।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २९ सप्टेंबर २०२० रोजी संपन्न झालेल्या ४९व्या मा. विद्या परिषद बैठकीतील विषय क्र.१०/४९–२०२०** च्या ठरावानुसार **प्रस्तुत विद्यापीठातील जैवतंत्रशास्त्र संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे आराखडा (Structure) बदलासह** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

01. M.Sc.-I & II Year-Botany
02. M.Sc.-I & II Year-Microbiology
03. M.Sc.-I & II Year-Zoology
04. M.Sc.-I & II Year-Biotechnology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.

जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर(संकुल)–सीबीसीएस अभ्यासक्रम/२०२०–२१/**१४६५**

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : १२.११.२०२०.

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. संचालक, जैवतंत्रशास्त्र संकुल, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

Swami Ramanand Teerth Marathwada University Nanded, 431606

School of Life Sciences

Name of programme: M.Sc. Biotechnology

Programme structure 2019-2020 onwards (CBCS pattern)

Semester	code	Title of the	No. Of instructional hrs/week	Type of	Total credits	Marks		Total marks
						CIA	ESA	
Theory								
Semester I	BTT-C-101	Biochemistry	04	CC	04	50	50	100
	BTT-C-102	Cell Biology	04	CC	04	50	50	100
	BTT-C-103	Bioinstrumentation	04	CC	04	50	50	100
	*****BTT-E-101 OR *BTT-E-102	**General Microbiology OR Biostatistics and basic computer**	04	**DSE**	04	50	50	100
Practical								
	BTL C- 101	Lab in Biochemistry	04	CC	02	25	25	50
	BTL C- 102	Lab in Cell Biology	04	CC	02	25	25	50
	BTL C- 103	Lab in Bioinstrumentation	04	CC	02	25	25	50
	BTL E-101 OR BTL E-102	**Lab in General Microbiology OR Lab in Biostatistics and basic computer**	04	DSE	02	25	25	50
		Total	**32**	**3-CC, 1-DSE**	**24**	**300**	**300**	**600**
Semester II	BTT-C- 201	Genetics and Molecular Biology	04	CC	04	50	50	100
	BTT-C- 202	Microbial and Enzyme Technology	04	CC	04	50	50	100
	BTT-C- 203	Bioprocess Engineering and Technology	04	CC	04	50	50	100
	*BTT-E- 201 OR BTT E-202	**Environmental Biotechnology OR Basic Bioinformatics**	04	**DSE**	04	50	50	100
		****Open Elective**	02	OE	02	25	25	50
	BTL C- 201	Lab in Genetics and Molecular Biology	04	CC	02	25	25	50
	BTL C- 202	Lab in Microbial and Enzyme Technology	04	CC	02	25	25	50
	BTL C- 203	Lab in Bioprocess Engineering and Technology	04	CC	02	25	25	50
	*BTL E- 201 OR BTL E-202	**Lab in Environmental Biotechnology OR Lab in Basic Bioinformatics**	04	DSE	02	25	25	50
		Total	**34**	**3-CC, 1 DSE 1-OE**	**26**	**325**	**325**	**650**

Semester III	BTT C- 301	r-DNA Technology	04	CC	04	50	50	100
	BTT C- 302	Immunology and Virology	04	CC	04	50	50	100
	BTT C- 303	Pharmaceutical Biotechnology	04	CC	04	50	50	100
	BTT E- 301 OR BTT E-302 OR BTT E-303	Communication Skill in English OR Foreign Language French OR Foreign Language Spanish	02	**SDC**	02	25	25	50
		****Open Elective**	04 OR 2+2	**OE**	04 OR 2+2	50 OR 25+25	50 OR 25+25	100
Practical								
	BTL C- 301	Lab in r-DNA Technology	04	CC	02	25	25	50
	BTL C- 302	Lab in Immunology and Virology	04	CC	02	25	25	50
	BTL C- 303	Lab in Pharmaceutical Biotechnology	04	CC	02	25	25	50
		Total	**30**	**3-CC, 1-SDC, 1(2)-OE**	**24**	**300**	**300**	**600**
Semester IV	BTT- C- 401	Plant Biotechnology	04	CC	04	50	50	100
	BTT- C- 402	Animal Biotechnology	04	CC	04	50	50	100
	BTT- C- 403	Genomics and Proteomics	04	CC	04	50	50	100
	*BTT- E- 401 OR BTT E-402	**Nanobiotechnology Or Food Biotechnology**	04	**DSE**	04	50	50	100
		****Open Elective**	02	**OE**	02	25	25	50
Practical								
	BTL- C- 401	Lab in Plant Biotechnology and Animal Biotechnology	04	CC	02	25	25	50
	BTL- C- 402	Lab in Genomics and Proteomics	04	CC	02	25	25	50
	BTL 403	**Project/ Review writing**	04	CC	04	-	100	100
		Total	**30**	**3-CC, 1-DSE, 1-OE**	**26**	**275**	**375**	**650**

CC: Core course, OE: Open Elective, DSE: Discipline Specific Elective, SDC: Skill Development Course MSA- Mid semester assessment, ESA: End Semester Assessment., Credits of Four Semesters = 100.

***Discipline specific Electives**	****Open Elective/***Skill Development Elective Course**
* Indicates an elective course. Biotechnology students in a particular semester can opt for either of these courses **or** a course offered by other programs of the school	****** Indicates an open elective course Biotechnology student must opt for any open elective course **or** skill development course offered by other schools of the campus **Or** NPTEL /SWAYM /MOOC

- Total credits/ year = 50
- Total credits of all four semester = 100
- Total marks of all four semester = 2500
- MSA – Two internal exams of 15 marks each (MCQ), Home assignment -10 marks, Seminar -10 marks per paper.

List of Open Electives in Biotechnology for Other Schools

Sr. No.	Course Code	Title of Open Elective Course	No. of Credits	Semester in Which It Is Offered	Prerequisite of the student (Eligibility)	Course Instructor
1	BTT OE 101	Introduction to Biotechnology	02	I/III	Should Have Studied Biology at XII	Prof. C.N. Khobragade
2	BTT OE-201	Energy and Environment	02	II/IV	Should Have Studied Biology at XII	Prof. C.N. Khobragade
3	BTT OE-301	Medical Biotechnology	02	I/III	Should Have Studied Biology at XII	Prof. C.N. Khobragade
4	BT OE-401	Cancer Biology and Infectious Diseases	02	II/IV	Should Have Studied Biology at XII	Prof. C.N. Khobragade

BTT-C- 101–Biochemistry

Course Objective: The Students will know how the collection of thousands of inanimate molecules that constitute living organisms interact each other to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the non-living things.

Detail contents

UNIT -1

Chemical Foundations of living systems: Molecular basis of life, Biological chemistry – Biomolecules, Bioenergetics- Entropy, Biochemical equilibria, Dissociation and association constants, pH and buffers. Interactions in biological systems: Intra and intermolecular forces, Electrostatic and hydrogen bonds, Disulphide bridges, Hydrophobic and hydrophilic molecules and forces, Water and weak interactions.

UNIT-2

Carbohydrates: Classification, Monosaccharides – structures and function; reactions of monosaccharides- mutarotation, glycoside formation, reduction and oxidation, epimerization and esterification, important monosaccharides and disaccharide; Polysaccharides –overview, structure; important polysaccharide; plant polysaccharide; Glycosaminoglycans and Glycoproteins.

Lipids: Fatty acids as building blocks of most lipids, their structure and properties, classification of lipids, General structure and function of major lipid subclasses: Acylglycerols, phosphoglycerides, sphingolipids, glycosphingolipids, terpenes, steroids, Prostaglandins.

UNIT-3

Amino acids and Proteins: Amino acids as building blocks of proteins, their structure, classification and chemical properties; non- proteinogenic amino acids; Structure of peptide bond, organizational levels of protein structure; alpha- helix, beta pleated sheet, Ramachandran Plot.

UNIT-4

Nucleic Acids and Porphyrins: Structure and properties of nucleic acid bases, nucleosides and nucleotides, biologically important nucleotides, Physical and chemical properties of RNA/DNA. Hydrolysis of nucleic acids. Structure, properties and classification of porphyrins.

Laboratory course BTL – 101

1.Calibration of instruments and verification of Lambert-Beer's Law

2.Preparation of buffer solutions

3. Determination of pK values of amino acids

4. Estimation of reducing sugars

5. Total carbohydrates, amino acids and proteins

6. Qualitative tests of carbohydrates

7. Quantitative analysis of lipids

8. Quantitative analysis of nucleic acids

Learning Outcomes (LO): Students will be able to

1. Know the chemical constituents of cells, the basic units of living organisms.
2. Explain various types of weak interactions between the biomolecules.
3. Know how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids and nucleic acids.
4. Correlate the structure-function relationship in various biomolecules
5. Know the role of biomolecules for orderly structures of the cells/tissues.

Reference Books

1. Nelson, DL and Cox MM., Lehninger: Principles of Biochemistry, WH Freeman (2008) 5th ed.
2. David E Metzler: Biochemistry, The Chemical reactions of Living Cells Vol. 1. 2nd Edition, Elsevier Academic Press (2003),
3. Berg JM, Tymoczko JL and Stryer L: Biochemistry, 5th Edition, WH Freeman and Company, (2005)
4. Koolman J and Roehm K H Color Atlas of Biochemistry, 2nd Edition, Georg Thieme Verlag Publishers (2005)
5. Jain, J.L., Jain, S. and Jain, N., Fundamentals of Biochemistry, S. Chand and Company Ltd. (2005).
6. Plummer DT An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Limited (1988)

BTT-C-102- Cell Biology

Learning Objectives:

1. To provide understanding of the different microscopic techniques used to study the biology of cell.
2. To understand the structure and role of various organelles**.**
3. To understand how these cellular components are used to generate and utilize energy in cells
4. Acquire in-depth knowledge of the cellular components underlying mitotic and meiotic cell division and regulation of cell cycle.
5. To have a concrete knowledge about transport and cell to cell communication in animals as well as plants.
6. To provide wider perspective of cancer and its control**.**

Detail contents

UNIT-1

Investigating the Cell: Cell theory, Microscope and its modifications: light, phase contrast, fluorescence, scanning and transmission electron microscopy.

Cell Organelles: Cell wall: Structure and functions; Plasma membrane: Molecular organization and functions; Vacuole: Tonoplast membrane, transporters, storage organelle; Glyoxysomes and peroxisomes: Structure, enzymes and functions: Golgi complex: Organization, role in storage and secretion; Cytoskeleton: Composition and organization of microtubules and microfilaments, role in cell division and mobility, intracellular motility; Lysozymes: Enzymes and role, Nucleus: structure, organization and regulation of nuclear pure complex, Role of Sarcoplasmic Reticulum in muscle contraction; Melanosomes, E/R etc.

UNIT-2

Transport across membrane: Cell and transport processes, simple diffusion, facilitated diffusion, Active transport, Sodium- potassium pump, proton pump, transport into prokaryotic cells, endocytosis and exocytose.

Cell Interactions: Extracellular matrix of animal cells, cell-cell recognition and adhesion, cell junctions.

Energy transduction: Role of mitochondria and chloroplast in energy transduction.

Cell division and cell cycle: Mitosis, meiosis, their regulation, steps in cell cycle and control of cell cycle.

UNIT-3

Cell Signalling: Hormones and their receptors, Cell surface receptors, signalling through G-protein coupled and protein kinase associated receptors, Signal transduction pathways, second messenger, Bacterial and plant two component signalling systems, Bacterial chemotaxis and quorum sensing, Signal transduction induced by auxins and GA in plants.

UNIT-4

Cancer: Normal cells and cancer cells, Causes, Genetic arrangements in progenitor cells, Oncogenes, Tumour suppressor genes, Cancer and cell cycle, virus induced cancer, Metastasis, interaction of cancer cells with normal cells, Therapeutic interventions of uncontrolled cell growth.

Apoptosis: Role of different genes, Cell organelles during apoptosis, Genetic control of apoptosis.

Flower induction, development its regulation in Arabidopsis.

Brief introduction to Life Cycle and Molecular Biology of some important pathogens: AIDS, Malaria, Hepatitis, Filaria and Kalazar.

BTL -102 Lab Course

1. Microscopy
2. Demonstration of phenomenon of osmosis through a cell membrane.
3. Histochemical techniques.
4. Microtomy.
5. Isolation of chloroplasts from spinach leaves.
6. Demonstration of Hill reaction to measure intactness of chloroplasts.
7. Isolation of mitochondria and mitochondrial swelling.
8. Isolation of mitochondria and activity of its marker enzyme, succinate dehydrogenase (SDH).
9. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.
10. Study of mitosis.
11. Study of meiosis.
12. Induction of polyploidy using colchicine treatment.
13. Isolation of lysosomal fraction and estimation of acid phosphatase activity.
14. Study of Karyotyping and ideogram.
15. Orcein and feulgen staining of salivary gland chromosomes of chironomas and Drosophila.
16. WBC count.
17. Sub-cellular fractionation and marker enzymes.
18. Visit to National Level institutes undertaking studies in cell and molecular biology.

Learning Outcomes (LO): On completion of this course, the students shall:

1. Understand the structure and function of cell and its organelles
2. Acquire combined knowledge on Cell division and cell cycle and cell cycle regulation
3. Acquire the knowledge about transport and cell to cell communication in animals as well as plants.
4. Acquire knowledge about causes of cancer, tumour suppressor genes and control of cancer.

Reference Books:

1. Alberts, B, Bray D, Lewis J Raff M, Roberts K, Watson J. D., 1994, Molecular Biology of Cell, Garland publishing Company.
2. Darnell J, Lodish H, Baltimore D, 1990, Molecular Cell Biology by Scientific American Books, New York.
3. Backer, Kleinsmith and Hardin, 2004, The World of the Cell by Pearson Education.
4. Gerald Karp, 1996, Cell and Molecular Biology by McGraw Hill Publishing Company, New York.
5. David E, Sadava, 1992 Cell Biology – Organell Structure and Function by Bostan and Bartlett publisher.
6. Loewy, Siekevitz, Manniger and Gallant, 1991, Cell Structure and Function (An integrated Approach), Saunders college bublishing house
7. Lewis J. Kleinsmith, Principles of Cell and Molecular Biology
8. Philip Sheeler and Donald Bianehi, Cell and Molecular Biology by John Wiley and Sons
9. Harrmann R. G., Wien, 1992, Cell organells by Springer Verlag

BTT- C-103- Bioanalytical Techniques

Course Objectives: To provide the Students with the understanding of various analytical techniques used in biotechnology-based research and industry. The course will acquaint the Students with the various instruments, their configuration and principle of working, operating procedures, data generation and its analysis.

Detail contents

UNIT-1

Chromatographic techniques: Theoretical basis of chromatographic separations. Column, thin layer, Paper, Normal phase and reverse phase chromatography, Ion-exchange, Affinity and Gas Chromatography, High performance liquid chromatography (HPLC).

UNIT-2

Electrophoretic techniques: Theory and application of polyacrylamide and agarose gel electrophoresis, electrophoresis of protein and nucleic acids, Capillary electrophoresis.

Centrifugation techniques: Introduction, Basic principle of sedimentation, Centrifuges and their uses, safety aspects in the use of centrifuges. Density gradient and analytical centrifugation.

UNIT-3

Spectroscopic techniques: Theory and application of UV-VIS, IR, NMR, Fluorescence, Atomic absorption spectroscopy; X-ray diffraction. Introduction to mass spectroscopy.

UNIT-4

Radio isotopic techniques: Introduction to radioisotopes, detection, measurement and uses of radioisotopes, counting efficiency and autoradiography, biotechnological application

Lab Course: BTL-103

1. Paper chromatography
2. Thin Layer Chromatography,
3. Column Chromatography,
4. Gas Chromatography
5. HPLC
6. Centrifugation,
7. UV visible spectroscopy,
8. SDS-PAGE and agarose gel electrophoresis

9. Dosimetry

Learning Outcomes (LO): Students will be able to

1. Apply basic principles of different analytical techniques in analytical work.
2. Use spectroscopy and radioactivity in biotechnological applications
3. Use microscopy, centrifugation and electrophoretic techniques.
4. Demonstrate principle and working of various instruments.
5. Use various techniques for solving industrial and research problems.

Reference Books

1. Wilson K., Walker J. Principle and Techniques of Biochemistry and Molecular Biology. Cambridge University Press (2006) 6th edition
2. Pingoud A., Urbanke C., et la. Biochemical Methods – A concise guide for Students and researchers. Wiley (2002)
3. Stryer, A.L., Berg J.A. and Tymoczko, J.L., Biochemistry, W.H. Freeman & Co Ltd (2002).
4. Hawes C., Satiat-Jeunemaitre B. Plant Cell Biology. Oxford University Press (2001) 2nd edition
5.. McHale J.L. Molecular Spectroscopy. Pearson (2008) 1st edition
6. Zubey, G.L., Principles of Biochemistry, Pearson-Education (2007).
7. Marimuthu R. Microscopy and Microtechniques. MJP Publishers Chennai (2008)

BTT-E- 101- General Microbiology

Course Objective: To provide fundamental understanding of the microbial world, basic structure and functions of microbes, metabolism, nutrition, their diversity, physiology and relationship to environment and human health. To impart practical skills of isolation and manipulating conditions for their propagation.

Detail contents

UNIT-1

History and classification: Brief history on development and scope of microbiology, characterization, classification and identification of microorganisms, numerical taxonomy and molecular approaches, microscopic examination of microorganisms, bacterial staining, simple and differential staining

Morphology and fine structure of microorganisms: Prokaryotes and eukaryotes, bacterial diversity, bacterial cell structures, Gram positive and Gram-negative bacteria, morphological features, cell structure and major characteristics of cellular (bacteria, fungi, algae, protozoa) and acellular (viruses) organisms.

UNIT-2

Cultivation and cultural characterization of microorganisms: Nutritional and physical requirements of autotrophs, heterotrophs, chemotrophs and lithotrophs, types of culture media, enumeration of microbial populations, pure culture and cultural characteristics.

UNIT-3

Microbial Growth: Modes of cell division, normal growth cycle, and quantitative measurement of growth, growth curve, synchronous growth and continuous culture, factors affecting growth, sporulation, Maintenance and preservation of microbial cultures and its importance, culture banks.

Microbial Physiology: Bacterial metabolism, energy production, respiration, intermediate metabolism, fermentation and photosynthesis.

UNIT-4

Microorganisms and Diseases: Major diseases caused by different microorganism in human, animals and plants**.**

Microbial Control: Physical and chemical agents for control of microbial growth, their mode of action, sterilization, disinfectants and antiseptics, chemotherapeutic agents, antibiotic susceptibility test.

Laboratory Course-BTL-E-101

1. Microscopic examination of stained cell preparation,
2. Gram staining and staining of spore, capsule,
3. Sterilization techniques,
4. Preparation of culture media,
5. Sources of microbial contamination,

6. Techniques for isolation of pure cultures,
7.Isolation of heterotrophs and autotrophs, isolation and enumeration of microbial population in soil and water,
8.Microscopic measurement of cell dimension and growth by cell counting, biochemical activity of bacteria,
9. Bacterial growth curve.

Learning Outcomes (LO): Students will be able to
1. Define the science of microbiology, its development and importance in human welfare.
2. Describe some of the general methods used in the study of microorganisms.
3.. Recognize and compare structure and function of microbes and factors affecting microbial growth.
5. Demonstrate aseptic microbiological techniques in the laboratory and check sources of microbial contamination and their control.

Reference Books

1. Pelzar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.
2. Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5thed. Reference Books
3. Tortora, G.J., Funke, B.R., and Case, C.L., Microbiology- An Introduction, Pearson Education (2007)8th ed.
1. Brock -Biology of Microorganisms by Michael T. Madigan, John M. Martinko, Jack Parker.

BTT-E -102 – Biostatistics and Basic Computer

Course Objective: To understand the basics of statistics and computers and apply it to solve biological problems. In addition to this, to learn basic word processing skills with Microsoft Word, such as text input and formatting, editing, cut, copy and paste, spell check, margin and tab controls, keyboard shortcuts, printing, as well as how to include some graphics such as pictures and charts. In general, develop an intuitive sense of how computers work and how they can be used to make academic work more efficient.

Detail contents

UNIT-1
Basic concepts: Variables & Constant; Population and Samples; Random samples; Discrete and Continuous variables, Parameters.
Measures of Central Tendency: Mean, Mode & Median

UNIT-2
Concepts of Probability:
Theorem on total probability, Theorem on compound probability.
Testing of hypothesis:
One and two tailed tests. Z-test. Students t-test F-test. Chi-square test.

UNIT-3
Correlations and Regression:
Correlation.
Regression.
ANOVA
Application of "R" for statistical analysis

UNIT-4
Basic Computer
Understanding Word Processing: Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Printing of word document. Using Spread Sheet: Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet and MS-Excel. Making Small Presentation: Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts.

BTL -E-102 - Lab course

1 MS Excel and Graph pad, data entry and graphical representation,
2 Calculate Mean, Mode and Median.
3 Equation formulation and analysis for sample testing, correlation, standard deviation, variance and regression.
4 Problems in Probability.
5 ANOVA, multiple comparisons.
6 Preparation of PPT

Learning Outcomes (LO):

Students will be able to learn

How to calculate and apply measures of location and measures of dispersion -- grouped and ungrouped data cases. 2) How to apply discrete and continuous probability distributions to various Biological problems. 3Understand the concept of p-values 4) Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit. 5) Compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test. Further, understand both the meaning and applicability of a dummy variable and the assumptions which underline a regression model. Be able to perform a multiple regression using computer software.

Reference Books

1 *Gupta S. C. and Kapoor, V. K., Elements of mathematical statistics (Third edition), Sultan Chand & Sons Publishers, ISBN 81-7014-290-3*
2 *Mahajan, B. K., Methods in biostatistics (Sixth edition), JAYPEE Brothers Medical Publishers Pvt. Ltd., ISBN 81-7179-520-X*
3 *Zar, J. H., Biostatistical analysis (Fifth edition), Pearson Prentice Hall publication, ISBN 978-0-13-100846-5*
4 *Rao, K. V., Biostatistics – A manual of statistical methods for use in health, nutrition and anthropology (Second edition), JAYPEE Brothers Medical Publishers Pvt. Ltd., ISBN 81-8448-055-5*

BTT-C-201 – Genetics and Molecular Biology

Course Objectives:

Understanding Concept of Mendelian and post Mendelian of genetics.

Understanding Genome organization, Genome duplication and genome function in. viruses, prokaryotes and Eukaryotes.

Detail contents

UNIT I

FUNDAMENTALS OF GENETICS

Review of basic terminologies (Allele, multiple alleles, pseudo allele, complementation tests) and principles of Mendelian (Dominance, segregation, independent assortment) and post Mendelian genetics (Codominance, incomplete dominance, gene interactions, pleiotropy), genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Maternal inheritance.

Overview of human genetics (Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders). Quantitative genetics. Population genetics.

Structural and numerical aberrations of chromosomes, linkage maps, tetrad analysis, recombination, sex determination.

Introduction to Microbial genetics (Transformation, Conjugation, Transduction). Mutation.

Focus of genetic studies as a platform for advances in molecular biology.

UNIT II

DNA STRUCTURE AND GENOME ORGANIZATION

DNA structure and topology. Physical properties of DNA: Tm, hypo and hyper chromicity, solubility, mutarotation and buoyancy. Organization of Viral, Prokaryotic and Eukaryotic genome (Structure of chromatin, nucleosome, chromatin organization, chromosome, centromere, telomere. General organization (size, banding, microsatellites, Gene distribution and density) of plant (rice) and animal (human) genome including their organelle genomes, Organization of genes: rRNA encoding Genes, mRNA encoding Genes, small nuclear RNA genes. Overlapping genes, genes within genes, gene families, pseudo genes, truncated genes and gene fragments. Operon, Fine structure of gene (r-II locus), fine structure analysis of gene (complementation and recombination).

Techniques and Technology involved in genome mapping low- and high-resolution mapping; Strategies and milestones in mapping and sequencing of human genome approaches to physical and genetic mapping. Next generation sequencing: principles and platforms. Principles and strategies for identifying unknown

disease or susceptibility genes. Major genomic databases, Glimpses and significance of the recently sequenced genomes of organisms.

UNIT III

DNA REPLICATION AND REPAIR:

DNA Replication models, DNA replication mechanism (Prokaryotes/eukaryotes). RNA world and RNA Replication. DNA modifying enzymes: DNA polymerases: types and mechanism of action. DNA damage and repair and recombination: mechanisms and structure and functions of enzymes involved. RNA Polymerases and reverse transcriptase: structure and mechanisms of action. DNA methyl transferases, Topoisomerase, Gyrase, Nucleases etc. Types, mechanisms, and significance of mutations.

UNIT IV

REGULATION OF GENE EXPRESSION

Chromatin structure and remodeling. Regulation of gene expression at chromatin level. Epigenetics: Genome imprinting, DNA methylation, Acetylation, Chromosome inactivation and sex determination. Gene silencing, RNA interference. Homeotic gene expression and pattern formation in plants and animals. Oncogenes and proto oncogenes.

Transcription in pro and eukaryotic organisms and transcription factors. Regulation of gene expression at transcriptional level (Phages, viruses, prokaryotic and eukaryotic genes). RNA processing: capping, polyadenylation, splicing, editing and transport of RNA. Structure and functions of ribonucleoproteins. Translation in pro and eukaryotic organisms and its regulation. Genetic code and factors. Translational proofreading, translational inhibitors. PTM.

BTL-C-201

Laboratory course in Genetics and Molecular Biology

1. Use of drosophila as a model system in genetics: Life history, morphology, mutants, culture, sexing pupae for setting up crosses etc.
2. Gene interactions
3. Mutants of Drosophila Mono and Di-hybrid crosses in Drosophila.
4. Sex linked lethal in Drosophila.
5. Estimating gene frequencies in population, estimation of heterozygote frequencies, pedigree analysis.
6. Human karyotype and chromosomal aberrations.
7. Ames test for genotoxins.

8. UV mutagenesis.
9. Bacteriophage titration.
10. Bacterial transformation.
11. Bacterial conjugation.
12. Bacterial transduction.
13. Isolation of nuclei and chromatin. Determination of mononucleosomal size.
14. Chromatin gel electrophoresis.
15. Isolation of genomic DNA from different sources viz. plant, animal, yeast and bacteria.
16. Restriction digestion of genomic DNA and analysis.
17. Thermal melting of DNA.
18. Agarose gel electrophoresis of DNA.
19. Isolation of organelle genome and restriction digestion.

Learning Outcomes (LO):

Students will be able to learn

1. Fundamentals of Mendelian and post-Mendelian genetics.
2. Genome (viral, prokaryotic and eukaryotic) organization, duplication and function.

Reference Books :

1. Birge, E.A. (2006) Bacterial and Bacteriophage Genetics. 5th Edition. Sriger Publications
2. Concepts of Genetics, 9th edition, 2009 by Klug et al
3. Dale, J.W., Park, S.F. (2005) Molecular Genetics of Bacteria 4th Edition Wiley and Sons Inc
4. Freifelder, D. (2005). Moleular Biology. 2nd Edition. Narosa Pub. House
5. Genes IX. Lewin B. (2008),
6. Introduction to Genetic Analysis, 9 th edition by Griffiths et al, 2008
7. Molecular Biology by Weaver.
8. Molecular Biology of the Cell. Alberts et. al. (5 th edn., 2007)
9. Molecular Biology of the Gene. Watson et. al. (6 th edn., 2009),
10. Molecular Cell Biology. Lodish et. al. (6 th edn., 2008)
11. Principles of Genetics by Snustad et al (2004)
12. Problems and Approaches 3rd edition (1997) and 4th edition (revised2009) Speicher, Michael; Antonarakis, Stylianos E.; Motulsky, Arno G. (Eds.)
13. Read Andrew and Donnai Dian (2007) New Clinical Genetics, Scion Publishing Ltd, UK.
14. Strachan Tom and Read Andrew P. (2004) Human Molecular Genetics, 3rd Edition, Garland Science (Taylor and Francis Group), London and New York

15. Synder, L., Champness W. (1997) Molecular Genetics of Bacteria. ASM Press.
16. Turn, N., Trempy, J. (2006) Fundamental Bacterial Genetics. Blackwell Publishers
17. Vogel and Motulsky's Human Genetics.

BTT-C-202- Microbial and Enzyme Technology

Course Objective: To make Students learn structural and functional relationships in enzymes and altering their structure in order to function 'better'. To provide basic knowledge of enzyme technology and use of enzymes as tools in industry, agriculture and medicine.

Detail contents:

UNIT-I

Fundamentals of Microbial Metabolism

Isolation, development, presentation and improvement of industrially important micro-organism; isolation of auxotrophic mutants; isolation of revertant mutants and use of recombinant systems for improvement of industrial microorganisms; metabolic pathways: Regulatory mechanism of metabolic pathways in industrial strains; bioenergetics-basic principles; equilibria and concept of free energy; coupled processes; glycolysis and glycolytic enzymes regulation; TCA-cycle and enzyme regulation; oxidative phosphorylation and enzyme regulation; fatty acid metabolism ; principles of metabolic regulation ; regulatory steps.

UNIT-2

Enzyme catalysis and kinetics

Source of enzymes; production, isolation and purification of enzymes; characterization in terms of pH, temperature, ionic strength, substrate and product tolerance, effect of metal ions etc. Enzyme kinetics: Enzymes as Biological catalysts; enzyme action: Active site, functional group, enzyme substrate complex, cofactors; Michaelis-Menten equation; enzyme inhibition; methods of plotting enzyme kinetics data; enzyme turnover; enzyme induction, repression, covalent modification, isoenzymes, allosteric effect

UNIT-3

Enzyme Engineering and Immobilization

Rationales for enzyme engineering, steps in enzyme engineering, chemical methods for modifying enzyme activity, site directed mutagenesis, protein engineering, mechanism of protein folding and its pathological effects, immobilized enzyme technology: different techniques of immobilization of enzymes and whole cells; advantages and disadvantages of immobilization; application of cell and enzyme immobilization and biosensors.

UNIT-4

Clinical and Industrial Enzymes

Clinical and diagnostics enzymes and their applications, enzymes as therapeutic agents, enzymes in food processing, leather, textile, detergent and pharmaceuticals and fine chemical industries. Enzymes in organic solvents and ionic liquids: various organic solvents and ionic liquids used in bio catalysis, potential of enzymes in organic solvents and ionic solvents.

BTL-C-202 Lab Course

1. Cultivation of microorganisms
2. Isolation, purification and characterization of microbial enzymes
3. Study of Maltose calibration curve
4. Determination of enzyme activity of α-amylase/lipase.
5. Effect of temperature, pH, metal ions and substrate concentration on enzyme activity
6. Study of kinetic parameters Km, Vmax and Kcat
7. Characterization of clinical and industrially important enzymes

Learning Outcomes (LO):

Students will be able to

1 Comprehend the importance of R groups of the amino acids in any protein/enzyme.
2 Know about domains and motifs in a protein and the basis of their prediction
3 Know relationship between structure and function of an Enzymes.
4 Design different strategies for protein engineering and protein design
5 Know the principles of isolation and purification of enzymes from various sources
6 Comprehend various methods involved in enzyme technology and their commercial applications.

Reference Books:

1 *Balasubramanian D, Bryce CFA, Dharmalingam K, Green J, and Jayaraman R, Concepts in*
2 *Biotechnology, Universities Press (2007).*
3 *Rastogi SC, Mendiratta N and Rastogi P, Bioinformatics - Methods and Applications, PHI (2006).*
4 *Satyanarayana, U, Biotechnology, Books and Allied (P) Ltd. (2005).*
5 *Smith JE, Biotechnology, Cambridge University Press (2006).*
6 *Berg JM, Tymoczko JL and Stryer L, Biochemistry, W H Freeman and Company (2002).*
7 *Creighton TE, Protein-Structure and Molecular Properties, W.H. Freeman and Co. (1997).*
8 *Primrose SB and Twyman RM, Principles of Gene Manipulation and Genomics, Blackwell*
9 *Publishing (2006) 7th ed.*
10 *Sambrook J, Fritsch EF, Maniatis T, Molecular Cloning: A Laboratory Manual, Cold Spring HarboLaboratory (1999)*

BTT-C-203- Bioprocess Engineering and Technology

Course Objective: The objective of this course is to apply fundamental principles and concepts of chemical engineering to biological systems. This will provide a comprehensive understanding of media formulations, microbial growth kinetics, bioreactor selection, upstream & fermentation processes, and its role in manufacturing bio-products.

Detail contents:

UNIT-1

Introduction: Interaction of two disciplines: biology and bio-chemical engineering, historical advancement in fermentation processes, current status of biochemical engineering in fermentation industry, range of microbial diversity in fermentative processes.

Microbial Growth Kinetics: Growth, growth measurement, media formulation, stoichiometry of cell growth and product formation, factors influencing product formation on varying carbon & nitrogen source, batch culture, Monod's kinetics, modelling of batch growth kinetics, environmental factors affecting microbial growth, continuous culture, an ideal chemo stat, advantages and limitations of continuous over bath culture, fed-batch culture and its applications.

UNIT-2

Aeration and Agitation: Fick's law, theories of mass transfer, mass transfer between two phases, role of aeration and agitation in a bioprocess, oxygen transfer methodology in a fermentation process, significance of volumetric transfer coefficient (K_La) and its determination, factors affecting K_La values in a bioreactor, power requirements in gassed and ungassed bioreactors, rheological characteristics of fermentation fluids.

UNIT-3

Bioreactor Selection and Design: Selection criteria for bioreactor, body construction of fermenter and its components *i.e.*, impellers, stirred glands and bearings, seal assemblies, baffles, sparger and valves, solid state and submerged fermentation, design aspects of bubble column bioreactor, air-lift fermenter, plug-flow and packed bed bioreactor, scaling up of bioreactor.

UNIT-4

Sterilization, Instrumentation and Process Control: Need of sterilization, media sterilization, Del factor, design of batch and continuous sterilization, air sterilization, log penetration theory, scale up of sterilization process, filter design, control systems in a bioprocess, methods of measuring process variables i.e., temperature, pressure, flow, dissolved oxygen, pH, role of computers in fermentation process analysis.

BTL-203 Lab Course:

1 Bacterial growth kinetics,
2 Effect of varying carbon substrate on specific growth rate,
3 Production of citric acid and lactic acid
4 Production of Alcohol (Ethanol)
5 Comparative study on rate of product formation using immobilized and suspension cells,
6 K_La determination using non-fermentative and fermentative methods,
7 effect of mixing and agitation rate on K_La,

Learning Outcomes (LO):

Students will be able to

1 Explain how microorganisms and biochemical processes can be applied in engineered Systems.
2 Distinguish among batch, continuous and fed-batch culture systems for the production of Biochemical products.
3 Describe microbial growth & cultivation, various bioreactor components, and types of Bioreactor used in biotechnology industries.
4 Design media sterilization and design of air filter in a bioprocess.
5 Apply various concepts to improve bioreactor performance and evaluate process variables to analyse a bioprocess.

Reference Books

1 *P.F. Stanbury and A. Whitaker-Principle of Fermentation Technology; PergamonPress (1988).*
2 *M. L. Shuler and F. Kargi-Bioprocess Engineering: Basic Concepts" by, 2nd Edition, PearsonEducation (2001).*
3 *P. M. Doran-Bioprocess Engineering Principles Academic Press (2012).*
4 *J. E. Bailey and D.F. Ollis-Biochemical Engineering Fundamentals, McGraw-Hill Book Co., New York (1986)*
5 *S. Aiba, A. E. Humphrey, N. F. Millis-Biochemical Engineering, Academic Press, New York 2nd Edition (1973).*

BTT-E-201- Environmental Biotechnology

Objectives: The exposure to this would facilitate the Students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the value of regional and global natural and energy resources; and emphasize on need for conservation of energy and environment.

Detail contents

UNIT-1

Natural Resources: Human settlements and resource consumption; Biological, mineral and energy resources; Land, water and air; Natural resources vis-à-vis human resources and technological resources; Concept of sustainability; Sustainable use of natural resources

Ecology, Structure and Functioning of Natural Ecosystems: Ecology, ecosystems and their structure, functioning and dynamics; Energy flow in ecosystems; biogeochemical cycles and climate; Population and communities

UNIT-2

Agricultural, Industrial Systems and Environment: Agricultural and industrial systems vis-à-visnatural ecosystems; Agricultural systems, and environment and natural resources; Industrial systems and environment

Environment Pollution, Global Warming and Climate Change: Air pollution (local, regional and global); Water pollution problems; Land pollution and food chain contaminations; Carbon cycle, greenhouse gases and global warming; Climate change – causes and consequences; Carbon footprint; Management of greenhouse gases at the source and at the sinks

UNIT-3

Energy Technologies and Environment: Electrical energy and steam energy; Fossil fuels, hydropower and nuclear energy; Solar energy, wind energy and biofuels; Wave, ocean thermal, tidal energy and ocean currents; Geothermal energy; Future energy sources; Hydrogen fuels; Sustainable energy

UNIT-4

Group Assignments: Assignments related to Sanitary landfill systems; e-waste management; Municipal solid waste management; Biodiversity and biopiracy; Air pollution control systems; Water treatment systems; Wastewater treatment plants; Solar heating systems; Solar power plants; Thermal power plants; Hydroelectric power plants; Biofuels; Environmental status assessments; Energy status assessments, etc.

BTE-201 Lab Course:

1. Microorganisms form polluted environment/Soil /Water resources /Air
2. Biotransformation
3. Microbial degradation of textile dyes/pesticides/hydrocarbons and oils
4. Assay of enzymes involved in biotransformation.
5. Analysis of product
6. Evaluation of toxicity of the product.
7. Bioremediation
8. Pollutant removal using microorganisms from industrial effluent.
9. Removal of oil spills form soil
10. Biomineralization
11. Effect of heavy metals on microbial growth
12. Microbial leaching of metals

13. Effect of pesticides on soil microorganisms
14. Pollution control
15. Activated sludge process
16. ETP: Primary, chemical and biological treatment

Learning Outcomes (CLO):

Students will be able to:

1 Outline the scenario of natural resources and their status
2 Calculate the flow of energy and mass balance in ecosystems
3 Analyse environmental status of human settlements
4 Monitor the energy performance of systems

Reference Books:

1 *Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).*
2 *Chapman, J.L. and Reiss, M.J., Ecology- Principles and Application, Cambridge University Press (LPE) (1999).*
3 *Joseph, B., Environmental Studies, Tata McGraw-Hill (2006).*
4 *Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman andHarow (2006).*
5 *Miller, G.T., Environmental Science- Working with Earth, Thomson (2006).*6. *Wright, R.T., Environmental Science-Towards a sustainable Future, Prentice Hall (2008).*
6 *O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).*

BTT-E- 202 – Basic Bioinformatics

Course Objective: The objective of this course is to familiarize students with basic concepts of sequences, structural alignment, database searching, protein structure prediction.

Detail Contents

UNIT-1

Introduction to Bioinformatics Resources

Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB, DDBJ: The knowledge of databases and bioinformatics tools available at these resources, organization of databases: data contents, purpose and utility. Open access bibliographic resources and literature databases: PubMed, BioMed Central, Public Library of Sciences (PloS), Cite Xplore.

UNIT-2

Sequence databases

Sequence databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ; Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL, UniParc; Structure Databases: PDB, NDB, PubChem, ChemBank. Sequence file formats: Various file formats for bio-molecular sequences:
GenBank, FASTA, GCG, MSF etc. Protein and nucleic acid properties: Proteomics tools at the ExPASy server, GCG utilities and EMBOSS, Computation of various parameters

UNIT-3

Sequence analysis

Sequence Analysis: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues Scoring matrices: basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles.

UNIT-4

Sequence alignment

Sequence alignment: Measurement of sequence similarity; Similarity and homology. Pairwise sequence alignment: Basic concepts of sequence alignment, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results.

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BTL-E-202 Lab Course:

1 Proteomics tools,
2 Structural and functional predictions,
3 Phylogenetic Analysis, Phylogenetic tree construction
4 DNA and protein sequence and PDB file formats,
5 Local and global sequence alignment of protein and DNA sequences,
6 Needleman Wunsch and Smith-Waterman algorithm,
7 BLAST, Multiple sequence alignment,

Reference

1. . Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D.and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith, Pearson Education. 1999
4. . Bioinformatics for Dummies by Jean-michel Claverie Cedric Notredame. Publisher: Dummies (Jan 2007)