M.SC., ENVIRONMENAL BIOTECHNOLOGY

MODEL SYLLABUS

AUGUST- 2022

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI – 600 005

LEARNING OUTCOMES – BASED CURRICULUM FRAME WORK GUIDELINES BASED REGULATIONS FOR POST GRADUATE PROGRAMME	
Programme:	**M.Sc. Environmental Biotechnology**
Programme Code	
Duration	**2 years [PG]**
Program Outcomes (PO)	
On successful completion of the **M.Sc., Environmental Biotechnology** program, the students are expected to	
PO1	Broad based knowledge in Environmental Biotechnology
PO2	Transforming meaningful applications for better healthcare, industries, and economic development
PO3	Constant updation of knowledge
PO4	Empowering skills
PO5	Sole responsibility of contributing the public to lead better life through extension activities
PO6	Development of critical thinking and problem-solving skills
PO7	The provision of an inspiring, exciting and collaborative scientific environment
PO8	To inculcate the values of professionalism and dedication
PO9	Develop intelligent strategies and biochemical approaches in problem solving methods
PO10	To compete globally with confidence in all the sectors of life science

Program Specific Outcomes (PSO)	
On successful completion of the **M.Sc., Environmental Biotechnology** program, the students are expected to	
PSO1	Ability to understand the technical aspects of existing technologies that help in addressing the biological and Environmental challenges faced by humankind.
PSO2	Ability to contribute effectively in the development of the ethical practices, societal contributions, and leading to responsible and competent professionals
PSO3	Acquiring the ability of leadership skills to manage projects in multidisciplinary environments
PSO4	Nurture problem solving skills, thinking, creativity through assignments, field work, seminar presentations and project work.
PSO5	Assist students in preparing (personal guidance, research papers, and books) for competitive exams e.g.,NET-JRF, SLET, etc.

M.Sc. ENVIRONMENTAL BIOTECHNOLOGY

The course of study and scheme of examination

1. Name of the course: **M.Sc. Environmental Biotechnology**

2. **Choice Based Credit System(CBCS)**

Choice based credit system is a flexible system of learning.
Credit‟ defines the quantum of contents/ syllabus prescribed for a course and determine the number of hours of instruction required.

The CBCS has unique features such as enhanced learning opportunities, ability to matchstudentsscholasticneedandaspirations,interinstitutiontransferabilityofstudents,partcompletion of an academic program in the institution of enrollment and part completion inspecializedandrecognizedinstitution,improvementineducationalqualityandexcellence,flexibilityforworkingstudentstocompleteProgrammeoveranextendedtimeandstandardizationandcomparabilityofeducationalprogramsacrossthecountry.

3. **The preamble of the syllabus**

Master of Science (M.Sc.) in Environmental Biotechnology, the curricula, and course content were designed to meet the standards of UGC-CSIR (NET) and (SLET) examinations. The choice-based credit system of learning develops a strong base in the core subject and specializes in the disciplines of his / her liking and abilities and develops an in-depth understanding of various aspects of Biotechnology. The students develop experimental skills, design, and implementation of novel synthetic methods, and develop the aptitude for academic and professional skills, by acquiring basic concepts for structural lucidation with hyphenated techniques, and understanding the fundamental biological process and rationale of the computer. The project introduced in the curriculum will motivate the students to pursue research and entrepreneurial skill development**.**

Examination Pattern:
Time allotted: Theory–

	External marks	Internals marks	Total marks
Theory	75	25	100
Practical	75	25	100

Marks distribution for internals:

	Test	seminars	Assignment	Total marks
Theory	15	05	05	25

	Test	Record	Total marks
Practical	10	15	25

Pattern of question paper (theory):

The course of study and the scheme of Examination–Department of Biotechnology

Study Components / ***Course Title***		***ins. hrs /week***	***Credit***	***Title of the Paper***	***Maximum Marks***		
					CIA	***Uni.Exam***	***Total***
SEMESTERI							
Core	Paper-1	5	4	Environmental Toxicology	25	75	100
Core	Paper-2	5	4	Environmental Biology	25	75	100
Core	Paper-3	5	4	Analytical Techniques	25	75	100
Internal Elective for same major students(Choose any one)							
Core Elective	Elective–I	3	3	A. Solid Waste Management B. Environmental Pollution C. Ggenetics	25	75	100
Practical-I		10	4	A.Lab in Biochemistry & Cell And Molecular Biology & Lab in Microbiology	25	75	100
Value Added course	VAC-1	2	2	A. Mushroom Cultivation and Apiculture B. Vermi Culture Technology C. Validation of Medicinal Plants	25	75	100
		30	**21**				
SEMESTERII					***CIA***	***Uni.Exam***	***Total***
Core	Paper–4	4	4	Natural Resources	25	75	100
Core	Paper–5	4	4	Environmental Microbiology	25	75	100
Core	Paper–6	4	4	Environmental Chemistry	25	75	100
Core	Paper-7	4	4	Bio stastics and Modelling	25	75	100
Internal Elective for same major students(Chooseanyone)							
Core Elective	Elective-II	2	2	A. Enzyme Technology B. Dairy Technology C. Pharmaceutical Technology	25	75	100
Practical-III		10	4	A.LabinImmunology&LabinGeneticEngineering and Bioinformatics	25	75	100
		28	**22**				

Study Components		*ins.hrs/week*	*Credit*	*Title of thePaper*	*Maximum Marks*		
Course Title					*CIA*	*Uni.Exam*	*Total*
SEMESTERIII							
Core	Paper-9	4	4	Immunology	25	75	100
Core	Paper–10	4	4	Cell and Molecular Biology	25	75	100
Core	Paper–11	4	4	Biotechnology	25	75	100
Core	Paper-12	4	4	Microbial and Industrial Applications	25	75	100
Internal Elective for same major students(Choose anyone)							
Core Elective	Elective-III	3	3	Water and waste water treatment technology B.Genomic and Proteomics C.Herbal Biotechnology	25	75	100
ExternalElectiveforothermajorstudents(Inter/multi-disciplinarypapers)(Chooseanyone)							
Open Elective	Open Elective-II	2	2	A. Environmental Science B. Medicinal Microbiology C.Agricultural biotechnology	25	75	100
Practical-V		10	4	A. Lab in Plant Biotechnology & Animal Biotchnology & B.Lab in Microbial Technology & Environmental Biotechnology.	25	75	100
***MOOC Courses**			2				100
***USRR**			2				100
		31	**29**				
SEMESTERIV					***CIA***	***Uni.Exam***	***Total***
Core	Paper-13	4	4	Genetic Engineering	25	75	100
Core Elective	Elective-IV	3	3	A.Bioremediation B. IPR and Biosafety C. Biochemistry	25	75	100
Core	**Project Compulsory**	**23**	8	Project with *viva voce*	100 (75Project +25viva)		100
		30	**15**				
		120	**91**		**725**	**2275**	**2900**

E**xtra credits for*MOOC course=2**
***USSR Project=2**

SEMESTER I

PAPER1:Environmental Toxicology

Paper code: Subject: **Environmental Toxicology**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the basic concepts ofToxic chemicals and also to learn the various mode of entry of toxic substance in environment.

Course Objectives

1. To learn thebasic concept of toxic substance in environment.
2. To learn the mode of entry of toxic substance.
3. To develop knowledge on Insecticides
4. To learn the possible effect of imbalance of some trace elements
5. To develop a piece of knowledge in biogeochemical factor in environmental health

Course Out Comes

After completing unit1,the students will be able to identify thetoxic chemicals and their biochemical aspects in environment

1.After studying unit2, the students will be able todescribe the mode of entry of toxic substance and carcinogenicity in environment.

2.After studying unit3,the students will be able to describe the Concept of major trace elements and its effects.

3.After studying unit4,the students will be able to explain biogeochemical factor in environmental health.

4.After studying unit5,the students will be able to explain about pollution

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Bio chemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.	**18hours**
Unit-II	Mode of entry of toxic substance, biotransformation of xenobiotics detoxification, Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.	**18hours**
Unit-III	Insecticides,MICeffects,Conceptofmajor,traceandRareEarthElement(REE)-possible effects of imbalance of some trace elements	**18hours**
Unit-IV	Biogeochemical factors in environ mental health. Epidemiological issues goiter, fluorosis, arsenic poisoning.	**18hours**
Unit-V	Introductiontopollution,air,noise,water,soil,thermal,marineandradioactivePollution, Concept of Waste management, Solid and hazardous waste management, Electrical energy generation, e-waste, flyash, plastic waste, Environmental management system standards, IPCC, UNEP, IGBP, Global environmental issues-Biodiversity loss, climate change, Ozone depletion, sea level rise	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

ReferenceBook:

1. Environmental chemistry-Sodhi
2. Principals of Environmental chemistry- Manhan
3. Environmental hazards & human health R.B.Philip
4. Toxicology-principles & applications-Niesink &Jondevries
5. Parasitology-Chatterjee
6. Preventive & Social medicines–Perk

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	3
CO2	2	2	2	3	3	2	3	3	2	2
CO3	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	3	3	2	3
CO5	2	2	2	3	2	3	2	2	3	3

PO–Programme Outcome, CO–Course out come,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER I PAPER2:Environmental Biology

Paper code: Subject: **Environmental Biology**
Hours/Week:5 Credits:4

Aim: To enable the students to understand the basic concepts of Ecosystem and also to learn thepopulation ecology and earths major ecosystem.

Course Objectives

1.To learn the basic concept of ecology and ecosystem.

2.To learn the Ecosystem structure and function.

3.To develop knowledge on Population ecology and Ecological Model.

4.To learn the earths major ecosystem and also about the man made reservoir.

5.To develop apiece of knowledge insoil micro organism.

Course Out Comes

6.After completingunit1,the students will be able to identify the origin of life and evolution.

7.After completingunit2, the students will be able to understand the ecosystem structure and ecological pyramids.

8.After completing unit3,thestudentswillbeable to explain the growth curve and models.

9.After completing unit4,thestudentswillbeabletoexplain the earths major ecosystem.

10. After completing unit5, the students will be able to explain the water conservation

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	Definition, principles and scope of ecology, human ecology and human settlements, evolution, origin of life and specification, Ecosystem stability-cybernatics and ecosystem regulation, evolution of biosphere.	**18hours**
Unit-II	Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles, ecological succession, Ecads and ecotypes.	**18hours**
Unit-III	Population ecology- density, natality, mortality, survivorship curves, age distribution, growth curves and models, r & k selection, population interactions- Mutualism, Parasitism, Predator- Prey relations, System Theory and Ecological Model.	**18hours**
Unit-IV	Earths major ecosystem - terrestial and aquatic ecosystem, soil microorganism and their functions, coastal management, criteria employed for disposal of pollutants in marine ecosystem, coastal water system and man-made reservoirs, biology and ecology of reservoirs.	**18 hours**
Unit-V	Waterconservation,Rainwaterharvesting&watershedmanagement,andenvironmentalethics.Climatechange,globalwarming,acid,rain,ozone layerdepletion.Environmentalprotectionact,populationexplosion.Disastermanagement	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. Basic ecology-E.P. Odum
2. Ecology and fieldbiology-R.L.Smith
3. Ecology-P.D.Sharma
4. Fundamentals of ecology-E.P. Odum
5. Principles of ecology–Rickleff

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	3
CO2	2	2	2	3	3	2	3	3	2	2
CO3	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	3	3	2	3
CO5	2	2	2	3	2	3	2	2	3	3

PO–Programme Outcome, CO–Course out come, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER I

PAPER3:Analytical Techniques

Paper code: Subject: M.sc Environmental Biotechnology

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of techniques .

Course Objectives

1.To learn the Principle and applications of Microscopes.

2.To learn the basic concept of chromatographic techniques.

3.To develop knowledge on Chromatography

4.To learn the methods for protein interaction .

5.To develop apiece of knowledge inMolecular markers..

Course Out Comes

6.After completingunit1,thestudentswillbeabletounderstand the principle and application of Spectrophotometer and Microscope.

7.After completingunit2, the students will able to understand the Chromatographic techniques.

8.After studying unit3,thestudentswillbeable to explain the Gas liquid chromatography and High pressure liquid chromatography.

9.After studying unit4, the students will be able to explain the methods for measuring nucleic acid and protein interaction.

10. After studying unit5,the students will be able to explain about the Electrophoresis .

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UnitI	Principles and application of Spectrophotometry (UV-Visible spectrophotometry), Titrimetry, Gravimetry, Colourimetry, NMR, ESR, Microscopy-phase, light and flourscence microscopes, Scanning and Transmission electron microscopes	**18hours**
Unit-II	Chromatographic techniques (Paper chromatography, thin layer chromatography, ion exchange chromatography, Column chromatography), Atomic absorption spectrophotometer, cytophotometry and flow cytometry, Fixation and staining, Principles and techniques of nucleic acid hybridization and Cot curves, Principle of biophysical method used for analysis of biopolymer structure, Hydrodynamics methods, Plasma emission spectroscopy.	**18hours**

Unit-III	Electrophoresis, solid and liquid scintillation, X-ray florescence, X-ray diffraction. Flame photomtery, Gas-liquid chromatography, High pressure liquid chromatography - auto radiography, Ultracentrifugation.	**18 hours**
Unit-IV	Methods for measuring nucleic acid and protein interactions, DNA finger printing Molecular markers RFLP, AFLP, RAPD, Sequencing of proteins and nucleic acids, southern, northern, western blotting techniques, PCR polymerase chain reaction	**18hours**
Unit-V	General principles. Factors affecting the migration rate – sample, electric field,buffer,andsupportingmedium.Tiseliusmovingboundaryelectrophoresis.PAGE.SDS–PAGE.Pulse-fieldgelelectrophoresis.Celluloseacetatemembraneelectrophoresis.Agarosegelelectrophoresis	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for Internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. Principles of Biophysical chemistry- Uppadahay-Uppadahay -and Nath.
2.Analytical Techniques-S.K. Sahani

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	3
CO2	2	2	2	3	3	2	3	3	2	2
CO3	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	3	3	2	3
CO5	2	2	2	3	2	3	2	2	3	3

PO–Programme Outcome, CO–Course outcome, S–3, M–2, L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER I

ELECTIVE PAPER1: Solid Waste Management

Paper code: Subject:M.sc Environmental Biotechnology

Hours/Week:5

Credits:3

Aim: To enable the students to understand the concept of Solid waste Management methods and also to understand the Control and Treatment of Hazardous Waste Management.

Course Objectives

1.To learn theSource, generation , classification & Composition of solid waste management.

2.To learn the basic concept of Solid Waste Management Plan

3.To develop knowledge on Hospital Waste Management

4.To learn the methods for Disaster Managementt

5.To develop apiece of knowledge in Hazardous Waste Management &Handlingrules,1989& 2000 (amendments)

Course Out Comes

6.After completingunit1,the students will be able to Understand the energy recovery from organic waste.

7.After completingunit2, the students will able to understand the Hazardous Waste Control & Treatment.

8.Aftercompletingunit3,the students will be able to explain the Hospital Waste Management

9.After completing unit4,thestudentswillbeabletoexplain the Primary, secondary & tertiary& advance treatment of various effluents.

10.After completing unit5,the students will be able to explain the process of urban waste .

11.After completing unit6,the students will be able to explain about the applied use of solid waste .

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
Unit-I	Sources, generation, classification & composition of solid wastes. Solid waste management methods-Sanitary landfilling, Recycling Composting, Vermicomposting, Incineration, energy recovery from organic waste.	**18hours**
Unit-II	Solid Waste Management Plan, Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment.	**18hours**
Unit-III	Hospital Waste Management, Hazardous Waste Management &Handlingrules,1989& 2000 (amendments)	**18 hours**
Unit-IV	Disaster Management, Fly ash generation & utilization, Primary, secondary & tertiary& advance treatment of various effluents.	**18hours**
Unit-V	**Processing of Urban Waste** □: Methods of collection, storage, transportation. □ Material Seperation □ Processing on site and off site for source reduction, product recovery and recycling □ Methods of disposal – Dumping, Sanitary Landfill, Incineration, Pyrolysis, Composting, Ocean Dumping. □ Leachate Management for MSW landfills	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for Internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. Solid Waste Management CPCB. NewDelhi.
2. Eco technology for pollution control & environmental management - By R.K. Trivedi & Arvind Kr.Basic Environmental Technology-J.A. Nathanson
3. WaterAnalysis:MeasurementofTotalSolids,Total–dissolvedsolids,Total-suspendedsolids,dissolved oxygen, total hardness, chloride, turbidity, nitrite, nitrate, fluoride and total nitrogen.
4. Estimation of COD, BOD of industrial effluents.
5. Portability test of water(MPN technique).
6. Degradation of phenols. Colorimetric assay
7. Estimation of MIC and Heavy metal to clearance of chromium resistant bacteria
8. Screening of Bio surfactant activity-Oil Displacement test-Drop collapse test
9. Isolation of Thiobacillus ferrooxxidans and Thiobacillus thiooxidans from metal sulphides, rock and acidmine water.
10. Microbialdegradation,decolourzsationandadsorptionoforganicdyesbyfree and immobilized cells
11. Studies on halophiles from seawater(pigmentation and salt to lerance

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	3
CO2	2	2	2	3	3	2	3	3	2	2
CO3	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	3	3	2	3
CO5	2	2	2	3	2	3	2	2	3	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER I

ELECTIVE PAPER2: Environmental Pollution

Paper code: Subject: **Environmental Pollution**

Hours/Week:5

Credits:3

Aim: To enable the students to understand the concept of air, water ,soil and noise pollution and also to understand the methods of monitoring and control of air pollution and also to understand the water quality and standards.

Course Objectives

1.To learn the natural and anthropogenic sources of pollution

2.To learn thetypes sources and consequences of water pollution

3.To develop knowledge on chemical and bacteriological sampling as analysis of soil quality

4.To learn the methods for sources of noise pollution

5.To develop apiece of knowledge in Effects of pollutant son human beings

Course Out Comes

6.After completing unit1,thestudentswillbeabletounderstand the behaviour of pollutants in the atmosphere

7.After completingunit2,thestudentswill able to understand the physico-chemical and bacteriological sampling

8. Aftercompletingunit3,thestudentswillbeable to explain the heavy metals and their in treactions with soil components.

9.After completing unit4,thestudentswillbeabletoexplain the sources of marine pollution and its control

10.After completing unit5,the students will be able to explain the Biodegradation .

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UnitI	Air pollution- natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffiusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, Methods of monitoring and control of air pollution, SO_2, NOx, CO, SPM.	**18 hours**
Unit-II	Water pollution - types sources and consequences of water pollution, physico-chemical and bacteriological sampling, Analysis of water quality, standards, sewage and wastewater treatment and recycling, water quality and standards.	**18 hours**
Unit-III	Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollution control, industrial waste effluents and heavy metals and their in treactions with soil components.	**18 hours**
Unit-IV	Noise pollution - sources of noise pollution, measurement and indices. Marine pollution, sources of marine pollution and its control. Effects of pollutants on human beings, plants, animals and climate. Air quality standards and air pollution.	**18 hours**
Unit-V	Biodegradation: Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclicaromatichydrocarbons,halogenatedhydrocarbons,azodyes,lignin andpesticides.Bioenergy.	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Reference Book:

1. Air pollution and control-K.V.S.G.Murlikrishan
2. Industrial noise control-Bell & Bell
3. Environmental engineering-Peary
4. Introduction to environmental engineering and science –Gilbert Masters

Mapping with Programme Out comes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	3
CO2	2	2	2	3	3	2	3	3	2	2
CO3	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	2	2	2	3	3	2	3
CO5	2	2	2	3	2	3	2	2	3	3

PO–Programme Outcome, CO – Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER I

ELECTIVE PAPER 3 Genetics

Paper code:
Subject: **Genetics**

Hours/Week:5 Credits:3

Aim: To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications ingenomics and proteomics.

Course objectives:

1. Toprovidethebasicknowledgeofgeneticsinhighereukaryoticdomainsandover all concepts of Mendeliangenetics.
2. To understand about genetic in heritance and linkages
3. To provide the basic concept sex determination
4. To understand about genetic code, mutationand regulations
5. To Enrich the students' knowledge with respect to genetic engineering, trans genesis and ethics

Course Out Comes (five outcomes for each units should be mentioned)

1. Afterstudyingunit-1,the student will be able to know about Mendelianlaws.
2. Afterstudyingunit-2,the student will be able to understand how gene in herited
3. Afterstudyingunit-3,the student will be able to understand about sex determination.
4. Afterstudyingunit-4,the student will be able to gene regulations.
5. Afterstudyingunit-5,the student will be able to know about ethics and trans genesis.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

UNIT I	History of Genetics : Definition and scope of Genetics-Pre-mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Chromosome theory of linkage, crossing over, recombinations and mapping of geneson chromosomes	18hours
UNIT-II	Blood Group sand their Inheritance in Human–Linkage and Crossing Over:- Drosophila – Morgans‟ Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Overtypes, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes–Interference and Coincidence.	18hours
UNIT–III	Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes–Non-Disjunction and Gynandromorphs–Cytoplasmic Inheritance–Meternal Effecton Limnaea (Shell Coiling), Male Sterlity (Rode‟s Experiment)	18 hours
UNIT–IV	Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non ambiguous, degenerate triplet code. Fine Structure of the Gene .Gene Regulation – Operon Concept –Lac Operon–Positive and Negative Regulation. Mutation–Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations– Numerical and Structural Examples from Human.	18hours
UNIT-V	Genetic engineering– Objectives, tools, gene cloning, and geneisolation.Transgenic plants and animals, Animal Breeding–Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics-Hardy Weinberg Law–Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Ethenics, Bioethics.	18hours
	Total Lecture hours 65 hours	90hours

Internal Assessment Methods:(25 marks)

Distribution for Internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Text Books

1. Gardneretal (1991).Principles of Genetics. John Wiley.
2. Hartl.D.L.A primer of population genetics. IIIedition, Sinauer associates inc. Sunderland, 2000
3. Human genetics, A.Gardner, R.T.Howell and T.Davies, Published by Vinod Vasishtha forViva Books private limited,2008.
4. The science of Genetics by Alan G. Atherly, Jack.R, Girton, Jhon. F, McDonald. Sounders college publishers.

Reference Book

Strachan and Read (2003).Human Molecular Genetics.Wiley.

1. Pasternak(2005).An Introduction to Molecular Human Genetics. Fritzgarald.
2. Prichard & Korf (2004).Medical Genetics at a Glance. Blackwell.
3. Manu L Lothari, Lopa A Mehta, Sadhana S Roy Choudhury (2009). Essential of Human Genetics (Universities Press Indialtd)Publishing.

Web Sources

1https://www.classcentral.com/course/swayam-genetics-and-genomics-17623 2.https://nptel.ac.in/courses/102/104/102104052/

3.https://www.coursera.org/learn/genetics-evolution

Mapping with Programme Out comes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

Practical1:Lab In Biochemistry And Cell & Molecular Biology Lab in biochemistry and Microbiology (10 credit)

1. Determination of Chl. a, Chl. B & total Chl. ByArnonmethod.

2. Estimation of Carbohydrates

3. Estimation of salivary amylase activity inrelation to, substrate/pH/Temperature

4. Estimation of blood glucose & urea

5. Estimationof LDH.

6.Estimation of total serum proteins

7.Estimation of creatin in urine.

8.Paper/thin layer chromatography

9.Isolation of Genomic DNA from E.coli

10.Isolation of plasmid DNA from E.coli

11.Elution&quantification of DNA from agarose gel.

12.Preparation of competent cells and transformation

13.PCR

14.Isolation of TotalRNA from bacteria

15.SynthesisofcDNAbyReversetranscriptionpolymerase chain reaction.

16.Sterilization techniques

17.Preparation of culture media(Selective and Enriched media)

18.Staining techniques-Simple,Differential,NegativestainingandMotilitystudies

19.Determination of Bacterial growth curve

20.Enumeration of bacteria from environmental samples-soil, water, air and milk.

21.Pureculturetechniques-Streak,pourplateandspreadplate.

22.Biochemical tests for identification of bacteria(IMViC,TSI,Catalase,Oxidase)

23.Antimicrobialassay, phenol coefficient, agar plate sensitivity method.

24.Waterqualityanalysis–MPNmethod.

25.Milk quality analysis–MBRT method

Reference

1.Introduction to Practical Biochemistry,E.FPlummerMu,PlummerTataMcGraw-HillEducation,1998.

2.Molecularcloning:alaboratorymanual,4th ed.J.Sambrook,FritschandT.Maniatis.coldspringharborlaboratorypress,NewYork,2012

3.Essential cell biology : a practical approach volume 1: cellstructure.JohnDavey,J.Michaellord.Oxforduniversitypress,USA,2003

4.Microbiology-A Laboratory manualP. Gunasekaran.Newagepublications,Newdelhi,1995.

5.Molecular cloning-A Laboratory manual. Sambrook, J , Fritsch. E.F, and T.Maniatis, 2nd Edition.ColdspringHarborLaboratorypress,NewYork,1989.

6.Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5th Edition, theMcGraw-Hillcompanies,2002.

7.Microbiology: A Laboratory Manual,J. G.Cappuccino and N.Sherman, Addison-Wesley,2002.

8.Laboratory Manual of Experimental Microbiology, R.M.Atlas, A.E.Brown andL.C.Parks,1995.Mosby,St.Louis,2002.

9.Laboratory manual in General Microbiology, N.Kannan, Panima publishers.

10.Bergey‟sManualofDeterminativeBacteriology.NinthEditionJ.G.Holt,N.R.Krieg.,LippincottWilliams,Wilkinpublishers,2000.

VALUE ADDED COURSES

(A) MUSHROOMCULTIVATIONANDAPICULTURE

Paper code: **Name of the Paper:** Mushroom Cultivation and Apiculture

Total Hours perWeek:2

Credits:2

Aim: To exploit possibilities and assist in building up a mushroom cultivation and apiculture industry that will make a significant contribution to the general economy.

1. To make the students to know about mushroom and their types.
2. To enable the students to learn the mushroom spawn production conditions.
3. To make the students learn about mushroom cultivation and maintenance.
4. To make the students to know about apiculture scope and bee keeping and types.
5. To enable the students to understand the importance of honey and applications.

Course Out Comes(five out comes for each units should be mentioned)

1. The student will be able to differentiate the edible and poisonous mushrooms.
2. The student will be able to develop mushrooms culture conditions.
3. The student will be able to practice the mushroom cultivation and production.
4. The student will be able to practice the bee keeping and culture maintenance.
5. The student will be able to produce and analyze the applications of honey in different Fields.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

UNITI	History of Mushroom, cultivations and its practice, Introduction to mushroom cultivation, Classification of Mushrooms and different types, Wdible Mushrooms, its types and their origin, Poisonous Mushrooms, its type sand the irorigin.	18 hours
UNIT-II	Introduction to mushroom cultivation, sources of beds and types, Spawn, Sources, spawn run, cultivation set up, Culture ventilation and humidity management, temperature, lighting, moisture, pH,CO2, Culture chamber spreparation, sterilization, Instructions, precautions, handling and sensors.	18 hours

UNIT –III	Mushroom cultivation maintenance, conditions, and duration, Spawn collection, preparation, storage, Spawning techniques, Environmental conditions, temperature, moist, Fruiting initiation, monitoring, maintenance and harvest.	18 hours
UNIT–IV	Introduction to apiculture, definitions, history, scope, importance of apiculture, Bee Keeping methods practiced in world and in India, Traditional Beekeeping techniques, Modern Beekeeping methods, Urban Bee keeping methods.	18 hours
UNIT-V	Introduction to nutritional product of honey and its constituents, Honey properties bio logical activities, medicinal values, Applications of Honey in various fields, Honey types and value Added honey products.	18 hours
	Total Lecture hours 65hours	90 hours

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Textbook:

1Paul Stamets, J.S.and Chilton, J.S.2004.Mushroom cultivation A practical guide to growing mushroom sathome, Agarikon Press.

2.TewanandPankajKapoorS.C.1993.Mushroomcultivation.MittalPublication.Delhi.

3.Marimuthetal.,1991.OysterMushrooms.Dept.ofPlant pathology, TNAU, Coimbatore.

4.NitaBahl.1988.HandbookofMushrooms,2ndEdition,VolI&II.

5.ShuFing Chang,PhilipG.MilesandChang,S.T.2004.MushroomsCultivation,nutritionalvalue,

6.medicinaleffectandenvironmentalimpact.2nded.,CRCpress.

7. Prost,P.J.(1962).Apiculture. Oxford and IBH, NewDelhi.

8.BishtD.S.,Apiculture, ICAR Publication.

9.SinghS.,BeekeepinginIndia,IndiancouncilofAgriculturalResearch,NewDelhi

Reference Book:

1.Laidlaw,H.H., 1997.Contemporary queen rearing. Published by Dadantand Sons.R.

A.Morse, Rearing queen honey bees.Wicwas press, NYA lison Benjamin, By (author)

BrianMcCallum,2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.

2.KimPezza,2013.BackyardFarming:

KeepingHoneyBees:FromHiveManagementtoHoneyHarvestingandMore.HatherleighPress,

U.S.

3.KimFlottum,2014.TheBackyardBeekeeper:AnAbsolute Beginner's Guide to Keeping Bees inYourYardandGarden.QuarryBooks.

4.Kannaiyan,S.Ramasamy, K.(1980). A hand bookofediblemushroom,Today&TomorrowsPrinters&Publishers,NewDelhi.

5.Pandey B P 1996. A textbook of fungi. Chand and Company N Delhi. **Course Material: website links, e-Books and e-journals**1.https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.

2.https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redirhttps://

books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course Outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

VALUEADDEDCOURSES

(B) VERMICULTURETECHNOLOGY

Paper code: **Name of the Paper :**Vermiculture Technology

Credits:2 **Total Hours perWeek:**2

Aim:Toexploitpossibilitiesandassistinbuildingupa Vermiculturetechnologyinsignificantcontribution tothegeneraleconomy.

Course Objectives

1. To enable the students learn about Vermi culture compositing.
2. To enable the students to know the humus cycle, s soil transformation
3. To enable the students analyze the nutritional composition of vermin compost.
4. To enable the students to learn Vermi culture technology.
5. To enable the students to learn the harvest of vermi compost.

Course Outcomes (five outcomes for each units should be mentioned)

1The student will be able to understand the Vermi culture and4R'sofrecycling.

2.The student will be able to identify the decomposing organic matter and humus formation.

3.The student will be able to differentiate nutritional value of vermin compost and fertilizer.

4.The student will be able to practice the Vermi culture composting and maintain conditions.

5.The student will be able to produce Vermi culture compost, harvest the compost and application.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	No
5	Yes	Yes	Yes	Yes	Yes	Yes

UNITI	Introduction toVermi culture technology, definition, meaning and history, Economic importance of Vermi culture, their value in soil texture, Concept of recycling, Concept of four r' s reduce, reuse, recycle and restore.	18 hours
UNIT-II	Introduction to matter, types of matter, Introduction to Humus, Humus cycle, Sources, quality of products for Humus formation, Ground population, and transformation process in organic matter.	18 hours
UNIT –III	Introduction of plant fertilizers, nutritional value and their importance, Vermi compost composition and its nutritional value, Importance of vermin compost fertilizer for plants, Comparison of Vermi compost with other fertilizers.	18 hours
UNIT–IV	Introduction to vermin beds, sources, types, Preparation of vermin beds, measurements, Maintenance of vermin compost, Compositing conditions, moist, temperature, aeration.	18 hours
UNIT-V	Vermi compost identification,conditions, and separation, compost packing, sources and methods, Compost storage, conditions and durations,Vermi compos than dling and transport.	18 hours
	Total Lecture hours 65 hours	90 hours

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Textbook:

1.Kevin, A and K.E.Lee (1989)"Earthworm for Gardeners and Fisherman"(CSIRO,Australia, Division of Soils)

2.RahudakarV.B.(2004).Gandulkhatashivay Naisargeek Paryay, Atul BookAgency,Pune.

3.Satchel,J.E.(1983)"Earthworm Ecology"Chapman Hall, London.

4.Wallwork,J.A.(1983)"EarthwormBiology"EdwardArnold(Publishers)Ltd.London.

Sultan Ahmed Ismail, 2005 .The Earth worm Book, Second Revised Edition. Other India Press, Goa,India.2.Bhatnagar&Patla,2007.

5.Earth worm vermin culture and vermin-composting, Kalyani Publishers,NewDelhi

Reference Book:

1. Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research,NewDelhi2.

2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminaron Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University,J yotiVihar, Orissa.

3. Edwards, C.A.andJ.R.Lofty(1977)"BiologyofEarthworms" Chapman and Hall Ltd., London.

4. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney. 5.Kevin,AandK.E.Lee (1989) "Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils)

5. MaryVioletChristy,2008.Vermitechnology,MJPPublishers,Chennai.

6. AravindKumar,2005.Verms&Vermitechnology,A.P.H.PublishingCorporation,New Delhi.

Course Material: website links, e-Books and e-journals

1.VermicultureTechnology, Earthworms, Organic Wastes, and Environmental Management Edited By Clive A.Edwards,NormanQ. Arancon,RhondaL.Sherman,

2.https://www.scirp.org/journal/paperinformation.aspx?paperid=2490,**DOI:**10.4236/ti.2010.13019

Mapping with Programme Out comes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course Outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

VALUEADDEDCOURSE(VAC-C)
C)VALIDATIONOFMEDICINAL PLANTS

Paper code: **Name of the Paper:** Validation of Medicinal plants
Credits:2 **Total Hours per Week:**2

Aim: The course aims to introduce the students to the identification and validation of medicinal plant and to understand the cultivation and propagation techniques. To understand the importance of medicinal plants in human health care.

Course Objectives

1.To enable the students to understand the importance of medicinal plants.

2. To enable the students to identify the medicinal plants.

3.To enable the students to learn the techniques of validation of medicinal plants.

4.To enable the students to learn the cultivation method sand maintenance of medicinal plants.

5.To enable the students to understand the importance of medicinal plant in human health.

Course Out Comes (five out comes for each units should be mentioned)

1. The student will be able to gain knowledge about importance of medicinal plant parts and its medicinal value.
2. The student will be able to classify the medicinal plants on Bentham and Hooker and Practice her barium techniques.
3. The student will be able to identify them edicinal values of plants using different validation Techniques.
4. The student will be able to cultivate and propagate the medic in alplants
5. Thestudentwillbeabletopracticetheusageofmedicinalplantsintreatmentofhuman Diseases.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	No	Yes	No	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

UNITI	Introduction to Medicinal plants, meaning, definition and types Medicinal properties of plants and their importance, Medicinalvalues in plant parts, fruits, stem, leaves and roots, Leaf, fruit, root and stem modifications, aeria land under ground.	18 hours
UNIT-II	IntroductiontoMedicinalplantidentification,Elementaryknowledgeof binomialnomenclature,BenthamandHookerclassification,Herbarium ,preparationandpreservation.	18 hours
UNIT –III	Introductiontovalidationofmedicinalplants,Macroscopiccharacteristi cs of medicinal plants, Microscopic characteristics of medicinal plants, Chemical compounds and tests of medicinal plants, Chromatographic techniques for validation TLC, HPLC,HPTLC& gas, Chromatography.	18 hours
UNIT–IV	Introduction to medicinal plant cultivation, Cultivation techniques, and factors affecting cultivation of medicinal plants, Propagation of medicinal plants and different methods of propagation, Management and Maintenance of medicinal plants.	18 hours
UNIT-V	Importance of medicinal value in plants, Medicinal properties of plants in human health and its role, advantages, Role of medicinal plants in prevention and treatment of human diseases, Traditional knowledge and utility of Indian medicinal plants.	18 hours
		90hours

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Textbook:

1. Indian Medicinal Plants by P.C.Trivedi(2009).
2. Medicinal Plants of Indian Himalaya by S.S.SamantandU.Dhar.
3. Indian Medicinal Plants(Vol1-4)byK.R.KirtikarandB.D. Basu(2006).
4. Indigenous Medicinal Plants Social Forestry & Tribalsby M.P.Singhetal.(2003).
5. Ayurvedic Drugs and their Plant Sources byV.V.Sivarajan& I. Balachandran, Oxford &IBH(1994).
6. The Hand book of Ayurveda Shantha by Godagama, Bishen Singh Mahendrpal Singh, Dehradun(2004).
7. Direct uses of medicinal plants and their identification by Vardhana, SarupandSons,

Ansari Road, Dariyaga NewDelhi (2008).

8. Medicinal plants, applied biology of domestic cation and export by K.Singh, S.K.Tyagi, Bishen Singh Mahendrapal Singh Dehradun.
9. Quality Control Methods for Medicinal Plants Materials, W.H.O.(1998).
10. Evaluation of her balmedicinal products by Houghton

ReferenceBook:

1. A Class Book of Botany .A.C.Dutta. Oxford University Press.
2. Cultivation of Medicinal Plants by C.K. Atal &B.M. Kapoor.
3. Hartmann, H.T&Kester,D.E (1989).Plant Propagation–Principles and Practices. Prentice Hall of India.
4. AwadeshN, Ghoeami A and Sharma R,Indigenous HealthCare and Ethno medicine, Sarup and Sons.
5. MedicinalPlantsCultivation:AScientificApproachbyS.S.Purohit,(2004).
6. BrunetonJean,CarolineK.Hatton,Pharmacognosy,Phytochemistry,Medicinalplants.La voisier,1999.ISBN1898298637.
7. NikolausJ.Sucher,MariaC.Carles, Genome-Based Approaches to the Authentication of Medicinal Plants.PlantaMed.,74:603–623;2008.
8. WHOguidelinesongoodagriculturalandcollectionpractices(GACP)formedicinalplants, WorldHealthOrganization,Geneva,2003.
9. IqbalAhmad, FarrukhAqil, and Mohammad Owais, Modern Phytomedicine: Turning Medicinal Plants into Drugs.WILEY-VCHVerlagGmbH&Co.KGaA,Weinheim,2006.ISBN-10:3-527-31530-6.
10. VedD.K.&Goraya,G.S.Demand & supply of medicinal plants in India, NMPB, NewDelhi & FRLHT, Bangalore, India, 2008.

Course Material: website links, e-Books and e-journals

1. PlantaMedica,Issue13·Volume79·August2013.https://www.thieme-connect.com/products/ejournals

2. https://www.sciencedirect.com/book/9780128008744/evidence-based-validation-of-herbal-medicine.3.https://www.tandfonline.com/doi/citedby/10.1080/13880200902800196?scroll=top&needAccess=true.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER II

PAPER1 : Natural Resource

Paper code: Subject: **Natural Resource**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of classification, composition, physico- chemical characteristics .

Course Objectives

1.To learn the solar radiations and its spectral characteristics

2.To learn the Principles of generation

3.To develop knowledge on Nuclear energy

4.To learn the Mineral resources and reserves

5.To develop a piece of knowledge in need areas for exploitation of Mineral resources.

Course Out Comes

6.After completing unit1,the students will be able to Understand source of energy

7.After completing unit 2, the students will able to understand the Principles of generation of hydroelectric power

8. After studying unit3, the students will be able to explain Impacts of large scale exploitation of solar, wind, hydro and ocean energy.

9. After studying unit4, the students will be able to explain the recycling of resources

10. After studying unit5,the students will be able to explain the recycling of resources

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	. Sun as a source of energy, solar radiations and its spectral characteristics, fossil fuels- classification, composition, physico-chemical characteristics and energy content of coal, petroleum and Natural gas.	**18 hours**
Unit-II	Principles of generation of hydroelectric power, tidal power, thermal energy conversion, wind, geo thermal energy, solar collectors, photovoltaic, solar ponds, oceans.	**18 hours**
Unit-III	Nuclear energy- fission and fusion, bio energy -energy from biomass and biogas, anaerobic digestion, energy use patterns in different parts of the world. Impacts of large scale exploitation of solar, wind, hydro and ocean energy.	**18 hours**
Unit-IV	Mineral resources and reserves, ocean ore and recycling of resources, Environmental impact of exploitation, processing and smelting of Mineral, oceans as need areas for exploitation of Mineral resources.	**18 hours**
Unit-V	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. Living in the environmental-T.J.Miller.
2. Natural resource conservation-Owen & Chiras.
3. Encyclopedia Energy-I& II.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER II

PAPER2 .: Environmental microbiology

Paper code: Subject: **Environmental microbiology**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of organisms in nature & their importance and also the uses in Environmental management recycling &up gradation technologies

Course Objectives

1.To learn the microbes in service of nature

2.To learn the Microbial Reactors

3.To develop knowledge on microbiology of an aerobic fermentation

4.To learn the Environmental problems

5.To develop a piece of knowledge in microbes as pathological agent in plant, animal and man.

Course OutComes

6.After complete in gunit1,the students will be able to Understand organisms in nature & their importance

7.After completing unit 2,the students will able to understand up gradation technologies and Production of products

8. After completing unit 3,the students will be able to explain microbiology of an aerobic fermentation.

9. After studying unit4, the students will be able to explain the Environmental problems & Environmental monitoring through micro organism.

10. After studying unit5, the students will be able to explain the Microbial diversity.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	. Microbiology- organisms in nature & their importance, sampling, culture & cultivation of microorganisms, microbes in service of nature & mankind, batch culture & continuous culture of microbes for commercial use.	**18hours**
Unit-II	Microbial Reactors, genetically modified microbes & their uses in Environmental management recycling &up gradation technologies, Production of products, energy form waste.	**18hours**
Unit-III	Biogas technology, plant design, construction, operation, biogas form organic wastes, water weeds, landfills, microbiology of anaerobic fermentation.	**18hours**
Unit-IV	Biotransformation, bioconversion, bioremediation, phytore mediation technology, fermentation technology, development of stress tolerant plants, Environmental problems & Environmental monitoring through micro organism, microbiology of water, air and soil, microbes as pathological agent in plant, animal and man.	**18hours**
Unit-V	Microbial diversity-methods to assess micro bialdi versity, Culture dependent, and culture- independent methods. Molecular analys is of bacterial community; Denatu rating Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).	**18 hours**
Total Teaching hours		**90**

Internal Assessment Methods: (25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1 . Principles of microbiology - Pelzar 2.Microbialbiotechnology-A.N.Glazer 3. Microbial ecology - R.M. Atlas 4.Molecular biology - H.D. Kumar

9. Environmental bio Technology- Sayler & Fox

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome ,CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER II

PAPER3.: Environmental Chemistry

Papercode: **Subject: Environmental Chemistry**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the conceptStochiometry, Gibb's energy and also the Classification of elements and also the thermodynamics

Course Objectives

1.To learn the Chemical potential and solubility of gases in water

2.To learn the Chemical processes for formation of inorganic and organic particulate matter

3.To develop knowledge on law of thermodynamics

4.Tolearn the Chemistry of air pollutants

5.To develop a piece of knowledge in nitrogen pathways.

Course Outcomes

6.After completing unit1, the students will be able to Understand the Chemical potential and equilibria reactions.

7. After completing unit 2, the students will able to understand the Chemical process and Thermo chemical and photochemical reactions in atmosphere.

8. Aftercompletingunit3,thestudentswillbeable to explain Laws of thermodynamics .

9.After completing unit4,thestudentswillbeabletoexplain Treatment off Water and ozone chemistry.

10. After completing unit5, the students will be able to explain about the Bio corrosion and micro bialmediated recovery.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
Unit-I	.Stochiometry, Gibb's energy, Chemical potential, Chemical equilibria, acid-base, reactions. Solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, Radio nuclides.	**18hours**
Unit-II	Classification of elements, chemical speciation, Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo chemical and photochemical reactions in the atmosphere.	**18hours**
Unit-III	Firstlawofthermodynamics,enthalphy,adiabatictransformations,secondlawof thermodynamics, Carnot's cycle, entropy, Gibb's free energy, chemical potential, phase equilibria, Gibb's Donnan equilibrium, third law of thermodynamics, enzymes catalysis, Michaelis/ Menten equation	**18hours**
Unit-IV	Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical Smog, Chemistry of water, concept of D.O., B.O.D., and C.O.D, water treatment : Sedimentation, Coagulation, Filtration, tertiary and advanced treatment, redox potential, Inorganic and organic components of soil, nitrogen pathways and NPK in soils	**18hours**
Unit-V	Biocorrosionandmicrobialmediatedrecovery:Microbialcorrosionanditscontrol(petroleumindustryandcoolingtowersystem).Biometallurgy-Bioleaching-application,biotechnologyapproachesforheavymetaleliminationfromeffluents.Bio-mediatedrecoveryofmetals(goldandplatinum).Recoveryofpetroleum-MEOR-Biosurfactant.	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. .Environmental Chemistry-G.S.Sodhi
2. Environmental Chemistry-Mannhan
3. Fundamantals of soil science -HenryD. Futh
4. Text book of limnology-G.A.Cole
5. Environmental Chemistry-Sharma and Kaur

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER II

PAPER4. Environmental modeling and Biostatistics.

Paper code: Subject: **Environmental modeling and Biostatistics.**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of Measurement of central tendency and also the random variable and also the modelling in environmental sciences and also the population growth and interactions.

Course Objectives

1.To learn the Measurement of central tendency and Correlation and line arregression

2.To learn theBasic concepts of binomial and normal distributions and hypothesis and significance.

3.To develop knowledge on Model classification, Methods for formulation of dynamic balance equations mass balance procedures.

4.To learn the Models of population growth and interactions.

5. To develop a piece of knowledge instages involved in model building.

Course OutComes

6.After completing unit 1, the students will be able to Understand the Basic laws and concepts

7. After completing unit 2, the students will able to understand the tests of hypothesis and significance

8. After studying unit 3, the students will be able to explain Role of modelling in environmental sciences

9.After studying unit 4, the students will be able to explain. Models of population growth and interactions

10. After studying unit5,the students will be able to explain about simple growth kinetics.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	Measurement of central tendency - mean (Geometric and Harmonic), median, mode, Measurement of dispersion moments, standard deviation, skewness and kurtosis, Correlation and line arregression of one independent variable, Basic laws and concepts of probability	**18hours**
Unit-II	Definition of random variable, density function, Basic concepts of binomial and normal distributions, Sampling measurement and distribution of attributes, Moments, matrics and simultaneous linear equations, tests of hypothesis and significance.	**18hours**
Unit-III	Role of modelling in environmental sciences, Model classification deterministic models, stochastic models, steady state models, dynamic models, Different stages involved in model building.	**18 hours**
Unit-IV	Models of population growth and interactions Lotka Volterramodel, Leslies matrix model, Point source streampollution, Box model, Gaussian plume model, Linear, simple and multiple regression models, validation and forecasting.	**18 hours**
Unit-V	Simple microbial growth kinetics monod equation, Methods for formulation of dynamic balance equations mass balance procedures.	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

ReferenceBook:

1. DynamicsofEnvironmentalBioprocesses-Modellingandsimulation-SnapeandDunn.
2. EnvironmentalModeling- Jorgense

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome,CO–Course outcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER II

ELECTIVE PAPER5 : Enzyme Technology

Papercode: Subject: Enzyme Technology

Hours/Week:5

Credits:2

Aim:To provide knowledge of various enzymes and enzyme technology applied in the industries.

Course objectives:

1. To Learn about the classification and structure properties of enzymes
2. To Understand the kinetics, catalysis and inhibitions activities of enzymes
3. To understand physical properties, down stream process and purification of enzymes.
4. To Expedite how enzymes are used as co-factors.
5. To Enrich the students' knowledge with respect to different applications of Enzymes

Course Outcomes (five outcomes for each units should be mentioned)

6. After studying unit-1, the student will be able to know about basic knowledge of enzymes
7. After studying unit-2, the student will be able to understand mechanism of enzyme activities
8. After studying unit-3, the student will be able to understand physical properties of enzyme.
9. After studying unit-4,the student will be able to function of enzyme in different processes.
10. After studying unit-5, the student will be able to know various application of enzyme technologies.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	No	Yes	Yes	No
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	No	Yes	Yes	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

UNIT I	Introductiontoenzymes:Historyofenzymes,nomenclatureandclassificationofenzymes.StructuralfeaturesofEnzymes:Chemicalnature of Enzymes: amino acids, protein structure: Primary, secondary,tertiaryandquartenerystructure.SpecificityofEnzymes:Typesofspecificity, thekoshland"induced fit"hypothesis, strain or transition-state stabilizationhypothesis.	18 hours
UNIT-II	Enzyme Catalysis and Kinetics: Factors affecting the rate of chemicalreactions, kinetics of un catalyzed chemical reactions, kinetics of enzymescatalyzedreaction,methodsforinvestigatingthekineticsofenzyme-catalyzedreaction,natureofenzymecatalysis,inhibitionofenzymeactivity.	18hours
UNIT–III	Extraction and purification of microbial enzymes : Importance of enzymepurification, different sources of enzymes. Extracellular an intracellularenzymes. Physical and Chemical methods used for cell disintegration.Enzymefractionationby precipitation(using Temperature,salt,solventpH,etc.),liquid-liquidextraction,ionicexchange,gelchromatography,affinity chromatography and other special purification methods, Enzymecrystallizationtechniques.Criteriaofpurityofenzymes.Pitfallsin workingwithpureenzymes.	18hours
UNIT – IV	Enzymes inhibition and Co-factors: Irreversible, reversible, competitive,non-competitive and un-competitive inhibition with suitable examples andtheirkineticstudies.Allostericinhibition,typesofallostericinhibitionandtheirsignificanceinmetabolicregulation&theirkineticstudyVitaminsandtheirco-enzymes:Structureandfunctionswithsuitable examples ,Metallo enzymes and Metal ions as co-factors and enzymesactivators.	18hours
UNIT-V	Immobilization of microbial enzymes and Enzyme Engineering: Methodsviz. adsorption, covalent bonding ,entrapment& membrane confinementand their analytical, therapeutic & industrial applications. Applications ofmicrobial enzymes: Microbial enzymes in textile ,leather, wood industriesanddetergents.Enzymesinclinicaldiagnostics.Enzymesensorsforclinicalprocessesandenvironmentalanalyses.Enzymesastherapeutic agents.	18hours
	Total Lecturehours	90hours

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Text Book(s)

1. Introduction to proteins Structure by Branden and Tooze (1998):Garland Publishing Group.
2. Biotechnology.Volume7A-Enzymes in Biotechnology. 1983E dited by H.J.Rehmand G.Reed.Verlag Chemie.
3. Methods of Enzymatic analysis by Hans Ulrich, Bergmeyer,Academic Press.
4. Methods in Enzymology byW.A.Wood,Acdemic Press.
5. Topics in Enzymeand Fermentation Biotechnology by L.N.Wiseman, JohnWiley and sons

References Books

1. Enzymes by palmer (2001):Horwood publishing series.
2. Fundamentals of Enzymology by price and Stevens (2002):Oxford University Press.
3. EnzymeTechnology by Helmut Uling (1998):JohnWiley.
4. Methods in Enzymology. Volume22-Enzyme purification and related techniques. Editedby William B.Jako by.Academic press,NewYork.
5. Allosteric Enzymes – Kinetic Behaviour. 1982. By B.I.Kurganov,JohnWiley and Sons. Inc.,New York.
6. Enzymesas Drugs Edited by JohnS.Holcen berg and Joseph Roberts, John Wiley & sons NewYork.
7. Advances in Enzmology byAlton Meister, Inter science Publishers.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

ELECTIVEII:(B)DAIRYTECHNOLOGY

Paper code: **Name of the Paper :** Dairy Technology

Total Hours perWeek:3 **Credits:2**

Aim:Toimpartcurrentknowledgeofbasicandappliedmicrobiologicalaspectsoffluidmilksanddairyproductsforimprovedqualityandfoodsafety.

Course objective:

1. To teach the microbial knowledge in milk
2. To learn the processing of milk micro biological methods
3. To understand how the milk products are in quality make through dairy industry
4. To made knowledge in differentiate the traditional and industrial make dairy products and its processing
5. To aware the students a bout milk borne diseases

Course outcome

1. Afterstudyingunit-1,the student will be able to know about basic knowledge of milk microbes and its changes in maintaining the storage of milk.
2. After studying unit-2, the student will be able to understand mechanism of processing of milk through micro biological methods
3. After studying unit-3, the student will be able to understand dairy products quality and its changes through micrbes
4. After studying unit-4, the student will be able to differentiate dairy products in industry and homemade.
5. After studying unit-5, the student will be able to know various application of milk and milk borne microbial diseases.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

UNIT I	Common microbes in milk and their significance. Sources of microbial contamination of raw milk in influencing quality of milk during production, collection, transformation and storage. Clean milk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of Raw milk.	18hours
UNIT-II	Microbiological processing techniques: bactofugation, the rmization , pasteurization, sterilization ,boiling ,UHT, non thermal processes and membrane filtration of milk role of psychrophilic mesophilic, the rmophilic and the rmoduric bacteria in spoilage of processed milks and prevention microbiological standards (BIS/PFA) of heat treated fluid milks.	18hours
UNIT–III	Microbiological quality of dairy products; fatrich (creamandbutter), frozen (ice cream), concentrated (evaporated and condensed milk), dried milks (roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution. Probiotics and prebiotics (GRAS), cloning-sanitation, control of micro organisms in Dairy processing	18hours
UNIT–IV	Microbiology quality of traditional dairy products; heat desiccated(khoa,burfi,peda,kheer),acidcoagulated(paneer,chhana,rasgulla), fermented (lassi, srikhand)and frozen (kulfi).sources ofmicrobial contaminants and their role in spoilage. Importance of personnel and environmental hygiene on quality of traditional milk Products. Microbiological standards for indigenous dairy foods.	18hours
UNIT-V	Milk-borne diseases–vira land bacterial, zoonotic infections , pathogens associated with fluids milks, dairy products and their public health significance. sources of pathogens and their prevention .importance of bio flims, their role in transmission ofpathogensindairyproductsandpreventivestrategies.regulatorycontrol of dairy products, testing of milk and milk products, treatment of dairy wastes.	18 hours
	TotalLecturehours65hours	90 hours

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Text Books:

1. Adams MRand Moss MO. (1995). Food microbiology, the royal society of chemistry, Cambridge.

2. Andrews AT, VarleyJ (1994) biochemistry of milk products. Royal society of chemistry.

3. Banwart GJ (1989), basic food microbiology, Chapman & hall, newYork.

4. Frazier WC and Westh off DC.(1988)food microbiology, TATA McGraw hill publishing company Ltd.NewDelhi.

References

1. HobbsBC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold (adivision of Hodder and Stoughton), London.

2. May JM.(1987)modern food microbiology,CBS publishers and distributors, NewDelhi.

3. Robinson RK.1990. the microbiology of milk. Elsevier applied Science. London

4. EdwardHarth, J.T.Steele. Applied dairy microbiology. 1998. Marcel DeekerInc.

5. Modi, HA (2009) dairy microbiology pointer publishers, India. Marth, E.Handsteel J.L (2001) applied Dairy microbiology, 2nd Edition, Marcel Dekker, Inc.270 Madison Avenue, NewYork, NewYork 10016.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

ELECTIVEII:(C)PHARMACEUTICALTECHNOLOGY

Aim: To impart knowledge on the importance of drug during life span. To enlighten onthe biotechnological modifications in drugs. To find mechanism of action of drugs used intherapy.

Course objectives

1.To learn drugs and its involve dde toxification through phase1&2 reactions 2 To teach drug mechan is mlik epassive and active phases

2.To learn the drugs manufacture biotechnological pharmaceutical industry

3.To understand the importance of drugs in treating various metabolic disorders 5 To teach various applications of drugs in various fields.

CourseoutComes(fiveoutcomesforeachunitsshouldbementioned)

1. After studying unit-1,the student will be able to know about basic knowledge of drugs of phase I & II
2. After studying unit-2,the student will be able to understand drug mechanism and its adverse effects.
3. After studying unit-3,the student will be able to understand biotechnology in drug development, especially for AIDS
4. After studying unit-4,the student will be able to know drugs and its importance various treatment like diabetes, cancer, lipidemia and infertility
5. After studying unit-5,the student will be able to know various application of drug dependence and a buse-management

Matching Table (PutYes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

UNIT I	Drug- structural feature and pharmacology activity, pro drug concept. Absorption–first–pass effect. distributor, metabolism-phase I, II reactions, action of cyto chrome p450 &elimination of drug receptor- localization, type and subtypes, models and their drug-receptorinte raction, against & antagonist.	18 hours
UNIT-II	Adver seresponse to drugs, drug to lerance, drug in to lerance, Idio SYNERACY (pharmacogenesis), drug allergy. Tachyphylaxis, drugabuse, vaccination against infection	18 hours
UNIT–III	Biotechnology and pharmacy: genetically engineered protein and peptide agents. Novel drug delivery systems–non conventional routes of administration. Anti AIDS drug development, on cogenestar get for drugs, multi-drugs resistance.	18 hours
UNIT–IV	Mechanism of action of drugs used in therapy of :respiratorysystem-cough,bronchial-asthma,pulmonarytuberculosis.GIT –digestents, appetite suppressants. Hypolipidemia agents,, vomiting, constipation and peptic ulcer. antimicrobial drugs-sulfonamides,trimethoprim,cotrimoxazole,penicillinandmacrolides.aminoglycosides,cephalosporinandbacterialresistance .Insulin and oral diabetic drugs, antifertility and ovulation inducing drugs.	18 hours
UNIT-V	Drugs of plant origin: drug dependence and abuse-managementofselfpoisoningcancer.Chemotherapy-cytotoxicdrug.immunosuppressivedrugtherapy.Newbiologicaltargetsfor Drug development. Novel drugs creening strategies.	18 hours
	Total Lecture hours	**90 hours**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Text Book:

1. ThepharmacologyVolIandVolII–Good man and Gillman,McGraw Hill professional;12ed (2010)

2. Basic pharmacology – Foxter coxbulter worth‟s1980.

Pharmacology and pharmaco therapeutics –R.S.Satoskar. S.D.Bhandhhakar & S.S.AnilapurepopulPrakasharBombay.

Reference 17

a. Principle so fmedical chemistry–WilliamO. Foge.B.I. Waverks Pvt Ltd, NewDelhi.

b. Oxford tex tbooks of clinical pharmacology and drug therapy .D.G.Burger‟s Medical chemistry & drug discovery.

c. Principles and practice–Manfred.E.WolfJohnWileyandsons.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

PRACTICALIII: LABINIMMUNOLOGY AND LAB INGENETIC ENGINEERING AND BIOINFORMATICS

(10 credit)

1. Blood grouping
2. Lymphocytesub set identification and enumeration.
3. Radialimmuno - diffusiontest.
4. Ouchter lony double diffusion
5. Immunoelectrophoresis
6. Rocket Immunoelectrophoresis
7. Latex Agglutination
8. Quantitative Precipitinassay
9. Complement fixationtest
10. ELISA
11. Western Blotting
12. Antigen-antibodyreaction(precipitationandagglutinationreactiontests)

GENETICENGINEERING

1. Isolation of genomicDNAfrom the given sample and its molecular weight determination
2. Isolation of RNA from the given sample and its molecular weight determination
3. Isolation of plasmid DNA from the given sample
4. Restriction digestion fL ambdaphage DNA
5. Ligation of DNA and analysis by electrophoresis
6. DNA amplification by PCR and RAPD
7. Preparation of competent cellsandtransformationbyCaCl2methodand Selection of trans formed colony by X-Galmethod
8. Determination of molecular weight of proteins by SDSPAGE

BIOINFORMATICS

1. Restriction mapping
2. PCR Primer Designing
3. ORF finding
4. Homology search
5. Multiple sequence alignment

References:

1. PracticalImmunology.FranckC.Hay,OlwynM.R.Westwood.Wiley-Blackwellpublications,2010.

2. Immunoassays:APracticalApproach.JamesP.Gosling(editor).Oxforduniversitypress,USA,2010.

3. Labmanualin biochemistry, immunology and biotechnology. Arti Nigam Archanaayyagari. McGraw-Hilleducation,2008.

4. Practic alimmunology.RabindraNarain,dom& wisdompublications,2012

SEMESTER III

PAPER1 .: Immunology

Papercode: Subject: **Immunology**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of anatomy of the immune system and also Band Tlymphocytes and also the Antigen-anti body interactions and also about Vaccinology and also about the Immuno haematology.

Course Objectives

1.To learn the strategies for Components of immunity

2.To learn the Immunoglobulins

3.To develop knowledge onimmunological techniques

4.To learn the Vaccine technology

5.To develop a piece of knowledge in Antibody genes and antibody engineering

Course OutComes

6.After completing unit1,the students will be able to Understand the Fundamental concept of Immunology and Lymphatic system.

7. After completing unit 2, the students will able to understand the Immune response and Principle of cell signaling

8. After studying unit 3,the students will be able to explain. Immunoglobulin techniques

9. After studying unit4, the students will be able to explain Vaccine technology.

10. After studying unit5,the students will be able to explain Hyper sensitivity.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	Componentsofinnateandacquiredimmunity;Phagocytosis;Complement and Inflammatoryresponses;Haematopoesis;Organsandcellsoftheimmunesystem-primaryandsecondarylymphoidorgans;Lymphaticsystem;Lymphocytecirculation; Lymphocyte homing;MucosalandCutaneous associatedLymphoid tissue. (MALT&CALT);MucosalImmunity; Antigens-immunogens, haptens; Major HistocompatibilityComplex-MHCgenes,MHCandimmuneresponsivenessand disease susceptibility, HLA typing.	**18hours**
Unit-II	.Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Principles of cell signaling; Immunological basis of self – non-selfdiscrimination; Kinetics of immune response, memory; B-cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell- mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system.	**18 hours**
Unit-III	Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasma resonance, Biosenor assaysfor assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptotosis, Microarrays, Transgenic mice, Gene knock outs.	**18hours**
Unit-IV	Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.	**18hours**

Unit-V	Hypersensitivity – types and mechanisms, Autoimmunity, Tumor and Transplantation immunology. Immune regulation mechanisms – brief account on immuno-induction, immunosuppression, immuno-tolerance, immuno-potentiation. Role of cytokines, lymphokines and chemokines	**18hours**
TotalTeachinghours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. WilliamE.Paul,Fundamental Immunology,Wolters Kluwer/Lippincott Williams & Wilkins.
2. Stephen KWikel,The Immunology Host-Ectoparasiticarthropod relationships. Cabinternational.
3. Herman N.Eisen,MD,GeneralImmunology.J.B.LippincottCompany.F.M. Burnet, Immonology. W.H. Freeman and company
4. Jack G. Chirikjian, Plant Biotechnology, Animal cell culture Immuno biotechnology. Jones and Bartlett Publishers.
5. Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003. 9. Noel R. Rose, Herman Friedman, John L. Fahey. Manual of Clinical Laboratory Immunology. ASM. 3rd ed., 1986.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER III

PAPER2 : Cell and Molecular Biology

Papercode: **Subject: Cell and Molecular Biology**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of Genome organization and also the DNA structure , Replication , Repair and Recombination and also the Prokaryotic and Eukaryotic Transcription and also the post Transcriptional Modification and microscopic techniques .

Course Objectives

1.To learn the Organization of bacterial genome

2.To learn the Structure of DNA and Gene targeting

3.To develop knowledge on Prokaryotic & Eukaryotic Transcription

4.To learn the Post Transcriptional Modifications

5.To develop a piece of knowledgein Translation &Transport

Course OutComes

6.After completingunit1,the students will be able to Understand the Genome Organisation.

7.After completing unit2,the students will able to understand the DNA structure ; Replication.

8. After completing unit3,the students will be able to understand the Prokaryotic and Eukaryotic Transcription.

9.After completing unit4,thestudentswillbeabletounderstand the concept of post transcriptional modification.

10.After completing unit5,the students will be able to explain the concept of Translation machinery and transport of proteins.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	Organization of bacterialgenome; Structure of eucaryotic chromosomes; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin; DNA reassociation kinetics(Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting and buoyant density; Nucleosome phasing; DNase I hypersensitive regions; DNA methylation & Imprinting	**18hours**
Unit-II	.Structure of DNA - A-,B-, Z- and triplex DNA; Measurement of properties- Spectrophotometric, CD, AFM and Electron microscope analysis of DNA structure; Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous; Site specific recombination; Chi sequences in prokaryotes; Gene targeting; Gene disruption; FLP/FRT and Cre/Lox recombination.	**18 hours**
Unit-III	Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac,trp,ara,his,andgaloperons;Transcriptionalcontrolinlambdaphage; Transcript processing; Processing of tRNA and rRNA Eucaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and post-transcriptional gene silencing	**18hours**
Unit-IV	Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA.	**18hours**
Unit-V	**Translation & Transport** Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Iso accepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications; Genetic code in mitochondria; Transport of proteins and molecular chaperones; Protein stability; Protein turnover and degradation	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Reference Book:

1. DavidFreifelder,EssentialsofMolecularBiology,NarosaPublishingHouse.

2. George M. Malacinski, Essentials of Molecular Biology, Jones and Bartlett Publishers.

3. CornelMulhard,MolecularBiologyandGenomicsAcademicPressisanimprintof Elsevier.
4. Harvey Lodish, Arnold Berk, Paul Matsudaira,Chris-A.Kaiser,MontyKrieger,Mathew
5. P.Scott,S.Lawrence Zipursky, James Darnell, Molecular Cell Biology (Fifth adition), W.H.Freeman and company
New York.
6. Reimer, L. and Kohl, H. (2008) Transmission electron microscopy. Springer.

7. Sharma, V. K. (1991) Techniques in microscopy and cell biology. Tata McGraw Hill

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER III

PAPER3 .: Biotechnology

Papercode: Subject: **Biotechnology**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of Scope of environmental biotechnology and also the basic techniques in genetic engineering and also the Genetically modified organism.

Course Objectives

1.To learn the scope of environmental biotechnology

2.To learn the Basic techniques in genetic engineering

3.To develop knowledge on concept of genetic engineering of plants and its application

4.To learn the Liquid waste treatment, solid waste management

5.To develop a piece of knowledge in Biotechnological approaches for Fermentor and industrial process of beveage

Course Out Comes

6.After completing unit1,the students will be able to Understand the scope of environmental biotechnology and also the fermentation technology.

7.After completing unit 2,the students will able to understand the techniques in genetic engineering.

8 After completing unit3,the students will be able to understand the concept of genetic engineering in plants and its applications

9.After completing unit4,the students will be able to explain phytotechnology and biotechnological approaches.

10.Aftercompleting unit5,the students will be able to explain about the bio reactor and fermentor .

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	The scope of environmental biotechnology; Biodegradation of macromolecules; biode gradation of genobiotics; Vermi composting. Heavy metalpollution; Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants. Microorganisms and organic pollutants; Extremophiles. Fermentation technology (Bioreactors).	**18hours**
Unit-II	.Basic techniques in genetic engineering: Genetic manipulation, Restriction endonucleases, Introduction of cloned genes into new hosts using plasmid and phage vector systems. RFLP, Polymerase chain reaction, Environmental genomics/metagenomics-a general account, Microbes and environmental management.	**18 hours**
Unit-III	Basic concept of genetic engineering of plants and its applications-herbicide and stress tolerant plant. Biotechnology strategies in forestry and wasteland management. Biotechnology in biodiversity conservation: gene banks, germplasm conservation and DNA Banks. Genetically modified organisms and Bio safety- a general account.	**18 hours**
Unit-IV	Bioenergy, ethanol fermentation. Liquid waste treatment; Biofilters, activated sludge systems; membrane bioreactors. Biotechnological approaches for solid waste management, Phytotechnology-terrestrial phytosystems, metal phytoremediation, Phytotechnology-aquaticphytosystems,nutrient filmtechniques,algaltreatment systems.	**18 hours**
Unit-V	Bioreactors / Fermentor: Types, features, operation: sterilization (Batch and Continuous), inoculation and sampling. Control of bioprocess parameters. Microbial growth and media formulation. Microbial culture - batch, fed batch, semi-continuous, continuous. Growth kinetics of microorganisms.	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. Manahan,S.E.1997.EnvironmentalScienceandTechnology.Lewis,NewYork.
2. MetcalfandEddy(Eds).2003,WastewaterEngineering:TreatmentandReuse, Tata McGraw-Hill, New Delhi.
3. Nelson,G.C.2001.GeneticallyModifiedOrganismsinAgriculture:Economics and Politics. Academic Press.
4. Evans,G.M.andFurlongJ.C.2003.EnvironmentalBiotechnology:Theoryand Application. John Wiley and Sons.
5. Thomas,J.A.andFuchs,R.2002.BiotechnologyandSafetyAssessment. Academic Press.
6. Wang L.K. Hung Y.T. nad Shammas N.K.(Eds). 2006. Advanced Physico chemical Treatment Processes. Springer-VerlagNewYork,LLC

7. Industrial Microbiology, Reed C., Prescott and Dann's, 1982. Macmillan publishers.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome, S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER III

PAPER4.: Microbial and Industrial application

Papercode: Subject: Microbial and Industrial application

Hours/Week:5

Credits:4

Aim: To enable the students to understand the concept of microbial diversity and also the microbial growth and also the microbial Interaction and also the Industrial applications.

Course Objectives

1.To learn the Classical and modern methods and concepts of microorganisms

2.To learn theMicrobial Growth & Physiology

3.To develop knowledge on Microbial Interactions and Infection

4.To learn the Microbes and Environment

5.To develop a piece of knowledge in Industrial Applications

Course OutComes

6.After completing unit1,the students will be able to Understand the Kingdom concepts in classification of microorganisms; Molecular methods.

7.After completing unit 2,the students will able to understand the Microbial growth

8. After completing unit 3, the students will be able to understand the Microbial Interactions and Infection

9.After completing unit4,the students will be able tounderstand the concept of Microbes and environment.

10.After completing unit5, the students will be able to under stand the concept of basic principles of bio process.

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	Course Contents	Teaching hours
UnitI	**Microbial Diversity & Systematics** Classical and modern methods and concepts; Domain and Kingdom concepts in classification of microorganisms; Criteria for classification; Classification of Bacteria according to Bergey's manual; Molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE), Temperature Gradient Gel Electrophoresis (TGGE), Amplified rDNA Restriction Analysis and Terminal Restriction Fragment Length Polymorphism (T-RFLP) in assessing microbial diversity;16S rDNA sequencing and Ribosomal Database Project.	**18hours**
Unit-II	.**Microbial Growth & Physiology** Ultra structure of Archaea (Methanococcus); Eubacteria (*E.coli*);Unicellular Eukaryotes (Yeast) and viruses (Bacterial, Plant, Animal and Tumor viruses); Microbial growth: Batch, fed-batch, continuous kinetics, synchronous growth, yield constants, methods of growth estimation, stringent response, death of a bacterial cell. Microbial physiology: Physiological adoption and life style of Prokaryotes; Unicellular Eukaryotes and the Extremophiles (with classical example from each group).	**18 hours**
Unit-III	**Microbial Interactions and Infection** Host–Pathogen interactions; Microbes infecting humans, veterinary animals and plants; Pathogenicity islands and their role in bacterial virulence	**18hours**
Unit-IV	**Microbes and Environment** Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics; Vaccines	**18 hours**
Unit-V	**Industrial Applications** Basic principles in bioprocess technology; Media Formulation; Sterilization; Thermaldeathkinetics; Batchand continuous sterilization systems; Primary and secondary metabolites; Extracellular enzymes; Biotechnologically important intracellular products; exopolymers; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH Microbial processes-production, optimization, screening, strain improvement, factors affecting down stream processing and recovery; Representative examples of ethanol, organic acids, antibiotics etc	**18hours**
Total Teaching hours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Total marks
Marks	15	05	05	25

Reference Book:

1. MichaelJ.Pelczar,Microbiology, Tata McGraw-Hill
2. L.ECasida,JR, Industrial Microbiology,NewAgeInternational,PJLimited, Publisher.
3. Prescott and Dunn, Industrial Microbiology,CBS Publisher and Distributor
4. GerandJ.Tortora,BerbellR. Funke, Christine L.Case,Microbiology, Pearson

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome,CO–Course outcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER III

ELECTIVE PAPER1.: Water and Waste water Technology

Papercode: Subject: **Water and Waste water Technology**

Hours/Week:5

Credits:3

Aim: To enable the students to understand the concept Water microbiology and analytical tools in assessment of water pollution.and also the water pollution monitoring and also the effluent treatment system and also the removal of specific pollution.

Course Objectives

1.To learn the standards of water in relation to public health

2.To learn the Principal forms of Water Pollutants

3.To develop knowledge on Water Pollution Monitoring

4.To learn the Development and optimization of membrane bioreactor process

5.To develop a piece of knowledge Effluent treatment systems

Course Outcomes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the Methods of water sampling for pollution analysis and Biosensors and also Biological treatment

7.Aftercompletingunit2,thestudentswill able to understand the Biological methods, Chemical methods for Monitoring Water Pollution

8.Afterstudyingunit3,thestudentswillbeable to understand the Sewage and waste water treatments systems

9.Afterstudyingunit4,thestudentswillbeabletoexplain.biotechnological application of hazardous waste management of water

Matching Table (Put Yes/No in the appropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	CourseContents	Teaching hours
UnitI	Overview of standards of water in relation to public health - Detection and control of micro-organisms inenvironmentalfresh water, insource and drinking water; Potable and nonpotable water; Methods of water sampling for pollution analysis; Biosensors - types and applications in environmental pollution detection and monitoring; Biological treatment: stabilization pond, aerated lagoon, activated sludge process, trickling filter anaerobic treatment. **WaterPollution** Principal forms of Water Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Water pollution monitoring and water quality standards; Ocean pollution – oil pollution; Ground water pollution and its control;Water pollution prevention.	**18hours**
Unit-II	.Methods of monitoring;Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Other emerging techniques such as enzyme detection, hybridization, PCR,Gene probe technology etc.; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors of pollution	**18 hours**
Unit-III	Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments;Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Biofilm development and biofilm Kinetics; Aerobic Biofilms; Bioreactors for waste water treatments; Reactors types and design; Reactors in series; Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment.	**18hours**
Unit-IV	Physicochemical characteristics and treatment strategies for effluent generated by Distillary and fermentation industry; Fertilizers and pesticide manufacturing industries; Dyes and dye intermediate producing industries and textile industries; Paper and pulp industries; Tanneries; Pharmaceuticals; Thermalpower plants; Food and dairy industries; Iron and steel industries; Organic solvents; Chlorinated minerals and inorganic chemical industries and petrochemicals; Biotechnological application of hazardous waste management of water; Use of microbial systems; Phytoremediation: Waste water treatment using aquatic plants; Root zone treatment; Development of new biocatalysts to be applied in waste water biotechnology.	**18hours**

Unit-V	Water Quality and Preliminary treatment. Water Quality-physical- chemical and biological parameters of water- water quality requirement - potable water standards -wastewater effluent standards -water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes- primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification - sedimentation; Types; aeration and gas transfer – coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, clariflocculation.	**18hours**
TotalTeachinghours		**90**

Internal Assessment Methods:(25 marks)

Distribution for Internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Reference Book:

1. NicolasPCherewsinott,HandbookofwaterandwastewaterTreatmentTechnology, Boston Oxford Auckland Johannesburg Melbourne ,N Delhi
2. FrederickWPontinus,WaterQualityandTreatment.Americanwaterworks Association, MC Graw Hill Inc.
3. SKAgarwal,WaterPollution,APHPublishingCorporation.
4. Ronald LDooste,Theoryand Practicalofwater andwastewaterTreatment.
5. BillT.Ray,EnvironmentalEngineering,PWSPublishingcompany.
6. W. Wesley Eckenfelder, Jr., “IndustrialWater Pollution Control”, 2ndEdn.,McGraw Hill Inc., 1989

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–Programme Outcome, CO–Course outcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

COREELECTIVEIII(B):GENOMICS&PROTEOMICS

Papercode: Paper name:
Genomics&ProteomicsHoursofteaching:3 Credits:3

Aim:**To enable ustoexploremanydifferentcomponentsoflivingsystemsandtheadventofproteomicswillmadeitpossible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and application singenomics and proteomics.**

Course objectives:

1. Toprovidethebasicknowledgeofgenecharacteristicfeatureandmappingconcepts
2. To understand about these quenching technologies
3. To provide the basic concept for protein analysis
4. To understand about protein sequencing
5. ToEnrichthestudents'knowledgewithrespecttometagenomicandapplications

CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

11. Afterstudyingunit-1,thestudentwillbeabletoknowaboutgenesfunctionalproperties.
12. Afterstudyingunit-2,thestudentwillbeable tounderstandhowgenesequencingaredone
13. Afterstudyingunit-3,thestudentwillbeable tounderstandProteinanalysis.
14. Afterstudyingunit-4,thestudentwillbeable to protein sequencingmethods.
15. Afterstudyingunit-5,thestudentwillbeable to know aboutmetagenomicsand itsapplication.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Cre
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	No
3	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	No	No
5	Yes	Yes	Yes	No	Yes	Yes

UNIT I	Organization of genes across living systems, interrupted genes,overlapping genes, alternative genes , (RNA editing and RNASplicing) etc. identification and characterization of insert DNAfragments,genecontentand Cvalueparadox – geneclusterandgenefamilies .restriction mapping, chromosome walking and chromosomallocalizationofgenes.RFLPandotherusesofclonedsequences,cloningofmicrobialgenes.	18 hours
UNIT-II	Methods of preparing genomic DNA, DNA sequence analysismethods, Sanger Di deoxy method, next generation sequencing,SNP – single nucleotide polymorphism, expressed sequencedTags(ESTs),Genediseaseassociation,sitedirectedmutagenesisandmolecular chimeras , gungal genome and genomics.PCR basedAnalysis,DNAFingerprinting.	18 hours
UNIT–III	Scope of proteomics, protein separation techniques – ion exchangechromatography, size – exclusion and affinity chromatographytechniques,size–exclusionandaffinitychromatographytechniques ,proteinanalysis(includesmeasurement ofconcentration,aminoacid composition, N-terminal sequencing); SDS-PAGE , twodimensionalgelelectrophoresisandimageanalysis.	18 hours
UNIT–IV	Introduction to mass spectrometry; strategies for proteinidentification ; protein sequencing ; protein modifications andproteomics ; applications of proteome analysis to drug; protein – proteininteraction(Twohybrid interactionscreening),analysisandsequencing individual spots by mass spectrometry (Maldi toff) andproteinmicroarrays.	18 hours
UNIT-V	agenomics–construction,vectordesignandscreeningo fmetagenomic libraries- biotechnological applications of metagenomics.	18 hours
	Total Lecturehours	**90 hours**

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

TextBooks

1. Introducingproteomics(2011)Josiplovric.JohnWileyPublication

2. Principlesofproteomics(2013). R.MTwyman.Taylorand Francispublish

ReferenceBooks

1. ExpressionGenetics:accelerated andHighThroughputMethods(1999). EditedbyM.McClelland and A.Pardee,EatonPublishing,MA.
2. MicrobialFunctionalGenomics(2004).J.Zhou,D.K.Thomson,Y.XuandJ.M.Tiedje,WileyLiss.
3. ReviewsandarticlesfromJournalssuchasNature,Science,PNAS(USA),NucleicAcidsResearch, Trends andCurrentOpinionSeries.
4. PrinciplesofGeneManipulationandGenomics(2013)SandyB.Primrose,RichardTwyman–BlackwellPublishing.
5. An IntroductiontoGeneticEngineering3rdEditionDesmondS.T.NichollCambridgeUniversityPress
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th Edition Bernard R. Glick, Jack J.Pasternak,CherylL.PattenASMPress
7. Post-translationalmodificationsinhostcellsduringbacterialinfection,D.Ribert,P.Cossart,FEBSletters, 2010.
8. Proteomicsinpractice:alaboratorymanualofproteomeanalysis(2002).Westermeier,R.,&Naven,T.JohnWiley&Sons,Inc.
9. Proteomicsforbiologicaldiscovery.Veenstra,(2006).TimothyD.andJohnR.YatesJohnWiley& Sons,
10. Plantproteomics:methodsandprotocols.(2007).Thiellement,H., Zivy,M.,Damerval,C. andMéchin,V.eds.Totowa(NJ):HumanaPress.

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	3	2	
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

COREELECTIVEIII(C):HerbalBiotechnology

Papercode: **Subject: Herbal Biotechnology**

Hours/Week:3

Credit:3

Aim:Togivethedetails of plant-derivedvalue-addedcompoundsandtheirfunctions.Toprovideknowledgeonbiotech-basedproductionofHerbalmedicines

CourseObjectives

1. Toenablethestudentstolearnaboutthe biochemicalparametersusedintheidentificationandutilizationof medicalplants
2. Toenablethestudentstolearnabouttheextractionofphytochemicalsandprocedures
3. Toexploitandexplorethemedicinalvaluesofplants
4. knowtheevaluationtechniquesfortheherbaldrugs
5. Toprovideknowledge onbiotech-basedproductionofHerbalmedicines

CourseOutcomes (fiveoutcomesforeachunitshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeableto–knowtheStudyofonhistoryandscopeofherbals
2. Afterstudyingunit-2,thestudentwillbeableto– understandtheImportantmedicinalherbsintreatingdiseases
3. Afterstudyingunit-3,thestudentwillbeableto– learntheBiotechnologicalmethodsofplantpropagation
4. Afterstudyingunit-4,thestudentwillbeableto– exploremethodsInvolvedinsecondarymetaboliteproduction
5. Afterstudyingunit-5,thestudentwillbeableto– knowaboutpharmaceuticalapplicationsandIntellectualPropertyRights

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Cre
1	Yes	Yes	No	No	No	No
2	Yes	Yes	No	No	No	No
3	Yes	Yes	No	No	No	No

4	Yes	Yes	No	No	No	No
5	Yes	Yes	No	No	No	No

Units	CourseContents	Teac ho
UnitI	Studyofonhistoryandscopeofherbals-IntroductiontotheIndiansystemofmedicine–Herbaldrugsandimportance-HerbalCosmeticandCosmeceuticals -FormulationDevelopmentofherbalpreparations-HerbalDrugdiscoveryandNoveldrugdeliverysystems.	18 hou
Unit-II	Important medicinal herbs in treating diseases- Phytochemistry of medicinalplants-alkaloids-flavones-flavonoidsandxanthones-furocoumarins-glycosides-naphthoquinones-phenolsandacylphloroglucinols-resins, oleoresins and gum resins. Saponins - sterols and steroid-like compounds - tanninsandterpenes.	18 hou
Unit-III	Biotechnological methods of plant propagation. - Micropropagation – SomaticEmbryogenesis and somoclonal variation. Herbal gardening and maintenance-Standardization of cultivation protocols of selected medicinal plants; *in vitro*productionofsecondarymetabolites.PolyhouseTechnology-Important diseasesofmedicinalplantsandtheirmanagement.	18 hou
Unit-IV	MethodsInvolvedinsecondarymetaboliteproduction-Organculture,Cellculture,Biotransformation(MicrobialandPlantcells)-Scaleup-Enhancement of product formation by elicitation-Immunodiagnostics and moleculardiagnosticsinselectionofelite plantspecies.	18 hou
Unit-V	Introduction to analysis and quality controls of herbal products (TLC, HPLC,IR, NMR, and mass spectroscopy). Pharmaceutical application of alkaloids,terpenoids, glycosides, volatile oils, tannins and resins. - Intellectual PropertyRights-RegulatoryAffairherbalpharmaceuticals-Entrepreneurship Management.	18 hou
	TotalTeachinghours	**90 hou**

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Reference&TextBooks:

1. Harborne,J.B.,1998.Phytochemicalmethodstomoderntechniquesofplantanalysis.Chapman &Hall, London.
2. Trease G.E,M.C.Evans,1979.TextbookofPharmacognosy12thed. Balliere-Tindal, London.
3. IrfanA.KhanandAtityaKhanum(Eds.).2004. RoleofBiotechnologyin medicinalandAromaticplants,Vols. I-X.UkaazPublications,Hyderabad.AnalyticaltechniquesinDNA sequencingeditedbyBrianK.Nunnally.
4. AgrawalS.S.andM.Paridhavi,HerbalDrugTechnology,Universitypress2007.
5. Henry,R.J.1997.PracticalApplicationsofPlantMolecularBiology.Chapman&Hall,London,

UK.

6. Bidlack,W.R.,Omaye,S.T.,Meskin,M.S.andTopham,D.K.W.,"Phytochemicals as BioactiveAgents",1St Edition,CRCPress,2000.
7. SharolTilgner,N.D.1999.Herbalmedicine-Fromtheheartoftheearth.Edn.1,PrintedintheUSA byMalloyLithographingInc.
8. Balasubramanian,Bryce,Dharmalingam,GreenandJayaraman(ed),Concepts inBiotechnology,University,Press,1996.
9. Anderson,F.JIllustratedHistoryoftheHerbals.NewYork:ColumbiaUniversitypress.2009.
10. Callow,J.A.,Ford-Lloyed, B.V. andNewbury, H.J.1997.BiotechnologyandPlantGeneticResources:ConservationandUse,CAB International,OxonUK.
11. Gokhale,S.S,C.K.KokateandA.P.Purohit(1994).Pharmacognosy.Niraliprakashan,Pune.
12. Faroogi,A.A.andB.S.Sreeramu(2004),CultivationofMedicinalandAromaticcrops.UniversityPress(India)P.Ltd.,Hyderabad.
13. Pal.D.CandS.K.Jain(1998),Tribalmedicine,Naya Prakash,206,BidhanSarani,Calcutta.
14. Thirugnanam, Akbarsha and Krishnamurthy (2010), Indian Medicinal plants and Home Remedies,SelviPathipagam,Trichy.

CourseMaterial:

1. Rasheeduzzafar(2006),Medicinalplantsof India,CBSpublication.
2. InternationalJournalofHerbalMedicine
3. JournalofHerbalmedicineElsevier
en.wikipedia.org/wiki/Herbalmedicine

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	3	2	
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

OPEN ELECTIVEII (A):ENVIRONMENTALSCIENCES

Paper code: **Name ofthePaper:**EnvironmentalSciences
TotalHours perWeek:2 **Credits:2**

CourseObjectives

1. Tointroducestudentstothebasicsof Environment.
2. Toenablethestudents learnbasicstructureand functionsofecosystem.
3. Tomakestudentsunderstandthedistributionoflifeandlifeformsonearth.
4. Tomakestudentsawareofthedifferentformsofenergyinenvironment.
5. Tomakethestudentsunderstandthedifferent pollutantsandpollutionandtheirManagement.

CourseOutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Thestudentwillbeabletounderstandtheprinciplesandscopeofenvironment.
2. Thestudentwillbeabletounderstandthedistributionandcyclingofenergyandmatterin Environ ment.
3. Thestudentwillbeabletoidentifyandcharacterizetheearthsciences.
4. Thestudentwillbeableexplorate thesourcesofenergyfromenvironment.
5. Thestudentswillbeabletoapplymethodstocontrolandmanagetheenvironmentpollution.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Cre
1	Yes	Yes	No	Yes	Yes	
2	Yes	Yes	Yes	Yes	Yes	
3	Yes	Yes	No	Yes	Yes	
4	Yes	Yes	Yes	Yes	Yes	
5	Yes	Yes	Yes	Yes	Yes	

UNITI	Definitions,principlesandscopeofenvironmentalscience.Structure and composition of atmosphere, hydrosphere, lithosphere,biosphere. Meteorological parameters. Environmental education andawareness.EnvironmentalEthics.	18 hours
UNIT-II	Introductiontooriginoflifeandspeciation,Ecosystemstructureandfunctions,foodchainsandwebs,Basisofecosystem classification, Biotransformation, water and air borne microbes,Bioremediation,Bioindicators,Biofertilizers,Biofuels,Biosensors.	18 hours
UNIT –III	Introduction to origin of earth, components of earth, zones of earth,Climates of India, weather reactions, erosion, transport, depositionofsediments,Soilformingmineralsandprocess,identificationa nd characterizationofclayminerals,Groundwaterquality,pollutionofground waterandmitigationofitsimpacts.	18 hours
UNIT–IV	Sources of energy, Sun as source of energy, Solar radiation and itsspectralcharacteristics,Characteristicsandenergycontent ofcoal,petroleum,andnatural gases,Energyusagepatterninworldand India,Pollutants,emissionsofCO_2 andGlobalwarming.	18 hours
UNIT-V	Introductiontopollution,air,noise,water,soil,thermal,marineandradioactivePollution, Concept of Waste management, Solid andhazardous waste management, Electrical energy generation, e-waste,flyash,plasticwaste,Environmentalmanagementsystem standards, IPCC, UNEP,IGBP,Global environmental issues-Biodiversityloss,climate change,Ozonedepletion,sealevel rise.	18 hours
	TotalLecturehours	90 hours

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Textbook:

1. Hardy,J.T.2003.ClimateChange:Causes,EffectsandSolutions.JohnWiley&Sons.
2. Harvey, D.2000.ClimateandGlobalClimateChange.PrenticeHall.
3. Minkoff,E.C.1983.EvolutionaryBiology. AddisonWesley.PublishingCompany.
4. Nei,M.&Kumar,S.2000.MolecularEvolutionandPhylogenetics.OxfordUniversityPress.
5. Pepper,I.L.,Gerba,C.P.&Brusseau,M.L.2006.EnvironmentalandPollutionScience.ElsevierAcademicPress.
6. Purohit, S.S.&Ranjan,R.2007.Ecology,Environment&Pollution.AgrobiosPublications.
7. Owen,O.S,Chiras,D.D,&Reganold,J.P.1998.NaturalResourceConservation–ManagementforSustainable Future(7thedition).PrenticeHall.
8. Elliott,D.1997.SustainableTechnology.Energy, SocietyandEnvironment(Chapter3).

NewYork,RoutledgePress.

9. Bagchi,A.2004. DesignofLandfillsand IntegratedSolidWasteManagement.JohnWiley&Sons.
10. Odum,E.P.1971.Fundamentals ofEcology.W.B.Sounders.
11. Barry,R.G.2003.Atmosphere,WeatherandClimate.RoutledgePress,UK.
12. Mitra,A.P.,Sharma,S.,Bhattacharya,S.,Garg,A.,Devotta,S.&Sen, K.2004.ClimateChangeandIndia.UniversitiesPress,India.

ReferenceBook:

1. Botkin,DanielB.(2011).EnvironmentalScience:EarthasalivingPlanet,JohnWileyandSons, NewDelhi.
2. Chapman.J.L.andReiss,M.J.(2005).Ecology,PrinciplesadApplictions,CambridgeUniversityPress,London.
3. Dash,M.C.(1994).FundamentalsofEcology, TataMcGrawHill,NewDelhi.
4. Gunther,O.(1998)EnvironmentalInformation Systems.Berlin,NewYork,Springer.
5. MillerG.TaylorandScotSpoolman.(2011).EssentialsofEcology,Books/ColeLearning,sU.S.A.
6. Odum,E.P.(1971).FundamentalsofEcology, W.B.SaunderCompany, Philadelphia
7. SharmaP.D.(1996).EnvironmentalBiology, RastogiPublications,Meerut.
8. VermaP.S.andV.K.Agarwal.(1985).PrinciplesofEcology.S.ChandandCompany(Pub.),NewDelhi.
9. Strahler,A.V.andStrahler,A.A(1973).EnvironmentalGeoscience,WileyInternational.
10. PrimackR.B.2014.EssentialsofConservationBiology, OxfordUniversityPress,USA.

CourseMaterial:websitelinks,e-Booksande-journals

1. **https://www.hzu.edu.in/bed/E%20V%20S.pdf.**
2. **https://www.intechopen.com/books/1882.**

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	32		
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

OPENELECTIVEII(B):MEDICALMICROBIOLOGY

Paper code: **NameofthePaper: MedicalMicrobiology**
TotalHours perWeek:2 **Credits:2**

Aim:Toenablethe studentstounderstandthebasicsofMedicalMicrobiology

CourseObjectives

1. Tointroducestudentstothebasicsofcollectionandtransportofmicrobialsource
2. Toteachstudentsabouthostparasiterelationship.
3. Tomakestudents understandthatbacterialpathogens anditsrelateddiseasesofphase I.
4. Tomakestudents understandthatbacterialpathogensanditsrelateddiseasesofphase II.
5. TomakethestudentsunderstandthatNosocomialandZoonoticdiseases

CourseoutComes(fiveoutcomesforeachunitsshouldbementioned)

1. Afterstudyingunit-1,thestudentwillbeableto– knowthebasicsofcollectionandtransportofmicrobialsource
2. Afterstudyingunit-2,thestudentwillbeableto–understandthehostparasiterelationship
3. Afterstudyingunit-3,thestudentwillbeableto– learnbacterialpathogensanditsrelateddiseasesofphaseI
4. Afterstudyingunit-4,thestudentwillbeabletobacterialpathogensanditsrelateddiseasesofphaseII
5. Afterstudyingunit-5,thestudentwillbeableto–knowaboutNosocomialandZoonoticdiseases

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Cre
1	Yes	Yes	No	Yes	Yes	
2	Yes	Yes	Yes	Yes	Yes	
3	Yes	Yes	No	Yes	Yes	
4	Yes	Yes	Yes	Yes	Yes	
5	Yes	Yes	Yes	Yes	Yes	

UNIT I	Collectionsandtransportofspecimens:Collectionsandtransportofspecimens.PrimaryMediaforisolationandtheirqualitycontrol. Antibioticsensitivitytestingprocedure.	18hours
UNIT-II	HostParasiteRelationship:Normalmicrobialfloraofhumanbody,Virulence factors of bacteria causing infection, Microbial Infections,HostParasiteRelationships.	18hours
UNIT–III	Bacterial pathogens and associated diseases part I, Classification,Morphology, cultural &Biochemical characteristics, pathogenicity,Lab diagnosis&Prophylaxis and treatmentof disease caused byStaphylococci,Streptococcai,Neisseriae,Mycobacteria, Corynebacteria,Bacillus,Clostridium.	18hours
UNIT–IV	Bacterialpathogensand associateddiseasespartII E,coli,Samonella,Shigella,Vibrio,pseudomonas,Spirochaetes,Rickettisiae.GramNegativeanaerobes.	18 hours
UNIT-V	NosocomialandZoonoticdiseases,Hospitalacquiredinfection–infectioncontrolcommittee,Zoonoticdiseases-Anthrax,Plague.	18 hours
	TotalLecturehours	90hours

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

TextBooks&References

1. DavidGreenwood,RichardC.B,Slack,JohnForestpeuthere“MedicalMicrobiology”14thEdn.ELBS withChurchillLivingstone.

2. AnanthanarayananRand JayaramPanicker,C.K.Textbookofmicrobiology-OrientLongman

3. ColleJC,DuguidJP, FraserAC,Marimon(Bp)1996.Mackie andMcCartneyPracticalMedicalMicrobiology14thEdn.ChurchillLivingstone.

4. Baron L.J, Peterson L.RandFinegodS.M(1994)BaileyandScottDiagnosticMicrobiology,9thEdn.MosbyPublications.

5. Cowan andSteel (1995)ManualforidentificatioinofMedicalBacteria.4thEDN,CambridgeUniversityPressLondon.

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	3	2	
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

OPENELECTIVEII(C):AGRICULTURALBIOTECHNOLOGY

Papercode: DDOBT13C **NameofthePaper:**AgriculturalBiotechnology

TotalHours/Week:2 **Credits:** 2

Aim: To make the students learn the fundamental principles of biotechnology, various developmentsand theirapplicationsandscopeinagriculturalBiotechnology.Toprovideknowledgeinbiotechnologic alinnovationspertainingtoissuesinagriculture.

CourseObjectives

1. Toprovidethestudentstheknowledge inbiotechnologicalinnovationspertainingtoissuesinagriculture
2. Toenablethestudents learnbasicsof geneticsintheplantevolution.
3. Toenablethestudentstounderstand theconcepts ofmolecularbiology.
4. Tomakethestudentsawareofadvancedmoleculartechniquesin plantbiotechnology.
5. Tomakethestudentsunderstandthedifferent waysof genetransfermethodsandIdentificationoftransgenicgenes.

CourseOutComes

1. Thestudentwill beabletoappreciatetheimportanceof agricultureandneedforBiotechnologyinagriculture.
2. Thestudentwill beabletolearnthebasicsconcepts ofplantsystem andtheirgenetics.
3. Thestudentwill beabletodifferentiatethe genome,plasmidsandvectorsandtheirtranslation.
4. Thestudentwill beabletoselectthedifferentways ofgenetransfermethodsforPlanttransgenesis,variousdevelopmentsandtheirapplications.
5. Thestudentswillbeabletoapplysuitablemethodsofbiotechnologyinagriculture andidentificationofplanthybridization.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Cre
1	Yes	Yes	No	Yes	Yes	
2	Yes	Yes	Yes	Yes	Yes	
3	Yes	Yes	No	Yes	Yes	
4	Yes	Yes	Yes	Yes	Yes	
5	Yes	Yes	Yes	Yes	Yes	

UNIT I	History,scopeandimportanceofbiotechnologyinAgriculture–ApplicationofbiotechnologyinAgriculture	18 hours
UNIT-II	Mendeliangenetics,allosomes,linkageandextrachromosomalinheritance-Introductiontogenetics-Earlierconceptsofinheritance –cell andcellorganelles-Cell division,Mendel‟slaws	18hours
UNIT–III	Nucleic acid structure and its function-Modes of DNA replication-Genetic code - Central dogma of life – Transcription – Translation-RecombinantDNAtechnology-DNAmodifyingenzymes–CloningVectors–Plasmids-cosmids-phagemids-Shuttlevectors-BAC-YAC-HAC-applications.	18hours
UNIT–IV	Gene transfer methods – *Agrobacterium* - mediated gene transfer,direct gene transfer, gene silencing – Principles of QTL and MarkerAssistedSelection(MAS)–Achievements-Transgenicplants–Achievements–Current trends.	18 hours
UNIT-V	Geneisolation,synthesisandcloning,genomicandcDNAlibraries,PCRbasedcloning,positionalcloning-Nucleicacidhybridization andimmunochemicaldetection-DNAsequencing.	18 hours
	TotalLecturehours	90hours

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

Textbook:

1. Benjamin Lewin,GeneIX,9thEdition,JonesandBarlettPublishers, 2007.
2. J.D.Watson,N.H.Hopkins,J.WRoberts,J.A.Seitz&A.M.Weiner;MolecularBiologyoftheGene,6thEdition,BenjaminCummingsPublishingCompanyInc,2007.
3. Albertsetal;MolecularBiologyoftheCell,4thedition,Garland,2002.
4. Esau'sPlantAnatomy;Meristems,Cells,andTissuesofthePlantBody: TheirStructure,Function,andDevelopment,3rdEdition,JohnWiley&Sons,2006.
5. MartinJIngrouilleandWilliamEddie,Plants:DiversityandEvolution
6. BingruHuang,Plant-EnvironmentInteractions,3rdEdition,CRCPress,2006.
7. R.H.Smith,PlantTissueCulture:TechniquesandExperiments,AcademicPress,SanDiego.1992.
8. SSBhojwaniandMKRazdan,PlantTissueCulture,ElsevierPubl.
9. S.B.Primrose,R.M.Twyman andR.W.Old;PrinciplesofGeneManipulation.6thEdition,S.B.UniversityPress,2001.
10. J.SambrookandD.W.Russel;MolecularCloning:A LaboratoryManual,Vols1-3,CSHL,2001.

ReferenceBook:

1. BrownCM,Campbell IandPriestFG.2005.IntroductiontoBiotechnology.PanimaPublications.
2. Bhojwaniand Dantu, 2013.Planttissueculture:Anintroductorytext,Springer,NewDelhi.
3. Singh,B.D., Fundamentalsofgenetics2014,KalyaniPublishers,NewDelhi.
4. Gardner,E.J.&Snustad,D.P.1991.PrinciplesofGenetics.JohnWiley&Sons,USA.
5. Chawla,H.S.2008.IntroductiontoPlantBiotechnology,3rdEd.OxfordIBH,India.69.
6. Dale,J.W.andVonSchantz,M.2002.FromGenestoGenomes: ConceptsandApplicationsofDNATechnology.JohnWiley&Sons,Newyork,USA.
7. Snustad,D.P.&Simmons,M.J.2006.Genetics.4thEd.JohnWiley&Sons,USA.
8. Strickberger,M.W.2005.Genetics(IIIEd).PrenticeHall,NewDelhi,India

CourseMaterial:websitelinks,e-Booksande-journals

1. **https://www.isaaa.org/resources/publications/agricultural_biotechnology/download /A gricultural_Biotechnology.pdf.**
2. **https://www.researchgate.net/publication/267338355_Book_Review_Agriculture_Biotechnology_and_Develop me**

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	32		
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

PRACTICALV:LABINPLANTBIOTECHNOLOGY &ANIMALBIOTECHNOLOGY AND

LABINMICROBIALTECHNOLOGY&ENVIRONMENTALBIOTECHNOLOGY

PlantBiotechnology (10 credit)

1. Introductiontoplanttissueculture-inductionofcallusand suspensioncultures.
2. Isolationandpurifytheprotoplastsandcheckitsviability.
3. Inductionofsomaticembryogenesisandanalysisofdifferentstages.
4. Extractthegenomic DNAfromplantsbyCTAB
5. CultureandselectionofAgobacteriumonAgarmedium
6. Agrobacteriummediatedgenetransformation
7. UseofAgroinfilterationforTransient ExpressioninPlant
8. Gusassay
9. AnalysisofWT/Transgenicplant byPCR
10. IsolationofTotalRNAfromleaves
11. Genegunmethodoftransformation
12. Syntheticseedpreparation

Lab inAnimalBiotechnology

1. Developmentofprimarycelllines/maintenanceof establishedcelllines.
2. Cellcountingandcellviability.
3. Trypsinizationofmonolayerandsubculturing.
4. Genetransferbytransfection
5. Preparationofmetaphasechromosomesfromculturedcells.
6. Isolationof DNAanddemonstrationofapoptosis ofDNAladdering
7. MTTassayforcellviabilityandgrowth

MicrobialTechnology

1. Studyoffermentor-Demonstration.
2. Productionandisolationofantibiotics(Penicillin andStreptomycin)
3. ProductionandanalysisofSinglecell protein(Spirullinaandyeast)
4. Productionof yoghurtandestimationoflacticacid.
5. Estimationofpercentageofalcoholof givensample
6. Productionandassayofα-amylasefromAspergillusnigerbysolidsubstratefermentation.
7. Immobilizationofgivenenzyme/wholecells
8. Estimationofamountofcitricacidinthegivensample.

References

1. PracticalApplicationsofPlantMolecularBiology.RobertJ.Henry.RoutledgeChapman&Hall,2008.
2. MolecularPlantBiology:Apracticalapproach(Vol.IandII).GilmartinandBowler.Oxford Universitypress,UK,2002.
3. PlantCellCulture:EssentialMethods.MichaelR.Davey,PaulAnthony.Wiley,2010.
4. PlantTissueCulture,ThirdEdition:Techniquesand Experiments.RobertaH.Smith.AcademicPress,2012.
5. PlantcellcultureProtocols(MethodsinMolecularBiology,3rdEd).VictorM.Loyola-Vargas,NeftaliOchoa-Alejo.HumanaPress,2012.
6. PlantCell,TissueandOrganCulture:FudamentalMethods(SpringerLabManuals).OlufL.Gamborg(Editor),GregoryPhillips(Editor),Springer,2013
7. WaterAnalysis:MeasurementofTotalSolids,Total–dissolvedsolids,Total-suspendedsolids,dissolvedoxygen,totalhardness,chloride,turbidity,nitrite,nitrate,fluoride andtotalnitrogen.
8. EstimationofCOD, BODofindustrialeffluents.
9. Potabilitytestofwater(MPNtechnique).
10. Degradationofphenols. Colorimetricassay
11. EstimationofMICandHeavymetaltoleranceofchromiumresistantbacteria
12. ScreeningofBiosurfactantactivity-OilDisplacement test-Dropcollapsetest
13. IsolationofThiobacillusferrooxxidansandThiobacillusthiooxidansfrommetalsulphides,rockand acidminewater.
14. Microbialdegradation,decolourzsationandadsorptionoforganicdyesbyfree andimmobilizedcells
15. Studiesonhalophilesfrom seawater(pigmentationandsalttolerance)

MOOC-MASSIVEOPENONLINECOURSES

USRR(UNIVERSITYSOCIALRESPONSIBILITYREPORT)

TheaimoftheFieldStudyistohelpstudentsconnectwiththesocietyintherespectivediscipline.Following aretheimportantfeaturesoftheFieldStudyandtheUSRR:

1. **Aim:** The Field Study must aim at relating the subject of study with the society in so far as theapplicationandtheusefulnessofthestudyareconcerned

2. **Topic selection:** The topic for the Field Study must be chosen by the student in the second semester inthe month of February; the process for the same shall begin on 1st February and shall end on the lastworking day of the month of February. Students are free to select the topic for the Field Study inconsultation with the Experts and Faculty Members of their choice, both from within and outside theUniversity

3. **Period and duration:** The Field Study shall be undertaken for a duration of 15 days in the summervacation that falls immediately at the end of the second semester of the program and the same should beaccountedfortheThirdSemesteroftheprogram

4. **USRR:** The USSR (University Social Responsibility Report) must be prepared by every student of theprogramwrittenin50to75pages.Thereportshallbewrittenbasedonthestandardresearchmethodology.

5. **Reviewandevaluationschedule:**

a. ***ReviewingtheFieldwork:***FirstweekofJuly

b. ***ReportReview:*** SecondweekofAugust

c. ***Reportsubmission:***FirstweekofSeptember

d. ***ReportEvaluation:*** ThirdweekofSeptember

6. **Faculty Composition:** The following members may be nominated for confirming the topic and forevaluatingtheUSRR:

a. ProfessorandHeadoftheconcernedDepartment

b. OneFacultymemberwithrelatedfieldofspecializationfrom theconcernedDepartment

c. OneseniorfacultymemberfromtheDepartmentofSociologyfromotherInstitution

SEMESTER IV

PAPER1: Genetic Engineering

Papercode: Subject: **Genetic Engineering**

Hours/Week:5

Credits:4

Aim: To enable the students to understand the basic concept and also the cloning vector and also the cloning methodology and also the sequencing methods.

CourseObjectives

1.TolearntheDNA Structure and properties

2.Tolearn the CloningVectors and plasmid based vector

3.TodevelopknowledgeonCloningMethodologies and PCR and Its Applications

4.Tolearn about the swquencing method and gene silencing

5.Todevelopapieceofknowledgeabout gene expression .

CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletounderstand the Basic concept and DNA structure and properties .

7.Aftercompletingunit2,thestudentswill able to understand the cloning vector and methodologies to reduce formation of inclusion bodies.

8.Aftercompleting unit3,thestudentswillbeable to understand Cloning methodologies and PCR and its applications.

9.Aftercompleting unit4,thestudentswillbeabletoexplainabout the PCR and its application .

10.Aftercompleting unit5,thestudentswillbeabletoexplainabout the sequencing method.

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	CourseContents	Teaching hours
UnitI	DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay; DNaseI footprinting; Methyl interference assay	**18hours**
Unit-II	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies;Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors	**18 hours**
Unit-III	Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Far-western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression	**18 hours**
Unit-IV	**PCR and Its Applications** Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; Proof reading enzymes;PCR ingene recombination;Deletion;addition;Overlapextension;and SOEing; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test).	**18 hours**

Unit-V	Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNAvectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.	**18hours**
TotalTeachinghours		**90**

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

ReferenceBook:

1. DavidP.Clark,NanetteJPazdernik,BiotechnologyApplyingtheGenetic Revolution, Elsevier.
2. JackG.Chirikjian,GeneticEngineeringMutagenesisSeparationTechnology, Jones and Bartlett Publishers.
3. U.Satyanarayana,Biotechnology,BooksandALLIED(p)Limited.
4. Michael P. Tombs, Biotechnology and Genetic Engineering Reviews volume 10. Intercept.
5. DannielL.Hart,ElizabethW.Jones,essentialGenetic(SecondEdition)Jones and Batlett Publishers.
6. EJohansenNange,ArthurPNange,BasicHumanGenetics(SecondEdition) Sinauer Association, Ins Publisher Sunderland, Massachusetts.

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	3	2	
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER IV

ELECTIVE PAPER 1.: Bioremediation

Papercode:Subject: Bioremediation

Hours/Week:5

Credits:3

Aim: To enable the students to understand the basic concept of bio remediation I and II and also the Hazardous waste management and also the concept of phyto remediation.

CourseObjectives

1.TolearntheIntroduction , Bioremediation and Bioaugumentation .

2.Tolearn the Solid phase bio remediation and Biosparging.

3.Todevelopknowledgeon Hazardous waste management

4.Tolearn the Concept of bioremediation and also Conceptsofphytoremediation

5. TodevelopapieceofknowledgeBioremediation of toxic metal ions- biosorption and bioaccumulationprinciples. And also about the microbial remediation and ecological restoration and bio remediation .

CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of bio remediation and bio augmentation.

7.Aftercompletingunit2,thestudentswill able to understand the solid phase bio remediation.

8.Aftercompletingunit3,thestudentswillbeable to understand the hazardous waste management.

9.Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of bio remediation and also the use of micro organism in augmentation..

10.Aftercompletingunit5,thestudentswillbeabletoexplainthe concept of microbial remediation

Matching Table (Put Yes/Nointheappropriatebox)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	CourseContents	Teaching hours
UnitI	**Bioremediation- I** Introduction, constraints and priorities of Bioremediation, BiostimulationofNaturallyoccurring microbialactivities, Bioaugmentation, insitu, ex situ, intrinsic & engineered bioremediation	**18 hours**
Unit-II	**Bioremediation –II**Solid phase bioremediation- land farming, preparedbeds, soilpiles, Phytoremediation.Composting,Bioventing&Biosparging;Liquidphaseb ioremediation -suspendedbioreactors,fixedbiofilmreactors.	**18 hours**
Unit-III	**Hazardous Waste Management** biotechnology application to hazardous waste management - examples of biotechnological applications to hazardous wastemanagement–cyanidedetoxification-detoxificationofoxalate, urea etc.-toxic organics -phenols.	**18 hours**
Unit-IV	Concept of bioremediation (in-situ & ex-situ), Bioremediation of toxic metal ions- biosorptionand bioaccumulationprinciples. Conceptsofphytoremediation. Microbial leaching of ore-direct and indirect mechanisms. Mining and metal. Use of microorganisms in augmentation of petroleum recovery. Biotechnology-with special reference to Copper and Iron.	**18 hours**
Unit-V	Microbial remediation of phenolics-sewage nutrients(phosphate and nittare). Impact of bioremediation in the petroleum industry,paperindustry,marineoilpollutantsandchemicalindustry.Phytor emediationadvantagesandapplications(agriculture)	**18hours**
TotalTeachinghours		**90**

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

ReferenceBook:

1. EnvironmentalBiotechnologybyS.K. Agarwal
2. Biodegradation&Bioremediation(1999), MartinAlexander,Academicpress.
3. StanierR.Y.,IngramJ.L.,WheelisM.L.,PainterR.R.,GeneralMicrobiology, McMillan Publications, 1989.
4. FosterC.F.,JohnWareD.A.,EnvironmentalBiotechnology,EllisHorwoodLtd., 1987.
5. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, AdvancesinAppliedBiotechnologySeries,Vol.4,GulfPublicationsCo.London, 1989.
6. Bioremediationengineering;designandapplication1995John.T.cookson, Jr. Mc Graw Hill, Inc.
7. EnvironmentalBiotechnologybyA.K.Chatterjee
8. EnvironmentalBiotechnologybyS.N.JogdandHimalayaPublishing

.**MappingwithProgrammeOutcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	32		
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15
Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

SEMESTER IV

ELECTIVE PAPER2: IPR and Biosafety

Papercode: Subject: **IPR and Biosafety**

Hours/Week:5

Credits:3

11

Aim: To enable the students to understand the basic concept of Introduction of intellectual property and also the basic patterns and concepts of prior art and also patent filing procedure and biosafety.

CourseObjectives

1.TolearntheIntroduction to intellectual property and types of IP .

2.Tolearn the basic patent and concept of Prior art and International Databases.

3.Todevelopknowledge about the patent filling procedure and infringement .

4.Tolearn the Concept of bio safety levels and bio safety guidelines .

5. Todevelopapieceofknowledgeabout the biological safety cabinets and risk analysis.

CourseOutComes

6.Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of Intellevtual property and agreement and treaties .

7.Aftercompletingunit2,thestudentswill able to understand the concept of patents .

8. Aftercompletingunit3,thestudentswillbeable to understand the patent filing procedure and patent licensing

9. Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of biosafety levels .
10. Aftercompletingunit5,thestudentswillbeabletoexplainthe concept of biosafety guidelines.

Matching Table (Put Yes/Nointheappropriatebox)

11

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating

1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	CourseContents	Teaching hours
UnitI	**Introduction to Intellectual Property**Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies **Agreements and Treaties**History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments	**18hours**
Unit-II	**Basics of Patents and Concept of Prior Art**Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTScope(WIPO), IPO, etc.)	**18hours**
Unit-III	**Patentfilingprocedures** National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement-meaning, scope, litigation, case studies	**18hours**
Unit-IV	**Biosafety** Introduction; Historical Backround; Introduction toBiological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;	**18hours**
Unit-V	**Biosafety guidelines** - Government of India; Definition of GMOs & LMOs; RolesofInstitutional BiosafetyCommittee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs;	**18hours**
TotalTeachinghours		**90**

InternalAssessmentMethods:(25 marks)

Distributionfor internals	Test(CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

ReferenceBook:

1. P.Narayanan,IntellectualPropertyLaws,EasternLawHouse.
2. MeenuPaul,IntellectualPropertyLaws,AllahabadLawAgency.
3. IntellectualPropertyLawcontainingActsandRules,UniversalLawPublication Company.

.**MappingwithProgrammeOutcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PC
CO1	3	3	3	2	3	3	3	3	2	
CO2	3	3	2	3	3	3	3	2	3	
CO3	3	3	3	3	3	2	3	3	3	
CO4	3	2	3	3	2	3	3	3	3	
CO5	3	3	3	3	3	3	3	3	2	

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	2	3
CO3	3	3	2	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3
Weightage	11 15	15	10	10	15
Weighted percentage (rounded of) Course Contribution to POs	3	3	2	2	3

Strong - 3, Medium – 2, Low - 1

SEMESTER IV

ELECTIVE PAPER3: Biochemistry

Papercode: Subject: **Biochemistry**

Hours/Week:5

Credits:3

Aim: To enable the students to understand the basic concept of bio molecules and also the classification of lipids and also about the amino acids and also the IUB classification and nomenclature .

CourseObjectives

1.Tolearntheconcept and organisation of biomolecules and Carbohydrates.

2.Tolearn the concept of classification of lipids.

3.Todevelopknowledge about the classification of amino acids

4.Tolearn the Concept of IUB classification and nomenclature of enzymes and nucleic acids .

5. Tounderstand the structure of proteins and also the structue of purine and prymidine bases.

CourseOutComes

6. Aftercompletingunit1,thestudentswillbeabletoUnderstand the concept of bio molecules and carbohydrates structure and classification..

7..Aftercompletingunit2,thestudentswill able to understand the concept of classification of lipids and properties of fatty acids.

8. Aftercompletingunit3,thestudentswillbeable to understand the concept of classification and structure of amino acids.

9.Aftercompletingunit4,thestudentswillbeabletoexplainthe concept of IUB classification and nomenclature of enzymes .

10.Aftercompletingunit5,thestudentswillbeabletoexplainthe basic concept of nucleic acid

Matching Table (Put Yes/No in the appropriate box)

Unit	i.Remembering	ii.Understanding	iii.Applying	iv.Analyzing	v.Evaluating	vi.Creating
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	No	Yes	Yes	Yes	No
3	No	Yes	No	Yes	Yes	Yes
4	No	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes

Units	**Course Contents**	**Teaching hours**
UnitI	**Organisation of Biomolecules**, Buffers, Principle and biological application of diffusion osmosis, viscosity and Donnan membrane equilibrium. Carbohydrates: structure and classification of carbohydrates, metabolism of carbohydrates : glycoysis, TCA ycle HMP pathways.	**18 hours**
Unit-II	**Lipids** : Classification, structure and nomenclature of lipids, Biological significance of lipids, physico- chemical properties of fattyacids and triacyl glycerol.	**18hours**
Unit-III	**Aminoacids** : classification, structure and nomenclature of aminoacids, physico-chemical properties of aminoacids. proteins: confirmation of proteins and polypeptides secondary, tertiary and quartenary and domain structure of proteins, denaturation of proteins and Ramchandran plots	**18hours**
Unit-IV	**IUB Classification and nomenclature of enzymes**, general properties of enzymes, enzyme kinetics- Michaelis Menten equations, Coenzymes - structure and biological fucntion of coenzymes A, TPP, FMN, FAD, NAD and lipoic acid, structure of purine and pyrimidine bases, nucleosides and nucleotides. Primary structure of nucleic acid, Three dimensional structure of t- RNA.	**18hours**

Unit-V	**Nucleic acids** Nature of genetic material, structure of purine and pyrimidine nucleotides. Composition of DNA and RNA-Watson crick model of DNA. Types of nucleic acid (DNA and RNA).Properties of nucleic acids-Tm, denaturation and renaturation, hypo and hyper chromicity.	**18hours**
Total Teachinghours		**90**

Internal Assessment Methods:(25 marks)

Distribution for internals	Test (CIAI+CIA II+CIAIII)	Seminars	Assignment	Totalmarks
Marks	15	05	05	25

ReferenceBook:

1.Principles of Biochemistry, Lehninger.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3

PO–ProgrammeOutcome,CO–Courseoutcome,S–3,M–2,L–1

Mapping with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Weightage	15	10	15	15	15

Weighted percentage (rounded of) Course Contribution to POs	3	2	3	3	3

Strong - 3, Medium – 2, Low - 1

PROJECT. **(8 CREDIT)**