325	B.Sc. Chemistrty	Core Elective II : Analytical Chemistry - II	21UCY6E21	2021
326	B.Sc. Chemistrty	Core Elective - II : Pharmaceutical Chemistry II	21UCY6E22	2021
327	B.Sc. Chemistrty	Core Elective - II : Agricultural Chemistry and Analytical Techniques for Agrochemicals	21UCY6E3	2021
328	B.Sc. Chemistrty	Advanced Learner Course - II: Applications of Spectroscopy (Optional)	21UCY6AL2	2021
329	B.Sc. Chemistrty	Skill Based Elective – II : Green chemistry	21UCY6S21	2021
330	B.Sc. Chemistrty	Skill Based Elective - II : Clean energy	21UCY6S22	2021
331	B.Sc. Chemistrty	Allied Chemistry Paper – I : Inorganic, Organic And Physical Chemistry	21UPS3A4/ 21UBY3A4/ 21UZY3A4/	2021
332	B.Sc. Chemistrty	Allied Chemistry Paper – II : Inorganic, Organic And Physical Chemistry	21UPS4A5/ 21UBY4A5/ 21UZY4A5	2021
333	B.Sc. Botany	Major Paper IX – Bioinformatics	21UBY509	2021
334	B.Sc. Botany	Major Paper X – Mathematics for Biologists	21UBY510	2021
335	B.Sc. Botany	Elective I – Microbiology and Plant pathology	21UBY5E1	2021
336	B.Sc. Botany	Elective I–Ethno Botany	21UBY5E2	2021
337	B.Sc. Botany	Elective I –Herbal cosmetics and Cosmeceuticals	21UBY5E3	2021
338	B.Sc. Botany	Advanced Learner Course - I Biological Disaster – Mitigation & Management	21UBY5AL	2021
339	B.Sc. Botany	Elective II – Habitat Ecology	21UBY6E4	2021
340	B.Sc. Botany	Elective II – Biodiversity and its Conservation	21UBY6E5	2021
341	B.Sc. Botany	Elective II – Environmental Biotechnology	21UBY6E6	2021
342	B.Sc. Botany	Elective III – Bioprospecting	21UBY6E7	2021
343	B.Sc. Botany	Elective III – Biofertilizers	21UBY6E8	2021
344	B.Sc. Botany	Elective III – Seed Technology	21UBY6E9	2021
345	B.Sc. Botany	Major Practical IV (for VI Sem theory papers)	21UBY615	2021
346	B.Sc. Botany	Advanced Learner Course II - Bionanotechnology	21UBY6AL	2021

BoS Minutes Highlighted

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NALLAMUTHU GOUNDER MAHALINGAM COLLEGE POLLACHI

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Nallamuthu Gounder mahalingam college, pollachi
Department of Botany 22.05.2021

Board of Studies - Panel members

1.	Dr. R. Kannan Chairman	Associate Professor & Head, Department of Botany, N.G.M. College, Pollachi.
2.	Dr. P. Ponmurugan University Nominee	Associate Professor, Department of Botany, Bharathiar University, Coimbatore
3.	Dr.K. Gajalakshmi Subject Expert	Assistant Professor, Department of Botany, PSG Krishnammal College for women, Coimbatore.
4.	Dr. Prema Subject Expert	Assistant Professor, Department of Botany, Sri Palaniandavar College for women, Palani.
5.	Mr. E.S. Karthy Industrial Expert	Biofertilizers - Enterpreneur Tirupur.
5.	Dr. Ramesh Banu Alumnus	Forest Guard Indira Gandhi Tiger Reserve Western Ghats.
6.	Mr. Maheshwaran Current Student (D3)	Department of Botany, N.G.M. College, Pollachi.
7.	Dr. M. Latha Isabel	Assistant Professor, Department of Botany, N.G.M. College, Pollachi.
8.	Dr. A. Logamadevi	Assistant Professor, Department of Botany, N.G.M. College, Pollachi.
9.	Dr. K. Rajalakshmi	Assistant Professor, Department of Botany, N.G.M. College, Pollachi.
10.	Dr. E.Neelamathi	Assistant Professor, Department of Botany, N.G.M. College, Pollachi.

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22/05/21

DEPARTMENT OF BOTANY (UG)
NGM COLLEGE, POLLACHI

22.05.2021

Board of Studies (on-line) Agenda:

- New core electives (optional)
- Advanced learner Course
- Value Added Course

Resolutions:

It is resolved in the Board of studies (on-line) on 22.05.2021

(i) To introduce new optional courses for Core electives in the fifth and sixth semester

Elective I	V Semester	Microbiology and Plant Pathology/ Ethno Botany/ Herbal Cosmetics
Elective II	VI Semester	Habitat Ecology/ Western Ghats Biodiversity/ Environmental Biotechnology
Elective III	VI Semester	Bioprospecting/ Biofertilizers/ Seed Technology

(ii) To introduce the advanced learner course for fast learners and to award them with extra credits

Advanced Learner Course I	V Semester	Biological Disaster – Mitigation & Management
Advanced Learner Course II	VI Semester	Bionanotechnology

(iii) To introduce the Value addedcourse for other Department of students

Value Added Course I	V Semester	Organic Farming
Value Added Course II	VI Semester	Coconut Farming

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22/05/21

(iv) To take up the suggestions from the subject Experts and University Nominee

- To revamp the title and content of Bioinformatics into 'Phytoinformatics'
- To add Aquaponics and Hydroponics in the paper Horticulture
- To include more field visits in the paper organic farming
- To include 'Environmental Management System' in the paper Western Ghats Biodiversity
- To include the specific Ethnic group (any five)of western ghats in the paper Ethnobotany
- To reduce the components of rubrics
- To include 'Quiz' as one of the component in the internal assessment
- To include 'marketing of herbal cosmetic products' in the paper Herbal Cosmetics
- To include Plant Growth Promoting Substances (PGPS) and Liquid Biofertilizers in the paper Biofertilizers

HOD
22/05/21

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NALLAMUTHU GOUNDER MAHALINGAM COLLEGE, POLLACHI.

DEPARTMENT OF BOTANY
B.Sc., BOTANY
SCHEME OF EXAMINATION (I -VI SEMESTER)
(FOR CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2021-2024)

(CBCS for under graduate programmes with language for 4 semesters)

Part No	Course Code	Course title	Lecture+ Tutorial/ Practical Hours/ week	Duration of Exam Hrs	Max. Marks			Credit Point
					Internal	End-of-Semester	Total	
	Semester I							
I	21UTL101 / 21UHN101 / 21UFR101	Tamil/Hindi/French Paper – I	6	3	30	70	100	3
II	21UEN101	English Paper – I	5	3	30	70	100	3
III	21UBY101	Major Paper I - Plant Diversity I (Phycology, Mycology and Bryology)	9	3	30	70	100	4
	21UBY1A1	Allied - Paper I Zoology	7	3	30	70	100	3
IV	21UHR101	Human Rights	1	2	-	50	50	2
	21HEC101	Human Excellence - Personal values & SKY yoga practice–I	2	2	25	25	50	1
V		Extension Activities (Annexure –I)						
	500 16							
	Semester II							
I	21UTL202 / 21UHN202 / 21UFR202	Tamil/ Hindi/ FrenchPaper – II	6	3	30	70	100	3
II	21UEN202	English Paper – II	5	3	30	70	100	3
III	21UBY202	Major Paper II Plant Diversity II (Pteridophytes Gymnosperms and Palaeobotany)	6	3	30	70	100	4
	21UBY203	Major Practical I – Paper III (Plant diversity I & II (Phycology, Mycology and Bryology &Pteridophytes Gymnosperms and Palaeobotany)	2	3	40	60	100	4
	21UBY2A2	Allied - Paper II Zoology	7	3	30	70	100	3
	21UBY2A3	Allied - Paper III Practical	2	3	40	60	100	4

IV	21EVS201	Environmental Studies	2	2	-	50	50	2
	21HEC202	Human Excellence - Family values & SKY yoga practice- II	2	2	25	25	50	1
V		Extension Activities (Annexure –I)						
							700	**24**
	Semester III							
I	21UTL303/ 21UHN303 / 21UFR303	Tamil/ Hindi/ French Paper – III	5	3	30	70	100	3
II	21UEN303	English Paper – III	6	3	30	70	100	3
III	21UBY304	Major Paper IV- Anatomy and Embryology	9	3	30	70	100	4
	21UBY3A4	Allied Paper IV - Chemistry	8	3	30	70	100	3
IV	21UBY3N11/ 21UBY3N12	Skill based subjects (Non major electives)- Landscape designing/ Herbal cosmetics *Basic Tamil paper I	1	2	-	50	50	2
	21HEC303	Human Excellence - Professional values & SKY yoga practice- III	2	2	25	25	50	1
V		Extension Activities (Annexure –I)						
							500	**16**
	Semester IV							
I	21UTL404/ 21UHN404/ 21UFR404	Tamil/ Hindi/ French Paper – IV	5	3	30	70	100	3
II	21UEN404	English Paper – IV	6	3	30	70	100	3
III	21UBY405	Major Paper V – Cell Biology, Biochemistry and Biophysics	6	3	30	70	100	4
	21UBY406	Major Practical II - Paper VI (Anatomy & Embryology, Cell Biology, Biochemistry and Biophysics)	2	3	40	60	100	4
	21UBY3A5	Allied - Paper V- Chemistry	6	3	30	70	100	3
	21UBY3A6	Allied paper VI – Chemistry Practical	2	3	40	60	100	4
IV	21UBY4N21/ 21UBY4N22	Skill based subjects (Non major electives)- (Remote sensing and natural resource management/ Bioinformatics) *Basic Tamil paper II	1	2	-	50	50	2

	21HEC404	Human Excellence – Social values & SKY yoga practice-IV	2	2	25	25	50	1
V		Extension Activities (Annexure –I)			50		50	1
						750	**25**	
	Semester V							
III	21UBY507	Major Paper – VII - Taxonomy of Angiosperms	5	3	30	70	100	4
	21UBY508	Major Paper VIII - Genetics and Evolution	5	3	30	70	100	4
	21UBY509	Major Paper IX – Bioinformatics	5	3	30	70	100	4
	21UBY510	Major Paper X – Mathematics for Biologists	5	3	30	70	100	4
	21UBY5E1/ 21UBY5E2/ 21UBY5E3	Elective I – Microbiology and Plant pathology Elective I–Ethno Botany Elective I –Herbal cosmetics and Cosmeceuticals	5	3	30	70	100	5
	21UBY5AL	Advanced Learner Course - I Biological Disaster – Mitigation &Management	SS	3	30	70	100	5*
IV	21UBY5S11/ 21UBY5S12	Skill Based Electives I- Network and Information security/ Cyber Security- Ethical Hacking	1	2	-	50	50	2
	21GKL501	General Knowledge & General Awareness (SBE)	SS	2	-	50	50	2
	21HEC505	Human Excellence - National values & SKY yoga practice-V	1	2	25	25	50	1
						650	**26**	
	Semester VI							
III	21UBY611	Major Paper XII – Plant Physiology	5	3	30	70	100	4
	21UBY612	Major Paper XIII – Biotechnology & Genetic Engineering	5	3	30	70	100	4
	21UBY613	Major Paper XIV - Horticulture & Plant Breeding	5	3	30	70	100	4
	21UBY6E4/ 21UBY6E5/	Elective II – Habitat Ecology Elective II – Biodiversity and its Conservation	5	3	30	70	100	5

	21UBY6E6	Elective II – Environmental Biotechnology						
	21UBY6E7/ 21UBY6E8/ 21UBY6E9	Elective III – Bioprospecting Elective III – Biofertilizers Elective III – Seed Technology	5	3	30	70	100	5
	21UBY614	Major Practical III – Paper XV (for V Sem theory papers)	2	3	40	60	100	4
	21UBY615	Major Practical IV (for VI Sem theory papers)	2	3	40	60	100	4
	21UBY5AL	Advanced Learner Course - II Bionanotechnology	SS	3	30	70	100	5*
IV	21UBY6S21 21UBY6S22	Skill Based Elective II – Forest Botany Skill based Elective II – Mushroom cultivation	1	2	-	50	50	2
	21HEC606	Human Excellence - Global values & SKY yoga practice-VI	1		25	25	50	1
							800	**33**
		**Grand total					**3900**	**140**

* The credits given are applicable only to the students who opt for Basic Tamil paper and the credits for Human Excellence papers cannot be given to them.

**Grand total should be equal/below 3900 (For UG Programmes); 2550 (For PG Programmes)

SS – Self study, SBE – Skill Based Elective, NME–Non Major Elective

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code 21UBY509		Course Title	2021-2024
		BIOINFORMATICS	Semester 5
Hrs/Week 5			Credits 5

Course Objective

- To introduce classical bioinformatics theory to students
- To focus computer science techniques used in biological studies
- To motivate the students to take-up research in their career

Course Outcome

K1	CO1	To introduce the biological databases and computer languages
K2	CO2	To understand the sequence analysis techniques
K3	CO3	To analyse the structure of proteins with the help of computers
K4	CO4	To distinguish genomics from proteomics
K5	CO5	To encourage the students to take-up research in Bioinformatics and Drug discovery

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	L	M	H	M	H	H	H	H	H	H
CO2	M	H	H	M	H	H	H	H	H	H
CO3	M	H	H	M	H	H	H	H	H	H
CO4	M	H	H	M	H	H	H	H	H	H
CO5	L	H	H	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Introduction to computers - components of computers – input devices – output devices - storage devices - operating system - DOS/WINDOWS/LINUX - computer languages - machine language – assembly language - high level languages - translators – compilers.	**13**
Unit II	Computer languages for bioinformatics - HTML – structure – tags – formatting – hyperlink – graphics; C language – history – features of C – structure of C program – character set – key words – data types – constants, variables – statements – functions.	**13**
Unit III	Introduction to internet - data communication concept – LAN / WAN / WWW – e-mail & FTP - Bioinformatics - definition - biological database (generalized & specialized) - nucleic acid database - protein database - genome database - bibliographic resources and literature database - bioinformatics servers.	**13**
Unit IV	Searching techniques – ENTREZ - sequence analysis tools - sequence alignment - pairwise alignment (BLAST) – multiple sequence alignment (CLUSTAL X) - phylogenetic analysis – tree building and tree analysis.	**13**

Unit V	Protein prediction - primary structure prediction - secondary structure prediction – bio molecular visualization (RASMOL) – drug discovery - target and lead discovery - Computer Aided Drug designing (CAD).	**13**

**Self study topics*

Powerpoint presentation, Seminar, Assignment

Text Books:

1. Lesk A.M., 2002, Introduction to Bioinformatics, Oxford University Press,Oxford.
2. Parthasarathy S., 2008. Essentials of programming in C for life sciences. Ane BooksIndia, New Delhi.
3. Sundararajan S. and R. Balaji, 2002 Introduction to Bioinformatics, HimalayaPublishing House – Mumbai.

Reference Books:

4. Chakraborthy C., 2004, Bioinformatics Approaches and Application. Chawla offsetprinters – Delhi.
5. Westhead D.R., J. Parish and R.M.Twyman, 2003. Bioinformatics (instant notes)Viva books pivate limited – New Delhi.
6. KhanI.A. and A. Khanum, 2002, Emerging trends in Bioinformatics, UkaazPublications.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code 21UBY510		Course Title	2021-2024
		MATHEMATICS FOR BIOLOGISTS	Semester 5
Hrs/Week 5			Credits 5

Course Objective

- To acquire knowledge on basic arithmetic and biostatistical methods
- To introduce the application of computers in Biostatistics
- To instill confidence among the students in taking up research and opting for interdisciplinary career options

Course Outcome

K1	CO1	To revise the basic arithmetic and number system
K2	CO2	To understand the role of mathematics and computers in solving biological problems
K3	CO3	To illustrate the different statistical methods to study a population
K4	CO4	To analyze and interpret a sample data using various methods
K5	CO5	To encourage students to take up research and other interdisciplinary courses for their higher studies

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	L	H	H	H	H	H	H	H	H	H
CO2	M	H	H	H	H	H	H	H	H	H
CO3	M	M	H	H	H	H	H	H	H	H
CO4	L	M	H	H	H	H	H	H	H	H
CO5	L	H	H	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Maths in Biology – manipulating numbers – units and conversion – units of concentration – normality, molarity, molality and dilutions – areas and volumes – exponents and logs.	**13**
Unit II	Matrices – types - addition – subtraction - multiplication – determinants – inverse matrix – solving a system of linear equations- Mathematical modelling in biology – Linear growth and decay models and Non-linear growth and decay models.	**13**
Unit III	Biostatistics – introduction - techniques: *Frequency distribution* - ***collection**, analysis and graphical representation of data - measures of central tendency: mean, median and mode - measures of dispersion: range, standard deviation, coefficient of variation and correlation.	**13**
Unit IV	*Theoretical distribution* – binomial, poisson and normal distribution – *Test of significance* - Chi-square test – test for goodness of fit (2x2 contingency table, Yate‘s correction to be omitted) - Student _t‘ test – ANOVA (one way classification).	**13**

Unit V	Softwares for biostatistics – ***MS Office** - Word & Powerpoint: Excel: spreadsheet – formula bar - standard deviation – correlation – t- test – Chi square test – ANOVA (one way) – charts. Access: Creation and querying the database.	**13**

Note: Special instruction to question setters: In either or type of questions in sections B andC, one must be a problem and the other will be a question for descriptive answer.

**Self study topics*

Worksheets, Take home assigments, Seminar, Quiz

Text Books:

1. Alexis Leon and Mathews Leon, 1999. Introduction to computers. Leon Tech World, Chennai.
2. Cann Alan J., 2003. Maths from scratch for Biologists. John Wiley & Sons Ltd.,Chichester, England.
3. Gurumani, N., 2005. An introduction to Biostatistics. MJP Publishers, Chennai.
4. Kapur J.N., 1988. Mathematical Modeling. Wiley Eastern Limited, New Delhi.

Reference Books:

5. ManicavachagomPillay, T.K., T. Natarajan and K.S. Ganapathy, 2006. Algebra Vol.II. S. Viswanathan (printers & publishers) Pvt Ltd., Chennai.
6. Prasad, S., 2001. Elements of Biostatistics. Rastogi publications, Meerut.
7. Edward Batschlet, 1973. Introduction to mathematics for life sciences. Springer Verlag, New York.
8. Pranab Kumar Banerjee, 2004. Introduction to Biostatistics. S. Chand & Company Ltd., New Delhi.
9. Schwartz J.T.,1961. Introduction to matrices and vectors. McGraw Hill Book Company, INC., New York.
10. Simons S., 1964. Vector analysis for mathematicians, scientists and engineers. Pergamon press, The Macmillan Company, New York.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)	
Course code	21UBY5E1	Course Title		2021-2024
		ELECTIVE – I – MICROBIOLOGY AND PLANT PATHOLOGY		Semester 5
Hrs/Week 5				Credits 5

Course Objective

- To know the microbial biodiversity
- To learn the techniques in bacteriology and immunology
- To know plant diseases and its control

Course Outcome

K1	CO1	To appreciate the diversity of microbes
K2	CO2	To understand the basic defence mechanism and concept of Immunology
K3	CO3	To demonstrate the food and water samples for contamination
K4	CO4	To get hands-on training in culturing microbes
K5	CO5	To summarize the economically important plant disease

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	M	M	L	H	H	H	H	H	H
CO2	H	H	M	L	H	H	H	H	H	H
CO3	M	M	H	M	H	H	H	H	H	H
CO4	H	H	H	M	H	H	H	H	H	H
CO5	M	M	M	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	**History and Scope of Microbiology-Bacteriology:** Bacteria - morphology and ultra-structure – major features – nutritional types – bacterial respiration - growth and reproduction – ***economic importance** - culture media and pure culture techniques (spread plate, pour plate and streak plate).	**15**
Unit II	**Virology:** Virus – characteristics - ultra structure, shape, - transmission and reproduction (HIV, Rabies & T4 Phage).	**15**
Unit III	**Immunology:** - antigen, antibody and vaccines - antibiotics - microbes producing ethanol, antibiotics (penicillin and streptomycin) control of microorganisms - chemotherapy.	**15**
Unit IV	**Food, soil and water microbiology:** microbial flora of fresh food - food spoilage and poisoning (botulism) - ***food preservation**-microbial flora of milk - pasteurization and dairy products - cheese production- production of ethanol, vinegar and citric acid.Microbiology of soil and water - detection of coliforms - MPN and MFT.	**15**
Unit V	**Plant pathology:** Introduction - brief history - classification of plant diseases - Koch‘s postulate - symptoms, causal organism and	**15**

	control measures of bacterial (citrus canker), fungal (tikka disease of ground nut, paddy blast, and red rot of sugarcane) and viral (TMV) diseases – control of plant diseases- BCA.	

**Self study topics*

Powerpoint presentation, Field observation of diseased plants, Quiz, Seminar, Assignment

Text Books:

1. Ananthanarayanan and Jayarampanikar, Textbook of microbiology, 2017 (10th Edn.)Universities press, Hyderabad.
2. Pelczar JR., M.J., R.D. Reid and E.C.S. Chan, 1983. Microbiology (4thed.) Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi.
3. Purohit, S.S., Microbiology – Fundamentals & applications, 2006, Agro Bios (India)..
4. Sharma, .P.D., Plant Pathology, Deep and Deep Publications, New Delhi.

Reference Books:

1. Atlas R.M., 1996. Principles of Microbiology. Wm.C. Brown Publishers
2. Black, J.G., Microbiology –II Edition, Prentice Hall publications.
3. Churchill, Immunobiology- The Immune System in Health and Disease. Livingstone publication. New York.
4. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edns
5. Kenneth J. Ryan, C. George Ray, Sherris Medical Microbiology: An Introduction to Infectious Diseases.
6. Prescott, L.M., Harley JP and Klein DA., 1990. Microbiology. Wan C.Publishers.
7. Rose, A.H., Chemical Microbiology, 3rded, Butterworth World Student Reprints.
8. Salle.A.J., Fundamental Principles of Bacteriology, Tata McGraw Hill.
9. Stanier R., General Microbiology, 5thed, Macmilan Press ltd.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)	
Course code	21UBY5E2	Course Title		2021-2024
		ELECTIVE – I – ETHNO BOTANY		Semester 5
Hrs/Week 5				Credits 5

Course Objective

- To study and understand the history, scope, importance and methodology of Ethnobotany.
- To study the importance of Ethno pharmacology and the role of primitive people in conservation of nature.
- To comprehend the knowledge of tribals in herbal medicine

Course Outcome

K1	CO1	To study and understand the history, scope, importance and methodology of Ethnobotany.
K2	CO2	To study the importance of People‘s Biodiversity Register
K3	CO3	To comprehend the tribal knowledge in medicinal plants
K4	CO4	To learn the issues related with IPR and Biopiracy.
K5	CO5	To recommend the students to take up research in Ethnobotany

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	H	H	M	M	H	H	H	H	H	H
CO3	M	M	L	H	M	H	H	H	H	H
CO4	L	M	L	H	M	H	H	H	H	H
CO5	M	M	M	H	M	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Ethnobotany: Introduction, History, concept, scope and objectives. Major ethnic groups in Tamil nadu. (Kadar, Malayalee, Badugars, Thodars, Pulayars) People‘s biodiversity Register (PBR). General account of Traditional medical systems of India.	**13**
Unit II	Methodology of Ethno botanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places. Plants used by ethnic groups as food, medicines (Ethnomedicine), beverages, fodder, fibre, resins, oils, fragrances and other uses.	**13**
Unit III	Plants and Tribal medicine: Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria.*	**13**
Unit IV	Ethnobotany as a source of drug. a) Reserpine b) Artemisin c) Gugulipid d) Cocaine e) Strychnine..Role of ethnobotany in	**13**

	modern medicine: (*Trichopus zeylanicus*) *Role of ethnopharmacology in drug development.	
Unit V	Endangered taxa and forest management (participatory forest management). Role of ethnic groups in conservation of plant genetic resources. *Biopiracy, Intellectual Property Rights (IPR). Ethno pharmacology and IPR issue Sharing of wealth concept with few examples from India.	**13**

**Self study topics*

Field study, Inventory of Campus vegetation, Powerpoint presentations, Seminar, Assignment

Text Books:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi – 1981
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Cotton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
6. Rajiv K. Sinha – Ethnobotany -The Renaissance of Traditional Herbal Medicine – INA –Shree Publishers, Jaipur-1996
7. Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. London
8. Gary J Martin, 2008. Ethnobotany A Methods manual, Earth scan, London.

Reference Books:

1. Traditional plant medicines as sources of new drugs. P J Houghton in Pharmacognosy Trease and Evan's.16 Ed .2009
2. Cunningham, A. B. (2001). Applied Ethnobotany. Earthscan publishers Ltd. London & Sterling, VA, USA Cotton, C.M. (1996).
3. Ethnobotany-Principles and application. John Wiley& Sons Ltd., West Sussex, England
4. In vivo and in vitro assays Glimpses of ethnopharmacology 1994 Eds. P Pushpangadan ,V George and U.Nyman 5. Faulks, P.J. (1958).

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY5E3	Course Title	2021-2024
		ELECTIVE – I – HERBAL COSMETICS AND COSMECEUTICALS	Semester 5
Hrs/Week 5			Credits 5

Course Objective

- To understand the role of herbs as a source of natural and safe cosmetics.
- To learn the principles of herbal cosmetics
- To expose the students to prepare home recipes with available herbs

Course Outcome

K1	CO1	To recollect the medicinal herbs and the need for herbal cosmetics
K2	CO2	To comprehend the principles behind herbal cosmetics
K3	CO3	To prepare the selected personal care remedies using herbs
K4	CO4	To identify the local plants that can be used up for herbal cosmetics.
K5	CO5	To encourage the students to start-up a small scale Herbal Cosmetic unit

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	M	M	H	H	M	H	H	H	H	H
CO2	M	H	H	H	M	H	H	H	H	H
CO3	M	L	H	H	M	H	H	H	H	H
CO4	H	M	H	H	M	H	H	H	H	H
CO5	M	M	H	H	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Herbal cosmetics – Introduction – principles – definition – history – Advantages of Herbal cosmetics over synthetics and limitations. Process used in the manufacture of cosmetics-Emulsification, Mixing, compaction, Moulding, Packing. Raw materials used in preparation of herbal cosmetics.	**13**
Unit II	Herbal skin care –Skin structure and function - Basic requirements of skin. Herbal products for skin hydration,whitening and ageing - Herbal skin care products: Creams, Lotions, Lipsticks, face packs. Herbal natural soap production process - herbal glycerine soap.	**13**
Unit III	Herbal hair care: Hair structure and function, Keyhair concerns-Hair fall, breakage,split ends and mechanism to solve these issues Basics of formulation development: Emulsions, Shampoo, Conditioners, Gel, Serums and Oils, hair colorant.	**13**
Unit IV	Study ofvarious herbs used in preparation of formulations:A*loe vera*, Carrot, Turmeric, Neem, Citrus peels, Henna, Shihakai, Amla. Almond oil and Coconut oil. Aromatherapy – Tooth	**13**

	powder& mouth washes.	
Unit V	Herbal Manicure and pedicure.General Principles of Quality control and standardization of cosmetics-Raw material control – Packaging material control, finished product control - Shelf testing.	**13**

**Self study topics*

Field study, Powerpoint presentations, Seminar, Assignment

Text Books:

1. Panda H, 2015. Herbal Cosmetics - Hand Book- Asia Pacific Business Press; 3rd Revised Edition, New Delhi, India
2. Babu,S.S., 2000. Herbal cosmetics - Pushkal publishers, Mumbai.

Reference Books:

1. Asharam,2002.Herbal Indian perfumes and cosmetics, Sri Satguru publications, New Delhi, India
2. Sharma.P.P.2018. Cosmetics- Formulation, Manufacturing And Quality Control – Vandama Publications, New Delhi, India

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY5AL	Course Title	2021-2024
		ADVANCED LEARNER COURSE - I BIOLOGICAL DISASTER – MITIGATION &MANAGEMENT	Semester 5
Hrs/Week SS			Credits 2

Course Objective

- To teach the causes of biological disasters
- To describe the adverse effects of biological disasters
- To suggest the risk reduction and preparedness measures

Course Outcome

K1	CO1	To introduce and define biological disaster
K2	CO2	To know the types of biological disaster
K3	CO3	To acquire knowledge on management of biological disaster
K4	CO4	To explain the legislation on biological disaster
K5	CO5	To summarize the impact of post disaster management

Mapping

P O /PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	M	M	H	H	H	M
CO3	M	M	M	M	H	M	M	H	H	H
CO4	M	M	M	M	L	L	M	H	M	L
CO5	H	H	H	H	M	H	H	H	H	M

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Biological disaster – Introduction – history – definition and types - **Natural disasters**: Flood, Cyclone, Earthquakes, Landslides etc.; **Man-made disasters:**Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.	**SS**
Unit II	Biological disasters: Epidemic & Pandemic – classification – Biosafety level (BSL1, BSL2, BSL3 and BSL4) – Biologics (category I, II & III) – Bioterrorism (bacterial and viral) Agroterrorism (plants and animals) - Zoonosis.	**SS**
Unit III	Biological disaster: Mitigation & Management - Disease surveillance - Isolation and quarantine - Outbreak investigation and source control - Hygiene and infection control - Vaccination and chemoprophylaxis -Risk communication.	**SS**
Unit IV	Biological disaster: Legislation - The Water (Prevention and Control of Pollution) Act (1974); The Air (Prevention and Control of Pollution) Act (1981); The Environmental (Protection) Act (1986) and the Rules (1986); Disaster Management Act (2005).	**SS**

Unit V	Case studies in biological disaster management & rehabilitation/re-settlement – Plague, tuberculosis, influenza, chickenpox, Meningitis – Ebola, HIV/AIDS - Malaria, dengue, filaria, chikungunya – Spanish flue, SARS – nCovid19 (Corona virus).	**SS**

Field study, Powerpoint presentations, Seminar, Assignment

Text Books:

1. Waugh, W.L., 2005. Handbook of Disaster Management, Crest Publishing House, New Delhi.
2. Gandhi, P.J., 2007. Disaster Mitigates and Management, Deep & Deep Pub., New Delhi.
3. Rai N. & Singh A.K. (ed), 2008. Disaster Management in India, New Royal Book Comp., Lucknow.

Reference Books:

1. National Disaster Management Guidelines—Management of Biological Disasters,2008. A publication of National Disaster Management Authority, Government of India. ISBN 978-81-906483-6-3, July 2008, New Delhi.
2. Jeanne Guillemin, ‑Scientists and the History of Biological Weapons: A Brief Historical Overview of the Development of Biological Weapons in the Twentieth Century,‖ EMBO Reports 7, no. S1 (2006): S45–49.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E4	Course Title	2021-2024
		ELECTIVE – II – HABITAT ECOLOGY	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To know the uniqueness of the varying habitats in the biosphere
- To acquire the knowledge about the structure and functions of different ecosystems
- To learn the techniques for environmental assessment and ecological dynamics.

Course Outcome

K1	CO1	To appreciate the various habitats and their vegetation
K2	CO2	To understand the concept of habitats and succession
K3	CO3	To demonstrate the components of different ecosystems
K4	CO4	To know-how the methods of Environmental audits and Environmental Impact Assessment
K5	CO5	To inventor and manage the natural resources using Remote sensing techniques.

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	M	H	H	M	H	H	H	H	H	H
CO3	M	H	M	M	H	H	H	H	H	H
CO4	M	H	H	H	H	H	H	H	H	H
CO5	M	H	L	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Introduction to habitat ecology: historical, ecological & evolutionary perspectives - habitat concepts (edge, ecotones, interspersion and juxtaposition) - units of vegetation – *__succession__.	**13**
Unit II	Ecology of major habitats: forest (tropical rain forest, deciduous and coniferous) – scrub jungle and deserts (hot, dry and cold deserts) – grasslands (temperate and tropical).	**13**
Unit III	Ecology of major habitats: aquatic (fresh water - lentic & lotic) – marine (coasts, estuaries, phytoplankton and phytobenthos, mangroves and coral reefs.) – tundra (arctic and alpine).	**13**
Unit IV	Physical and anthropogenic factors influencing habitats - habitat degradation and fragmentation - Environmental Impact Assessment (EIA) - environmental audits - ***Environmental Legislations and Regulations.**	**13**
Unit V	Inventory of unique habitats and their distribution - Remote Sensing (RS) - Geographical Information System (GIS) –Indian Regional Navigation Satellite System (IRNSS)- principles and applications of remote sensing techniques - cover classification and mapping - use and values of GIS approaches to habitat ecology.	**13**

**Self study topics*

Field study, Inventory of Campus vegetation, Powerpoint presentations, Seminar, Assignment

Text Books:

1. Odum E.P.(ed), 1971. Fundamentals of Ecology, W.B. Saunders Company, Philadelphia.
2. Sharma P.D., 1997. Ecology and Environment, Rastogi Publications, Meerut.
3. Dash M.C., 1993. Fundamentals of Ecology, Tata McGraw Hill, New Delhi.
4. Agarwal K.C., 1989. Environmental Biology, Agro Botanical Publishers (India), Delhi.
5. Ananthakrishnan T.N., 1987.Bioresources Ecology, Oxford and IBH, New Delhi.
6. Kormondy E.J., 1999. Concepts of Ecology, Prentice Hall, New Delhi.

Reference Books:

7. Leonard Ortolano, 1997. Environmental Regulation and impact Assessment. John Wiley & Sons, Inc.
8. Cadogan A. and G. Best, 1992. Environment and Ecology, Nelson Blackie, Glasgow.
9. Lenihan J. and W.W. Fletcher, 1977. Environment and Man, Vol IV. The Chemical Environment, Blackie, London.
10. Pandian T.J., 2000. Biodiversity: Status and Endeavours of India, UNESCO sponsored international workshop on Biodiversity, Ghent University, Belgium, pp. 3-6
11. Subrahmanyam N.S., and Sambamurthy, A.V.S., 2001. Ecology, Narosa Publishing House, New Delhi.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E5	Course Title	2021-2024
		ELECTIVE – II – BIODIVERSITYAND ITS CONSERVATION	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To learn the concepts of Plant community, distribution and speciation
- To acquire the knowledge on Biodiversity with special reference to western ghats
- To appreciate and follow various conservation strategies

Course Outcome

K1	CO1	To identify the Biodiversity hotspots of the world
K2	CO2	To identify the ethnobotanical perspectives of conservation
K3	CO3	To apply the conservation strategies to protect the western ghats biodiversity
K4	CO4	To explain the international and national efforts to conserve the biodiversity
K5	CO5	To know the employability in the fields of conservation biology

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	M	H	H	M	H	H	H	H	H	H
CO3	M	H	H	L	M	H	H	H	H	H
CO4	L	H	L	M	M	H	H	H	H	H
CO5	H	H	H	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Introduction to plant community concepts – Ecads, Ecotypes - Major biomes – Phytogeography - Speciation – Theories on speciation – Age and area hypothesis, Continental Drift theory, Dispersal and migration barriers, concept of endemism, peninsular and inland flora.	**13**
Unit II	Biodiversity - Concept, values, types, threats and loss; IUCN categories of rare, endangered, threatened, extinct species. Biodiversity hotspots – Hotspots in India. Conservation strategies: In situ: Biosphere reserves, National Parks, Sanctuaries, Sacred groves; Ex situ: Botanical gardens, seed bank, Pollen bank and Biotechnological interventions	**13**
Unit III	Western Ghats Biodiversity -Habitat, Resources: Flora and fauna Nilgiri Biosphere Reserve, Anamalai Tiger Reserve, Potential threats: Habitat degradation, Inventorying and Management of Resources in Western Ghats: - environmental audits – Ecotourism – Ecorestoration	**13**

Unit IV	Ethnobotany – History of conservation – Traditional Botanical knowledge -Ethnic tribes of Tamilnadu – (Kadar, Malayalee, Badugars, Thodars, Pulayars) – Conservation practises from local tribes*. Documentation and Interpretation of traditional knowledge, biopiracy, IPR, benefit sharing.	**13**
Unit V	Organizations associated with biodiversity management-IUCN, UNEP, UNESCO, WWF, – Convention on Biodiversity – ENVIS, NBA,and NBPGR;-Biodiveristy Information System – Integrated Taxonomic Information System – GBIF, Species 2000, Tree of life.	**13**

**Self study topics*

Field study, Powerpoint presentations, Seminar, Assignment

Text Books:

1. AgrawalK. C., 2009. Biodiversity: Concept Conservation and Management, Nidhi Publishers, India
2. Krishnamurthy, K.V. 2004. An advanced textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi.
3. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi.

Reference Books:

4. Chapman, J.L. and Reiss, M.J. 1999. Ecology; Principles and Applications. II Ed. Cambridge University Press. New York.
5. Groombridge, B. (Ed.) 1994. Global Biodiversity – Status of the Earth‘s living resources. Chapman & Hall, London.
6. Melchias,G. 2001. Biodiversity and Conservation. Oxford IBH. New Delhi.
7. Sharma PD. 2001. Ecology and Environment. Rastogi Publications, Meerut.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E6	Course Title	2021-2024
		ELECTIVE – II – ENVIRONMENTAL BIOTECHNOLOGY	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To learn the biotechnological intervention in abating pollution
- To acquire the knowledge on EIA, Green audit to ensure sustainable
- To educate the alternative sources of energy

Course Outcome

K1	CO1	To comprehend the quality of air, water and soil as per BIS
K2	CO2	To learn the preparation of documents like EIA, EIS, Green audit
K3	CO3	To illustrate the role of bioindicators in monitoring the environment
K4	CO4	To analyse the concepts of bioremediation and biological detoxification
K5	CO5	To evaluate the production and utility of non- conventional energy resources

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	M	H	H	H	H	H	H	H	H	H
CO2	L	H	H	M	H	H	H	H	H	H
CO3	H	H	M	M	H	H	H	H	H	H
CO4	M	H	M	H	H	H	H	H	H	H
CO5	M	H	M	H	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Environmental Biotechnology – Introduction – Scope of Biotechnology in pollution abatement – quality criteria for air, water, soil and noise (BIS) – biological treatment of sewage and solid wastes – biofilters - **Role of Government in pollution control**	**13**
Unit II	Environmental Impact Assessment (EIA) – Risk analysis – EIS – Environmental planning and management – Green audit - Carbon budget- Remote sensing and GIS for resource mapping and management	**13**
Unit III	Biotechnology for pollution assessment and monitoring- biomonitoring – biosensors – biofilms – biochip in Environmental analysis – Bioindicators in pollution monitoring (Bacteria, Algae Lichens and higher plants) – cytotoxicity tests.	**13**
Unit IV	Biodegradation of hazardous wastes (Plastics, microplastics) – xenobiotic compounds and radioactive wastes – bioremediation – phytoremediation – bioleaching – biosorption – biological	**13**

	detoxification	
Unit V	Biomass energy – Biofuels – Biogas – Biological hydrogen production–Solar energy* – wind energy – Tidal energy – Ocean Thermal Energy – Geothermal Energy – Energy audits	**13**

**Self study topics*

Field study, Powerpoint presentations, Seminar, Assignment, Group Discussion

Text Books: .

1. Chatterji, A.K. 2007. Introduction to Environmental Biotechnology, 2nd ed. Prentice Hall Pvt. Ltd, New Delhi.
2. Indu Shekhar Thakur. 2019. Environmental Biotechnology: Basic concepts and Applications (2nd ed.) Dreamtech Press, Delhi

Reference Books:

1. Ritmann, B. E. and McCarty, P.L. 2020. Environmental Biotechnology: Principles and Applications (2nd Ed), McGraw Hill, New York.
2. Sunil Khanna and Krishna Mohan (Eds). 1995. Wealth from Waste. Tata Energy Research Institute, New Delhi.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E7	Course Title	2021-2024
		ELECTIVE – III – BIOPROSPECTING	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To understand the current practices in Bioprospecting
- To know the basics and concepts of pharmaceutical bioprospecting
- To learn the marine and microbial metabolites and its applications

Course Outcome

K1	CO1	Understand the basic concepts of bioprospecting
K2	CO2	Learn the assays in medical bioprospecting
K3	CO3	Recognize the value of marine bioresources
K4	CO4	Analysethe techniques and applications of microbial populations
K5	CO5	Summarize the significance of forest products in day-to-day life

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	H	M	M	L	M	H	H	H	H	H
CO3	M	M	M	L	H	H	H	H	H	H
CO4	M	M	M	M	H	H	H	H	H	H
CO5	H	H	M	M	M	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Bioprospecting: Definition – Introduction - Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources. Bioprospecting Act: Introduction - Phases of Bioprospecting - Exemption to Act. Fields of Bioprospecting.	**13**
Unit II	Medicinal Plants Bioprospecting/ Pharmaceutical Bioprospecting: for new drugs - assays in bioprospecting. Antioxidant assay – NO free radical scavenging assay - Antigenotoxicity assay – MTT assay - Antiviral activities of plants – SRB assay.	**13**
Unit III	Marine Bioprospecting: Sources of marine planktons and their bioprospecting - isolation and cultivation of marine bioresources - isolation of marine yeast and its industrial applications - bioactive chemicals from seaweeds and their applications*.	**13**
Unit IV	Microbial Bioprospecting: Isolation of microbial metabolites and their bio-activity. Endophytic microbial products as antibiotics.	**13**
Unit V	Origin, evolution, botany, cultivation and uses of food, fodder, fibers, oil yielding crops, wood and timber, non-wood forest products(NWFPS): bamboos, gums, dyes, resins, fruits etc.	**13**

**Self study topics*

Powerpoint presentations, Seminar, Assignment

Text Books:

1. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
2. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,
3. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi,
4. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.,

Reference Books:

5. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science Monograph No.7.
6. Baker, H.G. (1978), Plants and civilization. Ill Ed. (A. Wadsworth, Belmount).
7. Bole, P.V. and Vaghani, Y. (T986). Field guide to common Indian trees, Oxford University Press, Mumbai.
8. CSIR (1986), the useful plants of India Publication and Information directorate, CSIR^ New Delhi.
9. CSIR (1948 - 1976) the wealth of India, 53

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E8	Course Title	2021-2024
		ELECTIVE – III – BIOFERTILIZERS	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To learn about the bioavailability of plant nutrients
- To comprehend the principles of Nitrogen fixation and Phosphate solubilization
- To learn the utility of Biofertilizers in organic farming

Course Outcome

K1	CO1	To know the microbes that are useful in the production of Biofertilizers
K2	CO2	To understand the various microbial metabolisms in fixing Nitrogen
K3	CO3	To learn know-how techniques of mass production of Biofertilizers
K4	CO4	To realize the role of VAM in Phosphate mobilisation
K5	CO5	To identify the government initiatives in the mass production of Biofertilizers

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	H	H	H	H	H	H	H	H
CO2	H	M	M	H	H	H	H	H	H	H
CO3	H	M	H	H	H	H	H	H	H	H
CO4	H	M	H	H	H	H	H	H	H	H
CO5	M	H	H	H	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Biofertilizers – Introduction – advantages - factors affecting the efficiency of biofertilizers- carrier materials – inoculants – general account on microbes as biofertilizers.	**13**
Unit II	Nitrogen fixers – Blue Green Algae - Nitrogen fixation by *Anabaena*, *Nostoc*, *Oscillatoria*, *Tolyopthrix* – *Azolla- anabaena* association – Nitrogen fixation – *Azolla* in rice cultivation.	**13**
Unit III	Nitrogen fixers -Bacteria – Symbiotic -*Rhizobium*, *Azospirillum* – *Azospirillum* – isolation and mass multiplication; Rhizobium – Identification, isolation and mass multiplication; Free-living *Azotobacter*, *Klebsiella* – *Azotobacter* – inoculum, mass production.	**13**
Unit IV	Phosphate solubilizers – factors affecting phosphate solubilisation – *Pseudomonas*, *Bacillus megaterium*; Mycorrhizal association – types – occurrence, colonization and inoculum production of VAM – effect on plant growth	**13**
Unit V	Biofertilizers – Application and Marketing– seed treatment, root dipping, soil applications –Role of Government initiatives in promotion of Biofertilizers* - National Project on Development	**13**

	and use of Biofertilizers (NPDB) – Integrated nutrient management.	

**Self study topics*

Field study, Powerpoint presentations, Seminar, Assignment, Industrial visits

Text Books:

1. Arun K. Sharma, 2004. Biofertilizers for Sustainable Agriculture. Agrobios India Ltd, JodhPur.
2. Dahama A.K., 2009. Organic farming for Sustainable Agriculture. Agrobios India Ltd,Jodhpur.
3. Mahendra K. Rai, 2005. Hand book of Microbial biofertilizers, The Haworth Press, Inc. NewYork.

Reference Books:

1. Amitava Rakshit, Vijay Singh Meena, Manoj Parihar, H.B. Singh and A.K. Singh. 2021.
2. Biofertilizers: Volume 1: Advances in Bio-inoculants. ELSEVIER, Woodhead Publishing, UK.
3. Bhoopander Giri, Ram Prasad, Qiang-Sheng Wu. 2019. Biofertilizers for Sustainable Agriculture and Environment. Springer.
4. NIIR Board, 2012. The Complete Technology Book on Bio-Fertilizer and Organic Farming, II Ed, NIIR Project Consultancy Services, New Delhi.
5. Subbarao, N.S. 2017. Bio-fertilizers in Agriculture and Forestry, IV Ed, Medtech, USA.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code	21UBY6E9	Course Title	2021-2024
		ELECTIVE – III – SEED TECHNOLOGY	Semester 6
Hrs/Week 5			Credits 5

Course Objective

- To understand the seed physiology, seed testing and seed storage
- To acquire knowledge on the seed certification procedures
- To learn the role of national agencies in seed development

Course Outcome

K1	CO1	Learn the development of a seed
K2	CO2	Understand the testing procedures for seed purity
K3	CO3	Classify the quality of seeds and certification
K4	CO4	Acquire skills on seed marketing
K5	CO5	Summarize the role of national agencies in seed development

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	H	H	M	M	M	H	H	H	H	H
CO3	M	H	H	L	M	H	H	H	H	H
CO4	M	M	H	M	H	H	H	H	H	H
CO5	H	M	H	M	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Seed technology - history, concepts and scope – types of seed – seed development programme - Role of National seed corporation (NSC), Tarai development corporation (TDC), and State farm corporation (SFC) agencies in development of Indian seed industry.	**13**
Unit II	Seed- Fertilization – embryo genesis and seed formation – development and maturation – seed structure and composition – seed quality characteristics- Seed Farm Management – Breeders seed – terminator seed – seed bank	**13**
Unit III	Seed testing – principles and importance heterogeneity and genuineness – Seed purity test – seed germination test – seed viability test – seed vigour test – seed health test – seed moisture test.	**13**
Unit IV	Seed processing – concepts and principles – methods of seed conditioning – Seed drying and cleaning – Seed treatment – advantages and kinds – Seed storage - principles and methods – factors affecting seed storage – Seed marketing.	**13**
Unit V	Seed Certification – objectives and concepts – function of seed	**13**

	certification agency - General certification standards – Essential qualities of certified seeds - Classes of seed - Seed legislation in India – Seed act – Seed control order – Essential commodity act – Requirement for sale of seeds	

**Self study topics*

Field study, Powerpoint presentations, Seminar, Assignment

Text Books:

1. Sumati Narayan Rajeev Kumar, Sushil Kumar Swarnkar, Sunil Kumar Singh , 2016. A Text book of seed technology, Kalyani publishers.
2. Phundan Singh, 2013. Principles of seed technology, Kalyani Publications.
3. Agarwal.R.L. 2004. Seed Technology, IVth Edition, Oxford and IBH Publishers Company, New Delhi.

Reference Books:

1. Ramamoorthy, K. and K. Sivasubramaniam. 2006. Seed Technology, Ready Recknoner, Agrobios Publishers, Jodhpur, Rajasthan
2. Sivasubramaniam.K. and S.K Yadav. 2007. A Dictionary of Seed Technological Teems, Kalyani Publishers, Ludhiana
3. Amarjit S. Basra, 2008. Handbook of seed science and technology, CRC Press.
4. Jana B.L., 2015. Principles of seed technology, Aavishkar publishers, Jaipur.

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code 21UBY615		Course Title	2021-2024
		MAJOR PRACTICAL - IV (for VI sem theory papers)	Semester 6
Hrs/Week 2			Credits 4

Course Objective

- To acquire basic knowledge in mathematics & biostatistics
- To create programs for bioinformatics
- To understand bioinformatics tools

Course Outcome

K1	CO1	To compare the physiological functions of plants under different environmental conditions
K2	CO2	To know the economically important plants and their produces
K3	CO3	To create interest in rearing plants *in vitro*
K4	CO4	To learn the bioinformatics tools to analyse the protein structure
K5	CO5	To study the vegetation using Quadrat and line transect method

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	M	M	H	H	H	H	H	H
CO2	H	H	M	M	M	H	H	H	H	H
CO3	M	H	H	L	M	H	H	H	H	H
CO4	M	M	M	M	H	H	H	H	H	H
CO5	H	M	M	M	H	H	H	H	H	H

High; M-Medium; L-Low

Unit	Content	Hrs

nit I	**Plant physiology Individual experiments:** 1. Estimation of water potential (DPD) by liquid immersion method and plasmolytic method. 2. Estimation of osmotic pressure by plasmolysis. 3. Determination of respiration by respiroscope 4. Determination of stomatal frequency and index. 5. Determination of rate of transpiration - Cobalt chloride, Ganongs potometer. 6. Determination of rate of photosynthesis under different Co_2 concentrations & different light intensities using wilmots bubbler **Plant physiology demonstration experiments:** 7. Light screen experiment 8. Amylase activity 9. Soil nitrification 10. Determination of respiratory quotient	**6**
	11. Essentiality of mineral elements on plant growth – Hydroponics	
Unit II	**Biotechnology & Genetic Engineering:** Charts/spotters on Genetic Engineering and biotechnologyDemonstration 1. Media for plant tissue culture 2. Callus induction 3. Regeneration of plantlet 4. Synthetic seeds	**5**
Unit III	**Horticulture and Plant Breeding** Charts and specimens Demonstration on propagation techniques Demonstration on fruit/vegetable preservation	**5**
Unit IV	**# Habitat Ecology** 1. Vegetation study by Quadrat and Line transect method 2. Estimation of plant biomass 3. Determination of dissolved oxygen 4. Estimation of CO_2 in selected water samples 5. Determination of Total Dissolved Solids 6. Spotters and charts on Habitat ecology. **# Biodiversity and its Conservation** 1. Biosphere reserves 2. Hotspots 3. Sacred groves **# Environmental Biotechnology** 1. Bioindicators 2. Green auditing 3. Biofuels 4. Remote sensing	**5**

Unit V	**# Bioprospecting** 1. Marine bioproducts 2. Microbial bioproducts 3. Anti-oxidant assay **# Biofertilizers** *1.* Mass culture of *Azolla*, *Rhizobium and Nostoc* 2. Identification and isolation of microbial inoculants **# Seed Technology** Simple tests on seed purity, vigor, viability, germinationand moisture content. 2. Seed processing and storage methods	**5**

Identification of plants, Demonstrations, culture techniques

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Programme Code	B.Sc.,	Programme Title	Bachelor of Science (BOTANY)
Course code 21UBY6AL		Course Title	2021-2024
		ADVANCED LEARNER COURSE - II BIONANOTECHNOLOGY	Semester 6
Hrs/Week SS			Credits 2

Course Objective

- Toimpart basic knowledge on the nano level integration of chemistry, physics and biology.
- To learn the concept of biomaterials and biomolecules as bases for inorganic structures.
- To know the role biomolecules as nano widgets.
- To study the diversity of application of nanodevices

Course Outcome

K1	CO1	To study the fundamentals of bionanotechnology.
K2	CO2	To learn the role of biomolecules at nano scale.
K3	CO3	To study the nanomaterials and devices and their functions at cellular level.
K4	CO4	To acquire knowledge on mimicking the biological systems.
K5	CO5	To inculcate the role of nanobots and their diversified application.

Mapping

PO /PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	H	H	H	H	H	H	H	H	H	H
CO2	H	M	M	H	H	H	H	H	M	M
CO3	H	H	H	M	M	M	M	H	M	M
CO4	M	M	M	L	L	L	M	H	M	M
CO5	H	H	H	H	H	H	H	H	H	H

igh; M-Medium; L-Low

Unit	Content	Hrs
Unit I	Introduction to Nanotechnology and Bionanotechnology – Cellular Machines: - Nanomaterials (nanoparticles, nanotubes, nanowires, manocrystals, block co-polymers) and Biomacromolecules (Nucleic acid and protein structure, MAGE).	**SS**
Unit II	Fundamentals of biological systems and bionanotechnology - Sensors - optics, acoustics: ion selective electrodes – gas and enzyme & protein based sensing principles – DNA Amplification, DNA probes and arrays, DNA application and liposomes, fluidics, nanomachining – Biomimetics/biomimicry (superhydrophobic structures-lotus effect)	**SS**
Unit III	Bionanomaterial production - Fabrication techniques, imaging and manipulation tools at the Nanoscale - nanoscale devices and circuits e.g. carbon nanotubes, FETs Quantum dots.	**SS**
Unit IV	Bionano robotics – nano/molecular – communicationnano-	**SS**

	navigation – nano-scale manipulation and control, nano robots.	
Unit V	Application of Bionanotechnology – Medicine – pharmaceuticals – Agriculture – Food – Cosmocetutical – Environment.	**SS**

Field study, Inventory of Campus vegetation, PowerPoint presentations, Seminar, Assignment

Text Books:

1. K.K.Jain, Nano Biotechnology, Horizions Biosciences, 2006.
2. Introduction to Nanotechnology, Charles P. Poole, Jr.Frank J. Owens, A John Wiley81Sons, Inc., Publication, (2003).

Reference Books:

1. Nanobiotechnology: Concepts, Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanotechnology 101, John Mongillo, Greenwood Press, (2007).

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