, clinical infections, laboratory diagnosis of UTI (2 Lectures) *Proteus spps*-Morphology, cultural characteristics, antigenic structure, virulence factors, clinical infections, laboratory diagnosis. (1 Lecture)		**15**
References	● Microbiology, Lansing Prescott 5th Ed ● Foundations in Microbiology, Talaro 9th Ed ● Microbiology, Pelczar, Krieg & Chan ● Textbook of Microbiology, Ananthnarayan 10th Ed		

Course Code	Title	Credits	No of lectures
UMMBTS3-202	**Molecular Biology-II**	**02**	**30**

Course Objectives: The objective of this course is to:

CO1: To provide a comprehensive understanding of gene expression and transcription mechanisms in prokaryotic and eukaryotic cells.

CO2: To introduce the structure of proteins and the genetic code.

CO3: To explain the molecular mechanisms of translation and protein synthesis.

CO4: To familiarize students with post-translational modifications and intracellular protein sorting processes.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Describe the mechanisms and regulation of transcription in prokaryotes and eukaryotes.

LO2: Explain the structure and function of proteins, amino acids, and the genetic code.

LO3: Illustrate the role of tRNA, ribosomes, and associated factors in protein synthesis.

LO4: Discuss post-translational modifications and protein targeting within the cell.

Unit I Transcription	**Gene Expression- an Overview.** **Transcription Process in Prokaryotes:** RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain (8 Lectures) **Transcription in Eukaryotes:** Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes; Spliceosomes; RNA editing (7 Lectures)		**15**
Unit II Translation	**Proteins:** Chemical and Molecular structure of proteins (1 Lecture) Amino acid classification (2 Lectures) **Nature of Genetic Code** (1 Lecture) **Wobble Hypothesis** (1 Lecture) **Translation: The Process of Protein Synthesis**		**15**

	Structure of Transfer RNA (1 Lecture) Structure of Ribosomes (1 Lectures) Process of Protein Synthesis: Initiation, Elongation, Translocation, Termination (4 Lectures) Post Translation Modifications. (2 Lecture) Protein Sorting in the Cell (2 Lectures)		
References	• iGenetics A Molecular Approach 3rd Edition Peter J. Russell-Pearson Education • Genetics, 5th Edition Peter J. Russell-Pearson Education • Genetics, (2006) Strickberger MW - (Prentice Hall, India) • Microbial Genetics- Freifelder –Narosa Publishing House		

Course Code	**Title**	**Credits**	**No of lectures**
UMMBTS3-203	**Ecology**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: To introduce the fundamental concepts of ecology and the interactions between organisms and their environment.

CO2: To develop an understanding of abiotic and biotic factors influencing the distribution and adaptation of organisms.

CO3: To explain the structure and functioning of ecosystems and the flow of energy through ecological systems.

CO4: To familiarize students with ecological relationships, food chains, ecological pyramids, and biogeochemical cycles.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Describe the basic principles, scope, and branches of ecology.

LO2: Explain the effects of abiotic and biotic factors on organisms and their adaptations.

LO3: Analyze the structure, components, and functions of different ecosystem types.

LO4: Illustrate energy flow, ecological pyramids, and major biogeochemical cycles in ecosystems.

Unit I Introduction to Ecology	**Introduction to Ecology** Definition of ecology, branches of ecology (1 Lecture) **Abiotic Factors**		**15**

	Types of abiotic environmental factors Response to abiotic factors and adaptation- light, temperature, precipitation, humidity, fire, wind, physiographic factors (10 Lecture) **Biotic Factors** Interspecific interactions - positive and negative (4 Lecture)		
Unit II Ecosystem	**Ecosystem–Structure** Kinds of ecosystems (1 Lecture) Structure of ecosystem (2 Lecture) **Function of Ecosystem** Food chain (1 Lecture) Ecological pyramids (3 Lectures) Energy flow (3 Lectures) Biogeochemical cycles (oxygen, carbon, phosphorus and nitrogen) (5 Lectures)		**15**
References	● Cell Biology, Genetics, Molecular Biology, Evolution and Ecology , P.S.Verma and V.K. Agarwal		

Course Code	Title	Credits
UMMBTS3-204	**Practicals Based on UMMBTS3-201**	**02**

1. Study of bacteriological media
2. Study of biochemical tests
3. Study of *S.aureus*
4. Study o*f S.pyogenes*
5. Study of *E.coli*
6. Study of *Salmonella spps*
7. Study of *Shigella spps*
8. Study of *Proteus sps*

Course Code	Title	Credits	No of lectures
UMNBTS3-216	**Biochemistry**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: To introduce lipids and proteins as biomolecules.

CO2: To enable the students with a basic understanding of the types, properties and functions of lipids and proteins.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: The students will be able to give an account of lipids and proteins as biomolecules.

LO2: They will be able to identify lipids and proteins from their names and structures.

LO3: Students will be able to explain the properties of lipids and proteins.

Unit I Lipid chemistry	**Lipid Chemistry** Introduction to lipids (1 Lecture) Classification of lipids and their functions (2 Lectures) Properties of saturated and unsaturated fatty acids (2 Lectures) Rancidity, and hydrogenation of oils (1 Lecture) Phospholipids: Lecithin, Cephalin, Plasmalogen (2 Lectures) Triacylgly by cerol-Structure and function (2 Lectures) Sterols: Cholesterol: Structure and function (1 Lecture) Lipoproteins: Structure and function, (2 Lectures) Storage lipids, Structural lipids (2 Lectures)		**15**
Unit II Amino acids and Proteins	**Amino Acids and Proteins** Classification of amino acids (2 Lectures) Structure and properties of amino acids - 3 Lectures Isoelectric point, zwitterion, titration curve of amino acids (2 Lectures) **Proteins** Classification based on structure and functions (1 Lecture) Primary structure (1 Lecture)		**15**

	Secondary structure (3 Lectures) N-terminal (Sanger and Edman's methods) and C-terminal Analysis (Enzyme) (3 Lectures)		
References	• Lehninger's Principles of Biochemistry. Nelson and Cox Seventh Edition • Outlines Of Biochemistry, 5Th Ed - Erice Conn, Paul Stumpf		

Course Code	Title	Credits
UMNBTS3-217	**Practicals based on UMNBTS3-216**	**02**

1. Qualitative estimation of lipids
2. Saponification of lipids
3. Calculation of saponification value
4. Estimation of serum cholesterol
5. Qualitative estimation of proteins
6. Quantitative estimation of proteins by Biuret method
7. Quantitative estimation of proteins by Lowry's Method
8. Quantitative estimation of proteins by Bradford's method

Course Code	Title	Credits
UVSBTPS3-226	**Tools of Molecular Biology**	**02**

1. Genomic DNA extraction: Bacterial cells
2. Genomic DNA extraction: Cheek cells
3. DNA analysis using AGE.
4. Plasmid extraction
5. Enzymes used in molecular biology.
6. Restriction enzyme digestion
7. Ligation of DNA fragments
8. Protein analysis by PAGE

Course Code	Title	Credits	No of lectures
UOEBTS3-252	**Hormones and You**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: Students will be able to correlate bodily activities to hormone levels in the body.

CO2: A general awareness towards lifestyle related changes in hormones will be created

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Understand the basis of the moods of the brain and ways to tackle them.

LO2: Awareness of all forms of addiction and the hormonal basis.

LO3: Significance of maintaining an active lifestyle to avoid hormonal disorders

Unit I	**Effect of hormones on mental well-being:** Introduction to hormones (3 Lectures) Hacking happy hormones-Dopamine, Oxytocin, Serotonin, Endorphins- Basis of release and action (6 lectures) Addiction and hormones: (6 lectures) Basis of release and action of Adrenalin, Dopamine and GABA		**15**
Unit II	**Effect of hormones on physical well-being:** Thyroid hormones and their effects (5 lectures) Hunger hormones and the importance of balanced diet Insulin hormone and its effects (5 lectures) PCOS - causes and effects (5 lectures) Growth hormones and Sex hormones		**15**
References	● How to Take Charge of Your Brain and Program More Happiness into Your Life-Ellen Petry Leanse ● Breaking Free of Addiction By Deborah Sosin ● Biochemistry by Satyanarayan		

SEMESTER IV

Course Code	Title	Credits	No of lectures
UMMBTS4-201	**Genetics**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: To understand the principles of bacterial genetics and gene transfer mechanisms.

CO2: To apply genetic mapping and operon models to explain gene regulation.

CO3: To analyze regulatory mechanisms in bacteriophages and eukaryotes.

CO4: To evaluate the role of epigenetic and post-transcriptional control in gene expression.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Explain bacterial gene transfer and genetic mapping methods.

LO2: Interpret bacterial genetic maps.

LO3: Apply operon models to interpret patterns of gene expression.

LO4: Analyze regulatory pathways in viruses and eukaryotic cells.

LO5: Evaluate the impact of epigenetic and RNA-based regulation on gene expression.

Unit I **Microbial Genetics**	**Fundamentals of Bacterial Genetics (3 Lectures)** Prototrophic and auxotrophic strains, nutritional mutants and their role in genetic analysis, replica plate technique **Genetic Mapping through Conjugation (4 Lectures)** Discovery of genetic exchange in Escherichia coli, the fertility (F) factor and its molecular basis, Hfr strains and their significance in chromosomal gene transfer, F′ plasmids and partial diploidy, Construction of bacterial linkage maps using conjugation data **Genetic Mapping by Transformation (3 Lectures)** Concept of natural competence in bacteria, mechanism of DNA uptake in Bacillus subtilis, use of transformation in determining gene order and distance **Genetic Mapping by Transduction (4 Lectures)** Bacteriophages and their life cycles: lytic and lysogenic, phage-mediated gene transfer, generalized transduction and chromosomal mapping, specialized transduction and		**15**

	site-specific gene transfer **Applications in bacterial genome analysis (1 Lecture)**		
Unit II **Regulation of Gene** **Expression**	**In Prokaryotes** **Bacterial Operon Systems** **Lac operon of E. coli (3 Lectures)** Structure and components, induction and repression, catabolite repression and CAP-cAMP regulation **Tryptophan operon of E. coli (2 Lectures)** Repressible operon model, attenuation and fine-tuned regulation **Regulation in Bacteriophages (3 Lectures)** Lytic and lysogenic growth cycles, genetic control of phage development, regulatory switches in viral gene expression **In Eukaryotes** **Transcriptional Regulation (3 Lectures)** Concept of gene clusters and operon-like organization, regulation of transcription initiation, role of activator and repressor proteins, influence of chromatin structure on gene accessibility, histone modifications and chromatin remodeling **Epigenetic Control of Gene Expression (2 Lectures)** Gene silencing at telomeric regions, DNA methylation and transcriptional repression, genomic imprinting and parent-of-origin effects **Post-Transcriptional Regulation (2 Lectures)** RNA interference (RNAi), role of siRNA and miRNA in gene silencing Biological significance and applications		**15**
References	● Russell, P. J. (2013). IGenetics: Pearson New International Edition PDF EBook: A Molecular Approach. United Kingdom: Pearson Education ● Strickberger M., Genetics. (1995). Australia: Deakin University.		

Course Code	Title	Credits	No of lectures
UMMBTS4-202	**Immunology II**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: To develop an understanding of MHC molecules, antigen presentation pathways, and their role in immune responses.

CO2: To explain the maturation, activation, and functional interactions of B and T lymphocytes.

CO3: To introduce the principles, procedures, and applications of immunological techniques used in research and diagnostics.

CO4: To familiarize students with immunoassays, monoclonal antibody technology, and advanced immunodiagnostic methods.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Explain the structure, function, and significance of MHC molecules and antigen presentation mechanisms.

LO2: Describe the activation, differentiation, and cooperative functions of B cells and T cells in adaptive immunity.

LO3: Perform and interpret immunoprecipitation, agglutination, and immunoassay-based techniques.

LO4: Discuss the production and applications of monoclonal antibodies and advanced immunological diagnostic methods.

Unit I MHC and Antigen Presentation Pathways, TCR/BCR, T-cell and B-cell Activation	**MHC Classes** - General organization and inheritance; structures and peptide interactions; class i and ii diversity and polymorphism; (4 Lectures) **Antigen Presentation** - Endocytic and exocytic pathways; MHC restriction. (3 Lectures) **B-cell Receptor:** Structure, maturation and activation B-T cell interaction (B-T cell Cooperation) (4 Lectures) **T-cell Receptor Complex**: Structure, maturation and activation. (4 Lectures)		**15**
Unit III Immuno-techniques	**Immuno-techniques** I. Immunoprecipitation (5 Lectures) 1. Immunoprecipitation reaction in solution 2. Immunoprecipitation reactions in gel: Radial immunodiffusion, Ouchterlony double immunodiffusion		**15**

	3. Immunoprecipitation using beads. II. Agglutination reactions (3 Lectures) 1. Coombs test 2. Passive, reverse passive, agglutination inhibition. coomb's test; complement fixation tests 3. Immunoassay: Competitive and non-competitive immunoassay III. RIA, ELISA, ELISPOT, immunofluorescence, chemiluminescence, immunoelectrophoresis, classical, crossed, rocket and immunofixation (3 Lectures) Monoclonal antibodies Hybridoma technology (4 Lectures) 1. Co- Immunoprecipitation 2. Co-IP,ChIP,RIP 3. Alternatives to antigen-antibody reactions		
References	● Immunology - 5th edition by Goldsby, Kuby, Kindt and Osborne ● Biophysics & Molecular Biology: Tools & Techniques by Pranav Kumar		

Course Code	**Title**	**Credits**
UMMBTS4-203	**Practicals Based on UMMBTS4-201**	**02**

1. Transformation
2. Replica plate technique
3. Bacteriophage enrichment and detection.
4. M-9 media preparation
5. Gradient plate
6. Cloning Vectors
7. Beta-gal Estimation.
8. Diauxic Growth Curve

Course Code	Title	Credits
UMMBTS4-204	Practicals based on UMMBTS4-202	02

1. Complement Fixation Test (CFT).
2. Passive Agglutination- RA Factor Test.
3. Demonstration of immunoelectrophoresis and its types
4. ELISA (Kit-based) - HEPALISA
5. DOT-ELISA.
6. Coombs test
7. Immunodiffusion

Course Code	Title	Credits	No of lectures
UMNBTS4-216	Instrumentation	02	30

Course Objectives: The objective of this course is:

CO1: To introduce students to some common instruments used in biotechnology laboratories.

CO2: To ensure an understanding of the principle and working of various spectrophotometers and chromatography techniques.

CO3: To develop an understanding of the applications of the various spectroscopic and chromatographic tools

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Ability to explain the concepts of spectroscopy and chromatography.

LO2: Development of an understanding of the principle and working of spectrophotometers and chromatographic tools

LO3: Ability to utilize the said instruments in research according to the defined problem.

Unit I Spectroscopy	Principle, Instrumentation, and Applications. UV-Vis Spectrophotometer, Single and dual-beam spectrophotometer (6 Lectures) Fluorescence spectroscopy (3 Lectures) CD spectroscopy (3 Lectures) Light scattering spectroscopy (3 Lectures)		**15**

Unit II Chromatography	Basic principle of chromatography: (3 Lectures) Planar chromatography - Paper chromatography, (2 Lectures) TLC (3 Lectures) Column chromatography - Ion-exchange, size exclusion, affinity chromatography, HPLC, gas chromatography (6 Lectures) Application of chromatography (1 lecture)		**15**
References	• Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Seventh Edition		

Course Code	Title	Credits
UMNBTS4-217	**Practicals based on UMNBTS4-216**	**02**

1. Paper chromatography for amino acids
2. Paper chromatography for sugars
3. Paper chromatography for plant pigment
4. TLC of plant pigments
5. TLC of lipids
6. Column chromatography
7. Absorption spectra of plant pigments
8. UV Absorption spectra of DNA and protein

Course Code	Title	Credits	No of lectures
USEBTS4-231	**Cell biology**	**02**	**30**

Course Objectives: The objective of this course is:

CO1: To introduce the structure, composition, and functions of the cytoskeleton and its role in cellular organization and movement.

CO2: To explain the structure, dynamics, and functions of microtubules, microfilaments, and intermediate filaments.

CO3: To develop an understanding of cell membrane organization, membrane transport, and membrane-associated functions.

CO4: To familiarize students with cell junctions and mechanisms of cellular communication and interactions.

Learning Outcomes: Upon successful completion of the course, students will be able to:

LO1: Describe the structure, organization, and functions of the major cytoskeletal components.

LO2: Explain the role of cytoskeletal elements and motor proteins in intracellular transport, cell motility, and cell division.

LO3: Illustrate the structure and functions of the cell membrane and the mechanisms of membrane transport.

LO4: Analyze the role of cell junctions and cell–cell interactions in maintaining tissue organization and communication.

Unit I- Cytoskeleton	**Cytoskeleton Overview of the major functions of the cytoskeleton**. (1 lecture) Microtubules: Structure and Composition. (1 lecture) MAPs: Functions- Role in Mitosis, Structural support, and cytoskeleton intracellular motility (3 lectures) Motor proteins: Kinesins, Dynein; MTOCs. Dynamic properties of microtubules. Microtubules in cilia and flagella. (3 lectures) Microfilaments: Structure, Composition, Assembly, and disassembly. (2 lectures) Motor protein: Myosin. (1 lecture) Muscle contractility: Sliding filament model. Actin binding proteins: Examples of Non-muscle motility. (2		**15**

	lectures) Intermediate Filaments: Structure and composition; Assembly and disassembly; Types and functions. (2 lectures)		
Unit II- Cell Membrane	**Cell Membrane** An overview of membrane functions (1 lecture) Cell membrane structure & composition (3 lectures) Principles of membrane transport (3 lectures) Cell Junctions; Cell adhesion and extracellular material Microvilli; Tight junctions, Gap junctions; (5 lectures) Cell coat and cell recognition. Cellular interactions. (3 lectures)		**15**
References	● Cell and Molecular biology by Karp ● Essential Cell biology 4th ed Bruce Alberts ● Cell and Molecular Biology DeRobertis 8th ed		

Course Code	Title	Credits	No of lectures
UOEBTS4-252	**Hormones and you**	**02**	**30**

- **Course Objectives:** The objective of this course is:
- CO1: Students will be able to correlate bodily activities to hormone levels in the body.
- CO2: A general awareness towards lifestyle related changes in hormones will be created
- **Learning Outcomes:** Upon successful completion of the course, students will be able to:
- LO1: Understand the basis of the moods of the brain and ways to tackle them.
- LO2: Awareness of all forms of addiction and the hormonal basis.
- LO3: Significance of maintaining an active lifestyle to avoid hormonal disorders

Unit I	**Effect of hormones on mental well-being:** Introduction to hormones (3 Lectures) Hacking happy hormones-Dopamine, Oxytocin, Serotonin, Endorphins- Basis of release and action (6 lectures) Addiction and hormones: (6 lectures) Basis of release and action of Adrenalin, Dopamine and GABA		**15**
Unit II	**Effect of hormones on physical well-being:** Thyroid hormones and their effects (5 lectures) Hunger hormones and the importance of balanced diet Insulin hormone and its effects (5 lectures) PCOS - causes and effects (5 lectures) Growth hormones and Sex hormones		**15**
References	• How to Take Charge of Your Brain and Program More Happiness into Your Life-El Petry Leanse • Breaking Free of Addiction By Deborah Sosin • Biochemistry by Satyanarayan		

MODALITY OF ASSESSMENT

The performance of the learners for those papers 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% mark**s. Practical papers will consist of semester-end examination only.

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

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

Semester End Assessment: It is defined as the assessment of the learners based on performance in the semester-end theory/practical examination.

Table 1- Mode of Assessment under NEP 2020

Name of the course	Credits	Nature of Evaluation & Mode of Assessment	Duration	Marks
Major/ Minor Subject (Theory)	**2 Credit**	**1. Internal (40%) (Table 2)**		20
		2. Semester-end Theory Examination (60%) (Table 3)	**90 mins**	30
Major (Practical) **(2 subjects)**	**2 Credit**	**Semester-end Practical Examination (Table 4)**	**3 hours**	50
Open Electives (OE) OR Value Education Course (**VEC**) OR Indian Knowledge system (**IKS**)	**2 Credit**	Continuous Internal Evaluation - Assignments/Presentations/Group Discussions/Case Studies etc. **Any two modes of assessment with evaluation at the department level (25 M Each)**	-	50
Vocation Skill Course (VSC) (Practical)	**2 Credit**	Practicals (Table 4)	**3 hours**	50

Skill Enhancement Course (**SEC**)(Theory) OR Ability Enhancement Course (**AEC**)	**2 Credit**	**1. Internal (40%) (Table 2)**		20
		2. Semester-end Theory Examination (60%) (Table 3)	**90 mins**	30
On Job training (**OJT**)/NSS/ NCC/ Co-curricular Course (**CC**)/ Field project (**FP**)/ Internship	**2 Credit**	Continuous Internal Evaluation Tests, Essays, Articles, Group assignments/ Reports/ Journals/ Diaries/ Reviews/ Dissertations/ Observations of Students/Presentation etc (As per the nature of the course)	-	

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 must be documented with signatures of staff concerned in students' CC Cards.

Table 2

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

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

Table 3

Paper Pattern for Semester-End Theory Examination
Each unit should have equal weightage. Minimum one question per unit No MCQ/True-False type of questions should be asked, only descriptive questions are allowed. Each question should have extra sub-questions (max 100% option)

Table 4
Semester End Examination for Practical Assessment -50 marks (2-Credit) Major
[To be conducted at departmental level]

	For 1 subject		For 2 subjects	
A	Any one/ more experiment/s	35	Min two experiments per subject	40
B	Viva	10	Viva	05
C	Journal	05	Journal	05
	Total	**50 M**	Total	**50 M**