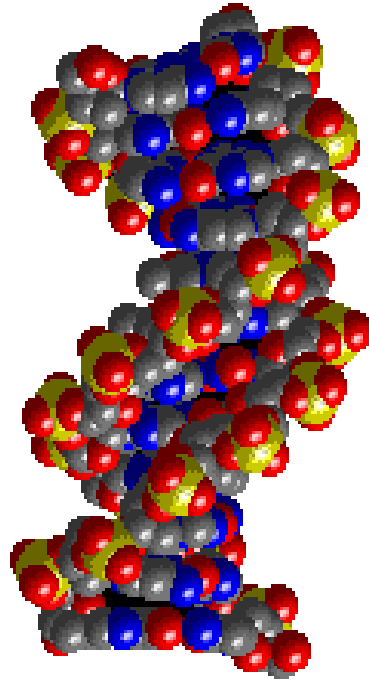


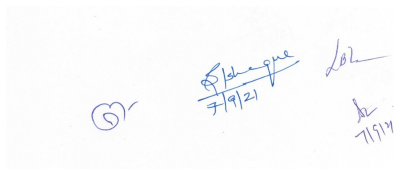
B.SC. (HONS.) BIOTECHNOLOGY
SEMESTER SYSTEM
(2018 – 2020)



COURSE STRUCTURE & SYLLABUS



DEPARTMENT OF BIOTECHNOLOGY



**SCHOOL OF STUDIES IN ZOOLOGY &
BIOTECHNOLOGY**

VIKRAM UNIVERSITY, UJJAIN

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7/9/21
Dr. *[Signature]*
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Preamble: B.Sc. Biotechnology syllabus provides students with an in-depth understanding of Biology, computer science, biological chemistry, microbiology, molecular biology, genetics, analytical techniques, bioinformatics, computer programming and other topics are included in the B.Sc. syllabus. This syllabus entails a through examination of the cellular and bio molecular processes involved in creating a wide range of innovation and products that help people to live better lives with better health. This course's sole purpose is to provide students with advanced biological processes knowledge for industrial and other purposes.

Introduction: B.Sc. (Hons) Biotechnology is a three year course comprising of systematic and multidisciplinary curriculum involving theoretical and practical aspects. The various subjects in Biotechnology syllabus emphasizing distribution, morphology and physiology of microorganisms in addition to skills in aseptic procedures, isolation and identification. The course also includes sophomore level material covering immunology, cell biology, animal diversity, plant diversity, biochemistry, biophysics, applied plant science, industrial biotechnology, environmental biotechnology, medical biotechnology, computer and statistics. The course aims at producing professionals, who can be furnished into true biotechnologist and can be capable enough to serve the nation.

Duration of the course

B.Sc. (Hons) Biotechnology will be a full time three year program to be covered in 6 semesters each of six months duration. The first year of the program will complete the first and second semester and the second year will complete third and fourth semester and the final year will complete fifth and sixth semester. The maximum duration of the program shall be twice of the minimum duration of the program that is sixth year.

Admission to the course

The number of seats shall be in accordance with directives by the university. A candidate after having 12th class with at least 55% marks from a recognized university with a subject of life science shall be eligible for admission to the course. The admission to the course will be on basis of merit and according to guidelines from university and government of Madhya Pradesh. After the term end examination at the end of each semester the students will be provisionally admitted to next semester. Each semester will be followed by a brake not exceeding 15 days.

Continuous evaluation

During the semester a teacher offering the course will do the continuous evolution of the students at three points of time by conducting three tests of 20 marks each. Of these, two must be written tests and third may be written test/quiz/seminar/assignment for theoretical courses. Marks obtained in two best tests out of three will be awarded to the students.

Attendance

Students who have less than 75% attendance will not be allowed to appear in the end semester examination and will be declared as fail in that semester.

Tuition fees

The admitted candidate shall pay the course fee in addition to tuition fee and such other fees as prescribed by the university.

End semester Examination

There shall be end semester examination at the end of first, second, third semester, fourth, fifth and sixth semesters respectively. The semester examination will be conducted every year normally in December and June or on the dates declared by the academic calendar of the university. A student proceeding to appear in end semester examination should submit his/her application through head of the department on prescribed form along with required examination fees etc. to the registrar of the university. Each student has to appear in the end semester examination otherwise will be awarded “Ab” grade in the course. The scheme of marks for evaluating the various components of the dissertation will be followed as per given the syllabus.

Program objectives

1. The objectives of bachelors program in biotechnology are to equip the students to gain conceptual and analytical skills about biological material, biotechnological tools and techniques.
2. The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular process, structural and genetic manipulation of cellular material and processes, data processing and interpretation techniques.
3. The imparting of laboratory training for bioassay protocols of biological material, their manipulative treatments, emerging tissue culture and genetic recombinant techniques, bioinformatics database and tools.
4. A student will be able to address application skills of biotechnological techniques and tools in the field of biomolecules including enzymes, environment, animals, microbes and plants.

Program outcome

B.Sc. Biotechnology students will be able to independently study and perform research related to –

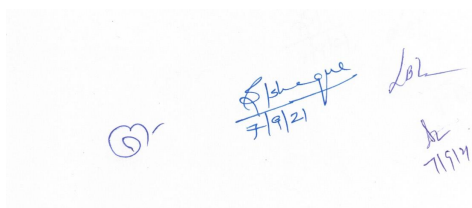
1. Isolation of novel biological material, its assay and manipulation.
2. Application of modern emerging methodological and analytical tools and techniques in qualitative and quantitative assessment of biological material and processes.
3. Extraction of biological molecules, sub molecules and their biochemical, genetic and molecular characteristics.

4. Designing of bioassay experiments, assessment of their outcomes, their modeling and simulation.
5. Efficient retrieval of information from national and international biological database, analysis of retrieved information and contribution to new knowledge.
6. Integration of up and downstream processing of bioassay experiments and their analytical and application assessment.
7. Undertaking of researches involving genomics, metabolomics and proteomics.
8. Competition at national and international to peruse carrier in advanced studies in research and industrial establishment
9. Independent documentation and communication of scientific results in the public domain as well as peer reviewed scientific magazines and journals.
10. Filling of intellectual property rights to national and international registries.

Program specific outcome (PSOS)

A successful graduate student will be understand and asses variety of biological entities including structure, metabolism and dynamics. The student will be able to design and execute experiments related to immunology, molecular biology, recombinant DNA technology and bioinformatics.

He/she will be able to peruse independent researches in industrial and research establishment by utilizing his/her analytical and creative biotechnological skill.



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VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2018-2020)
Scheme of Course and Distribution of Marks

First Semester

Sub. Code	Paper Name	Theory Marks		Practicals Marks	Total
		Th.	Int. Ass.		
BT – 01	Paper –I Introduction to Biotechnology	35	15	-	50
BT – 02	Paper –II Cell Biology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 03	Paper –III Basics of Organic Chemistry	35	15	-	50
BT – 04	Paper –IV Basics of Inorganic & Physical chemistry	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

Second Semester

Sub. Code	Paper Name	Theory Marks		Practicals Marks	Total
		Th.	Int. Ass.		
BT - 05	Paper –I Animal Diversity	35	15	-	50
BT - 06	Paper –II Plant Diversity	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT - 07	Paper –III Basics of Computer	35	15	-	50
BT - 08	Paper –IV Biostatistics and Mathematics	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

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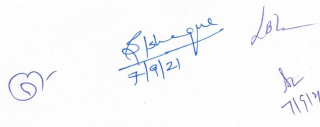
VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2014-2015)
Scheme of Course and Distribution of Marks

Third Semester

Sub. Code	Paper Name	Theory Marks		Practicals Marks	Total
		Th.	Int. Ass.		
BT – 09	Paper –I Genetics	35	15	-	50
BT – 10	Paper –II Molecular Biology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 11	Paper –III Environmental Science	35	15	-	50
BT – 12	Paper –IV Communication Skills	35	15	-	50
BT – 13	Paper –V Entrepreneurship development	35	15	-	50
	Project Work	-	-	-	50
		Total			350

Fourth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT – 14	Paper –I Biophysics	35	15	-	50
BT – 15	Paper –II Introduction to Biochemistry	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 16	Paper –III Applied plant science and Tissue Culture	35	15	-	50
BT – 17	Paper –IV Human Physiology & Developmental Biology	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350



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VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2014-2015)
Scheme of Course and Distribution of Marks

Fifth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT - 18	Paper –I Principles of Microbiology	35	15	-	50
BT - 19	Paper –II Microbial Biotechnology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT -20	Paper –III Plant Biotechnology and Genomics	35	15	-	50
BT -21	Paper –IV Animal Biotechnology and Genomics	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
Total					350

Sixth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT -22	Paper –I Immunotechnology	35	15	-	50
BT -23	Paper –II Medical Biotechnology & Bioinformatics	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT -24	Paper –III Environmental Biotechnology	35	15	-	50
BT – 25	Paper –IV Industrial Biotechnology	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
Total					350
Grand Total					2100

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**B.Sc. (Hons) Biotechnology
Semester System
Scheme of Practical Examination**

Practical I – Based on Paper I and Paper II

Q.1- Major experiment	-	12 Marks
Q.2- Minor experiment	-	04 Marks
Q.3- Minor experiment	-	04 Marks
Q.4- Spotting – (10 spots)	-	20Marks
Q.5- Practical Record	-	05 Marks
Q.6- Viva	-	05marks
Total	-	50 Marks

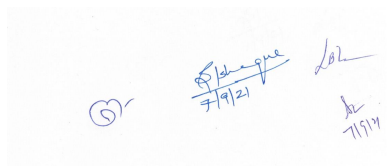
Practical II - Based on Paper III and Paper IV

Q.1- Major experiment	-	12 Marks
Q.2- Minor experiment	-	04 Marks
Q.3- Minor experiment	-	04 Marks
Q.4- Spotting – (10 spots)	-	20 Marks
Q.5- Practical Record	-	05 Marks
Q.6- Viva	-	05marks
Total	-	50 Marks

Internal Assessment

Each theory Papers contains 15 marks for internal assessment of the students based on the seminar, poster, model, attendance and overall performance of the student during the academic session.

Project Work Each semester contains project of 50 marks based on theory papers.


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B.Sc.(Hons.) Biotechnology

1st SEMESTER

Academic Session

2018-2020

VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2018-2020)
Scheme of Course and Distribution of Marks

First Semester

Sub. Code	Paper Name	Theory Marks		Practicals Marks	Total
		Th.	Int. Ass.		
BT – 01	Paper –I Introduction to Biotechnology	35	15	-	50
BT – 02	Paper –II Cell Biology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 03	Paper –III Basics of Organic Chemistry	35	15	-	50
BT – 04	Paper –IV Basics of Inorganic & Physical chemistry	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

Outcome of first semester: In the first semester students will study basic concept of biotechnology, cell biology, organic, inorganic and physical chemistry. A general information about these papers will enable students to develop a basic understanding about biotechnology and will further enable them to develop their interest in their respective field. In this semester students will gain basic knowledge of chemical science which will be used in the field of biotechnology in future.

BT -01

PAPER –I: Introduction to Biotechnology

Learning Outcomes: The paper will provide students with the basic concept of biotechnology and will teach students about the elementary techniques used in biotechnology such as cell culture, tissue and organ culture. This will further create student's interest in the field of biotechnology, will provide him knowledge about different fields of biotechnology and will encourage him/her to decide his area of interest.

UNIT I

Biotechnology: Definition, Origin, History and Sub fields. Scope and Importance of Biotechnology (in tissue culture, gene technology, monoclonal antibody, medicine, protein engineering, agriculture, microbiology and environment).

UNIT II

Plant Biotechnology: Plant tissue culture, plant culture media, transgenic plant, Gene transfer in plants, Cryopreservation.

Animal Biotechnology: Animal cell culture, substrate for growth, cell culture media, transgenic animals.

UNIT III

Microbial biotechnology : Culturing microorganisms, types of microorganisms, microbial fermentations, Microorganisms and their products, Primary and secondary metabolites, Microbes as insecticides.

Environmental biotechnology: Bioremediation, degradation of Xenobiotics, Bio-magnification, Bioleaching.

UNIT IV

Medical Biotechnology : DNA fingerprinting, DNA library, Pharmacogenomics and gene therapy.

Agricultural Biotechnology : In vitro pollination, embryo culture, Anther and pollen culture, Biopesticides, Organic fertilizer, vermi composting.

UNIT V

Cloning: Restriction endonucleases and their types, cloning vector, [plasmid vector, phages, cosmids and other vectors (YAC)].

Molecular Biotechnology: Southern, Northern, Western, Hybridization, Human Genome Project.

Recommended Books

1. P.K. Gupta, Biotechnology and Genomics, Rastogi Publications, Meerut
2. H. D. Kumar, Modern Concepts of Biotechnology, Vikas Publishing House, New Delhi.
3. J.E. Smith, Biotechnology, Cambridge University Press.
4. R.P. Singh, Introductory Biotechnology, Central Book Depot, Allahabad.
5. K. Trehan, Biotechnology, Wiley Eastern Ltd., Delhi.
6. B. D. Singh, Biotechnology, (2007), Kalyani Publication, New Delhi.

BT – 02

PAPER –II: Cell Biology

Learning Outcomes: Paper will introduce students to basic understanding about structure and function of cell. It will also enable students to have a deep understanding about cell organelles and their mechanism of working, this will further be helpful for the students to develop scientific attitude toward the gained knowledge. The paper will make students capable of understanding cell skeleton, cell division and transport of different essential molecules into various cell organelles.

UNIT I

Introduction, Scope and Importance, History of Cytology. Prokaryotic cell, Eukaryotic cell (Plant and Animal Cell).

Plasma membrane: structure and functions (simple diffusion, facilitated diffusion, active transport, endocytosis, pinocytosis, phagocytosis, and exocytosis), Cell walls.

UNIT II

Structure and functions of mitochondria, mitochondrial Genetic system, protein import and sorting in mitochondria.

chloroplast and other plastids. chloroplast genome, import and sorting of chloroplast protein.

Structure and functions of Endoplasmic reticulum, Endoplasmic reticulum targeting proteins, protein folding and processing in ER, ER and Lipid Synthesis, Export of protein and lipid from ER.

UNIT III

Structure and function of Golgi complex, Protein Glycosylation within the Golgi , Lipid and Polysaccharide metabolism in the Golgi, protein sorting and export from the Golgi complex. Mechanism of Vesicular Transport. Structure and functions of Ribosome and Lysosomes, The cytoskeleton, Centrioles and basal bodies.

UNIT IV

The nucleus and nucleolus. structure and classification of Chromosomes. Lampbrush and Polytene Chromosomes, Structural changes in chromosomes, Numerical changes in chromosomes.

Cancer and carcinogens. Oncogenes, Protooncogenes and Tumor suppressor genes. cell senescence, programmed cell death.

UNIT V

Cellular reproduction: Cell cycle- mitosis and meiosis.

Techniques in cell biology: Autoradiography, chromosomal banding techniques. Principles and applications of light microscope and electron microscope (Scanning and transmission).

RECOMMENDED BOOKS

1. De Robertis, E.D.P. & De Robertis, E.M.F., 2001, Cell and Molecular Biology, Lea & Febiger.
2. Bruce Albert, A., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D., 2000, Molecular Biology of Cell, 4 Edition, Garland Publishing Inc., New York, USA.
3. Lodish, H., 1999, Molecular Cell Biology, W.H. Freeman & Co. 4th Ed. Darnell, J.E., 2000, Molecular Cell Biology, W.H. Freeman & Co.

BT - 03

PAPER –III: Basics of Organic Chemistry

Learning Outcomes: The course provides elementary knowledge about organic chemistry, and some important concepts like chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanisms. The paper also teaches techniques like spectroscopy and chromatography which will be required by the student while working in industrial section.

UNIT 1

Structure of Organic compounds, Chemical bonding, bond length, bond angle, and bond dissociation energy, Hydrogen bond, Resonance, Electronic effects, inductive, Mesomeric, Electromeric & Hyperconjugation. Nucleophiles and Electrophiles, Reaction intermediates Carbonium ions, Carbanions, Free radicals and Carbenes, Homolytic fission and Heterolytic fission.

UNIT II

Introduction, Nomenclature, Isomerism, Preparation and General Properties of Aliphatic hydrocarbons, Alkanes, Alkenes and Alkynes, Cycloalkanes,

UNIT III

Alkyl and arylhalides, Aromatic hydrocarbons, Alcohols, Phenols, Carboxylic acids, Amines, Aldehyde and Ketones. Aromaticity & Huckler rule.

UNIT IV

Spectroscopy: Introduction, Electromagnetic spectrum, Principle of Spectroscopy, the Spectrometer, Ultraviolet Visible (UV), absorption spectroscopy, Principal and applications of Infra red Spectroscopy, Nuclear Magnetic Spectroscopy and Mass Spectroscopy.

UNIT V

Stereochemistry: Simple molecules , Hybridization, conformation & configuration, Geometrical isomerism, optical isomerism, Chirality, Enantiomers and optical activity.

Recommended Books :

1. Morrison & Boyd, 1992, Organic Chemistry, Addiso-Wesley Pub. Co. 6th
2. Finar, I.L., 1988, Organic Chemistry, vol. I & II, Wiley John & Sons.
3. Soni, P.L., 2001, Organic Chemistry, S. Chand & Co., Delhi.
4. P.S. Kalsi, 2000, Organic Chemistry, [Recent edition].
5. Tondon, M. M. , Organic Chemistry, [Recent edition].

PAPER –IV: Basics of In-Organic and Physical Chemistry

Learning Outcomes: The paper is a basic paper of chemistry so that students acquire basic knowledge of chemistry which will be used by them while working in industries, research and development unit. The course comprises of two parts in-organic and physical chemistry highlighting method of chemical preparation and errors occurring during research.

UNIT I

Atomic and Molecule Structure: Idea of De-Broglie matter waves, Heisenberg Uncertainty Principal, atomic orbital, quantum numbers, radial and angular waver functions and probability distributions curves, shapes of s, p, d orbital's, Aufbau and Pauli exclusion Principles, Hund's multiplicity rule, Electronic configuration of the elements, Effective nuclear charge. Periodic properties: Atomic radii, Ionic radii, Ionization energy, affinity and electronegativity.

UNIT II

Coordination Compounds and Complexation, Complexes and chelating agents, Essential and trace elements in biological processes, Metalloporphyrins with special reference to hemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ions.

UNIT III

Errors in Chemical analysis, Precision, Accuracy, Absolute and standard deviation, Significant figure, Titrimetric Methods: Neutralization, Precipitation, Redox Complexation titrimetry, Introduction to Analytical Separation, Chromatography Liquid (Partition & Adsorption), Gas Chromatography, High performance liquid Chromatography.

UNIT IV

Solution, Ideal and non-Ideal solutions, Dilute solutions, Concentration Expressions, Solubility Expressions, The solution process, Colligative properties of solutions, Raoult's law, Abnormal molar Masses, Acids and Bases, Hard and soft acids and bases (HSAB), Non – aqueous solvents.

UNIT V

Thermodynamics – Principles, The Henderson – Hasselbalch equation, Buffering, First law of thermodynamics, Enthalpy, Second law of thermodynamics, Entropy Free energy, Chemical equilibrium, law of Mass action. Chemical kinetics and its scope, Rate of Reaction, Factors influencing the rate of reaction, zero order, second order, pseudo order, half life and mean life.

Recommended Book

1. Soni, P.L., 2001, In-organic Chemistry, S. Chand & Co., Delhi.
2. Scoog and Weston, Analytical Chemistry, [Recent edition].
3. Soni, P.L. Physical Chemistry, [Recent Edition].
4. Bogel, V. Analytical Chemistry,[Recent edition].
5. Chatwal G.R. , Organic Chemistry, [Recent edition].
6. Finar, I.L., 1988, Organic Chemistry, vol. I & II, Wiley John & Sons.

B.Sc.(Hons.) Biotechnology

IInd SEMESTER

Academic Sesion

2018-2020

B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2018-2020)
Scheme of Course and Distribution of Marks

Second Semester

Sub. Code	Paper Name	Theory Marks		Practical s Marks	Total
		Th.	Int. Ass.		
BT - 05	Paper –I Animal Diversity	35	15	-	50
BT - 06	Paper –II Plant Diversity	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT - 07	Paper –III Basics of Computer	35	15	-	50
BT - 08	Paper –IV Biostatistics and Mathematics	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

In this semester students will learn about basics of plant & animal diversity which will provide them a base for developing different biotechnological techniques. This semester also contains papers like basics of computer sciences and statistics where computer is required at industrial level for accomplishing their basic work and statistics will be required by them during their research work for interpreting data.

BT – 05
PAPER –I Animal Diversity

Learning Outcomes: The paper contains basic knowledge about animal diversity, classification and features of invertebrates and vertebrates. Last section of the paper focuses on applied Zoology which will help students to develop their mind as entrepreneur and will guide them with techniques like vermin-composting, apiculture, sericulture and Lac culture etc.

UNIT I

General Principles of Taxonomy and Animal classification.
Classification of following up to class only with characters and suitable examples
Protozoa, Porifera, Coelentrata, Platyhelminthes, Nematelminthes.
Life cycle of *Plasmodium*, *Entamoeba histolytica*, *Fasciola hepatica*, Economic importance of sponges.

UNIT II

Classification of following up to class only with characters and suitable examples
Annelida, Arthropoda, Mollusca, Echinodermata.
Character and Structure of Neries and Heteroneries.
Character, Structure and Reproduction of Prawn and Pila.
External features of Starfish.

UNIT III

Classification of Phylum Chordata up to class only with characters and suitable examples: (Hemichordata, Urochordata, Cephalochordata, Pisces, Amphibia, Reptilia, Aves and Mammal)
Characteristic features of Balanoglossus and Petromyzon, Fish migration.
Parental care in Amphibia. Poisonous and Nonpoisonous snakes.
Migration of birds.

UNIT IV

Applied animal science: Sericulture, Apiculture and Lac Culture.
Common pests of oil seeds, vegetables and stored grains.
Biological control of insect pests, vermiculture and vermicomposting,

UNIT V

Aquaculture : Definition scope and significance.
Prawn culture, Pearl culture.
Fish culture [carp culture, poly culture], maintenance of Aquarium.

Recommended Books

- 1- Green N.P.O. et al., 1995, Biological Sciences, Second Edition, Cambridge University Press.
- 2- Kotpal R.L., 2001, Modern Text Book of Zoology, Vertabrates, Rastogi Publication, Meerut, India.
- 3- Parker T.J. and Haswell W.A., 1990, A Text Book of Zoology, Vol. II Revised by A.J. Marshall.
Low Priced Publication Delhi.
- 4- Sinha, A.K., Adhikari, S., and Ganguli, B.B., 2001, Biology of Animals (Vol.-II & III), New Central Book Agency, Calcutta.
- 5- Ganguli, B.B., Sinha, A.K. and Adhikari, S., 2001, Biology of Animals, (Vol. I and III), New Central Book Agency, Calcutta.
- 6- Kotpal, R.L., 1990, Modern Text Book of Zoology, Invertebrates, 8th Edition, Rastogi Publication, Meerut.
- 7- Jordan, E.L., Varma, P.S., 2001, Invertebrate Zoology, S. Chand & Co., New Delhi.
- 8- V.G. Jhingran 1992, Fish and Fisheries of India.
- 9- Arvind Shukla and R. Tyagi, 2001, Encyclopedia of Mollusca vol. 1-3, Anmol publ., New Delhi.
- 10- Arvind Shukla and R. Tyagi, 2001, Encyclopedia of Birds vol. 1-3, Anmol publ., New Delhi.
- 11- Arvind Shukla and R. Tyagi, 2002, Encyclopedia of Animal Diseases vol. 1-6, Anmol publ., New Delhi.

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BT – 06
PAPER –II Plant Diversity

Learning Outcomes: The paper provides clear knowledge about plant kingdom, classification and diversity. The paper also features economic importance of plants, Algae, Fungi and Lichens, such knowledge will be important for the students to understand the concept of plant biotechnology.

UNIT I

Cyanobacteria: General features, Distribution, Cell structure, Heterocyst, Water bloom, Reproduction and economic importance. General features of Bacteria, Viruses and Bacteriophage.

UNIT II

Algae : General features, Distribution, Reproduction, Economic importance.

Fungi : General features, Reproduction, Parasexual cycle and economic importance with special reference to slime molds.

Lichens : General features, Distribution, Ecological significance and economic importance.

UNIT III

Bryophytes :General features, Thallus organization, Reproduction, Economic importance.

Pteridophytes :General features, Structure, Reproduction, Alternation of Generation, Stellar evolution, Heterospory and seed habit.

UNIT IV

Gymnosperms :General features, evolution, external features, development, reproduction, economic importance.

Angiosperms :General features, evolution, anatomy and reproduction, economic importance.

UNIT V

Centers of origin of cultivated crops.

Pollination biology- Structural and functional aspects of pollen & pistil.

Fertilization & control of fertilization.

Embryo and seed development.

Recommended Books

- 1- Bhatnagar, S.P. and Moitra, A., 1996, Gymnosperms New Age International Pvt. Ltd., New Delhi.
- 2- Davis, P.H. and Heywood, V.H., 1973, Principles of Angiosperms Taxonomy, Robert E. Krieger Pub. Co., New York.
- 3- Grant V., 1971, Plant Speciation, Columbia Univ. Press, London.
- 4- Harrison, H.J., 1971, New Concepts of Flowering Plant Taxonomy, Hieman Educational Books Ltd., London.
- 5- Nordenstam, B., El Ghazaley, G. and Kassam, M., 2000, Plant Systematics for 21st Century, Portland Press Ltd., London.
- 6- Takhtajan, A.L., 1997, Diversity and Classification of Flowering Plants, Columbia Univ. Press, New York.
- 7- Pandey, Mishra & Trivedi, 2001, A Text Book of Botany, Vol. II & III, Vikas Publishing House Pvt. Ltd., Delhi.
- 8- Vashishta, 1976, Botany for Degree Students (Algae, Fungi, Bryophyta & Gymnosperms) Gymnosperms (Vol. III), S. Chand & Co. Ltd., Delhi.
- 9- Biswas, C. and Johri, B.M., 1998, The Gymnosperms, Springer Verlag.
- 10- Alexopoulos, C.J., Mims, C.W. and Blackwell, M., 1996, Introductory Mycology, John Wiley and Sons, Inc.
- 11- Kumar, H.D., 1988, Introductory Phycology, Affiliated East-West press Ltd., New Delhi.
- 12- Parihar, N.S., 1991, Bryophyta, Central Book Depot, Allahabad.
- 13- Parihar, N.S., 1996, Biology & Morphology of Pteridophytes, Central Book Depot, Allahabad.
- 14- Stewart, W.N. and Rathwell, G.W., 1993, Paleobotany and the Evolution of Plants, Cambridge University Press.

BT - 07
PAPER –III BASICS OF COMPUTER SCIENCE

Learning Outcomes: The course deals with basic concepts of computer, its working and assess of internet. The paper provides students to develop base regarding use of computer hardware and software which is need of the hour in today's fast growing world.

UNIT I

Computer and its components, Characteristics of Computers, Classification of Computers, Types of Digital Computer, Main frame, Workstations, Micro Computers, Super computer.

Input Devices : Keyboard, Mouse, Light Pen, Joy-Stick.

Output Device : CRT, Monitors, Printers and their types.

UNIT II

Memory : Types of Memory, RAM, ROM, Secondary Memory Devices.

DOS- Internal and External commands of DOS.

Microsoft Windows, Concept of files & folders of windows, Desktop, Icons, Taskbar, Title bar, Status bar, Address bar, Tool bar, Menu bar, Start button, Shutdown Process, Control Panel, Recycle Bin, Windows Explorer, Cut, Copy & Paste of Files, Note Pad.

UNIT III

Computer Viruses : Definition, Types of Viruses, Effect of some common viruses.

Antivirus : Definition, Name of some popular anti-viruses.

Internet and World Wide Web, Client-Server concept, Protocols, TCP/IP, HTTP, FTP, E-mail.

UNIT IV

MS - Word : Word processing, Spell Check & Grammar, Bullets & Numbers, Tables, Formatting of Texts, Fonts & Paragraphs.

MS - Excel : Work Sheet, Work Book, Mathematical formulas & Functions, Charts- Column, Bar, Pie, XY. Formatting of Cells.

Power Point : Presentation – Blank, Template, Auto-Content Wizard, Inserting Slides, Objects, View Presentation.

UNIT V

Programming in C Language : Character Set, Key Words, Identifiers, Variables, Constants, Data types, Header files, Input-Output Statement, Operators – Arithmetic, Relational, Logical, Assignment, Increment, Decrement & Conditional operator.

Branching Statements : if, if-else, Nesting of if-else, switch statement,

Introduction to C++, OOPs, Class, Object, Function Overloading.

Recommended Books :

1. Fundamentals of Computers – V. Raja Raman
2. Fundamentals of Computers – P.K. Sinha
3. ABC of Internet - BPB
4. Internet Complete - BPB
5. Digital logic and Computer design - M. Morris Mano
6. Microsoft Office 2000 - BPB
7. Microsoft Windows 98 - BPB
8. Elements of Computer Science – C.K. Nagpal
9. Introduction to Computer MS DOS – Ajeet Singh
10. Programming in ANSI C – E Balaguruswamy
11. Object Oriented Programming in C++ - E Balaguruswamy

BT – 08

PAPER –IV BIOSTATISTICS AND MATHEMATICS

Learning Outcomes: The paper specifically deals with general and common statistical techniques generally applied in the field of Life-Sciences to accomplish research. Last two unit of the paper deal with basic concepts of mathematics which will be useful for the students in their overall development.

UNIT – I

Collection of Data, Classification and Tabulation of Data : Graphical presentation, bar charts, Pie diagrams, Graphs, Ogives, Measures of Central Tendency, Measures of Dispersion. Correlation and Regression.

UNIT – II

Statistical Population, Sample from Population, sample space, events, independent and dependent events, mutually exclusive events, classical definition of probability, Probability Distribution, Binomial Poisson and Normal Distribution.

UNIT – III

Parameters and Statistics, Sampling Distribution, Theory of Error, Test of Significant, Mean and Standard deviation, chi-square test for goodness of fit, T-test, Analysis of Variance.

UNIT – IV

Matrix and Determinant: Matrices Manipulation Simultaneous equation.
Differential Calculus: Derivative and its Physical interpretation, Basic rules for differentiation, Application of Differential Calculus in the Biology and Chemistry.

UNIT – V

Integral Calculus: Basic rule of integration for indefinite and definite integral geometric meaning of integration Application in Biology and Chemistry.
Differential equation and linear equation, equations of second order, Application of differential equation.

Recommended Book

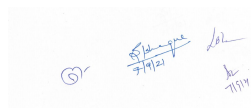
1. Arora, P.N. and Malhan, P.K. 2002. Biostatistics, Himalyan Publishing House.
2. SC. Gupta and V.K. Kapoor, Applied Mathematics.
3. SP Gupta, Elementary Statistical Methods.
4. SC Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics
5. P.N. Arora, and S. Arora, Statistics. S. Chand Pub.

B.Sc.(Hons.) Biotechnology

IIIrd SEMESTER

Academic Sesion

2018-2020



B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2018-2020)
Scheme of Course and Distribution of Marks

Third Semester

Sub. Code	Paper Name	Theory Marks		Practicals Marks	Total
		Th.	Int. Ass.		
BT – 09	Paper –I Genetics	35	15	-	50
BT – 10	Paper –II Molecular Biology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 11	Paper –III Environmental Science	35	15	-	50
BT – 12	Paper –IV Communication Skills	35	15	-	50
BT – 13	Paper –V Entrepreneurship development	35	15	-	50
	Project Work	-	-	-	50
		Total			350

Outcome: In this semester students will study paper of genetics and molecular biology which will provide them genetic methodology and how quantification of heritable traits in families and populations provide insight into cellular and molecular mechanisms. The semester also contains paper like environmental science which will provide student's knowledge about interaction between environmental and living organism. Students will also be enlightened by knowledge of communication skills and entrepreneur development which will help them in their personality development and growth.

PAPER I : Genetics

Learning Outcomes: The paper deals with detailed understanding and chemical basis of heredity. It will provide comprehensive and elaborated understanding of genetic methodology and how genetic concepts affect broad societal issues including health and diseases, food and natural resources, environmental sustainability etc. The students will be able to design execute and analyze the results of genetic experimentation in animal and plant model systems.

UNIT I

Importance of Genetics, terminology, life history of Mendel.
Mendelian laws of inheritance, Monohybrid cross, Law of Dominance and the law of segregation, Dihybrid cross and law of independent assortment.
Interactions of genes, complementary genes, reversions, lethal genes, epistasis.
Multiple alleles, Blood groups, Rh factor.

UNIT II

Chromosome theory of inheritance. Linkage and Crossing over mechanism.
Mapping of genes, interference and coincidence.
Extra chromosomal inheritance, coiling of shell in snails.
Mitochondrial and chloroplast genetic systems,

UNIT III

Cell divisions: Mitosis and meiosis,
Chromosomes: structural organization.
Nucleosome organization : (Euchromatin and heterochromatin).
Chromosomal aberrations : Structural changes – duplication, deletion, inversion and translocation.
Numerical changes: euploidy and aneuploidy.
Hereditary defects: Klinefelter, Turner, Cri-du-Chat and Down syndromes.

UNIT IV

Sex linked inheritance: X linkage, sex linkage in man, color blindness, Hemophilia (Bleeder's disease) and other genetic diseases.
Characteristics of X linked inheritance.
Inheritance of Z – Linked recessive genes in moths, Sex linkage in poultry.
Y linked inheritance in Man, Inheritance of X-Y linked genes.

UNIT V

Mutations: spontaneous and induced, Chemical and physical mutagens.
Population genetics: Hardy-Weinberg equilibrium, Gene and genotypic frequencies.
Inbreeding depression and heterosis. Genetic basis of evolution.

Recommended Books

1. Strickberger M.W., 2002, Genetics, Prentice Hall, India.
2. Friefelder, D., 1993, Molecular Biology, Jones & Bartlett Publishers, Boston, London.
3. Brown, T.A., 1998, Genetics: a molecular approach, Chapman & Hall, London.
4. Snustad & Simmons [2003], Genetics
5. P.K. Gupta [2004], Genet

BT - 10

PAPER II : Molecular Biology and DNA Technology

Learning Outcomes: Knowledge of Molecular Biology will demonstrate the knowledge of common and advanced laboratory practice in molecular biology. The paper will exhibit clear concise of scientific data and will guide students about molecular mechanisms by which DNA controls developments, growth or morphological characteristics of organisms. The paper will also provide students with knowledge about principles of cloning and genetic manipulation.

UNIT I

Molecular basis of life. Nucleic acids as genetic material.
Structure of DNA and its alternative forms.
Structure and Types of RNA.
DNA replication in prokaryotes and eukaryotes.
Structure of prokaryotic and eukaryotic genomes.
Insertion elements and transposons.

UNIT II

Prokaryotic gene expression: Prokaryotic transcription.
Prokaryotic translation.
Regulation of gene expression. Genetic code
DNA recombination in Prokaryotes.

UNIT III

Eukaryotic gene expression: Eukaryotic transcription
Eukaryotic translation.
Post translation control.
Regulation of gene expression in eukaryotes.
DNA recombination: molecular mechanisms in eukaryotes.

UNIT IV

Recombinant DNA and Gene Cloning: Cloning vector.
Restriction enzymes, Construction of Chimeric DNA.
Construction and screening of genomic and C-DNA library. Molecular probes.

UNIT V

Polymerase Chain Reaction (PCR), Applications of PCR in biotechnology and Genetic Engineering, Types PCR.
Types of DNA chip and their production, Application of Micro arrays on DNA.
Isolation of Genes, sequencing of a Gene , Synthesis of Genes.

Recommended Books

1. Friefelder, D., [Recent edition] Molecular Biology, Jones and Bartlett Publishers, Boston, London.
2. Hoffee, P.A., [Recent edition] Medical Molecular Genetics, Fence Creek Publishing, Madison Connecticut, USA.
3. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D., 2002, Molecular Biology of the Cell, Garland Publishing Inc. New York, USA.
4. Davis, [Recent edition], Microbiology, Harper & Row.
5. Lewin, B., 2000, Genes VII, Oxford University Press.

PAPER III: Environmental Science

Learning Outcomes: The paper deals with understanding core concepts and methods from ecological and physical sciences and their applications in environmental problem solving, appreciate the ethical, cross culturally and historical context of environmental issues and the links between human and natural systems.

UNIT I

Scope and importance of the environmental science. Natural resources (Renewable and non-renewable resources). Conservation and Management of Natural Resources. Equitable use of resources for sustainable lifestyles.

UNIT II

Concept of ecosystem: Structure and function of an ecosystem. Energy flow in the ecosystem. Ecological succession. Food chains, food web and ecological pyramids. Types and characteristic features of the forest, grassland, desert and aquatic ecosystems.

UNIT III

Concept of Biodiversity: Definitions and types of Biodiversity (genetic, species and ecosystem diversity). Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels. Hot spots and threats to biodiversity. Endangered and endemic species of India. Conservation of biodiversity.

UNIT IV

Environmental Pollution: Causes, effects and control of Air, Water and Soil pollution. Waste water treatment.

Disaster Management : Floods, earthquakes, landslides and cyclones.

Environmental legislation: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act.

UNIT V

Environmental Ethics: Issues and possible solutions. Water conservation, rain water harvesting and watershed management.

Climatic change: global warming, acid rain, ozone layer depletion, and nuclear accidents. Wasteland reclamation. Consumerism and waste products.

Reference Books:

1. S. K. Choudhuri: Environmental Legislation in India. Oxford & IBH Publ. Delhi. 1996.
2. E.A.. Keller: Environmental Geology. Charles E. Merrill Publ. Co.Columbus, U.S.A. 1976
3. S. S. Purohit, Q. J. Shammi and A. K. Agrawal: A text book of Environmental Sciences. Student Edition, Jodhpur. 2004
4. S. C. Santra: Environmental Science. New Central Book Agency (P) Ltd. Calcutta. 2001.
5. B. K Sharma: Environmental Chemistry. Goel Publ. House, Meerut. 2001
6. P. D Sharma: Ecology and Environment. Rastogi Pub. Meerut 1995.
7. R. K Trivedi: Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards. Enviro Media (R).

BT - 12

PAPER IV : Communication skills

Learning Outcomes: In this segment students will be demonstrated about critical and innovative thinking, display competence in oral, written and visual communication. Students will get chance to develop an understanding of opportunities in the field of communication, they will also learn to use current technology related to communication field.

UNIT I

Nature, role and importance of communication in an organization–verbal and non-verbal. Organization Communication Network–formal & informal, effectiveness of communication, process of communication. Global communication.

UNIT II

Barriers and Gateways in communication. Public speaking and oral reporting-making formal speeches, conduct and participation in meetings, agenda and minutes of meetings.

UNIT III

Written communication-Basic principles. Business report writing–organization, interpretation and techniques of report writing, précis writing. Reading skills

UNIT IV

Non-verbal communication, resume preparation, letters of appointment, communication on disciplinary matters. Interviews.

UNIT V

Listening Skills, conversation skills, feedback skills, counseling skills, negotiation skills.

Reference Books:

1. Nageshwar Rao and R.P. Das: Communication Skills. Himalaya Publication House, Mumbai.
2. Diwan and Agarwal: Business Communication.
3. Pradhan, Bhende and Thakur: Business Communication.
4. A.H. Murphy and C.E. Peck: Effective Business Communication. Tata Mc Graw Hill, New Delhi.
5. R.K. Madhukar: Business Communication.
6. C.G. Pearce et. al. : Business Communications Principles and Applications. John Wiley, New York.
7. M. Treece: Successful Business Communications: Allyn and Bacon Boston.

BT - 13

PAPER V : Entrepreneurship Development

Learning Outcomes: After, learning this course, students will be able to run a small enterprise with small capital for a short period and experience the science and art of doing business. Thus, this will allow any students to know the parameter, assess opportunities and constraints for new business ideas.

UNIT I

Entrepreneurship: Definition, characteristics, importance, types and functions of an entrepreneur, qualities of a good entrepreneur; entrepreneurial motivation factors.

UNIT II

Women entrepreneurship: Opportunities and problems, search and selection of business idea.

UNIT III

Preparation of project report: Preparation of preliminary project report, main elements of a detailed project report, selection of types of organization and factors influencing the choice of organization, sole proprietorship, partnership, co-operative society.

UNIT IV

Role of regulatory institutions: District industries centre, Madhya Pradesh pollution control board, food and drug administration, electricity board, municipal corporation. Role of promotional institutions: Khadi and Village industries commission, Madhya Pradesh finance corporation and scheduled banks, women economic development corporation of Madhya Pradesh.

UNIT V

Incentives and subsidies: Concepts and needs [control investment subsidy, interest subsidy, subsidy for power, margin money assistance], special incentives to women entrepreneurs. Major Government Schemes- PMRY, S.J.R.Y., R.D.S.Y. and Deendyal swarojgur yojana.

Reference Books:

1. C.B. Gupta: Entrepreneurship Development.
2. G.S. Sudha: Udyamita.
3. Vasant Desai: Dynamics of Entrepreneurial Development and Management.
4. G.A. Kaulgud: Entrepreneurship Development.

⑤ $\frac{5x^2 - 4x}{x^2 + 1}$ $\frac{5x}{x^2 + 1}$

B.Sc.(Hons.) Biotechnology

IVth SEMESTER

Academic Sesion

2018-2020

VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2018-2020)
Scheme of Course and Distribution of Marks

Fourth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT – 14	Paper –I Biophysics	35	15	-	50
BT – 15	Paper –II Introduction to Biochemistry	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT – 16	Paper –III Applied plant science and Tissue Culture	35	15	-	50
BT – 17	Paper –IV Human Physiology & Developmental Biology	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

BT - 14

PAPER I: Biophysics

Learning Outcomes: The paper will enable to illustrate the basic principle and techniques to understand the biological problem. Students will gain knowledge of commonly used process measurement, devices, control methods and strategies and proper selection, identification, design, installation and operation of instrumentation

UNIT I

Energetic of a living body: Laws of Thermodynamics, Entropy, Concept of free energy. Enthalpy, Osmosis, Diffusion, Active and Passive transport.

UNIT II

Lambert- Beer law: Spectrophotometry Types and application, (UV-Visible, fluorescence, atomic absorption,) IR, Raman spectra, X-ray crystallography and NMR.

UNIT III

Microscopy : Principle and applications. Light Microscope, Phase & Interference Microscopy, Dark Field Microscopy & Polarization Microscopy and compound microscopes, phase contrast, dark field, fluorescence microscopy, Electron Microscopy (TEM & SEM) .

UNIT IV

Autoradiography, Centrifugation, Chromatography (TLC, Paper, GC) Radioactive isotopes.

UNIT V

Ultrasound, Optical filters, X-ray, CAT scan, ECG, EEG, NMR imaging, SDS Page, Electrophoresis and its types. Electronic Spin Resonance [ESR],

Recommended Books

1. Pattabhi, V., 2002, Biophysics, Narosa Publishing House, New Delhi.
2. Michel Daune, 1999, Mol. Biophysics, Oxford University Press.
3. Roland Glaser, 1991, Biophysics, Oxford University Press.
4. Gordon G. Hammes, 2000, Thermodynamics and Kinetics for the Biological Sciences, John Wiley & Sons.
5. Atkins, P.W., 2001, Physical Chemistry, W.H. Freeman & Co. 7th Edition.
6. Clycle, R. Metz, 1998, Schaums' Series, Outline of Physical Chemistry, McGrawHill.
7. Puri & Sharma, 2002, Physical Chemistry, S. Chand & Sons Co.
8. Bahl & Tuli, 2002, Essential of Physical Chemistry, S. Chand & Sons. Co.

PAPER- II: Introduction to Biochemistry

Learning Outcomes: The paper will enable students to use current biochemical and molecular techniques to plan and carry experiments, laboratory investigation, It will help students to understand the fundamental chemical principles that govern complex biological systems.

UNIT I

Introduction of Biochemistry: Introduction and scope of Biochemistry, Nature of Biological material,

Biomolecules: General structure and properties of biomolecules, (protein, lipid, carbohydrate and Nucleic acid), acid, base, buffers, polyprotic acids.

UNIT II

Carbohydrate: classification and configuration of Monosaccharides, Disaccharides, polysaccharides,

Lipids: Structure & function of Glycoprotein, Fatty acids, Triacylglycerol, Glycerophospholipids, Sphingolipids: Cholesterol, Lipoprotein.

UNIT III

Amino acids: structure, nomenclature and general properties of amino acids, Peptide bond.

Protein: Primary structure, Secondary structure, Tertiary structure, Quaternary Structure of protein, Ramachandran diagram, Protein stability.

UNIT IV

Vitamins: Types, sources and Biochemical functions of Vitamins, recommended dietary allowance (RDA).

Enzymes: Historical perspective, structure, classification of enzymes, Enzyme action, Factors affecting enzyme action, Uses of Enzymes, Co-enzymes.

UNIT V

Pathway : Glycolysis, TCA cycle, HMP pathway, Urea cycle.

Glycogenesis, Gluconeogenesis, Glycogenolysis, Oxidation of fatty acids, Mobilization & transport of Amino groups from amino acids,

Recommended Books

1. Voet & Voet, 2000, Biochemistry, John Wiley, New York
2. Zubay, 1995, Biochemistry, Brown Publishers.
3. Lehninger, 2000, Principles of Biochemistry, CBS Publishers.
4. L. Stryer, 2002, Biochemistry, W.H. Freeman.
5. Harper, 2003, Biochemistry, McGraw-Hill.
6. P.K. Gupta, Biotechnology and Genomics, Rastogi publications, Meerut
7. H. D. Kumar, Modern concepts of Biotechnology, Vikas Publishing house, New Delhi.
8. Arvind Shukla, Encyclopedea of Enzymology, 2008, Discovery Publication, New Delhi.

BT – 16
PAPER-III : APPLIED PLANT SCIENCES

Learning Outcomes: The paper focuses on imparting up to date information about plant science, with an objective of providing training in scientific and transferable skills through modular lecture courses, project work, written work and supervisions.

UNIT I

Economically important Plants: Introductory study of economically important plant groups : fiber, sugar, starch and cellulose, oils and fats yielding plants, fumigatory/masticatory and medicinal plants, their cultivation, important products they yield.

Micropropagation: Methods of micropropagation and their applications in forestry, floriculture, agriculture and conservation of biodiversity and threatened plants.

UNIT II

Plant Metabolites: Production of commercially useful compounds by plant cells (secondary plant metabolites), Alkaloids, antitumour agents, saponins and steroids, insecticide additives.

Biotransformation :Genetic transformation for increase in plant productivity, Growth of cells in bioreactors, commercialization, Biomass for energy production.

UNIT III

Protoplast Culture:*In vitro* approaches to genetic manipulation of plants, Protoplast isolation, Culture and Fusion ,application of plant protoplast culture in somatic hybridization and cybridization.

Genetically engineered plants: current status and commercial opportunities for genetically engineered plants for insect, virus, herbicide and pesticide resistance, stress tolerance.

UNIT IV

Plant cell and Tissue culture:Introduction to plant tissue culture,History and fundamentals of tissues culture,Plant Regeneration, Culture Media, Initiation and Mentenence of callus,cell.Anther and embryo cuture.

UNIT V

Plant cell and Tissue Culture: Antisense RNA technology .

Development of Male sterile plant, Synthetic Seeds.

Commercial opportunity for plant tissue culture, Clonal propagation.

Recommended Books

1. P.K. Gupta, Biotechnology and Genomics, Rastogi publications, Meerut
2. H. D. Kumar, Modern concepts of Biotechnology, Vikas Publishing house, New Delhi.
3. J.E. Smith, Biotechnology, Cambridge University Press.
4. R.P. Singh, Introductory Biotechnology, Central Book Depot, Allahabad.
5. K.Trehan, Biotechnology, Wiley Eastern Ltd., Delhi.
6. S.S. Purohit, A Laboratory manual of Plant Biotechnology (2004) Agrobios India.
7. M.K Razdan, Introduction to Plant Tissue Culture (2003) Oxford and IBH Publishing Co., New Delhi.
8. H.S. Chawala, Introduction to Plant Biotechnology (2003) Oxford and IBH Publishing Co., New Delhi.

BT – 17

PAPER-II: Human Physiology and Developmental Biology

Learning Outcomes: The syllabus provides study of human physiology, building knowledge of basic physiology, principles, establishes new and more complex physiological functions, helps to understand interaction between human body and different body systems, The paper will also enhance students to understand interaction to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail.

UNIT I

Introductory Knowledge of Different Organ System of Body, Structure and parts of Digestive tract, Physiology of digestion and disorders of digestive tract. Structure and parts of Respiratory system, Physiology of Respiration, disorders of Respiratory system, Anatomy and physiology of Heart, disorders of Circulatory system .

UNIT II

Structure and parts of Excretory system, structure of kidney, Physiology of Excretion disorders of Excretory system, Structure, parts and Physiology of Nervous system, disorders of Nervous system, Physiology of Muscle contraction.

UNIT III

Endocrine system : Introduction to Endocrinology, Structure and Hormones of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, gonads, thymus, gastro intestine, Regulation of endocrine system and Disorders of Endocrine system.

UNIT IV

Structure of male reproductive Organs, Structure of female reproductive organs, reproductive hormones, menstrual cycle, pregnancy and lactation, disorders of reproductive system, placentation.

UNIT V

Historical perspective, Aims and Scope of Developmental Biology, Gametogenesis – Spermatogenesis and Oogenesis, Fertilization, cleavage, Blastulation, Gastrulation, Fate map, Organizer Concept, Concept of Regeneration.

Recommended books :

1. Guyton, A.C. and Hall, J.E., 2000, A Text Book of Medical Physiology, Xth Edition, W.B. Saunders Company.
2. Ganong, H. 2003, Review of Medical Physiology, 21st Edition, McGraw Hill.
3. Strand Fleur , 1978, Physiology (A regulatory system approach) McMillan Pub. Co.
4. David Shier, Jakie, Butler & Lewis, 1996, Human Anatomy & Physiology, WCB , USA.

B.Sc.(Hons.) Biotechnology

Vth SEMESTER

Academic Session

2018-2020

VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2014-2015)
Scheme of Course and Distribution of Marks

Fifth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT - 18	Paper –I Principles of Microbiology	35	15	-	50
BT - 19	Paper –II Microbial Biotechnology	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT -20	Paper –III Plant Biotechnology and Genomics	35	15	-	50
BT -21	Paper –IV Animal Biotechnology and Genomics	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350

PAPER I: Principles of Microbiology

Learning Outcomes: The paper focuses on general principles of microbiology, microbial cell structure, functions, their growth and metabolism. The students will be able to understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes and also learn the theory and practical skills in microscopy handling and staining techniques. The student will gain various culture media and their applications and understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure culture. The paper will make students understand the microbial physiology along with various methods of bacterial growth measurements

UNIT I

Scope of Microbiology: Micro-organisms in Human Affairs and industry,

Historical aspect: Early observations of Antony Van Leeuwenhoek, Contributions of Louis Pasteur, Robert Koch, Robert Hooke, Edward Jenner.

Control of Infections: Vaccination, Chemotherapy, Antibiotics.

Aseptic Techniques: Disinfection, sterilization, pasteurization.

UNIT II

Diversity of Micro organisms: Archaea, Prokaryota, Eukaryota [an overview of structure]. Brief introduction of Bacteria, Fungi, Protozoa, Algae [protistean] and Viruses. Viroids and Prions.

Kingdom Monera, Five kingdom system and its modifications. The Three Domains. Bergey's manual of Systematic Bacteriology.

Identification of bacteria. Bergey's Manual of Determinative Bacteriology

UNIT III

Staining of bacteria: Gram stain, Acid-fast stain, Endospore stain, Negative stain, flagella stain.

Methods of Pure culture of Microorganisms: Concept of Pure culture, Streak plate method, Pour plate method.

Culture media

Estimation of Micro-organisms: Dilution plate technique, MPN method.

UNIT IV

Microbial Growth.

Measurement of Growth: Turbidity, Dry weight measurement.

Physical factors affecting growth: Temperature, pH, Water activity.

Chemical factors affecting growth: carbon, Nitrogen, Sulphur, Phosphorus, Trace elements, Oxygen.

Continuous and Batch culture.

UNIT V

Bacterial cell: Flagella, Pili, Glyocalyx, Cell wall

Gram Positive and Gram negative bacteria,

Internal Structure: Cytoplasm, Nucleoid, Endospore.

Structure of Archaea cell.

Eukaryotic cell : External structures – Flagella, Cilia, Cell wall.

Cell membrane, cytoplasm.

Organelles: Nucleus, Mitochondria, Endoplasmic reticulum, Ribosomes, Golgi bodies, Lysosomes, Chloroplast.

Recommended Books :

1. Pelczar, M.J. Jr., Chan, E.C.S. and Krieg M.R., [Recent edition], Microbiology, McGraw Hill.
2. Prescott, L.M., Harley, J.P. and Klein, D.A., 2002, Microbiology, McGrawHill
3. Atlas, R. M. 1987, Microbiology, Fundamentals and Applications, Prentice Hall.
4. Stanier, R. Y., Ingram, J.L., Wheelis, M.L. and Painter, P.R. [Recent edition], General Microbiology, McMillan Publishing Co.
5. Madigam, M.T. , Martinko, J.M. & Parker, J. (2000), Brock Biology of Microorganisms, tenth edition, Prentice Hall International Inc.
6. Shimeld, L. A. , Rodgers, A.T. (1999) Essentials of Diagnostics Microbiology, Delmer Publishers.
7. Black, J.G. (2002) Microbiology: Principals and explorations, fifth edition, John Wiley & sons.
8. Nester, E.W., Roberts, C.E., Nester, M.T. (1995). Microbiology : A Human Perspective, first edition W.M.C. Brown Publishers.
9. Arvind N. Shukla, Encyclopaedia of Animal diseases “ Microbial disease” 2001, Anmol Publications.
10. Tortora, G.J., Funcke, B.R. and case, C.L. 2006, Microbiology – An Introduction VIIIth edition, Pearson Education, New Delhi.
11. Cappuccino, J.G. and Sherman, N. 2004. Microbiology – A laboratory manual, Pearson Education , New Delhi.

BT – 19
PAPER II : Microbial Biotechnology

Learning Outcomes: The paper will provide information about preparation of beverages and industrial alcohol. It will make students understand the methods followed in the production of industrially important microbial primary metabolites, secondary metabolites and the physical and chemical conditions influencing their production.

UNIT I

Microbial metabolism- Primary and secondary metabolic products, Introduction to microbial products obtained by industrial processes.
Isolation, preservation and maintenance of industrial microorganisms.
Mass culture of Microbes , Media for industrial fermentation, air and media sterilization.
Types of fermentation processes – analysis of batch , fed- batch and continuous bioreactors, stability and microbial reactors.
Types of Fermenters – Aerated and Agitated fermenter, Air lift fermenter.
Basic functions of Baffle, Impeller and Sparger.
General Introduction of Specialized bioreactors (pulse, fluidized , photo bioreactors etc.)
Environmental control of bioreactors.

UNIT II

Fermentation as a biochemical process, bioconversion.
Production of wine and beer, production of Cidar and vinegar.
Microbial production of cheese, production of ethanol,
New steps in Antibiotic fermentations, production of Acetone and Butanol.
Biogas and methanogenic microbes.

UNIT III

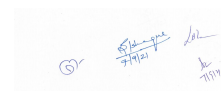
Microbial production of food : Single cell protein.
Microbial production of flavors, other Products and generalized food biotechnology.
Microbial transformation of metals, leaching and extraction.
Production of Lactic acid, Citric acid.
Production of amylases, proteases and lipases.

UNIT IV

Bacterial genomics, sequencing of microbial genome, genome economization.
Symbiosis and genetic isolation, biofilms.
Restriction enzymes, Cloning vectors [Plastids, phages and cosmids, BAC's]
Expression vectors. Genomic and c DNA libraries, DNA Micro arrays,

UNIT V

HIV Therapeutics, AIDS vaccines, Bacteriophages as antibiotics.
Antimicrobial drugs, antimicrobial chemotherapy, modern information rich drugs.
Human insulin and production of human growth hormones.
Production of interferon and Somatostatin, Hybrid antibiotics.
Hepatitis vaccine production.
High temperature resistant proteases, Biofilters, Biochips and biosensors.



Recommended Books :

- 1) Pelczar, M.J. Jr., Chan, E.C.S. and Krieg M.R., [Recent edition], Microbiology, McGraw Hill.
- 2) Prescott, L.M., Harley, J.P. and Klein, D.A., 2002, Microbiology, McGrawHill
- 3) Ronald M. Atlas, 1987, Microbiology, Fundamentals and Applications, Prentice Hall.
- 4) Stanier, 1986, General Microbiology, McMillan Publishing Co.
- 5) Madigam, M.T., Martinko, J.M. & Parker (2000), Brock Biology of Microorganisms, tenth edition, Prentice Hall International Inc.
- 6) Shimeld, L. A. , Rodgers, A.T. (1999) Essentials of Diagnostics Microbiology, Delmer Publishers.
- 7) Black, J.G. (2002) Microbiology: Principles and explorations, fifth edition, John Wiley & sons.
- 8) Nester, E.W., Roberts, C.E., Nester, M.T. (1995). Microbiology : A Human Perspective, first edition ,W.M.C. Brown Publishers.
- 9) Trehan Keshav Biotechnology, 1991 Willy Eastern Limited , New Delhi.
- 10) Ratledge, C. and Kristiansen B., Basic Biotechnology , 2002, Cambridge University Press.
- 11) Friefelder, D., [Recent edition] Molecular Biology, Jones and Bartlett Publishers, Bostan, London.
- 12) Brown, T.A., 2001. Gene Cloning and DNA Analysis, IV ed. Blackwell Science.
- 13) Lewin, B. Gene VII, Willey Eastern Publication.
- 14) Crueger, W. and Crueger, A. 2005, Biotechnology- A textbook of Industrial Microbiology IInd Ed. Panima Publishing.

PAPER –III: Plant Biotechnology and Genomics

Learning Outcomes: This course involves understanding tools of genomics which can be used to understand plant function. The paper also focuses on techniques of gene identification, genome sequencing, chloroplast engineering, micro propagation, somatic hybridization

UNIT I

Plant Tissue Culture : Basic aspects of plant biotechnology (History application and scope and importance), laboratory and culture media for plant tissue culture, cell Culture and its applications.

Clonal Propagation and Protoplast Culture: Micropropagation, Somaclonal Variation, Production and uses of Haploids, Protoplast isolation, Regeneration of plant, Somatic Hybridization

UNIT II

Gene Transfer in Plants : Vectors of gene transfer (Plasmids, Agrobacterium and Virus vector) Transformation technique {Agrobacterium mediated gene transfer, DNA mediated gene transfer(DMGT)} Removal of selected Marker Genes from Transgenic Plants, Regulatory sequences of induced genes.

Transgenic Plant resistance against Stress: Development of herbicide resistant transgenic plant, Development of insect resistant transgenic plant, Transgenic plant resistance against virus, bacterial and fungal pathogens, transgenic plant resistance against abiotic stress.

UNIT III

Genetically Modified Crops and Floricultural Plants: Transgenic plants with improved crop productivity, Transgenic plants with improved nutritional quality, Transgenic plants for Floriculture.

Molecular Farming:

Transgenic Plants for Value Added Specialty Crops, Transgenic Plants for Edible Vaccines, Transgenic Plants for Antibodies and Transgenic Plants for Biopharmaceuticals

UNIT IV

Transgenic Plants for Biosafety: Biosafety regulations of Transgenic Crops, Commercialization of Transgenic plants, quality modifications of plants (Modification of starch quality, modification and future of oil quality and modification of seed protein quality).

Choloroplast Engineering: plants Engineering of Chloroplast Genome, Transformation of choloroplast genome in higher plants, Transplastomic Plants and its applications (in Tobacco, Patato, Rice, Tomato etc.)

UNIT V

Construction of Molecular Maps: Preparation of Genetic Maps, (cereals, millets, sugarcane, cotton, Soyabean, Pea, Sunflower, etc.), Molecular genetics maps of high density plants, Uses of molecular genetics maps.

Genomics: Microcllinearity in DNA Sequences of Small Genomic Regions, Thale cress genome, Rice (*Oryza Sativa*) genome, Maize (*Zea Mays*) genome, Applications of functional genomics.

Recommended Books

1. Callom, J.A., Ford – Lloyd, B.V. and Newbury, H.J., 1997, Biotechnology and Plant Genetic Resources, Conservation and use, CAB International Oxon, U.K.
2. Chrispeds, M.J. and Sadana, D.E., 1994, Plant Cell Culture, Bios Scientific Publishers, Oxford, U.K.
3. Vasisit, I.K. and Thorpe, T.A., 1994, Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
4. Razdan, M.K., 1993, An Introduction to Plant Tissue Culture, Published by Oxford and I.B.H. Publishing Co. Pvt. Ltd. New Delhi.

PAPER –IV: Animal Biotechnology & Genomics

Learning Outcomes: The paper will enable students to understand the basic principles of animal culture, media preparation, in-vitro fertilization and embryo transfer technology. The paper also provides insights in progressing genomic research and integrated genomic maps which will be helpful for the students to understand different biotechnological processes.

UNIT I

Animal cell and tissue culture: History and scope of animal biotechnology and genomics, advantage and Laboratory Facilities for Cell and Tissue Culture, Substrate Culture Media and Procedures for Cell and Tissue Culture, Primary cell Culture and Cell Lines,

Stem Cells: Definition, Origin Types and functions of Stem Cells, Therapeutic cloning for embryonic stem cells, Stem Cell Therapy.

UNIT II

Organ/Embryo Culture: Primary Tissue Explanation Techniques, Organ Culture, Embryo Culture.

Cell and Tissue engineering: Approaches and Bio-Materials for tissue engineering, Tissue engineering of skin (Skin Graft), Engineering of Bone Crafts and Artificial Nerve Crafts, Future Limitations and Possibilities of Tissue Engineering.

UNIT III

In Vitro Fertilization and Embryo Transfer: In Vitro Fertilization in Human, Embryo Transfer (ET) in Humans, Super Ovulation and Embryo Transfer in Farm Animals (e.g. Cow).

Cloning of Animals: Method ,Type and utility of cloning animals, Cloning for Production of Transgenic Animals, Human Cloning and Ethical issue and Risk.

UNIT IV

Transgenic Animals: Gene Transfer or Transfection (Transfection of embryo, unfertilized eggs, culture of mammalian cells), Transgenic Animals, Cryopreservation.

UNIT V

Molecular Maps: Genetic Maps Using Molecular Markers, Cytogenetic Maps Using Molecular Markers, Physical Maps Using Molecular Markers.

Genomics and Proteomics: Human Genome project, Progressing Genomic Research (*Drosophila*, Mouse, Rat, Chimpanzee), Integrated Genomic Maps and Linkage Disequilibrium, Maps of the Future, Introduction types and application of proteomics.

Recommended Books:

1. Callom,J.A., Ford - Kornberg, A., 1991, DNA Replication, W.H. Freeman & Co.
2. Brown, T.A., 2001, Gene Cloning and DNA analysis Blackwell Science.
3. Darnell, J.E., 2000, Molecular Cell Biology, W.H. Freeman & Co.
4. B.D. Singh, Biotechnology (2007), Kalyani publication New Delhi.
5. J.E. Smith (2002), Biotechnology, Cambridge University press.
6. Arvind Shukla (2009), Enzymology, Discovery Publication, New Delhi.

B.Sc.(Hons.) Biotechnology

VIth SEMESTER

Academic Session

2018-2020

VIKRAM UNIVERSIYT UJJAIN
B.Sc. (Hons.) Biotechnology
Semester System (Academic session 2014-2015)
Scheme of Course and Distribution of Marks

Sixth Semester

Sub. Code	Paper Name	Theory Marks		Practical Marks	Total
		Th.	Int. Ass.		
BT - 22	Paper –I Immunotechnology	35	15	-	50
BT - 23	Paper –II Medical Biotechnology & Bioinformatics	35	15	-	50
	Practical –I (Based on Paper I and II)	-	-	50	50
BT -24	Paper –III Environmental Biotechnology	35	15	-	50
BT -25	Paper –IV Industrial Biotechnology	35	15	-	50
	Practical –II (Based on Paper III and IV)	-	-	50	50
	Project Work	-	-	-	50
		Total			350
		Grand Total			2100

PAPER I: Immunotechnology

Learning Outcomes: The paper will enable students to identify the cellular and molecular basis of immune response thus, enabling them to describe the role of the immune system in both maintaining health and contributing to disease. The students will be able to describe immunological response, how it is triggered and regulated. The students going through the paper will be able to demonstrate a capacity for problem solving about immune response and will be able to transfer knowledge of immunology into clinical decision making through case studies presented in the class.

UNIT I

Concept of Immunology History: Definition, History and Importance of Immunology and Organs of immune system and cells of the immune system.

Immunity: Introduction to innate/nonspecific immunity and Acquired/Specific immunity, Innate immune responses (External Barrier, Physiological Barrier, Inflammation, complement, Phagocytosis, interferon)

UNIT II

Antigens: Antigen, types and recognition, Adjuvants, Haptens, antigen Processing and presentation, Role of MHC and other molecules.

Antibody : Theories of antibody formation, Structure, classes and functions of Immunoglobulins, Antigen-Antibody Reactions (Agglutination, Precipitation, Neutralization, Complementation)

UNIT III

Cell mediated Immune Response- Cell mediated Immunity, Structure, Types Lineage Receptors, Activation and function of T-cells.

Humoral Immune Response: Structure, Types Lineage Receptors, Activation and function of B-cells.

UNIT IV

Cytotoxic Response: Cytotoxic Response (CTL-mediated Cytotoxicity, NK-cell mediated Cytotoxicity, Antibody Dependent cell mediated Cytotoxicity)

Immune Disorders: Autoimmunity and Autoimmune diseases, Hypersensitivity.

UNIT V

Antibody engineering: Hybridoma technology and Production of Monoclonal Antibody, Uses of Monoclonal Antibody, Production of Humanized and Human Antibody, Antibody Engineering Using Genetic Manipulation.

Vaccines: History and Progress of Vaccine Development, types and nature of vaccines and vaccination methods, boosters, Recombinant proteins.

Recommended Books:

1. Ivan M. Roitt, 2001, Essential Immunology, 6th edition, Blackwell Science Publications, England.
2. Coleman, R.M., 1992, Fundamental Immunology, WCB, McGraw-Hill.
3. Benjamini, E., Coico, R., Sunshine, G., 2000, Immunology: A Short Course, John Wiley & Sons Inc. Publications, USA.

BT – 23
PAPER II : Medical Biotechnology

Learning Outcomes: This segment of the curriculum will provide students with integrated knowledge in both bio-molecular and basic medicine disciplines in particular, with the knowledge necessary to understand complex biological systems at the cellular and molecular levels and of the biological processes related to them, so as to enable them to take action and modify them with biotechnological methods.

UNIT I

Biotechnology in medicine: History, scope & importance of Biotechnology in medicine Disease Diagnosis (DNA, RNA probes, Monoclonal Antibodies auto Antibodies), Detection and Treatment of genetic Diseases.

Genetic Counseling and Forensic Medicine: Fertility control, Genetic counseling, (Chance of having child with congenital defects, choice of Baby sex), DNA Fingerprinting in Forensic Medicines.

UNIT II

Gene therapy: Definition and types of Gene therapy, Initial success and future of Gene therapy, Vectors and other delivery system of gene therapy, Target tissue for gene therapy system, Gene therapy of genetic diseases (Neurological Disorders, Cystic Fibrosis), Gene therapy of Acquire diseases (Infectious Diseases, Cardiovascular diseases, cancer), Nanobiotechnology for drug targeting and gene therapy.

UNIT III

Pharmaceutical Biotechnology: Drug development, drug manufacturing processes, manufacturing processes of antiviral drugs, drug designing, Novel drug delivery systems, Antimicrobial drugs.

Pharmacogenetics: Pharmacogenetics and personalized medicine, genetics and genomics in medical practice, use of SNPs in pharmacogenomics.

UNIT IV

Genetic Engineering: Genetic and recombinant vaccines; Edible vaccines production of therapeutic proteins; Genetic engineering for production of Factor VIII, tissue plasminogen activator, Interferon.

Tissue Engineering: Tissue engineering of skin and cartilage and their applications, properties and types of stem cells, culture and applications of stem cells, Transplant rejection, Intellectual property issues in using human embryonic stem cells.

UNIT V

Biological Database : Introduction, History and applications of Bio-Informatics, Sequences and Nomenclature (DNA sequences, Amino acid sequences of proteins, Types of sequences in nucleotide sequence database), Database and search tool (FASTA, BLASTA Nucleotide sequence database, protein database), GCG: The Wisconsin package of sequence analysis programs, Detection of genes, Protein structure prediction, Large scale Bio-informatics genome projects.

Recommended Books:

1. Ivan M. Roitt, 2001, Essential Immunology, 6th edition, Blackwell Science Publications, England.Cole
 2. Man, R.M., 1992, Fundamental Immunology, WCB, McGraw-Hill.
 3. Benjamini, E., Coico, R., Sunshine, G., 2000, Immunology: A Short Course, John Willey & Sons Inc. Publications, USA.
 4. P.K. Gupta, Biotechnology and Genomics, Rastogi publications, Meerut
 5. H. D. Kumar, Modern concepts of Biotechnology, Vikas Publishing house, New Delhi
6. B.D. Singh, Biotechnology.
7.Arvind Shukla (2009) Enzymology, Discovery Publication, New Delhi.

PAPER III: Environmental Biotechnology

Learning Outcomes: The paper aims to introduce the students to various regional and global concerns regarding the environment including the natural challenges, various types of environmental pollutants and their effects, the changing environment, and the developments of diverse technologies to detect, study and address these concerns. The subject aims to introduce specific examples and cases, it also explains how chemical, biological and molecular sciences can be applied to identify and address issues of environmental concerns

UNIT I

Basic concepts of Environment: Basic concept of Environment & its component (Origin of earth, atmosphere, life & ecosystem), Scope & importance of environmental biotechnology.

Global Environmental Problems: Ozone depletion, UV- B, Green House Effect, Acid Rain, Climate change

UNIT II

Environmental Monitoring: Methods for sampling & measurement of air pollution, methods for sampling & measurement of water pollution, methods for sampling & measurement of soil pollution, permissible limits & indices for pollution.

Environmental Pollution & Control: sources, effects & control of air pollution, noise pollution, thermal pollution, water pollution, soil & solid waste pollution.

UNIT III

Bioremediation: Bio-remediation of inorganic & organic pollutants, bioremediation of xenobiotics, phytoremediation.

Solid & liquid waste Treatment: Microbial treatment of solid waste, liquid waste (Example sewage) waste water treatment, biotechnology for enhanced oil recovery.

UNIT IV

Clean Technology: Integrated pest management, biopolymer production & bioplastic technology, biotechnology for energy (production of biofuel, biogas, microbial hydrogen).

Bio-fertilizers: vermin compost, green manure, use of microbes for improving soil fertility.

UNIT V

Restoration Technology: Reforestation through micro-propagation, Soil restoration, Lake Restoration, Biodiversity conservation.

Biosensor and Bio-reporter Technology: Principle types and application of biosensor, bio-reporter (Reporter Gene System).

Recommended Books:

1. Ian L. Pepper, Charler P. Gevba, Mark L. Brusseau, Pollution, 1996, Science, Edited, Academic Press.
2. Chapman, J.L. and M.J. Reiss, 1995, Ecology, Principle and Applications, Cambridge University Press.
3. Varma, P.S., V.K. Agarwal, 1998, Environmental Biology Principles of Ecology, S. Chand & Co. Ltd.
4. Kormondy, E.J., 1989, Concept of Ecology, Prentice-Hall of India Pvt. Ltd.
5. Abbasi, S.A. and Abbasi, N., 2002, Renewable Energy Sources and their Environmental Impact, Prentice-Hall of India Pvt. Ltd., New Delhi.

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PAPER IV: Industrial Biotechnology

Learning Outcomes: The paper will illustrate various aspects of biotechnological applications in fermentation industries. It will describe the principles underlying design of fermenters, fermentation processes and downstream processing and its applications. It will integrate scientific and technological knowledge on the use of bioprocesses for industrial products and will apply the practical skills for entrepreneurial development.

UNIT I

Isolation and Culture of microorganisms: History scope and importance of industrial biotechnology, isolation, screening, culture and preservation of microorganism, strain improvement.

Fermentation Technology: Bioreactor design, and operation types of fermenters, Fermentation media, Batch. Fed batch, continuous culture system, *In situ* recovery of products.

UNIT II

Alcohol and acid Production: Industrial production of alcoholic beverages vinegar, Ethanol, organic acids, Amino acids and Antibiotics.

Enzyme Production: Properties and types of enzymes, Enzymes production, types and application, immobilization of Enzymes, Enzyme/protein Engineering, industrial processing: (Down stream processing, recovery, extraction and purification of fermentation products).

UNIT III

Dairy Industry: Fermented foods cheese production, use of enzymes in food industry, processing of milk and dairy products (Pasteurized milk, sterilized milk, cream and butter), enzymes in fruit juice and brewing industries (Fruit Juice and Wines, Beer), single cell protein.

Polymer and colloid production: Microbial and algal polysaccharides and polyesters production, (Production of Hydrocolloids and polyhydroxyalkonoides) Mass culture technique for algae, primary and secondary metabolites of microorganism and plants.

UNIT IV

Drug Discovery and Designing: History and molecular aspects of drug discovery, drug discovery in cancer, microbial genomics for new antibiotics, drug designing.

Metabolic engineering: Cloning and expression of heterologous genes, molecular breeding of Bio synthetic pathways, metabolomics and metabolic engineering, limitations in metabolic engineering.

UNIT V

Fuel biotechnology: Concept scope and importance of bio-fuels, bio-ethanol, bio-diesel, bio-hydrogen and biogas.

Bio-pesticides: Microbial insecticides (Types Production and uses) Bio-pesticides (Types production and uses) principles and objectives of integrated nutrient management, biofertilizer

Recommended Books:

1. Pelczar & Krieg, 1986, Microbiology, McGraw Hill.
2. Prescott, H. & Klein 2000, Microbiology, McGrawHill.
3. Ronald M. Atlas, 1987, Microbiology, McMillan Publishing Co.
4. Stanier, 1986, General Microbiology, McMillan Publishing Co.
5. Davis, 1980, Microbiology, Harper & Row.
6. P.K. Gupta, Biotechnology and Genomics, Rastogi publications, Meerut
7. H. D. Kumar, Modern concepts of Biotechnology, Vikas Publishing house, New Delhi.
8. J.E. Smith, Biotechnology, Cambridge University Press.
9. R.P. Singh, Introductory Biotechnology, Central Book Depot, Allahabad.
10. K.Trehan, Biotechnology, Wiley Eastern Ltd., Delhi.