BOS Approved Syllabus
for
5 year Integrated M.Sc.
Biotechnology & Bioinformatics Course

(Effective from the academic year 2018-19)

Dept. of Biotechnology & Bioinformatics
Yogi Vemana University
Vemanapuram, Kadapa - 516 003. Andhra Pradesh

5 Year Integrated M Sc Course Structure

Semester	Number of Papers	Marks in the Semester End Examinations for each Paper	Internal Tests for Each Paper	Total Marks for all the Papers
I	Theory:4 Physical Sciences I Practicals:3	75 70 100	25 30 -	100x4=400 100x1=100 100x3=300
II	Theory:4 Physical Sciences II Practicals:3	75 70 100	25 30 -	100x4=400 100x1=100 100x3=300
III	Theory:4 Physical Sciences III Practicals:3	75 70 100	25 30 --	100x4=400 100x1=100 100x3=300
IV	Theory:5 Practicals:3 Seminar	75 80 --	25 -- 60	100x5=500 80x3=240 60
V	Theory:5 Practicals:3 Seminar	75 80 --	25 -- 60	100x5=500 80x3=240 60
VI	Theory:5 Practicals:3 Seminar	75 80 --	25 -- 60	100x5=500 80x3=240 60
VII	Theory:5 Practicals:3 Seminar	75 80 --	25 -- 60	100x5=500 80x3=240 60
VIII	Theory:5 Non- core I Practicals:3 Seminar	75 75 80 --	25 25 -- 60	100x5=500 100x1=100 80x3=240 60
IX	Theory:5 Non-core II Practicals:1 Project Design Seminar	75 75 80 -- --	25 25 -- 80 40	100x5=500 100x1=100 80x1=80 80x1=80 40
X	Research Methodology Project (Individual) Viva Voce	100 150 50	-- 100 --	100x1=100 250 50
Total				**7500** **200**[*]

* These marks will not be considered for awarding the Grade Points but the candidate should pass since these are part of CBCS.

YOGI VEMANA UNIVERSITY
5 years Integrated M. Sc. Biotechnology & Bioinformatics

SYLLABUS
w.e.f. Academic Year 2018-19

Semester – I

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	16011	Second language (Telugu)	4	100	4
2	16012	Introduction to biology	4	100	4
3	16013	Mathematics-I	5	100	4
4	16014	Physical Sciences-I	4	100	4
5	16015	Cell biology	4	100	4
6	16011P	Biology Lab	3	100	4
7	16012P	Physics Lab-I	3	100	4
8	16013P	Chemistry Lab-I	3	100	4
Total			30	800	32

Semester – II

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	26011	English	4	100	4
2	26012	Computer Science-I	4	100	4
3	26013	Mathematics-II	5	100	4
4	26014	Physical Sciences-II	4	100	4
5	26015	Biodiversity and ecological principles	4	100	4
6	26011P	Computer science Lab-I	3	100	4
7	26012P	Physics Lab-II	3	100	4
8	26013P	Chemistry Lab-II	3	100	4
Total			30	800	32

Semester - III

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	36011	Communication Skills (English)-I	5	100	4
2	36012	Computer Science-II	4	100	4
3	36013	Mathematics and Statistics	6	100	4
4	36014	Physical Sciences-III	4	100	4
5	36015	Principles of Microbiology	4	100	4
6	36011P	Computer science Lab-II	3	100	4
7	36012P	Physics Lab-III	3	100	4
8	36013P	Chemistry Lab-III	3	100	4
Total			32	800	32

Semester - IV

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	46011	Communication Skills (English)-II	4	100	4
2	46012	Environmental Studies	4	100	4
3	46013	Principles of Management and Entrepreneurship	4	100	4
4	46014	Introduction to Bioinformatics	4	100	4
5	46015	Biomolecules	4	100	4
6	46011P	Communication skills lab	3	80	4
7	46012P	Microbiology & Introduction to Bioinformatics lab	3	80	4
8	46013P	Biomolecules lab	3	80	4
9	46011S	Seminar	3	60	4
Total			32	800	36

Semester - V

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	56011	Biochemical and biophysical tools	4	100	4
2	56012	Genetics	4	100	4
3	56013	Molecular biology	4	100	4
4	56014	Enzymology and Bioenergetics	4	100	4
5	56015	UNIX, HTML and BIOPERL	4	100	4
6	56011P	Biochemical and biophysical tools lab	3	80	4
7	56012P	Genetics and Molecular biology lab	3	80	4
8	56013P	Enzymology&UNIX,HTML&Bioperl lab	3	80	4
9	56011S	Seminar Presentation	3	60	4
Total			32	800	36

Semester – VI

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	66011	Immunology	4	100	4
2	66012	Genetic engineering	4	100	4
3	66013	Intermediary metabolism	4	100	4
4	66014	Data mining in bioinformatics	4	100	4
5	66015	Plant biotechnology	4	100	4
6	66011P	Immunology lab	3	80	4
7	66012P	Data mining in bioinformatics lab	3	80	4
8	66013P	Plant biotechnology lab	3	80	4
9	66011S	Seminar Presentation	3	60	4
Total			32	800	36

Semester – VII

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	76011	Genomics	4	100	4
2	76012	Microbial biotechnology	4	100	4
3	76013	Animal biotechnology	4	100	4
4	76014	Molecular modeling	4	100	4
5	76015	Elective 1: Plant system physiology/ Bacteriology and Virology	4	100	4
6	76011P	Genetic engineering & Genomics lab	3	80	4
7	76012P	Animal biotechnology lab	3	80	4
8	76013P	Molecular modeling lab	3	80	4
9	76011S	Seminar Presentation	3	60	4
Total			32	800	36

Semester – VIII

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	86011	Environmental Biotechnology	4	100	4
2	86012	Stem cell biology & Regenerative medicine	4	100	4
3	86013	Proteomics and Protein Engineering	4	100	4
4	86014	Drug design and targeting	4	100	4
5	86015	Elective 2: Animal System Physiology/ Agricultural biotechnology	4	100	4
6	86016	Non-core paper I Introduction to bioinformatics*	4	100	-
7	86011P	Microbial and Environmental biotechnology lab	3	80	4
8	86012P	Proteomics lab	3	80	4
9	86013P	Drug design lab	3	80	4
10	86011S	Seminar Presentation	6	60	4
Total			36	900	36

Semester – IX

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	96011	Cell signaling and Cancer Biology	4	100	4
2	96012	Bioethics, Biosafety, and IPR	4	100	4
3	96013	Elective 3: Nanobiotechnology/ Medical biotechnology	4	100	4
4	96014	Elective 4: Metabolomics/R Programme and system biology.	4	100	4
5	96015	Elective 5: Developmental biology/ Oxidative Stress, Antioxidant Defence in health & Disease.	4	100	4
6	96016	Non-core Paper II: Natural products in Industrial applications*	4	100	-
7	96011P	Cancer biology/R Programming lab	3	80	4
8	96011T	Project design	6	80	4
9	96011S	Seminar	3	80	4
Total			36	800	32

Semester – X

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks	Credits
1	06011	Research Methodology	4	100	4
2	06011T	Project/ Dissertation	28	300	8
Total			32	400	12

*Open to other PG departments as per CBCS system.

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester I

Paper code 16011: Telugu (Second language)

5 సం॥ ఇంటిగ్రేటెడ్ పాఠ్యాంశ ప్రణాళిక

తెలుగు – మొదటి సెమిస్టర్

యూనిట్ – 1 : ప్రాచీన కవిత్వం

1.1. తిక్కన – ద్రౌపతీ పరిదేవనం – ఆంధ్రమహాభారతం ఉద్యోగ పర్వం తృతీయ ఆశ్వాసం (100–125)

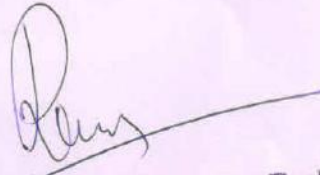1.2. ధూర్జటి – సాయుజ్యము – శ్రీకాళహస్తీశ్వర మాహాత్మ్యం ద్వితీయ ఆశ్వాసం (109–139)

యూనిట్ – 2

2.1. జాషువా – పిరదోసి లేఖ (ఆ సుల్తాను నుండి అనుభవించేవరకు)

2.2. సావిత్రి – బందిపోట్లు

2.3. విద్వాన్ విశ్వం – పెన్నేటిపాట (1వ సర్గ)

యూనిట్ – 3 : గద్యభాగం

3.1. ముప్పాళ్ళ రంగనాయకమ్మ – అమ్మకు ఆదివారం లేదా

3.2. పాపినేని శివశంకర్ – చింతలతోపు

3.3. బండి నారాయణ స్వామి – సావు కూడు

యూనిట్ – 4 : ప్రత్యేక కవి

4.1. వేమన – సామాజిక, ఆర్థిక, కౌటింబిక అంశాలు

Prof. T. Rama Prasada Reddy
Head
Dept. of Telugu
Yogi Vemana University
KADAPA - 516 003, (A.P.)

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester I

Paper 16012: INTRODUCTION TO BIOLOGY

Unit I: Evolution and classification

Origin of life - Origin of basic biological molecules; concept of Oparin and Haldane; Miller experiment; evolution of prokaryotes; evolution of eukaryotic cells. Classification of living organisms; viruses, prokaryotes, Eukaryotes, fungi, plants, and animals.

Unit II: Cell and organism biology

Cell structures - Prokaryotic cell, Eukaryotic cell – plant, animal cell structures and differences. Animal tissues (epithelial tissue, connective tissue, muscle tissue). Plant tissues, plant structure and functions.

Unit III: Metabolism and reproduction

Energy and metabolism, modes of nutrition, autotrophs, heterotrophs, respiration, fermentation, photosynthesis. Reproduction – Asexual reproduction, sexual reproduction, breeding systems in plants and commercial applications, overview on development of an embryo to adult in humans.

Unit IV: Inheritance biology

Inheritance, DNA, the genetic material, Mendelian principles, law of dominance, law of segregation, independent assortment, mutations, cytoplasmic inheritance.

References:

1. Biological science – low price ed
2. Biology - Davidson
3. "Evolution" by D. J. Futuyma.
4. "Ecology-Principles and Applications" by Chapman and Reiss Cambridge
5. "Developmental biology" by Scott Gilbert
6. "Animal Physiology", Hill R, Wise G A & Anderson M Sinauer.
7. "Plant Physiology" Taiz & Zeiger Sinauer.
8. "Molecular biology of the Cell" by Albert et.al
9. Verma PS, Agarwal V.K. Cell Biology, Genetics, Evolution and Ecology. S.chand & Co.

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Semester I

16013: MATHEMATICS-I

Unit-I: Partial Fractions

Introduction – General rules to resolve a given fraction into partial fractions - Non-repeated linear factors – Repeated linear factors – Quadratic factors.
Sections 1.1 to 1.6 of chapter **I** of Elementary Engineering Mathematics by Dr.B.S.Grewal.

Unit-II: Matrices

Introduction – Definition- Special matrices- Matrix operations – Related matrices – Matrix method of solution of simultaneous equations.
Sections 5.1 to 5.5 of chapter V of Elimentary Engineering Mathematics by Dr.B.S.Grewal.

Unit-III: Trigonometry

Trigonometric Ratios of Acute & Compound Angles

Sections 7.1 to 7.4 of Chapter **VII** of Business Mathematics by P.R.VITTAL Margham Publications.

Unit- IV: DIFFERENTATION:

Definition: General rules of differentiation – Derivatives of standard functions – Derivatives of parametric forms and implicit functions- Logarithmic differentiation.
Sections 12.1 to 12.4 of chapter **12** of Elementary Engineering Mathematics by Dr.B.S.Grewal.

Reference Books:

Units I & II "Intermediate Mathematics" –Volume II by S.Chand Publications.
Units III & IV "Intermediate Mathematics" by S.Chand Publications.

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Semester I

16014: Physical Sciences-I

Part A: Physics of Mechanics

Unit-I: Vector analysis   **7 hours**

Scalar and Vector fields – Gradient of a scalar field and physical significance. Divergence and Curl of a vector field. Integration of vectors - Line, Surface and Volume integrals. Stock's, Guas's and Green's theorems.

Unit-II: Mechanics of Particles and a Rigid body   **18 hours**

Laws of motion - Motion of variable mass system - motion of a rocket – Collisions in two and three dimensions – Concepts of impact parameter and scattering cross-section - Rutherford's scattering. Definition of a rigid body – Rotational motion – rotational kinematics relations – equation of motion of a rigid rotating body –angular momentum and inertia tensor- Euler's equation.

Reference Books:
1. Fundamentals of Physics by David Haliday, Robert Resnick and
2. Mechanics by Hans and Puri, Tata McGraw Hill Pub.
3. Introduction to Physics for Scientists and Engineers by F.J. Ruche(Mc Graw Hill).
4. Mechanics by Upadhyaya.
5. A text book of Engineering Mechanics by R.K. Rajput (Dhanpat Rai and sons).
6. B.Sc. Physics Vol.-1 by C. Murali Mohan Sastry, K. Shankar Rao, P. Babu Rao.
7. B.Sc. Physics Vol.-1 – Unified Physics.

Part B: Inorganic chemistry

Unit – I: Inorganic metals in biological system   **11 hours**

Introduction, essential and trace elements, biological significance of sodium, potassium and chlorine, iron, zinc, cobalt, toxic metals and their toxicity of As, Hg, and Pb; metallophorphyrins with emphasis on hemoglobin – structure and fusion, chlorophyll – structure and fusion, functions of nitrogenase.

Unit – II: Coordination compounds   **13 hours**

Introduction, nomenclature of inorganic molecules and complex compounds, Werner's theory – postulates, experimental evidences. Sidwick's theory – calculation of EAN, limitations. Metal – ligand bonding in transition metal complexes – valence bond theory – postulates, geometrics of coordination number 4 – tetrahedral and square planner, and coordination number 6 – octahedral complexes, and crystal field stabilization energy. (Elementary treatment – diagrams only).

Reference books:
1. Concise Inorganic Chemistry by J.D. Lee
2. Basic Inorganic Chemistry by Cotton & Wilkinson
3. Inorganic Chemistry by J.E. Huheey
4. Selected Topics in Inorganic Chemistry by Wahid U.Malik
5. Vogel's Text book of Qualitative inorganic Analysis
6. Unified course in Chemistry by O.P. Agarwal, Vol. I, II, and III

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Semester I

Paper 16015: Cell Biology

UNIT I:
Cell Theory and the Cell: Discovery of cell and the cell theory, exceptions to the cell theory. Cell structure – bacteria, plant and animal cell. Structural differences between prokaryote and eukaryotic cells and plant and animal cells.

UNIT II:
Membrane structure and function – Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

UNIT III:
Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton.

UNIT IV:
Organization of chromosomes: Structure of chromatin and chromosomes, organization of chromosomes in eukaryotes and prokaryotes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. **Cell division and Cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

References:
1. De Robertis and De Robertis. Cell and Molecular Biology, P.K.Gupta. Cell and Molecular Biology. Narosa Publisher.
2. Verma PS, Agarwal V.K. Cell Biology, Genetics, Evolution and Ecology. S.chand & Co.
3. Bruce Alberts. Essential cell biology an introduction to Molecular Biology of the Cell. Garland
4. Cooper – Introduction to the Cell.

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Semester I

16011P: Biology lab
  i.   pH determination
  ii. Buffer preparation
  iii. Colorimetric estimations of biomolecules (proteins, sugars)
  iv. Cell biology experiments (Slides of various organisms, and types of cells)
  v.   Simple staining for bacteria.

16012P: Physics lab - I

  i.   Determine the acceleration due to gravity using compound pendulum.
  ii. Determine the frequency of given tuning fork using Volume resonator.
  iii. Determine the surface tension of a liquid using capillary rise method.
  iv. Verify the laws of transverse vibrations of a given stretched string.
  v.   Study the oscillations of mass under series and parallel combinations of two different strings.
  vi. Determine the viscosity of water.

16013P: Chemistry lab – I

Inorganic chemistry
  i. Acid Base Titrations
Determination weight of carbonate in given Sodium Carbonate solution – by using acid base titration method.
  ii. EDTA Titrations
Determination of weight of Zinc in given $ZnSO_4$ solution by using standard EDTA solution.
Determination of weight of copper in given $CuSO_4$ solution by using standard EDTA solution.

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Semester II

Paper code 26011: ENGLISH

SECTION	SELECTIONS	AUTHOR
Poetry- 20 Marks	1.Pied Beauty 2. Still I Rise	G.M. Hopkins Maya Angelou
Prose- 10 Marks	3.True and Rare Genius (Vemana) 4. The Power of Prayer	V. Narla Abdul Kalam
One Act Play	5.Thirst	M.V.Madasu

Grammar	40 Marks
1. Parts of Speech 2. Tenses	20 Marks
3. Concord (5 Sentences out of ten) 4. Transformation of Sentences 5. Synonyms and Antonyms	20 Marks

Books:
1. Selections from English Prose (Common Core Syllabus), Oxford Press
2. Poetry for Pleasure (Common Core for Under Graduate)
3. True and Rare Genius – Nala's writings Vol-11.
4. Finesse, Selections from Poetry and Prose. ISBN: 9878-93-5138-119-8.
5. Non detail (Common Core for Under Graduate)
6. Murphy's English Grammar, Cambridge University Press
7. Oxford English Grammar by John Eastwood, Oxford University Press.

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Semester II

Paper 26012: COMPUTER SCIENCES - I

Unit-1

Creating new document; opening existing document; file, edit, insert format, tools, table, and window menu commands.

Working with excel; spread sheet features; file, edit, insert format and tools, using different types of charts

MS power point: auto content wizard; master slides; fines with other presentations

Unit-II

Introduction to C-programming language: History of C-program, structure of C-program, identifiers' and keywords, data types, constants, variables, arrays and pointers

Operators and Expressions: Arithmetic operators, unary operators, relational and logical operators, assignment operators, conditional operators and library functions

Unit-III

Control statement: Branching: if-else statement; Looping: while-loop, do-while and

For-loop statement; Jumping: break, continue, goto; switch statement and comma statement, I/O statements

Function: defining a function, accessing a function, function prototype, passing arguments to a function, recursion

Unit-IV

Program Structure: storage classes, automatic variables, global (external) variables, static variables

Programing in C: Arrays, pointers, structures and unions; file handling

TEXT BOOKS:
1. Let us C, Kanethkar
2. ANSI-C Balaguruswamy
3. MS office 2007

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Semester II

Paper 26013: MATHEMATICS-II

Unit – I: Integration:

Definition: Standard results – Integration by substitution – Integration by Parts.
Sections 16.1 to 16.3 and **16.8** of Chapter **16** Elementary Engineering Mathematics
by Dr.B.S.Grewal.

Unit – II: The Plane

Definition – Equation to the plane into the normal form – Angles between two planes –
Perpendicular distance of a Point from a Plane – Distance between Parallel Planes –
Planes Bisecting the Angles Between two Planes.
Chapter – 3 of " A Textbook of B.Sc., Mathematics – Volume –II" by S.Chand Publications.

Unit- III: The Right Line

Definition – Angle between a line and a Plane- Conditions for a line to lie in a
plane-Coplanarity of lines – Shortest Distance Between two skew lines – Length of
the Perpendicular from a point to a line.
Chapter-4 of " A Textbook of B.Sc., Mathematics – Volume –II" by S.Chand Publications.

Unit-IV: Differential Equation of First order and First degree

Introduction- Separation of variables – Homogeneous equations- Equations reducible
to homogeneous form. **Sections 2.1 to 2.6** of Chapter -**2** of Ordinary and Partial
Differential Equations by M.D.Raisinghania.

Reference Books:

Unit-I: "Intermediate Mathematics" by S.Chand Publications.
Unit –II, III,IV : Higher Engineering Mathematics by Dr.B.S.Grewal.

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Semester II

PAPER 26014: PHYSICAL SCIENCES-II

Part A: Physics of Thermodynamics and Optics

Unit-I: Thermodynamics (15 hours)

The zeroth law and first law of thermodynamics – Internal energy – work done in isothermal and adiabatic processes – reversible and irreversible processes – Carnot's theorem – Carnot's engine – efficiency – Clausius – Clapeyron equation. Second law of theoremdynamics – entropy – concept – entropy and disorder measurement of entropy changes in reversible and irreversible processes – entropy of universe. Joule – Kelvin effect – expression for Joule - Kelvin coefficient – Liquefaction of gases – Principle of Refrigeration.

Unit-II: Interference Diffraction & Polarization (13 hours)

Interference of light – the principle of superposition – Young's double slit theory and experiment - Diffraction – Fraunhofer diffraction – Fraunhofer diffraction at a single slit and double slit. Diffraction grating – Grating spectrum – Fresnel half period zones – zone plate. Polarization – Nicol prism – theory of circular and elliptical polarized light – Quarter and Half wave plates – Polarimeter experiment.

Reference Books:
1. B.Sc. Phyics Vol.-II by Sastry and Babu Rao (S. Chand and Co.)
2. Optics by Brijlal and Subrahmanyam (S. Chand and Co.)
3. Heat and Thermodynamics by Brijlal and Subrahmanyam (S. Chand and Co.)
4. B.Sc. Physics Unified Physics- II by Gupta and Gupta (Jai Prakashnath & Co.)

Part – B: Physical Chemistry

UNIT–I: Chemical kinetics

Rate of a reaction, factors of influencing the rate of a reaction-concentration, temperature, pressure, solvent, catalyst and light. Concentration dependence of rates, mathematical characteristics of simple chemical reaction-zero order, first order second order, pseudo first order, Half-life. Determination of order of a reaction-deferential method, method of integration, half-life method and isolation method. Methods of determining order of a reaction.

Unit–II: Phase Equilibria

Homogeneous and heterogeneous system, statement and meaning of the terms-Phase, Component and degrees of freedom, Gibb's Phase rule, phase equlibria of one component system-water system. Phase equlibria of two-component system-solid-liquid equlibria, simple eutectic. Pb-Ag system, desilverization of lead. Solid solutions-definition of compound with congruent melting point system and incongruent melting point system. NaC1-H2O system.

Reference books on Physical Chemistry
1. Thermodynamics for Chemists by S. Glasstone
2. Chemical Thermodynamics by R.P. Rastogi & S.S. Misra
3. Advanced Physical Chemistry by Gurdeep Raj
4. Principles of Physical chemistry by Puri, Sharma and Pathania

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Semester II

Paper 26015: Biodiversity and Ecological principles

Unit I:
Biodiversity: Introduction, definition, levels of biodiversity, magnitude and distribution of biodiversity, methods for biodiversity monitoring, megadiversity zones and hot spots.

Unit II:
Natural history of Indian subcontinent: Biodiversity at global, National and local levels. Major habitat types of the subcontinent, geographic origins and migrations of species; common Indian mammals, birds; seasonality and phenology of the subcontinent.
Organisms of health and agricultural importance: Common parasites and pathogens of humans, domestic animals and crops.

Unit III:
Biodiversity conservation: Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. IUCN threat categories, Red data book. Strategies for biodiversity conservation: Principles of biodiversity conservation, in-situ and ex-situ conservation strategies. Biodiversity act.

Unit IV:
Ecology: Environment, concept of habitat and niche, ecological succession, concept of climax. Ecosystem – structure and function, energy flow, structure and functions of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography.

References:

1. Raven P.H.et al. (2006) Biology 7th edition Tata Mc Graw Hill Publishers, New Delhi.
2. Mauseth, James.D (2003) Botany: An introduction to plant biology. 3rd edition Jones and Bartlett Publishers.

26011P: Computer lab – I

MS-OFFICE LAB EXERCISE:

      EXERCISE 1: To create a resume using MS Word

      EXERCISE 2: Procedures to create a mail merge letter

      EXERCISE 3: procedures to create a worksheet with 4 columns enter 10 records and find   the sum of all columns

      EXERCISE 4: procedures to create a student result sheet

      EXERCISE 5: procedures to create a simple bar chart to high light the sales of a company for 3 different periods

PROGRAMMING USING C LAB PRACTICAL:

1. WAP to reverse a number?
2. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100?
3. WAP to print a triangle of stars as follows (take number of lines from user):

```
        *
       ***
      *****
     *******
    *********
```

4. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not?
5. WAP to display Fibonacci series?
6. WAP to calculate Factorial of a number?
7. Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file?
8. Write a program to retrieve the student information from file created in previous question and print it in following format: Roll No. Name Marks?
9. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order?
10. Write a program that swaps two numbers using pointers?

26012P: Physics lab – II

1. To form a wedge shaped air film between two glass plates with a given wire and determine the thickness of the given wire.
2. To determine the Radius of curvature of the given palno-convex lens by forming Newton's Rings?
3. To determine the dispersive power of the material of a given quartz prism using a spectrometer?
4. To determine the wavelengths of a given white light using a plane transition grating placed in normal incidence position.
5. To draw the graph between the angle of incidence(i) and angle of deviation (d) produced by minimum deviation and refractive index of the prism?
6. To determine the refractive index (M) of a given liquid and glass using boy's method

26012: Chemistry Lab - II   **Physical chemistry**

1. Chemical kinetics: Determination of specific rate of the hydrolysis of methyl/ethyl acetate catalyzed by hydrogen ion at room temperature.
2. Electrochemistry: Determination of HCl strength conductometrically using standard NaOH
3. Critical solution temperature (CST): Determination of CST of phenol-water system.
4. Determination of adsorption isotherm of acetic acid on activated charcoal.

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III Semester

PAPER 36011: COMMUNICATION SKILLS (English) - II

1. Communication
1. Objectives of Communication
2. Types of Communication
3. Verbal and Non-verbal Communication
4. Characteristics of Successful Communication
5 Principles and Barriers of Communication

2. Listening
1. The Listening Process   2. Types of Listening
3. Principles of Good Listening   4. Listening with a purpose
5. Barriers to Listening

3. Speaking
1. The Syllable   2. Word Stress
3. Accent and Rhythm in Connected Speech   4. Intonation
5. American and British Accents

4. Writing
1. Principles of Effective writing   2. Formal and Informal Letter Writing
3. E-mail   4. Resume & Job application

Books Suggested:

1. Essentials of Business Communication by Rajendra Rao
2. A Course in Listening and Speaking II
3. Business Correspondence and Report Writing R.C. Sharma Krishna Mohan
4. The Oxford Guide to Writing and Speaking by John Seely, (Oxford)
5. Developing Communication Skills by Krishna Mohan & Meera Benerji, Macmillan.
6. Effective Technical Communication – M. Ashraf Rizvi (Tata Mc Grew Hill)
7. Communication – C.S. Rayudu, Himalaya Publishing House
8. Business Communication – D.D. Chaturvedi, Mukesh Chaturvedi (Pearson Edu.)
9. Communication Skills – Dr. Nageshwara Rao, Dr. Rajendra P. Das (Himalaya Publication House)

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III Semester

36012 COMPUTER SCIENCES- II

Unit-1
Introduction to DBMS: Introducing the database and DBMS, Database system Applications, Problems with File System and advantages of Database Management systems, View of Data, Database Language, Database Architecture: Data base users and Administrators, Data Dictionary.
Data Models: Entity-Relationship Model-Developing ER-Diagrams, Constraints, Keys,
Advanced Data Modeling: The Extended Entity Relationship Mode

Unit-2
Relational Algebra: Basic Operations, Union (U), Difference (-), Intersection, Cartesian product (x); Additional Relational Algebraic Operations, Projection, Selection, JOIN, Division **Relational Calculus:** Tuple Relational Calculus, Semantics of TRC Queries, Examples of TRC Queries; Domain Relational Calculus; Relational ALGEBRA vs Relational CALCULUS

Unit-3
Normalization: Functional Dependency; Anomalies in a Database; Properties of Normalized Relations; First Normalization; Second Normal Form Relation; Third Normal Form; Boyce-Codd Normal Form (BNCF); Fourth and Fifth Normal Form
SQL: Basic Structure and Queries (DDL, DML, DRL, DCL and TCL Statements), clauses
Advanced SQL: Relational Set Operators, SQL Join Operators, SQL views, SQL Functions

Unit-4
Java Basics: History of Java, Java buzzwords, Simple Java program, How to set Java path, how to compile and execute java program, how to read data from keyboard and how to display data on the monitor

TEXT BOOKS:
1. DATABASE SYSTEM CONCEPTS SIXTH EDITION Abraham Silberschatz Yale University Henry F. Korth Lehigh University S. Sudarshan Indian Institute of Technology, Bombay
2. Database Management Systems - 3rd Edition Raghu Ramakrishnan Johannes Gehrke
3. Peter Rob, Carlos Coronel, Database Systems Design, Implementation and Management, Seventh Edition, Thomson (2007) 2. Elimasri / Navathe, Fundamentals of Database Systems, Fifth Edition, Pearson Addison Wesley (2007).
4. Elimasri / Navathe, Fundamentals of Database Systems, Fifth Edition, Pearson Addison Wesley (2007)

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III Semester

36013: MATHEMATICS & STATISTICS

Unit-I: Vector Calculus:

Definitions and Properties of the Dot or Scalar products and Cross or Vector products - Gradient – Divergence – Curl.
Chapter 4 of "Vector Analysis" by Schaum's Outline Series.

STATISTICS
Unit-II:

Definition – Scope – Limitations- Primary and Secondary data -collection and Sources of data – Classification and Tabulation – PieChart – Histogram- Frequency Polygon- Frequency Curve- Ogive.
Scope and standard as in **"Fundamentals of Statistics – by SC Gupta, Himalaya Publications"**
Sections 1.1 to 1.4 of chapter 1,
Sections 2.1.3, 2.1.4 of 2.1; 2.2,2.3,2.5 of chapter 2
Sections 3.1 to 3.5 of chapter 3
Sections 4.1 to 4.4 of chapter 4

Unit-III: Measures of Central Tendencies and Dispersion.

Mean –Median – Mode- Range- Quartile Deviation – Mean Deviation – Standard derivation – Coefficient of variation. Scope and standard as in **"Fundamentals of Statistics – by SC Gupta, Himalaya Publications".** Sections 5.3,5.4,5.6,5.7,of Chapter 5 and Sections6.1, 6.4,6.5,6.6,6.8.6.9 of Chapter 6

Unit-IV: Correlation and Regression.

Curve fitting-Fitting of a straight line-Fitting of a parabola-fitting of Exponential Curve-Types of Correlation-Regression Line of Y on X – Regression Line of X on Y.
Scope and standard as in **"Fundamentals of Statistics – by SC Gupta, Himalaya Publications"**
Sections 11.5.3 of Chapter 11.
Sections 8.1 to8.4 of Chapter 8.
Sections 9.1 to9.3 of Chapter 9.

Reference Books:
"Fundamentals of Statistics – by SC Gupta, Himalaya Publications
S.P.Gupta : Statiscal Methods by S.Chand.
S.C.Gupta : and V.K.Kapur – Fundamentals of Mathematical Statistics by S.Chand.
Probability and Statistics by SCHAUM'S OUT LINE SERIES.

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III Semester

36014: PHYSICAL SCIENCES-III

Part A: Physics of Semiconductor devices and Lasers

Unit-I: Semiconductor devices (15 hours)
Intrinsic and extrinsic semiconductors –p-n junction diodes – energy band diagram - Zener diode – applications of Zener diode – tunnel diode – transistors - Bipolar junction transistor- p-n-p transistors - CB,CE,CC configurations - transistor hybrid parameters - determination of hybrid parameters from transistor characteristics.

Unit-II: Lasers (10 hours)
Introduction – Characteristics of Laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Ruby Laser – Helium- Neon Laser – Applications of Lasers In Industry, Scientific and Medical Fields.

Reference Books
1. B.Sc. Physics: Unified Physics Vol.III
2. Engineering Physics by M. R. Srinivasan, New Age Publications

Part B - Organic Chemistry

Unit–I: Structural theory in Organic Chemistry (12 hours)
Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity – electromeric effect, inductive effect, mesomeric effect or resonance and hyperconjugation, and their applications. Concept of aromaticity-definition, Huckel's rule-application to Benzenoid and Non-benzenoid compounds. Reactions-General mechanism of electrophilic substitution, mechanism of nitration and sulfonation. Mechanism of halogination, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution-definition of *ortho*, *para* and *meta* directing groups

UNIT–II: Stereochemistry of carbon compounds (12 hours)
Molecular representations: Wedge, Fischer, Newman and Saw-horse formulae, stereoisomers: enantiomers and diastereomers, conformational and configurational isomerism. Enantiomers: Optical activity: wave nature of light, plane polarized light, interaction with molecules, optical rotation and specific rotation. Chiral centers: definition-molecules with similar chiral carbons-definition of mesomers. Molecules with dissimilar chiral carbons. Number of enantiomers and mesomers-alculation. D, L & R, S configuration for symmetric and dissymmetric molecules. Cahn-Ingold-Prelog rules. Racemic mixture, racemization and resolution techniques.

Reference Books
Organic Chemistry
1) Advanced Organic chemistry- Reactions, Mechanism and Structure, Jerry March, Wiley.
2) Organic Chemistry, R.T. Morrison & R.N. Boyd, Prentice-Hall.
3) Text book of Organic Chemistry, T.W. Solomon.
4) Stereo Chemistry, P.S. Kalsi
5) Reaction mechanisms by P.S. Kalsi
6) A guide book to Mechanisms in Organic Chemistry by Mukherji & S.P. Singh

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Semester III

Paper 36015: Principles of Microbiology

Unit I:
Historical introduction **-** Discovering the Microbial world and developments in Microbiology, origin and evaluation of microbes, Scope of Microbiology and Importance of microorganisms to human welfare. Principles of physical, chemical, and mechanical sterilization methods, antimicrobial compounds.

Unit II:
Classification – Basics of microorganisms classification (Hackle and Whittakar Kingdom concepts, Bergey's manual, Alexopoulos classifiction), General and distinctive characteristics of the major groups of Microorganisms – Bacteria, mycoplasma, actinomycetes, fungi and protozoa. Ultra-structure of bacteria. Cell wall structure and staining techniques, Microscopy – light and electron microscopy

Unit III:
Isolation and characterization of common microorganisms – bacteria, cyanobacteria, fungi. Direct and indirect methods of maintenance and of cultures. Preservation of microbial cultures (glycerol stocks, oil overlay, drying and freeze- drying). **Viruses:** Nature, properties and classification of Viruses. Viruses of Plants, animals and microorganisms. Morphology, size, ultra-structure and life cycles of some representative viruses - TMV, T4, Lambda, HIV and SV40, Prions, Viroids.

Unit IV:
Nutritional requirements – mode of nutrition – Phototrophy, chemotrophy, symbiotic and parasite microorganisms. Saprophytes; symbiotic and parasitic modes of nutrition. Types of media – basal, defined complex, enrichment, selective, differential, maintenance and transport media. Cell growth and kinetics of bacterial growth, Normal and biphasic growth curve, batch and continuous cultures,

References:
1. Microbiology: concepts and Applications. Michael J. Pelczar, Jr., E.C.S., Chan, Noel R. Krieg, 1993. Mc. Graw Hill, Inc.
2. Fundamentals of Microbiology. 4th ed. 1994. I.E. Alcamo. Scientific Publication.
3. Microbiology, 1990. 4th Ed.B.D. Davis, R. Dulbeco, H.N. Eisen and H.S. Ginsberg and J.B. Lippincott Company.
4. Fundamental Principles of Bacteriology. 1994. A.J. Sake. Tata McGraw Hill.
5. Microbiological Applications: A Laboratory Manual in General Microbiology. 5th ed. 1990. H.J. Benson. Panama Publications. PP 459.
6. Microbiology Prescott et al., Wm. C. Brown Publications

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Semester III

36011P: Computer lab – II
Sql lab Programs:
1. Selecting all records from a table and displaying all columns
2. Get First_Name,Last_Name from employee table
3. Get First_Name from employee table in upper case
4. Get First_Name from employee table in lower case
5. Get unique DEPARTMENT from employee table
6. Get length of FIRST_NAME from employee table
7. Get all employee details from the employee table order by First_Name Ascending
8. Get all employee details from the employee table order by First_Name descending
9. Get all employee details from the employee table order by First_Name Ascending and Salary descending
10. Get employee details from employee table whose employee name is "John"
11. Get employee details from employee table whose employee name are "John" and "Roy"
12. Get employee details from employee table whose employee name are not "John" and "Roy"
13. Get employee details from employee table whose first name starts with 'J'
14. Get employee details from employee table whose first name contains 'o'
15. Get employee details from employee table whose first name ends with 'n'
16. Get employee details from employee table whose first name starts with 'J' and name contains 4 letters
17. Get employee details from employee table whose Salary greater than 600000
18. Get employee details from employee table whose Salary between 500000 and 800000
19. Get employee details from employee table whose joining year is "2013"
20. Get Last Name from employee table after replacing special character with white space
21. To Perform set operators
22. To perform aggregate functions
23. Create , update and drop operation on views
24. To perform simple join queries

Java programming lab:
1. Write a java program that swaps two numbers from keyboard
2. Write a java program to find the given number is palindrome or not
3. Write a java program to perform quadratic equation
4. Write a java program to perform the factorial value
5. Write a java program to print the below pattern
   a) ******
      ******
      ******

   b) ******
       *****
        ***
        **
         *

36012P: Physics lab – III

1. To draw the I-V characteristics of a given p-n junction diode.
2. To draw the I-V characteristics of a given zener diode.
3. To draw the I-V characteristics of a transistor and determine the h-parameters of transistor.

36013P: Chemistry lab – III

Organic chemistry:
1. Qualitative analysis: identification of an organic compound through the functional group analysis and preparation of suitable derivatives
2. Preparations
a) Preparation of *p*-bromo acetanilide
b) Preparation of *p*-nitro acetanilide

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Semester IV

Paper code 46011: COMMUNICATION SKILLS – ll

75 MARKS

I. Listening   **20M**
1. Listening Comprehension   2. Effective Listening Strategies
3. Listening to structured Talks   4. Intensive Listening
5. Team Listening (Listening & Note Taking)

II. Speaking   **20M**
1. Oral Communication   2. Presentation Skills
3. Use of Visual Aids   4. Group Discussions   5. Facing Interviews

III. Reading   **15M**
1. Types of Reading   2. Understanding the gist of an argument
3. Identifying the topic sentence

IV. Writing   **20M**
1. Paragraph Writing   2. Report writing
3. Minutes Drafting   4. Information Transfer   5. Interpreting data editing a passage

Books suggested:
1. Essentials of Business Communication by Rajendra Rao
2. A Course in Listening and Speaking II
3. The Oxford Guide to Writing and Speaking by John Seely, Oxford
4. Developing Communication Skills by Krishna Mohan and Meera Benerji (Macmilan)
5. Speaking English Effectively by Krishna Mohan and N.P. Singh (Macmilan)
6. Effective Technical Communication – M. Ashraf Rizvi (Tata Mc Grew Hill)
7. Communication – C.S. Rayudu, Himalaya Publishing House
8. Business Communication – D.D. Chaturvedi, Mukesh Chaturvedi (Pearson Edu.)
9. Communication Skills – Dr. Nageshwara Rao, Dr. Rajendra P. Das (Himalaya Publication House)

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Semester IV

Paper 46012: ENVIRONMENTAL STUDIES

Unit – I

Environment: introduction; Bio-geo chemical cycles and their significance in nature. Ecosystem: Definition, Components, Structure, types of food chain, food web and energy flow, rain water harvesting, climate change.

Unit –II

Natural resources, and sustainable development energy resources, renewable energy resources, bio fuels, solar energy, forest type of India, soil erosion, water management.

Unit –III

Biodiversity conservation: biodiversity, definition, value of biodiversity, hot spots of biodiversity, threats to biodiversity, India a mega diversity nation, types of conservation, ex-situ conservation and in-situ conservation

UNIT-IV

Pollution and control measures air pollution greenhouse effect global warming ozone depletion water pollution industrial effluents agricultural and municipal wastes. Soil pollution heavy metals pesticides prevention and control measures.

References

1. Prithipal Sigh (2006) Perspectives in Plant Ecology and environmental biology. Scientific Publishers Jodhpur
2. SAHU T.R and sahu P.K (2006) biodiversity and sustainable utilization of biological resources. Scientific Publishers Jodhpur
3. Aravind Kumar(2003)environmental challenges of the 21 century . APH Publishing Carporation New Delhi.
4. Subramanian V (2002)A text book of environmental science. Narosa Publishing House , New Delhi
5. Sharma PD. (2006) Ecology and environment Rastogi Publications, Meerut.
6. Biswarrop Mukharjee (1997) Environmental biology. Tata Mc Graw hill publishing Company Limited.
7. Kumar H.D. (1994) Environmental ecology, Vikas Publishing House Pvt. Ltd. New Delhi
8. A.B. Choudary and sarkar D.D (2006) Biodiversity Endangerd. Scientefic Publishers Jodhpur.
9. A text book of environmental studies (2014). Asthana and Meera Asthana.

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Semester IV

Paper 46013: PRINCIPLES OF MANAGEMENT AND ENTREPRENEURSHIP

UNIT – I:
Introduction to Management: Definition **-** Concept – Significance - Management Vs Administration – Leader Vs Manager - Principles of Management - Functions of Management; Planning – Definition of Planning – Steps in Planning – Types of Plans.

UNIT – II:
Organizing and Communication: Nature of Organizing – Organisation Levels – Organisation Design and Structure – Delegation; Communication - Process of Communication – Barriers to Effective Communication - Measures to Effective Communication.

UNIT – III:
Motivation, Leadership and Controlling: Motivational Theories – Maslows Need Hierarchy Theory – Two Factor Theory; Leadership Styles; Controlling - Concept - Process – Control Techniques.

UNIT – IV:
Entrepreneurship Development: Concept – Characteristics - Functions of Entrepreneur – Types of Entrepreneur - Factors Affecting Entrepreneurial Growth - Women Entrepreneurship - Problems in Entrepreneurship Development - Role of Entrepreneurship in Economic Development – Entrepreneurship Development Programmes (EDPs) - Various Entrepreneurship Development institutions in India.

Reference Books:

1. Subba Rao P., Management & Organisational Behaviour, Himalaya Publications, New Delhi.
2. Agrwa, Research and Development Organisation and Management, Tata McGraw hill.
3. Koontz and Weichrich; Essential of management, Text and cases, Tata Mcgraw.
4. S.S. Khanka, Entrepreneurship Development, S. Chand Publications, New Delhi
5. Vasanth Desai, Dynamics of Entrepreneurship Development and Management, Himalaya Publications, New Delhi.

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Semester IV

Paper 46014: INTRODUCTION TO BIOINFORMATICS

Unit I:
Basics of Internet: Internet, Applications, World Wide Web. Elementary commands and protocols used in Bioinformatics.

Unit II:
Introduction to Bioinformatics: Definition, history and development of Bioinformatics, Aim and Scope of bioinformatics, Branches of bioinformatics, Applications of Bioinformatics.

Unit III:
Biological data bases: Definition, types of data bases, Sequence data bases, Primary data bases - nucleic acid, proteins, Secondary data bases, Specialized data bases, Structural databases, Data retrieval.

Unit IV:
Sequence Alignment: Definition, local and global alignments, pair-wise, multiple sequence alignment. Phylogenetic analysis - definition, software used in phylogeny.

References:

1. Essential bioinformatics by C.S.V. Murthy
2. Basic concepts are bioinformatics by P. Goutham
3. Introduction to Bioinformatics by T.K. Attwood and D.J. Parry Smith.

Paper 46015: BIOMOLECULES

Unit I:
Chemical foundation of biology – pH, pK, acids, bases, chemical bonding, properties of water. **Carbohydrates** – Classification, structure and properties of carbohydrates, mono (glucose, galactose, fructose) di (lactose, maltose, sucrose), polysaccharides (starch, glycogen, cellulose). Mucopolysaccharides. **Lipids** –Classification. Structure and biological functions of fatty acids, triacylglycerols, phospholipids, steroids. Physico-chemical properties and analysis of fats and oils. Structure and functions of prostaglandins, leukotrienes, thromboxanes.

Unit II
Amino acids – Classification, structures and physicochemical properties. Peptides – Peptide bonds, naturally occurring peptides. **Proteins** – Classification, properties, functions, Isolation and purification of protein, criteria of homogeneity. Primary structure of proteins and its sequence determination.

Unit III
Secondary (alpha, beta, random coils, Ramachandran plot), tertiary and quaternary structural features of proteins, Forces responsible for protein stability. Structural organization of globular (myoglobin, hemoglobin), fibrous proteins (collagen, keratins, silk fibroin). Denaturation and renaturation of proteins, chaotropic agents. Structure and functions of glycoproteins and lipoproteins. Classification and functions of vitamins.

Unit IV
Nucleic Acids – Structure of purines, pyrimidine, nucleosides, and nucleotides. Structure, properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA. Denaturation and renaturation of nucleic acids, cot curves. The law of DNA constancy and C value paradox.

References:
1. Principles of Biochemistry. A.L. Lehninger, Nelson and Cox. (C.B.S., India).
3. Principles of Biochemistry General Aspects. 1983 by Smith *et al*., (McGraw Hill).
4. Biochemistry (2nd edition) by Donald Voet and Judith Voet.
5. Biochemistry (4th edition) by L. Stryer (Free man).
6. Textbook of Biochemistry with Clinical Correlation by Thomas M. Devlin.
7. Biochemistry by Zubay.
8. Nucleic acid Biochemistry and Molecular Biology by Main Waring *et al*., (Blackwell).

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Semester IV

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46011P: Communication skills laboratory

Problems as per theory

46012P: Microbiology & Introduction to Bioinformatics laboratory
1. Rules and regulations of Microbiology Laboratory
2. Sterilization
3. Preparations of Media
4. Simple staining
5. Gram staining
6. Motility test for Microorganisms from soil by Hanging –Drop method
7. Preparations of slant and stab cultures
8. Isolation and maintenance of microorganisms
9. Enumeration of microorganisms from soil
10. Enumeration of microorganisms from water
11. Enumeration of microorganisms from air
12. Slides:
13. NCBI
14. Data bases – GenBank, DDBJ, EMBL
15. Data retrieval
16. BLAST
17. FASTA
18. CLUSTAL W
19. PHYLIP

46013P: Biomolecules laboratory
1. General reactions of amino acids and sugars to identify the unknown solutions
2. Preparation of buffers
3. Isolation and estimation of glycogen from liver
4. Isolation and estimation of Cholesterol from brain
5. Preparation of lecithin
6. Estimation of proteins by Biuret, modified Lowry, UV methods and Bradford method.
7. Estimation of amino acids by ninhydrin method.
8. Estimation of glucose by glucose oxidase/Nelson-Somagyi method
9. Titration curve of an amino acid and calculation of pK and pI values.

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Semester V

Paper 56011: BIOCHEMICAL AND BIOPHYSICAL TOOLS

Unit – I: Measurement of pH, biochemical buffers, oxygen electrode and biosensors. Cell disruption methods: French press, sonication, freeze-thaw techniques, enzymatic method, use of liquid nitrogen in cell disruption. Centrifugation. Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation - differential centrifugation, density-gradient. Analytical ultracentrifugation and applications.

Unit – II: Separation methods - General principles and definitions. Methods based on polarity. Partition chromatography (Paper chromatography), adsorption chromatography (thin-layer chromatography), gas-liquid chromatography, reverse phase liquid chromatography. Methods based on size - Principle of Gel filtration, methodology and applications. Methods based on affinity - Principle of Affinity chromatography, methodology and applications. High-performance liquid chromatography - Principle, instrumentation, practical procedure and applications. HPTLC, Ion-exchange chromatography - Principle, ion exchangers, methodology, applications. Amino acid analyzer.

Unit – III: Electrophoresis. General principles and definitions. PAGE. Native-PAGE, SDS-PAGE, Isoelectricfocussing, 2D electrophoresis, capillary electrophoresis. Agarose gel electrophoresis - Preparation, separation and determination of molecular size of DNA, Pulse-field gel electrophoresis - Principle, methodology and applications.

Unit – IV: Biophysical methods: Principles, laws of light absorption, Instrumentation and applications of UV-Vis spectrophotometer, fluorescence spectroscopy, ESR, NMR, Mass spectroscopy, Radioisotope Techniques - Types of isotopes, radioactive decay. Detection and measurement of radioactivity - GM counter, scintillation counter, autoradiography. Incorporation of radioisotopes in biological tissues and cells, CD and ORD. Principles and applications of X-Ray diffraction.

References:

1. Biochemical methods - Pingoud
2. Biochemical research technique. Ed. John M. Wriggles worth
3. Analytical biochemistry by David J. Holmes and Hazel peck
4. Biophysical chemistry Upadyay and Nath
5. Practical experimental Biochemistry – Rodney Boyer.
6. Practical biochemistry: Principles & Techniques. Wilson & Walker,

Paper 56012: GENETICS

Unit I:
Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Non-Mendelian inheritance.

Unit II:
Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Unit III:
Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, rII locus (Benzers expt), fine structure analysis of genes. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit IV:
Population Genetics - Gene pool and gene frequencies: Hardy-Weinvberg principle. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications. **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

Reference books:
1. Genetics ; From Genes to Genomes by Hartwell I.H. etal (2000) McGraw Hill
2. Human Molecular Genetics by Sudbery P (1998). Addison – Wesley Longman Harbor.
3. Gene VIII & IX by Benjamin Lewin, Odford University press, Oxford.
4. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
5. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
6. Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York

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Semester V

Paper 56013: MOLECULAR BIOLOGY

Unit I:
DNA replication, repair and recombination: Evidence of DNA as genetic material, Evidence of semi conservative mode of replication, Unit of replication, enzymes involved, Replication origin and replication fork, fidelity of the replication, Replication mechanism in E.coli, extrachromosomal replicons, Replication apparatus and mechanism of DNA replication in eukaryotes, DNA damage and repair mechanisms. Recombination – Homologous, site-specific and transposition.

Unit II:
Transcription: RNA synthesis and processing: RNA synthesis in prokaryotes - Transcription factors and machinery, formation of Initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA synthesis in eukaryotic cell – RNA polymerases, RNA synthesis, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit III:
Translation: Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof reading, Mechanism of protein biosynthesis in E.coli, translational inhibitors, post- translational modification of proteins.

Unit IV:
Gene regulation: Principles of gene regulation, Operon concept, structure, function and expression of lac, trp, ara in E.coli and gal operon in yeast. Induction of transcriptional activity by environmental and biological factors in regulation of eukaryotic gene expression (hsp), light (Rubisco), signal molecules. Molecular control of transcription - DNA sequence and protein involved in the control of transcription in eukaryotes. Role of chromatin in regulating gene expression and gene silencing.

References:
1 Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts,
2 Molecular Cell Biology (2nd Edn) J. Darnell, H.Lodish and D. Baltimore, Scientific American Books, Inc. USA 1994
3. Genetics – Conceptual approach, Benjimin Pierce
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers Ltd.,Oxford, 1991

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Semester VI

Paper 56014: ENZYMOLOGY AND BIOENERGETICS

Unit I: Enzyme Definition, general properties, IUB nomenclature and classification of enzymes. Nature of enzymes, active site, coenzymes, cofactors, assay of enzyme, units of enzyme activity. Kinetics of enzyme catalyzed reaction - Michaelis-Menten equation Determination of Vmax, Km, Kcat, and their significance. Factors affecting on enzyme activity. Mechanism of enzyme catalysis.

Unit II: Enzyme inhibition – Reversible and irreversible. Competitive, non-competitive and feed-back enzyme inhibition, enzyme poisoning. Enzyme regulation – Allosteric modification, covalent modification, zymogens activation. Isoenzymes (LDH), Multienzyme complexes, Multifunctional enzymes, Modern concepts of evolution of catalysis – ribozymes, Abzymes

Unit III: Bioenergetics: Concept of free energy, thermodynamic principles in biology. Free energy changes in biological transformations in living systems. High energy compounds, Biological Oxidation-Reduction Reactions, Components and organization of mitochondrial electron transport system (experimental approach). Classes of electron-transferring enzymes, inhibitors of electron transport. Oxidative phosphorylation and ATP synthesis. Uncouplers, Regulation of Oxidative Phosphorylation,

Unit IV:
Photosynthesis: Light harvesting complexes; mechanisms of electron transport; Mechanism of photosynthesis. Plant mitochondrial electron transport and ATP synthesis, alternate oxidase.
Secondary metabolites of bacteria, fungi and plants – Types, structures, properties and functions.

References:

1. Lehninger's Biochemistry2008 Nelson and Cox CBS India.
2. Harpers Illustrated Biochemistry 28th Edition. Longman
3. T B Biochemistry Clinical relations – Thomas Devlin 2005
4. Outlines of Biochemistry By Cohn and Stumf
5. Biochemistry by Zubay.
6. Principles of Biochemistry General Aspects. 1983 by Smith *et al*., (McGraw Hill).
7. Biochemistry (2nd edition) by Donald Voet and Judith Voet.
8. Biochemistry (4th edition) by L. Stryer (Free man).

Paper 56015: UNIX, HTML and BIOPERL

UNIT – I:
Introduction to UNIX
Listing files and directories, Making Directories, Changing to a different Directory ,More about home directories and path names, Copying Files Moving Files, Removing Files and directories, Displaying, Searching the contents of a file on the screen Redirecting the input, Output, File system security (access rights).

UNIT – II:
Basics of HTML
The web browsers in use, the use of hypertext, design a web page using web documents, Hypertext Markup language, the HTML Elements, format of HTML text, Rules for the HTML language.

UNIT – III:
Introduction to PERL
Starting a PERL Script and data types, scalars, arrays, and hashes @ ARGV, operators, variables, control structures, file handlings and debugging.

UNIT – IV:
Bio PERL
BIOPERL installation and applications, BIOPERL modules – databases, sequence retrieval and alignment, Phylogentic tree construction, restriction enzyme analysis, maturation studies.

Reference Books:
1. UNIX: Concepts and applications by sunitha dass.
2. HTML: Web enablead commercial applicatons Development using
HTML,DHMFL,PERL CGI   by Bagross ivan
3. Harsha Vardhan Bal PERL programming for Bioinformatics, TATA MACGRAWHILL, 2003.
4. James Lee. Beginning PERL, 2004.
5. Micheal Murrows, Paul Berring. Bioinforamtics Biocomputing of PERL. Wiley, 2004.

Practical 56011P: Biochemical and Biophysical tools

1. Preparation of buffers and measurement of pH
2. Separation and identification of amino acids by paper chromatography.
3. Separation and identification of sugars by TLC.
4. Separation and identification of lipids by TLC.
5. Separation of amino acids by Ion-exchange chromatography.
6. Separation of proteins by Gel filtration
7. Absorption spectra of amino acids, Proteins and nucleic acids
8. Verification of Beer's law.
9. Dialysis.
10. HPLC demonstration
11. Isolation of mitochondria by subcellular fractionation.
12. SDS PAGE
13. Agarose gel electrophoresis

Practical 56012P: Genetics and Molecular biology

1. Genetics problems from theory
2. Estimation of gene frequencies and testing equilibria at loci with two alleles – multiple and sex linked genes
3. Testing Hardy-Weinberg equilibrium for two linked loci
4. Calculation of inbreeding coefficient from pedigree data
5. Effects of mutation and selection on gene frequency
6. Problems on genetic drift and effective population size.
7. Genetics problems
8. Isolation of genomic DNA from bacteria, plant and sheep liver
9. Determination of purity of the isolated DNA by UV spectrophometry
10. Quantification of DNA
    . Spectroscopic method (UV absorption method)
    . Colorimetric method (Diplhenylamine reagent)
11. Thermal denaturation of DNA and demonstration of hyperchromic effect.
12. Determination of melting temperature (Tm) and estimation of GC content.
13. Isolation of RNA and estimation of RNA.
14. Isolation of plasmids from *E.coli* and separation of CCC, Open circular and linear forms of plasmids
15. Agarose gel electrophoresis – Separation and molecular size determination of DNA
16. Isolation and separation of proteins by SDS- PAGE

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Practical 56013P: Enzymology and Unix, HTML and BIOPERL lab

1. Assay of trypsin
2. Assay of alpha-amylase from saliva
3. Assay of LDH from serum
4. Assay of acid and alkaline phosphatase
5. A preparation of urease crystals from horsegram seeds and assay
6. Purification of an enzyme and effect of time pH, temperature, substrate concentration, enzyme concentration, inhibition on enzyme activity.
7. Molecular weight determination of enzyme by SDS - PAGE
8. Mitochondrial respiration by oxygraph (O_2 electrode)
9. Warburg Manometer
10. Operation of Unix commands
11. Solving biological problems using Bioperl
12. HTML usage in web design

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Semester VI

Paper 66011: IMMUNOLOGY

UNIT – I
History and scope of immunology, structure, composition and function of cells and organs involved in immune system. Types of immunity, innate immunity, acquired immunity; immunohematology, blood groups, blood transfusion and Rh – incompatibility, phagocytes, inflammation. **Antigens – Antibodies:** Antigens – structure and properties – types (Iso and allo) haptens, adjuvants, antigenic specificity. Membrane receptors for antigens; Immunoglobulins, structure – heterogeneity – types and sub types properties (physico chemical and biological); theories of antibody – production, polyclonal, monoclonal and recombinant antibodies and their applications.

UNIT – II
Antigen and Antibody interactions: Affinity and avidity, Immunodiffusion, Immuno-electrophoresis, Immuno-florescence. RIA, ELISA, western blot. Complement system; complement components, complement activation, regulation of complement system, biological consequences and pathways of complement activation, and complement deficiencies.

UNIT – III
Structure and functions of MHC and HLA system; gene regulation and r – genes; HLA and tissue transplantation – tissue typing, methods for organ and tissue transplantations in humans; graft versus host reaction and rejection. Auto immunity, autoimmune diseases and their treatment, tumor immunology–tumor specific antigens, immune response to tumor, Immunotherapy of tumors, genetic control of immune response.

UNIT – IV
Hypersensitivity reactions: Classification, Antibody–mediated–type I. Anaphylaxis; type II Antibody dependent cell cytotoxicity; Type III Immune complex mediated reactions; type IV cell mediated hypersensitivity reactions (the respective diseases, immunological methods of their diagnosis, lymphokines and cytokinins, their Assay methods. **Immunization:** Active and passive immunization**;** objectives of immunization, types of vaccines: whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, subunit vaccines, immunization procedures, adverse reactions to vaccines.

BOOKS RECOMMENDED
1. Essentials of Immunology - Ian Roitt - Blackwell Scinentific Publications.
2. Fundamentals of immunology - William C. Boyed (Wiley Toppan).
3. Introduction to Immunology - John W. Kinball.
4. Fundamentals of Immunology - Otto S. View and others.
5. Immunology - D.M. Wier.

Paper 66012: GENETIC ENGINEERING

Unit I:
Introduction and outlines of gene cloning**,** isolation and purification of RNA & DNA. Different enzymes used in rDNA technology, Restriction and modification enzymes – Classification, nomenclature and importance, Restriction mapping. RFLP, Polymerase chain reaction – Principle, variations of PCRs (RT PCR, QPCR, inverse PCR, nested PCR) and their applications. RAPD, AFLP, DNA fingerprinting. DNA sequencing – Maxum-Gilbert, Sanger and automated.

Unit II:
Host cells and Vectors - Characteristics of a vector. Vectors used for cloning in *E.coli* (plasmid vectors – pBR, pUC, Bluescript vectors, bacteriophages, cosmids, phasemids), Super vectors - BACs, YACs, shuttle vectors, higher plants (Ti plasmid, caulimovirus) and animal cells (constructs of SV 40 and retroviruses). Baculovirus vectors. Expression vectors.

Unit III:
Cloning strategies: Preparation of genomic and cDNA libraries. Generation of DNA molecules, Cloning from mRNA, Cloning from genomic DNA, Joining of DNA fragments to vector molecules - cohesive termini ligation and blunt end ligation - linkers, adaptors and homopolymer tails, delivery of recombinant molecules into host cells – transformation, transfection; Agrobacterium mediated transformation, electroporation, particle bombardment method. Screening and identification of positives clones- antibiotic, nucleic acid and protein based approaches.

Unit IV:
Expression of cloned genes, IPTG, x-gal, lac, trp, tac promoters. Factors influencing the expression of recombinant proteins. Expression of fusion protein tags, purification tags (His tags, GST tags), IPTG inducible expression systems, inclusion bodies, solubilization of proteins. Production of recombinant insulin, growth hormone. Genetically engineered organisms.

References:
1. An Introduction to genetic engineering - Nicoll
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T.Maniatis, Old Spring Harbor Laboratory Press New York, 2000
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd,
5. Genetic engineering - TA Brown (Ed)
6. From Genes to Genome – Dale
7. Principles of gene manipulation – Primrose et al.

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Paper 66013: INTERMEDIARY METABOLISM

Unit-I
Introduction to intermediary metabolism, Glycolysis and its regulation. Fermentation. HMP shunt pathway and its significance. Glucuronic acid pathway and ascorbic acid pathway. TCA cycle - reactions of the TCA cycle and regulation. Anaploretic reaction. Shuttle systems, glyoxylate cycle. Gluconeogenesis and regulation. Glycogen metabolism and regulation. Disorders of carbohydrate metabolism- glycogen, Lactose, Galactose and fructose.

Unit -II
Lipid digestion, absorption and transport. Oxidation of fatty acids - oxidation of unsaturated, odd-chain fatty acids, peroxisomal oxidation. Regulation of fatty acid oxidation. Degradation of triacyl glycerol and phospholipids. Ketone bodies - Formation and utilization. Fatty acid synthase complex, biosynthesis and regulation of fatty acid synthesis. Biosynthesis of TAG and its regulation. Sphingolipid storage diseases. Biosynthesis of cholesterol and its regulation, Biosynthesis of prostaglandins.

Unit - III
General metabolic reactions of amino acids. Urea cycle and its regulation. Metabolic breakdown of individual amino acids. Ketogenic and glucogenic amino acids; Biosynthesis and regulation of aspartate family amino acids, branched chain amino acids, Metabolic defects of amino acid metabolism. Amino acids as biosynthetic precursors - formation of creatine, serotonin, melatonin, histamine, anserine, carnosine. GABA, melanin, catecholamine.

Unit IV
Biosynthesis and degradation of porphyrin (Heme). Biosynthesis, degradation and regulation of purine and pyrimidine nucleotides, Salvage pathway. Disorders of purine and pyrimidine metabolism.

References:
1. Principles of Biochemistry. A.L.Lehninger(CBS Publishers).
2. Biochemistry. Lubert Stryer (5th Edition).
3. Principles of Biochemistry. General aspects . Smith et al., (8th edition).
4. Harper.s Review of Biochemistry. Martin et al., (Lange).
5. Text Book of Biocehmistry with clinical correlation. Thomas M.Devlin (John Wiley).
6. Text Book of Biochemistry. West et al., 1966 (MacMillian).
7. Biochemistry 2nd ed. C.K.Mathews and K.E.Van Holde (1995).
8. Biochemistry 2nd ed Donald Voet and J.G.Voet (1994)(John Wiley).

Paper 66014: DATA MINING IN BIOINFORMATICS

UNIT– I: The central dogma in molecular biology-the killer application, Parallel universes, top-down verses bottom-up, information flow from data to knowledge. Data management in bioinformatics – strategies & their limitations.

UNIT – II: Data lifecycle-creation, acquisition, modification, archiving. Biological data integration- specifications, technical approaches, development process, nature of biological data, data sources in life science, approaches to integrate data bases & scientific algorithms, ontology.

UNIT–III: Data Mining Techniques - knowledge discovery process. Data mining methods, technology overview, infrastructure, pattern recognition, machine learning technologies, Text mining - Text summarization, tools. Bioinformatics problems related to data-mining.

UNIT – IV: Intermolecular interactions & biological pathways: Introduction, pathway and molecular interaction databases - primarily molecular interaction databases (e,g BIND, DIP). Primarily metabolic pathway databases – KEGG, ECOCYC. Prediction algorithms for pathways and interactions – methods to predict protein-protein interactions.

Reference Books:

1. Bioinformatics-A Practical guide to the analysis of genes & proteins by Andres D. Baxevnes B.F. Francis Ouellette
2. Advanced Data Mining Technologies in Bioinformatics – Hui- Huang Hsu.
3. Bioinformatics Managing scientific data by Zoe Lacroix, Terence Critchlow.
4. Bioinformatics computing by Bryan Bergeron,M.D.

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Paper 66015: PLANT BIOTECHNOLOGY

Unit I: Introduction to cell and tissue culture. Tissue culture media. Initiation and maintenance of callus and suspension culture. Organogenesis, somatic embryogenesis. Shoot-tip culture: Micro tip culture; rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue. Anther, pollen, ovary, ovule, nucellus culture, Endosperm culture for production of haploid plants and homozygous lines. Protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids. Cryopreservation.

Unit II : Plant Transformation Technology, Vector mediated or Indirect gene transfer - Agrobacterium-mechanism of T-DNA transfer and its integration into plant genome, basis of tumor formation ,role of virulence gene, use of Ti and Ri plasmids as vectors, Direct Gene transfer-microinjection, electroporation, particle gun, Chloroplast transformation and applications Gene silencing. Nitrogen fixation and biofertilizers - nitrogen fixation genes, transfer of *nif* genes to microorganisms.

Unit III: Application of Plant Transformation for Productivity and Performance-Herbicide Resistance, Male sterility, Virus resistance, Pest Resistance, Fungal resistance. Genetic Engineering of plant for extended shelf life of fruits, manipulation of starch biosynthesis. Terminator technology, plantibodies.

Unit IV: Introduction to molecular markers, different types-PCR based and Non PCR based, role of molecular marker in plant breeding, types of maps-physical and genetic map, applications of molecular markers in plant biotechnology. phytodiagnostics based on immunological and molecular techniques, biopesticides, transgenic plants as biofactories-biodegradable plastics, therapeutic proteins

References:

1. Molecular approaches to crop improvement. 1991. Dennnis and Liwelly eds. PP. 164.
2. Plant cell and Tissue culture. A Laboratory Manual. 1994. Reinert. J. and Yeoman,
3. Plant biotechnology, 1994. Prakash and Pierik. Oxford & IBH Publishing Co.
4. Gene transfer to plants. 1995. Potrykus-I and Spangenberg, G. Des. Springer Scan.
5. Methods in Plant Molecular Biology and biotechnology, 1993.
6. Genetic engineering with plant viruses. 1992. T. Michale. A. Wilson and J.W. Davies.
8. Microalgal Biotechnology. 1988. Borocotizka M.A. and Borocoitzka L.J. Cambridge University Press.

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Practical 66011P: Immunology
1. Staining of blood smear and identification of different lukocytes.
2. Determination of A,B, O and Rh blood groups in humans
3. Identification of primary and secondary lymphoid organs.
4. Recognition of T-cell by rosette formation.
5. Injection of antigen into experimental animals by different routes.
6. Preparation of antigen
7. Electrophoretic study of normal and immune serum - immunodiffusion
8. Isolation and separation of immunoglobulins by gel electrophoresis.
9. Labeling of purified immunoglobulins with enzymes/dyes.
10. Western blotting
11. Different serological tests
    a. Agglutination - Brucella system
    b. Precipitation test - Ring interface and agar gel double diffusion tests.
    c. Immunoelectrophoresis - Counter current and Rocket.
    d. Hemagglutination and Hemagglulination inhibition tests.
    e. Labeled antibody tests - ELISA, Dot ELISA, FAT and Western blotting.
    f. Viral infectivity neutralization test.
12. Cell - mediated immunity tests
    a. Leukocyte migration inhibition test
    b. Opsonic index.

Practical 66012P: Data mining in bioinformatics
1. Primary molecular interaction databases
2. Protein- protein interactions analysis.
3. Protein secondary and tertiary structure prediction.
4. Metabolic pathway databases.
5. Sequence and structure analysis.
6. Molecular interaction databases.

Practical 66013P: Plant Biotechnology
1. Preparation of tissue culture media
2. Surface sterilization
3. Organ culture
4. Callus propagation, organogenesis, transfer of plants to soil.
5. Protoplast isolation and culture
6. Anther culture, production of haploids.
7. Cytological examination of regenerated plants
8. *Agrobacterium* culture, selection of transformants, reporter gene (GUS) assays.
9. Developing RFLP and RAPD maps

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Paper 76011: GENOMICS

Unit I:
Introduction to genomics, types of genomics and its databases, genome, genome sizes, organization and structure of genomes of viruses, prokaryotes and eukaryotes, organization of organelle genomes. Genome projects – Aims of project, model organisms, Human genome project and its applications. Computational genomics – concepts.

Unit II:
Structural Genomics - Concept, genome mapping, genome sequencing, sequence assembly, genome annotation, whole genome sequencing by shotgun approach and sequencing; Analysis of sequence data – ORF, exon/intron boundaries, promoters, expression signals, etc. Gene ontology, phylogenetics. Centers of Genomics -JCSG, BSGC, MCSG, NYSG, TBSG. Comparative genomics – introduction, comparative genomics of prokaryotes, eukaryotes and organelles.

Unit III:
Functional genomics – concepts and applications. Analysis of gene function - gene knockouts, complementation, gene function through protein interactions. Forward genetics, reverse genetics – knock-ins, knock-outs, RNAi technology Mutagenesis as functional genomics tool – T- DNA, T- DNA Insertional mutagenesis, transposan (_Ac_/_Ds_ and _En_/_Spm_), Genome wide mutation screening - TILLING (Targeted Induced Local Lesion IN Genome) - principle and mechanism. DeALING (Detecting Adducts Local Lesions IN Genome) – principle and experimental approach to identify deletions.

Unit IV:
Functional genomics and epigenomics – Activation tagging. GAL4 mediated over expression. Gene expression analysis - traditional sequence based approaches, microarray based approaches. SAGE, SADE and microbead – based expression profiling, Epigenomics – mechanism and applications. _In silico_ genomics, metagenomics.

References:
1. Principles of Gene Manipulation and Genomics. 3rd Edition By S B Primerose and R. M. Twyman.
2. A Primer of genome science. 2nd Edition by G Gibson, and S V Muse
3. Essential bioinformatics by Jin Xiong, Cambridge University press.
4. From Genes to Genome by Dale and Schanz.
5. Functional genomics by Hunt and Livesey.
6. Genomics by Arther Lesk.

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<u>Paper 76012: MICROBIAL BIOTECHNOLOGY</u>

Unit I:
Introduction to Fermentation process
Fermentation – Definition. The component parts of a fermentation process, chronological development of fermentation industry. Fermentors/Bioreactors – types and features. Isolation, preservation and strain improvement of industrially important microorganisms. Media design and sterilization for industrial fermentation. Principles of microbial growth and culture system, scale up, and downstream processing.

Unit II:
Immobilized Enzymes
Introduction, definition, applications. Commercial production of enzymes. Methods of immobilization of cells and enzymes. Stabilization of enzymes and cells. Production of amylases, glucose isomerase and proteases. Biosensor – definition, types and applications.

Unit III:
Production of products.
A brief outline of process for the production of some commercially important organic acids – citric acid, lactic acid, acetic acid, aminoacids - Glutamic acid , Lysine, aspartic acid; antibiotics – pencillins, aminoglycosides, tetracyclines; Vitamins – Vit B_{12}, Beverages- alcohol, wine and beer. Production of hepatitis B vaccine.

Unit IV:
Microbial transformations – types of biotransformation reactions, Steroids and antibiotics transformation. **Introduction to food technology** - Elementary idea of canning and packing. Sterilization and pasteurization of food products. Technology of typical food/food products (bread, cheese, idli, yoghurt). Food preservation. Commercial production of SCP. Production of biogas from biomass.

References:
1. Industrial Microbiology - J.E. Casida
2. Industrial Microbiology – A.H.Patel
3. Microbial biotechnology Glazer and Nikaido 1995
4. Principles o fermentation technology, Stanbury, Whittaker and Hall 1997
5. Prescott and Dunns Industrial microbiology. Reed (Ed)
6. Biotechnology 3 rd edition by john E.Smith . Cambridge low price editions.

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Semester VII

Paper 76013: ANIMAL BIOTECHNOLOGY

Unit I: History and development of animal tissue culture. Application of animal cell culture. Equipment and materials required. Principles of sterile techniques. Sources of tissues, types of tissues. Balanced salt solution. Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, serum-free media, features and specifications of MEM, DMEM, RPMI and Ham's medium. Role of antibiotics in media. Measurement of cell number. Measurement of cell viability and cytotoxicity. Measuring parameters of growth – Growth curves, PDT, Plating efficiency and factors influencing growth.

Unit II: Primary culture – Mechanical and enzymatic desegregation, establishment of primary culture. Subculture - passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines - definite and continuous cell lines, characterization, authentication, maintenance and preservation of cell lines. Contamination - bacterial, viral, fungal and mycoplasma, contamination detection and control. Cell transformation – normal vs. transformed cells, growth characteristics of transformed cells. Viral and chemical-mediated methods of cell immortalization.
Scale-up of animal cell culture – Factors to be considered. Scale-up of suspension cultures - Batch reactor, continuous culture, perfusion systems. Scale-up of monolayer cultures – roller bottles, Nunc cell factory, microcarrier cultures. Organotypic culture, Histotypic culture. Concepts of tissue engineering.

Unit III: *In vitro* fertilization - Concept of superovulation, collection, maintenance, and maturation of oocytes, fertilization of oocytes, Maintenance and assessment of embryos, embryo transfer - Artificial insemination, preparation of foster mother, surgical and non-surgical methods of embryo transfer, donor and recipient aftercare. Animal cloning - concept of nuclear transfer, nuclear reprogramming and creation of Dolly. Transgenic animals. Application of transgenic animals. Biopharming, disease models, functional knockouts. Gene therapy - *ex vivo* and *in vivo* gene therapy methods, applications. Vaccine production through cell culture.

Unit IV: Aquaculture: Principles and species suitable for aquaculture. Pisciculture, Genetic status of culture stocks. Chromosome manipulations - Production of all male and sterile populations, Hypophysation in fishes and prawns. Pearl culture - pearl producing mollusks, rearing of oysters, nucleation for pearl formation and harvesting of pearls. Probiotics and their significance in aquaculture. Molecular tools for the identification of diseases in aquatic species.

References:
1. Culture of Animal Cells, (3rd Edn) R Ian Fredhney. Wiley-Liss
2. Animal Cell Culture – Practical Approach, Ed. John RW. Masters, Oxford
3. Animal Biotechnology – Ramasamy

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Semester VIII

Paper 76014: MOLECULAR MODELING

Unit I:
Introduction to molecular modeling, Geometric parameters in proteins, nucleic acids and small molecular systems. Stereochemistry – 3D structures from X-ray-CPK space filling models, Computer models and Calculations, Physical and computer models, Visualization of peptides, proteins and different representations.

Unit II:
Computer aided molecular design, energy minimization, molecular mechanics, force field, Conformational studies. Molecular dynamics - concept of molecular dynamics, periodic boundary conditions, salvation, long range electro statistics, numerical integrations, termination criteria, equilibration and production phase, trajectors of RMSD, conformational flexibility and RMSF, High temperature dynamics, Brownian dynamics, Homology modeling and protein folding.

Unit III:
Prediction and visualization of shapes and properties of biological and simple molecules, modeling reaction pathways and animating transition states, Application to conformations and vibrations, Applications of modeling in development of chemical sensors and probes, Study of molecular properties, 2D diagrams.

Unit IV:
Solving and Building of structures, SHELX program, drawing using Ortep, Rasmol, Chime and crystal office. Software packages in molecular modeling, detailed discussions on GROMACS, AMBER, CHARMM, Discovery studio.

References:
1. Principles of Gene Manipulation and Genomics Third Edition By Richard M.Twyman, Sandy Blackadder Primrose Blackwell Scientific Publications.
2. Introduction to Proteomics - Dunn
3. Computational Modeling of Genetic and Biochemical Networks by James M.Bower and Hamid Bolouri, MIT press.

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Elective 1: Paper 76015A: PLANT SYSTEM PHYSIOLOGY

Unit I.
Photosynthesis and Respiration & photorespiration: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit II.
Plant hormones and Secondary metabolites: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit III.
Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Unit IV.
Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

References:

1. Plant Physiology- Salisbury & Ross
2. Plant Growth & Development: Hormones and Environment- Srivastava
3. Plant Physiology-Taiz and Zeiger

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Elective 1: Paper 76015B: BACTERIOLOGY & VIROLOGY

UNIT I: Morphological types- cell walls of archaebacteria, Gram positive Gram negative bacteria and L-forms; antigenic properties; capsule types, composition and function., Cell membrane- structure, composition and properties. Structure and function of flagella, cilia, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobilisomes, nucleoids, spores and cell division. Reserve food materials polyhydroxybuterate, polyphosphate granules, oil droplets, cyanophycin granules and sulfur inclusions.

UNIT II: Salient features and classification of bacteria as per the second edition of ergey's Manual of Systematic Bacteriology. Characteristics, classification and economic importance of major bacterial groups: *Enterobacteriae*, *Rickettsiae*, *Mycoplasma*, *Mycobacteria*, oxygenic and anoxigenic photosynthetic bacteria and actinomycetes (as per First edition of Bergey's manual).

UNIT III: Brief outline on discovery nature and properties of viruses, Chemical composition of viruses, morphology, architecture, principles of symmetry with reference to T4, TMV, Adeno Polio, Influenza, Rhabdo, Reo and HIV. Nucleic acid diversity, sub viral particles, satellite viruses, viroids, virusoids. DI particles and prions. Taxonomy of viruses: classification and nomenclature of viruses, as per ICTV. General methods of detection, Isolation, cultivation, characterization and assay / qualification of plant, animal and bacterial viruses.

UNIT IV: Life Cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, λ and φ X 174. Importance of Phages.Replication strategies of viruses (TMV, CaMV.) and animal viruses (SV 40, HBV, HIV).Transmission management on plant and animal viral diseases.

Reference:
1. Atlas, RM., (1998) Microbiology, Fundamentals and Applications (IIed) Macmillan Publishing Company.
2. A. Balows, A.G. Thuper, M. Dworkes, W. Harder, (1991) The Prokaryotes, K. Schleifer, Springer Verleag, Publ.
3. A. J. Salle A Fundamental principles of Bacteriology Publ.
4. Alan J. Cann (1997). Principles of Molecular virology.(2nd edition).Academic press, California.
5. Bergey's Manual 2nd Ed. "Systemic Bacteriology" 2001-2005

Practical 76011P: Genetic engineering and Genomics

1. Bacterial culture and antibiotic selection media.
2. Preparation of competent cells.
3. Isolation of lambda phage DNA
4. Agarose gel electrophoresis and restriction mapping of DNA
5. Construction of restriction map of plasmid DNA
6. Cloning in plasmid/phagemid vectors –Selection of positive clones using blue/white colours.
7. Preparation of single stranded DNA template
8. DNA sequencing
9. Gene expression in *E.coli* and analysis of gene product
10. PCR
11. Reporter gene assay (Gus/CAT/b-GAL)
12. Demonstration of blotting methods – Sourthern, northern.
13. Bioinformatics for genome sequence
14. Finding genes in prokaryotic and eukaryotic genomes ORF, contents, signals
15. Searching DNA databases with FASTA and BLAST
16. Multiple sequence alignment

Practical 76012P: Animal biotechnology

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and cell viabililty
4. Macrophage monolayer from PEC, and measurement of phagocytic activity
5. Trypsinizaation of monolayer and subculturing
6. Cryopreservation and thawing
7. Measurement of doubling time
8. Role of serum in cell culture
9. Preparation of metaphage chromosomes from cultured cells.
10. Isolation of DNA and demonstration of apoptosis by DNA laddering
11. MTT assay for cell viability and growth
12. Cell fusion with PEG

Practical 76013P: Molecular modeling

1. Solving and Building of structures
2. Protein structure modeling by SwissParam.
3. Structural prediction through homology modeling, Stereo chemical quality. Structure
4. Protein folding.
5. Visualization software usage – RASMOL, Phymol.

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Paper 86011: ENVIRONMENTAL BIOTECHNOLOGY

Unit I:
Environmental pollution and biotechnological methods for management. Water pollution and sewage. Microbiology of waste water treatment – aerobic and anaerobic processes, activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Aerobic and Anaerobic microbes. Purification of water by water weeds and membrane filters, reclaim of treated waste water.

Unit II
Pesticides and other pollutants degradation by microorganisms and genetically engineered microbes. Degradation of oil spills and plastics by microorganisms for production of useful products. Recovery of minerals by microbes. Bioindicators of hazardous pollutants, Aquifer (underground water) indicators and mineral indicators. Use of biosources for detecting environmental pollutants and environmental resources.

Unit III
Bioremediation of contaminated soils and water land, Biopesticides in integrated pest management, Biofertilizers (Rhizobial, free living N_2 fixers and Phosphate solubilizing bacteria) and their importance significance and practice. Production of biopesticides and biofertilizers for large scale production. Genetically engineered bacteria in bioremediation of organic pesticides, insecticides, oil spills. Phytoremediation

Unit IV
Microbial leaching – Introduction, organisms for leaching, chemistry of leaching and commercial processes. Genetically engineered microbes in environmental health. Genetically engineered plants and microbes in agriculture and productivity,

Referenes:
1. Microbial Ecology – fundamentals and applications. Atlas and Bartha
2. Environmental Microbiology. Grant and Long
3. Microbial aspects of Pollution. Skyes and Skinner.
4. Microbial Biotechnology – Glazer and Nikaido 1995
5. Biotechnology – A Text Book of Industrial Microbiology – Crueger and Crueger.
6. Concepts in Biotechnology – Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman

YOGI VEMANA UNIVERSITY
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Semester VIII

Paper 86012: STEM CELL BIOLOGY AND REGENERATIVE MEDICINE

Unit I
Basics of stem cell biology: Overview, different types of stem cells, stem cell differentiation, Self-renewal of Stem Cells, Study the factors that generate stem cells and to maintain stem cells in undifferentiated, trafficking of stem cells Asymmetric Cell Division and Cellular Aging, Germ Cell Specification and Pluripotency, Nuclear Reprogramming Unexpected Cellular Plasticity. Stem cell plasticity.

Unit II
Stem cell assay protocols and stem cell therapies: Isolation of defined stem cell population, Stem cell banks, Progenitor cell assays, Flow cytometry, cell selection through MAb, Magnetic approaches to cell separation. Stem cell therapies – Clinical applications – neurodegenerative diseases Human embryonic stem cells - Generation of human embryonic stem cell lines; ES cells a tool to study cellular & molecular mechanisms of disease. Use of embryonic stem cells for drug testing

Unit III
Regenerative Medicine: Define regenerative medicine, Importance in medicine, Organogenesis Hematopoietic and Vascular Stem Cells, Mesenchymal and Cardiac Stem Cells Pancreatic and Liver Regeneration, Neural Stem Cells.

Unit IV
Tissue engineering: Embryonic Stem Cells role in tissue engineering, and their Ethics, Hematopoietic Stem Cells and Transplantation, Cancer Stem Cells, Cell and Gene Therapy, Scaffolds for tissue regeneration

References:

1. Nature Insight "Stem Cells," edited by Natalie Dewitt, Nature 414, 87-131, 2001.
2. Cogle, C. *et al.* (2003) An overview of stem cell research and regulatory issues. Mayo Clin Proc 78(8): 993-1003

YOGI VEMANA UNIVERSITY
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Semester VIII

Paper 86013: PROTEOMICS AND PROTEIN ENGINEERING

Unit I: Introduction to Proteomics - The concept of proteomics, Types of proteomics: Expression proteomics, structural proteomics, functional proteomics, applications of proteomics. Structural overview of proteins structures and functions, Protein localization and compartmentalization, Protein structure visualization, protein structure databases, visualization databases and tools, Prediction of secondary, tertiary structures of proteins, protein function prediction and modeling,

Unit II: Tools of proteomics – Technology for protein expression analysis - Protein separation of proteins by 2D electrophoresis – principles, detections, and softwares to handle electrophoretogram, Alternatives of Electrophoresis separation and isolation of protein, Protein digestion techniques. Protein characterization - Mass spectrometry, ESIMS, Tandem MS, MALDI-TOF, QTOF, SELDI, and SALSA. DIGE, SILAC. Mass Spectrometry Protein Identification, Protein Identification through Database Searching, Protein structure analysis - X-ray Crystallography, NMR. CryoEM. Post translational modifications and their predictions through bioinformatics tools. Protein identification through database searching,

Unit III: Functional Proteomics - Protein expression analysis - Protein biochips, Protein microarrays (Ab array, Ag array). Protein - protein Interactions – Phage display, Yeast two hybrid; Protein expression profiling; Protein folding - Chaperones and their role in protein folding. Proteomics approach to protein phosphorylation; protein mining. Making of proteins through rDNA technology - Native and fusion proteins, Yeast expression systems, The baculovirus expression system, Mammalian cell lines.

Unit IV: Protein engineering – Concepts and significance, Methods in protein engineering – Rational design and direct evolution, site directed mutagenesis for specific protein function. Protein engineering of lysozyme, and sublitisin, protein engineering - protein design, design of peptide and protein mimics, development of peptide vaccines. Biomarker discovery through proteomics; Pharmaceutical proteomics for drug development.

Reference:
1. Concepts in biotechnology – Balasubramanian
2. Protein Engineering – Moody and Wilkinson.
3. C. Kohner and U L Rajbhandary, Protein Engineering Springer
4. J LCleland and C S Craik. Protein engineering Wiley
5. S Lutz and U T Bornscheuer, Protein enginnering Handbook. Wiley VCH
6. S B Primrose and R M Twyman. Principles of Gene manipulation and Genomics,
7. Principles of proteomics – R M Twyman
8. Principles of proteomics tools for the new biology

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Semester VIII

Paper 86014: DRUG DESIGN AND TARGETING

UNIT – I:
Introduction: History of drug design, Introduction and overview, Drug-receptor interactions and mechanisms, Molecular basis of receptor subtypes, Pharmacogenetics/Drug Resistance, Molecular Approaches to Drug Mechanism.

UNIT – II:
Molecular Approaches to Drug Discovery: From Disease to Target to Drug: Finding new drug targets for anti-cancer drugs, High-throughput/combinatorial approaches, Biological combinatorial approaches, Structure-based drug design. Drug Docking – Auto dock, and GOLD; QSAR software.

UNIT – III:
Targeting Molecular Pathways for Drug Discovery: Targeting signal transduction, Designing receptor antagonists, disrupting intracellular signaling, Designing drugs vs. central dogma targets. Drug designing – use of Dock program – selection of new molecules as potential ligands, receptors and inhibitors – energetics – reactions of drugs, virtual screening.

UNIT – IV:
Drug discovery cycle, Role of Bioinformatics in Drug designing, Modeling of target-small molecule interactions, Insilco analysis of drug designing and modeling. Structure display – calculation of low energy pathways for reactions – structure refinement – ADMET Toxicity.

Reference Books:
1. Greer, J., Eickson, J.W,Baldwin,JJ and Varney,MD. Application of the three-dimensional structures of protein targe molecules in structure- based drug design.
2. Cohen,N.c. Molcular modeling SW and methods for medicinal chemistry.
3. Kuntz, I.D, Meng, EC; and shoichet, BK structure – based Molecular Design.
4. Kanny lal dey :Ingerious drugs of India. Hand book of spectrophotometric data of drugs.
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Semester VIII

Elective 2: 86015A: ANIMAL SYSTEM PHYSIOLOGY

Unit I. Cardiovascular System: Blood, hemopoiesis, homeostatis. Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Thermoregulation,

Unit II. Respiratory system and digestive system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Digestive system - Digestion, absorption, energy balance, BMR.

Unit III. Nervous system and endocrine system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs – vision, hearing and tactile response. Endocrinology - Endocrine glands, basic mechanism of hormone action, hormones and diseases

Unit IV. Excretory system and reproductive system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

References:

1. C.L. Prosser, Comparative Animal Physiology. W.B. Saunders & Company
2. R. Eckert. Animal Physiology. Mechanisms and Adaptation. W.H. Freeman & Company
3. W.S. Hoar. General and Comparative Animal Physiology
4. Schiemdt-Nielsen. Animal Physiology. Adaptation and Environment. Cambridge
5. C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.

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Semester VIII

Elective 2: 86015B: AGRICULTURAL BIOTECHNOLOGY

Unit I:
Production of commercially useful compounds by cell culture Secondary plant products useful to mankind; cultured plant cells and tissues as a source of secondary products; cell line selection and commercial production of pharmaceutically important compounds using cell culture techniques; physical and chemical factors that influence the production of secondary metabolites in vitro; induction of hairy root cultures and their uses; biotransformations using cell culture methods; production and use of biopesticides

Unit II:
Molecular aspects of beneficial plant microbe association Types of plant microbe association; symbiotic and other beneficial associations, pathogenic association; Rhizobium plant interaction and biological nitrogen fixation; plant mycorrhizal association in plant improvement; plant mycorrhizal and the molecular mechanism of antagonistic process

Unit III:
Introduction to biotic and abiotic stress; Biotic stresses – viral resistance, bacterial resistance, fungal resistance, insect resistance; Abiotic stresses – drought tolerance, salt tolerance, temperature tolerance, submergence tolerance, photooxidative stress.

Unit IV:
Biotechnology for crop improvement Conventional methods for crop improvement; tissue culture in crop improvement; genetic engineering in for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency; Genetic engineering for abiotic stress tolerance; Molecular breeding; plants as bioreactors

References:

1. Principles of plant breeding by Robert W allard
2. Plant cell, tissue and organ cultute Applied and fundamental aspects by Bajaj and Reinhard
3. Plant tissue culture and biotechnology by W Barz

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Semester VIII

Practical 86011P: Microbial and Environmental Biotechnology

1. Production of alcohol by *S. Cerevisiae*
2. Production of citric acid by *A. niger*.
3. Production of streptomycin by fermentation.
4. Production of wine from grapes.
5. Production of glutamic acid.
6. Production of protease/glucose isomerase by batch fermentation.
7. Preparation of toxoid from a toxin.
8. Immobilization of an enzyme by gel-electrophoresis.
9. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
10. Characterization of microbes useful in biodegradable organic matter destruction.

Practical 86012P: Proteomics

1. Isolation and purification of protein
2. SDS - PAGE
3. Separation of protein through 2D PAGE
4. Mass spectroscopy MOLDI TOF
5. protein structure prediction by bioinformatics
6. Protein structure prediction and classification
7. Bioinformatics in support of proteomic research
8. Searching protein sequence databases with FASTA and BLAST
9. Protein structure visualization
10. Secondary structure prediction
11. Protein structure prediction. Structure visualization, Secondary structure prediction, Structural prediction through homology modeling,

Practical 86013P: Drug design and targeting

1. Drug –receptor interactions (Molecular docking)
2. Chemo informatics
3. Drug bank-Drug card analysis
4. Protein structure analysis
5. Restriction site analysis
6. Retrieval of Human annotated gene from Entrez database

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Semester IX

Paper 96011: CELL SIGNALING AND CANCER BIOLOGY

Unit I:
Cell signaling - Intracellular signaling, types of signal receptors - Cytosolic, Nuclear & Membrane bound receptors, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, Chemo receptors of Bacteria (Attractants & Repellents), signal transduction pathways, secondary messengers, protein kinases, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Unit II
Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.
Host parasite interaction - Recognition and entry process of different pathogens like bacteria, viruses into animal cells. Pathogen induced diseases in animals.

Unit III:
Cancer - basic concepts, Introduction and Characteristics of Cancer Cells, Types of Tumors, Factors influencing on the development of Cancer, Genetic Alterations in Cancer Cells, modulation of cell cycle in cancer, Causes of Cancer,

Unit IV:
Molecular Basis of Cancer – Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, growth factors. Cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, Signal transduction mechanisms, telomerase, apoptosis, angiogenesis and metastasis, cancer therapy.

References
1. The Cell by Cooper.
2. Cell and Molecular biology – De Robertis and De Robertis (1998) Waverly Pvt.
3. "Cancer Biology", Raymond W. Ruddon, Oxford University Press
4. Cell & Molecular Biology by Gerald Karp (2nd Ed.) Wiley publishers.
5. The World of the cell by Becker, Reece, Poenie (3rd edition) Benjamin Publishers.
6. Molecular Biology of the cell by Bruce Alberts.
7. The biochemistry of Cell Signalling-Ernst J.M.Helmreich. Oxford Press.
8. The world of Cell. 5th edition- Becker, Kleinsmith, Harden,-Pearson Publishers.

96012: BIOETHICS, BIOSAFETY, AND IPR

Unit I
Biotechnology and Society – Social, ethical and legal aspects of biotechnology. Implications of biotechnology on health, environment, food and sustainable agriculture. Beneficial application and development of research focus to the need of the poor, identication of directions for yield effect in agricultural, aqua cultural, bioremediation.

UNIT I
Ethical issues - introduction, causes of unethical acts, ignorance of laws , codes policies and procedures, recognition, friendship, personal gains, ethical decision making ,teaching ethical values to scientist , good laboratory practices, good manufacturing practices, laboratory accreditation. Bioethics and biosafety regulations

UNIT II
Environmental and health aspects of biotechnology – Genetically engineered microorganism – introduction of novel species and natural equilibrium – environmental security and safety – precautionary measures – Genetically modifies foods –health safety, biosafety concern with radioactivity.
Prenatal diagnosis – Genetic screening – surrogate mothers, manipulation of human genome, gene therapy, cloning, technology transfer.

Unit IV
IPR – definition – classification and forms, Rationale for protection of IPRs, importance of IPRs in the fields of science and technology. Patenting – Examples of Patents in Biotechnology. Essential requirements for IPR procedures of filling. Global and Indian Biodiversity Act, Indian Patent Act and their revised versions. Regulatory mechanisms in releasing GMOs. Plant breeders rights, WTO, GATT & TRIPS.

References:
1. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
2. Singh K. Intellectual Property rights on Biotechnology, BCIL, New Delhi. Gene cloning – Brown
3. Concepts in Biotechnology – Balasubramanyam.D
4. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
5. Environmental Biotechnology- Forster and wase

Elective 3: 96013A: NANO-BIOTECHNOLOGY

Unit I
Introduction to Nano biotechnology: Definitions, history of nanotechnology; motivation for nanotechnology; nanoparticles and properties, types, bionanomaterials and properties; calculating the size and concentration of nanoparticles.

Unit II
Nanoparticles fabrication – micro and nanolithocraphy; characterization – structurally (XRD, TEM, SEM, STM, AFM), chemical and optical characterization; outline design of enzyme reactors based on nano-structured materials; Use of biological organisms (biological methods) for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Viruses as components for the formation of nanomaterials – VLPs, VNPs; Role of plants in nanoparticle synthesis.

Unit III
Nanobiotechnology and its advanced biomedical applications covering topics like medical nanorobotics, artificial organ, DNA chip, smart bomb for cancer, nanodiagnosis, treatment nanosystem for heart, nanosurgeries, Nano drug delivery system, nanobiotechnology for HIV virus and its diagnosis and treatment, Cancer diagnosis, and treatment through nanotechnology. Nanotechnology for tissue regeneration. DNA based nanomechanical devices.

Unit IV
Nanoparticles as molecular labels and imaging applications. Nanodevices for sensing and therapy. Environmental and safety aspects of nanotechnology, Potential Health Impact of Nanoparticles, Nanosensors, nanobiolistics. Nanotribology, Concept of nanotoxicology.

References
1. Bionanotechnology: Lessons from Nature by David S. Goodsell
2. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
3. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers
4. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas
5. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh
6. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.

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Semester IX

Elective 3: 96013B: MEDICAL BIOTECHNOLOGY

Unit I:
Genetic disease – Chromosomal disorders, gene controlled diseases (autosomal and X-linked disorders, mitochondrial disorders); identification of disease; functional cloning; positional cloning; candidate gene approach (Marfans, alzeimers); molecular basis of human disease; Genomic imprinting.

Unit II:
Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Humoral and cell mediated immunity; Vaccinnes; Immune deficiency; Human disease caused by viruses, bacteria, and pathogenic fungi.

Unit III:
Chemical Synthesis and oligo nucleotides and PCR reaction in disease, diagnostics and other potentialities. Expression systems and Markers for identification of transformed and transected genes; transient transfection, stable transfection and targeted transformation. Viral markers – diagnostic and therapeutic markers. Markers for evaluation of therapeutic response. Reverse genetics, Random and site directed DNA mutagenesis.

Unit IV:
Diagnostics and therapeutics: Prenatal diagnosis – invasive techniques and noninvasive techniques; Diagnosis using protein and enzyme markers. DNA/RNA based diagnosis. Gene therapy; Antisense therapy, protein aptamers, intrabodies. Vectors used in gene therapy. Stem cell therapy, nanomedicine. Strategies for the Expression of therauptic portions and proteins of commercial importance in heterologus systems.
Viral therapies – current targets and candidate drugs for viral infections in humans. Application in molecular medicine – the applications of recombinant viruses. Viral vectors and viral antigens in molecular diagnosis and therapy. Metabolomics and significance.

References:

1. Introduction to Human molecular genetics – Strachen
2. Human genetics molecular evolution – Mc Conkey
3. Principles and practice of Medical Genetics, I,II,III volumes

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Semester IX

Elective 4: 96014A: METABOLOMICS

Unit I: Introduction to metabolomics:
Introduction, background and definitions of metabolomics; Importance of metabolomics, Metabolomics, Endometabolome, Exometabolome; Approaches for metabolomics – targeted and nontargeted; Metabolite library; UIUC Metabolomics; Metabolite identification.

Unit II: Analytical platforms
Spectroscopy – UV-Vis, FT-IR, Raman, NMR (C13, H1, N15), Metabolite isolation and analysis by Mass Spectrometry, Sample preparation (fractionation, enrichment, derivatization), Mass (LC/GC-MS, DIMS, IRMS, MALDI-TOF). Chromatography – Column, TLC, HPTLC, HPLC, FPLC, GC, UPLC.

Unit III: Metabolome Foot printing and Finger printing and metabolic target analysis. Quenching protocols for microbial metabolite profiling. Metabolites and their pathways; KEGG pathways, MetaCyc, The Human Metabolome Databases, Biocart; Computational modeling of metabolic control and pathway simulation.

Unit IV: Prospects
Metabolic pathways discovery and disease characterization; Drug metabolisms and pharmacology; Mining of novel and new metabolites; Environmental sciences and toxicology: Molecular markers and systematics. Integrated analysis of transcriptomics and metabolomics; industrial applications. Nutritional applications

References:

1. Measuring the metabolome: current analytical techniques. Dunn etal (2005).
2. Metabolomics: Methodologies and applications LIN (2006)
3. Metabolome analysis Birkemeyer et al (2005)
4. Metabolomics and system biology Kell (2004).
5. The Handbook of Metabolomics and Metabolomics by John C. Lindon, Jeremy K. Nicholson

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Semester IX

Elective 4: 96014B: R PROGRAMMING AND SYSTEM BIOLOGY

Unit I.

R Programming: Introduction, functions introduction, R Data Structures, Vectors: Scalars, Arrays and Matrices.

Unit II.

Data frame, factors and tables, control statements, Maths functions, Installing R, Installation of packages. Writing of software packages writing and debug; profile R code.

Unit III.

Algorithms: Introduction to Genetic Algorithms. Smith-Waterman Algorithm and Neddleman-Wunsch Algorithm, Dynamic Programming, Multiple alignment, developing decision support for clinical bioinformatics.

Unit IV.

Systems Biology: Introduction, Basic Concept, Modelling System Biology, Biological Networks, representation, Network visualization, Structural Analysis, Metabolic Networks, System Biology databases and software for System Biology.

References:

1. Introduction to Mathematical methods in bioinformatics—Alexande Isaev
2. The art of R Programming – Norman Matloss (A Tour of Statistical software designing).
3. Introduction to System biology –
4. Handbook of system biology

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester IX

Elective 5: 96015A: DEVELOPMENTAL BIOLOGY

Unit I
Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II
Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III
Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination. **Programmed cell death, aging in animals**

Unit IV
Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum,* **senescence in plants**

References:

1. Animal Embryology
2. Guha and maheswari Embryology

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Semester IX

Elective 5: 96015B: Oxidative stress, antioxidant defense in health & disease

Unit I:
Chemistry of Oxygen Free radicals – definition, Oxygen radicals – types, mechanism of formation, environmental factors in generation of free radicals. Effect of free radicals on bimolecules – carbohydrates, lipids, proteins and nucleic acids. Oxidative stress related disorders.

Unit II:
Free radicals, Oxidative stress and lipid peroxidation -Non enzymatic lipofusion (age pigments) – enzymatic - leukotrienes- mediators of allergy, asthma - Prostaglandins- mediators of inflammation and cancer

Unit III:
Oxidative stress and degenerative disorders – Inflammation; Chronic respiratory disorders – asthma, cardiovascular disease, atherosclerosis, neurodegenerative disorders, stroke, Parkinsosn's, Alzheimer's, Diabetes, Cancer and aging.

Unit IV:
Antioxidant protection from oxidative damage; enzymatic and nonenzymatic protectants – glutathione, vitamins, minerals. Natural products. Biopharming. Golden rice. Functional food. Neutraceuticals and health.

References

1. Free radical biology

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Semester IX

Practical 96011P: Cancer Biology & R programme

1. Identification of cancer cells
2. Cell proliferation assay
3. Cell signaling
4. R studio use for solving problem
5. Programmes

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Semester X

Paper 06011: RESEARCH METHODOLOGY

Unit I
Introduction to research methodology- Define research? Basic and applied research. Significance of Research. Essential steps in research, Literature survey - defining the research problem, Formulation and Validation of hypothesis - Designing experimental techniques and Execution of designed experiments – Data compilation and analysis - Presentation of research findings in graphs and tables - Preparation of technical report or manuscript for publication in peer reviewed scientific journals.

UNIT – II:
Design of the experimental programme- variable in the experiments, materials and methods, application of methods. Progress of research – evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications.

Unit III
Scientific writing - Research report, thesis and dissertation, Manuscript/research article, review monographs. Preparation of Manuscript/Dissertation for research proposals. Introduction or review of literature, aims and objectives, Materials and methods, Result analysis – evaluation of results, statistical approach, Discussion and comparison of results, literature citation, bibliography and reference, impact factor of journals.

Unit – IV
Plagiarism; softwares used in plagiarism; Ethics in manuscript writing; Conflicts of interest; Copyright issues; patents; uploading of manuscript; Thesis; Dissertation; Shodhganga and its importance; Themes and role of different scientific funding agencies of India and abroad.

References:
1. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
2. Singh K. Intellectual Property rights on Biotechnology, BCIL, New Delhi. Gene cloning – Brown
3. Concepts in Biotechnology – Balasubramanyam.D
4. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
5. Environmental Biotechnology- Forster and wase
6. Biotechnological Innovations in Environmental Management – Leach and Van Dam-mieras

06011T: PROJECT WORK

Duration of project -   **3 months**

Students are required to carry out a research project of 3 month duration related to Biotechnology and bioinformatics. Arrangements could also be made to pursue research studies at institutions other than the relevant faculties of Yogi Vemana University. In such circumstances, the student is assigned with two supervisors: an internal supervisor from the panel of teachers and an external supervisor from the institution where the research project is carried out. After completion of project, students have to submit their project dissertation to the Yogi Vemana University, Kadapa and also to be given project viva and presentations in the presence of departmental board and external examiner.

Paper No.	Title of paper	Marks in semester end exam	Internal marks for exam	Total marks
06011	Research methodology	100	-	100
06012T	Project			
	Individual project	150	100	
	Viva- voce	50	-	300

YOGI VEMANA UNIVERSITY
Department of Biotechnology and Bioinformatics
Choice based credit system

Open for other PG Departments of University

Non-core Paper I: INTRODUCTION TO BIOINFORMATICS

Unit I:
Define bioinformatics? Goals of Bioinformatics; Scope of Bioinformatics; Applications and limitations of Bioinformatics. Generation of large scale molecular biology data through genome sequencing, and protein sequencing. Introduction to Internet and internet resources of biology interest.

Unit II:
Define database? Types of databases; General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB). Information retrieval from biological databases.

Unit III:
Introduction to sequences, sequence alignments – Pairwise alignment (BLAST and FASTA) and multiple sequence alignment (Clustal W). Methods for presenting large quantities of biological data: sequence viewers (SeqVISTA), 3D structure viewers (Rasmol).

Unit IV:
Introduction to phylogenetics, construction of phylogenetic tree.
Introduction on molecular modeling and drug design.
Role of bioinformatics in Genomics, proteomics and metabolomics.

References
1. Text book of Bioinformatics – S C Rastogi
2. Bioinformatics – Ghosh
3. Essential bioinformatics - Xiong

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Open for other PG Departments of University

Non-core Paper II: Natural Products in Industrial Applications

Unit I:
Introduction to bioactive natural compounds
Terpenes, phenols, flavonoids, tannins, quinones, amines and alkaloids, anthocyanins, amino acids, and nucleosides. Production of natural products by plant tissue culture, and molecular farming.

Unit II:
Isolation and characterization of bioactive compounds
Solvent extraction, Isolation of phenols, nucleosides, and alkaloids. Characterization by UV, IR, NMR and MS spectroscopy. Biological activity screening against microbes and cancer cells, toxicity evaluation through teratological study and mutagenic and carcinogenic study.

Unit III:
Therapeutic applications of bioactive compounds
Bioactive compounds therapeutic applications in - Anesthetics, Sedatives and hypnotics, Anticonvultants, Muscle relaxants, CNS stimulants, Antipyretic analgesics, Cardiovascular drugs, Antihistamines, diuretics, NSAIDS, antimalarials, Antibiotics, antivirals, Anticancer agents. Insulin and oral hypoglycemic agents, Steroids, Antipsychotics (Tranquilizers),

Unit IV:
Natural products in drug discovery
Important parameters for drug discovery. Concept of lead molecule. Computational approaches for the discovery of natural lead structure. Strategies for development of drug from natural products using bioinformatics tools. Natural product derived pharmaceuticals.

References:
1. Modern phytomedicine (2006)
2. Medicinal chemistry (2009)

MODEL QUESTION PAPER
5 Year M.Sc., Degree Examinations 2018 (Model Paper)
Semester: VI
Subject: Biotechnology and Bioinformatics
Paper 66012: Genetic Engineering (Example)

Time: 3 Hours   Max marks: 75 Marks

Part – A
Answer any five (5) questions.
Each question carries Three (3) marks   (5X3=15)

1. Isolation of mRNA

2. RAPD

3. pUC19

4. Charan phases

5. Adapters

6. Gene gun method

7. Taq promoters

8. His tag

Part B
Answer all questions.
Each question comes FIFTEEN (15) Marks   (4 X15=60)

9. Discuss about the restriction endonucleases properties, classification, and nomenclature.

OR

10. Describe in detail about the Sangers dideoxy chain termination method.

11. Give detailed account on the vectors used cloning of genes in plants.

OR

12. Explain about the supervectors.

13. Describe the genomic library preparation.

OR

14. Discuss about the methods used in the screening and identification of positive clones.

15. Write about the factors influencing the expression of recombinant proteins.

OR

16. Describe the production of insulin through recombinant DNA technology.

<u>5 Year M.Sc., Degree Examinations 2018 (Model Paper)</u>
Semester: X
Subject: Biotechnology and Bioinformatics

Paper 06011: Research methodology
Time: 3 Hours   Max marks: 100 Marks

Part – A
Answer any five (5) questions.
Each question carries four (4) marks   (5X4=20)

1. Origin of problem

2. Peer reviewed journal

3. Impact factor

4. Evaluation of results

5. GMO

6. Legal aspects of biotechnology

7. WIPO

8. Patenting

Part B
Answer all questions.
Each question comes twenty (20) Marks   (4 X20=80)

9. Discuss about the literature survey for identification of problem and formulation of hypothesis.
OR
10. Describe the preparation of manuscript for publication in scientific journal.

11. Give detailed account on the experimental design for any research work.
OR
12. Explain the methods of evaluation and presentation of results.

13. Describe the social, and ethical issues of biotechnology.
OR
14. Explain the implications of biotechnology in health, environment, food and sustainable agriculture.

15. Discuss about the IPR definition, classification and importance in science and technology.
OR
16. Describe the global and Indian Biodiversity Act.

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Pre PhD Examination Syllabus

Paper I: RESEARCH METHODOLOGY

UNIT – I:
Characteristics of Research –definition, steps in research process, selection of research problem, literature survey, hypothesis, Designing experimental techniques for validating the hypothesis, Execution of designed experiments, presentation and interpretation of research data, preparation of abstract/technical report/manuscript for publication in peer reviewed scientific journals, research proposal preparation for grants.

UNIT – II:
Ethical and legal aspects in biotechnology, Bioethics and Biosafety regulations. IPR, importance of IPRs in the field of science and technology, patenting, Indian patent Act, Regulatory mechanisms in releasing GMO's, Global and Indian biodiversity Act, WTO, GATT, TRIPS.

UNIT – III:
Techniques: Isolation and separation of cell organelles and macromolecules, Principles and application of centrifugation (Preparative, analytical). Chromatography principles and applications (GLC, Gel filtration, affinity, ion exchange, HPLC and FPLC). Electrophoresis (agarose gel, PAGE, 2D gel). Spectrophotometric principles and application (UV-Visible, MS, NMR). X-RD.

UNIT- IV
Biostatistics – collection, classification and tabulation of data. Importance of statistics in biology, principles of experimental design, normal distribution test, significance, analysis of variance (ANOVA), F-test, T-test. Correlation and regression analysis.

UNIT – V:
Bioinformatics definition, history and application of Bioinformatics in Biology. Sequence date bases and their use: NCBI, EMBL, DDBJ, protein sequence data bases: UNIPROT, PDB, PIR. Sequence database searching tools: FASTA, BLAST. Sequence Alignment: Pairwise and multiple Sequence Alignment (MSA) (CLUSTALW). Phylogeny: phylogenetic tree.

References:
1. Concepts in Biotechnology – Balasubramanyam.D
2. From Genes to Clones, Introduction to Gene Technology- Winnacker, Ernst.L
3. Safety, Moral, Social and Ethical issues related to genetically modified foods –
4. Molecular Biology and Biotechnology – Meyer R A
5. Biotechnological Innovations in Environmental Management – Leach and VanDam
6. Modern Practical Experimental Biochemistry – Rodney Boyer

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Pre PhD Examination

Paper I: Research Methodology
(Model question paper)

Time: 3 hours   Max. Marks: 100

Answer all questions
Each question carries 20 marks

Unit – I

1. Write down the steps involved in designing and execution of an experiment after formulation of hypothesis

(OR)

2. How will you prepare a research proposal for obtaining grants? Name the national and international funding agencies who support for research in biotechnology.

Unit – II

3. Describe the ethical and legal aspects of biotechnology

(OR)

4. What is IPR? Write its importance in the field of science and technology

Unit – III

5. Describe the methodology involved in protein isolation and purification

(OR)

6. Discuss the principle and applications of mass spectroscopy.

Unit – IV

7. Describe analysis of variance (ANOVA)

(OR)

8. Discuss the importance of statistics in biotechnology

Unit – V

9. Write down on multiple sequence alignment

(OR)

10. How will you construct the phylogenetic tree?

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Panel of examiners for paper setting and evaluation

Eligibility:

Any Government university teacher (Professor, Associate Professor and Assistant Professor) or Institution Scientist are eligible for paper setting, evaluation and conducting practical examinations for 5 Year Integrated Biotechnology & Bioinformatics course.

Panel of examiners for paper setting and evaluation for
Pre-Ph.D examination and Ph.D Thesis evaluation

Eligibility:

Any Government university teacher (Professor, and Associate Professor) or Institution Scientist (Above Scientist D cadre) are eligible for paper setting & evaluation of Pre-Ph.D examinations and also for thesis evaluation and conducting Viva-voce in Biotechnology & Bioinformatics course as per university norms.

CHAIRPERSON & CONVENER
(Prof. P. CHANDRAMATHI SHANKAR.)