CBCS SYLLABUS

FOR

POST-GRADUATE COURSES

SUBJECT-BOTANY

SUBMITTED BY

DEPARTMENT OF BOTANY, J.P. UNIVERSITY, CHAPRA

SUBJECT EXPERTS:

1. Dr. Md. Sarfaraz Ahmad, Head, Department of Botany, J.P. University, Chapra.
2. Prof. Ashok Kumar Jha, Department of Botany, J.P. University, Chapra.
3. Dr. Amarendra Kumar Jha, Department of Botany, J.P. University, Chapra.

JAI PRAKASH UNIVERSITY, CHAPRA

RAHUL SANKRITYAYAN NAGAR, CHAPRA-841301

Department of Botany

Ref.....

Date.....

Proceeding of Meeting of Board of Courses of Studies (BOCS)

As per the directions of the Dean, Faculty of Science, J.P.University Chapra, a meeting of the Board of Courses of Studies was held at 11:00 AM on 18.01.2021 to discuss about the CBCS based Syllabus for M.Sc. Botany (effective from session 2018-20) in the Department of Botany.

The following members attended the meeting:

1. Dr. Md. Sarfaraz Ahmad (Chairman).
   Head, Department of Botany, J.P. Universiity, Chapra.
2. Prof. Ashok Kumar Jha (Member)
   Department of Botany, J.P. University, Chapra.
3. Dr. Amarendra Kumar Jha (Member)
   Department of Botany, J.P. University, Chapra.

Agenda:

To adopt and recommend the new CBCS Syllabus of Botany for University Department and PG Centres of different colleges under J.P. University, Chapra.

Resolution:

1. The CBCS Syllabus of Botany given by Raj Bhawan, Bihar was minutely studied by the members.
2. After studying the CBCS Syllabus of Botany, it was found satisfactory and decided to adopt it for further approval and necessary action.
3. The committee has decided to adopt the full syllabus provided by Raj Bhawan, Bihar, as it is.
4. The committee has decided to adopt following three elective papers for Semester-IV of University Department and its PG Centres of different colleges of J.P. University, Chapra.
   I. Cytogenetics and Crop Improvement.
   II. Applied Microbiology and Plant Pathology.
   III. Environmental Biology (Syllabus prepared by Board of Courses of Studies, Deptt. of Botany, J.P.University, Chapra).
5. This Syllabus shall be effective from 2018-20 session after approval of the Academic council of the J.P University, Chapra.

Dr. Md. Sarfaraz Ahmad
(Chairman)

Prof. Ashok Kumar Jha
(Member)

Dr. Amrendra Kumar Jha
(Member)

Revised Curriculum for M.Sc. in Botany

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

(To be effective from 2018 -19)

Implementation
in the State Universities of Bihar

1. Prof. A. K. Sharan
Retd. Professor and Former Head
Department of Botany,
V.K.S. University, Ara

2. Dr. Birendra Prasad
Associate Professor
Department of Botany
Patna University

14/06/2018

14/6/18

OUTLINE OF THE CHOICE BASED CREDIT SYSTEM (CBCS) for PG degree courses:

It consists of a number of courses i.e. **Core Course (CC), Elective Course (EC), Discipline Specific Elective Course (DSE), Ability/Skill Enhancement Courses (AEC/SEC), and Ability Enhancement Compulsory Courses (AECC).** Each course is equivalent to a paper. The nature of these courses is defined below.

1.1 Core Course (CC):

A course which should compulsorily be studied by a candidate as a core requirement on the basis of subject of M.Sc. studies and is termed as a Core course.

1.2. Elective Course (EC):

Generally a course which can be chosen from a pool of courses (Basket) and which may be very specific or specialized or advanced or supportive to the subject/ discipline of study or which provides an extended scope or which enables an exposure to some other subject/discipline/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

1.3 Discipline Specific Elective Course (DSE):

Elective courses may be offered by the main discipline/subject of study is referred to as **Discipline Specific Elective**. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

1.4 Generic Elective (GE) Course:

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a **Generic Elective.**

1.5 Ability Enhancement Courses (AEC/SEC):

The Ability Enhancement Courses (AEC) / Skill Enhancement Courses (SEC). "AEC/SEC" is the courses based upon the content that leads to life skill enhancement.

1.6 Ability Enhancement Compulsory Courses (AECC):

University will run a number of **Ability Enhancement Compulsory Courses (AECC)** which is qualifying in nature and student from all faculties have to qualify in all such courses.

1.7 Dissertation/Project/ Internship/ Industrial Training/ Field Work:

Elective courses are designed to acquire advanced knowledge to supplement /support the main subject through project work/ internship/ industrial training/ field work. A student studies such a course on his/her own with mentoring support by a teacher / faculty member called the guide/ supervisor. In case of internship/ industrial training the student will work

under the joint guidance of one teacher-supervisor from the parent department to be termed as Supervisor-1 and one suitably qualified personnel at the research institute/ research laboratory/ industrial organization, to be termed as Supervisor-2. A student may join any recognized research institute/ research laboratory/ the industrial organization with the approval of parent department. The student has to work for a minimum number of days/ hour as decided by the parent department. On completion of the project work/ training at the research institute/ research laboratory/ industrial organization, student will submit a written project report certified by both supervisors to the parent department. Supervisor-2 will issue a letter certifying that the candidate has successfully completed the project and also award marks/ grade to him/ her. The certificate will be submitted to the parent department confidentially. The Board of Courses of Studies (BOCS) of the concerned subject/ department will draft and design the certificate and other documents as per requirement. The parent department will also assist the students to choose proper organizations for their project work/ industrial training/ field work etc. The student can also do Project dissertation work in parent department on selected topic under the supervision of teacher of the department.

2.0 CREDIT

The total minimum credits, required for completing a PG program is 100.

The details of credits for individual components and individual courses are given in Table.1.

Table 1: Structure of the 2 Yrs (Four Semesters) Post Graduate Degree course under CBCS:

Semester	No of COURSE / Papers	Credit per COURSE/ paper	Total credit	Minimum No of Learning Hours#	No of CORE COURSE/ PAPER	No of ELECTIVE Course/ PAPER	Code & Nature of Elective Course/ paper
I	05	05	25	250	4	1	AECC-1
SEMESTER BREAK							
II	06	05	30	300	5	1	AEC-1
SEMESTER BREAK							
III	06	05	30	300	5	1	AECC-2
SEMESTER BREAK							
IV	03	05	15	150	0	3	EC -1* EC -2* DSE-1 or GE-1
Total	**20**		**100**	**1000**	**14**	**6**	

#For Tutorial (T)/ Practical (P)/ Field Work (FW)/ Internship etc. extra working hour to be added as per requirement and will be decided by the BOCS of the respective subject.

* The two Elective Courses (EC) to be studied in semester IV may be

One Theory paper and One Practical paper

/One Theory paper and One Project work

IMP : It is desirable that all students of all courses be given adequate exposure over and above the class room teaching to enhance the scope of skill development/ entrepreneurship and employability.

2.1. There shall be six elective courses - two EC, one DSE or one GE, two AECC, one AEC/SEC. Students may opt for any elective course out of a list of elective papers **(Basket)** offered by the parent department or any other department/s as per his/her choice with the prior permission of the parent department. The list of elective papers, syllabus and prerequisite of the elective course will be as decided by the Board of Courses of Studies (BOCS) of the concerned subject/ department. All elective course listed may not be available in all semesters. Based on the availability of resource persons and infrastructure the parent department will assist the students to select elective courses of their choice.

2.2. The final CGPA/ class will be decided on the performance of the student in the 16 courses / papers including the 14 Core Courses (CC) / papers and two Elective Courses (EC)/ papers.

2.3. The one DSE or one GE, two AECC, one AEC/SEC papers will be qualifying in nature and a student has to score at least 45% marks in these papers. Grade will be awarded separately for these courses, however, performance in these elective courses/ papers will not be considered for awarding the final CGPA/ class.

2.4. **Ability Enhancement Compulsory Courses (AECC):**

University will run two **Ability Enhancement Compulsory Courses (AECC)** which are qualifying in nature and a student has to qualify in both these courses. The courses are:

AECC-1
Environmental Sustainability (3 Credit) & Swachchha Bharat Abhiyan Activities (2 Credit)
AECC-2
Human Values & Professional Ethics (3 credits) and Gender sensitization (2 credits)

Students will do assignments/project work related to institutional social responsibilities including Swachchha Bharat Abhiyan activities during SEMESTER BREAK.

2.5. University will run a number of **Ability Enhancement Courses** (AEC)/ **Skill Enhancement Courses** (SEC); a student can choose one from these. For example:

Basket of Ability Enhancement or Skilled Enhancement Courses (AEC/SEC)

- Computers and IT Skill
- Web Designing
- Financial Risk Management/
- Solid waste Management/
- Mushroom Culture /
- Bio-fertilizer production/
- Environmental Law/
- Tourism and Hospitality Management/
- Life-skill and skill development /
- Yoga Studies

  etc.

2.6 Discipline Specific Elective (DSE):

In each subject the **CC-5** being taught in the **second semester** will be open to be selected as a DSE paper. In the first phase a student will be allowed to choose a paper from any subject other than his/ her Core Course (CC) from the same faculty in the same university.

2.7 Generic Elective (GE) Course:

University will run a number of **Generic Elective Courses** (GE); a student can choose one from these. For example:

Basket of Generic Elective (GE) courses

- Music
- Dramatics
- Fine Arts
- Graphic Design
- Inclusive Policies
- Human Rights
- Any such course run by any department

14/6/18

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Name of the Programme: M.Sc. Botany (Choice Based Credit System)
(Four Semester programme)

PROGRAM OBJECTIVES:

1. To promote interest, participation and commitment in the subject Botany.
2. To acquire competencies in theoretical as well as experimental Botany in order to enhance knowledge in Plant Science and to further contribute for the development of the society.
3. To strengthen aptitude for research in basic plant science and its interdisciplinary areas.
4. To prepare the students to successfully compete for employment in academia, agriculture, horticulture and need based industry.
5. To help students develop integrity and objectivity and disseminate the knowledge for scientific, economic and social benefit, hence contributing towards national and global development.

Course Structure for M.Sc. Botany

Semester	Course/ Paper Code	Nature of Course/ Paper	Credit	Marks	Marks of CIA	Marks of ESE	Passing criterion	Qualifying Criterion
SEMESTER I	MBOTCC-1	Phycology, Mycology & Bryology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-2	Microbiology & Plant Pathology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-3	Pteridophyta, Gymnosperm & Paleobotany	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-4	Practical 1 (Based on MBOTCC 1, 2 & 3)	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTAECC-1	Environmental Sustainability & Swachchha Bharat Abhiyan Activities	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER II	MBOTCC-5 DSE-1 for other Department	Biofertilizer Technology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-6	Taxonomy & Anatomy & Embryology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-7	Physiology & Biochemistry	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-8	Plant tissue culture, Ethanobotany, Biodiversity & Biometry	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-9	Practical 2 (Based on MBOTCC 5, 6, 7 & 8)	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTAEC-1 /SEC-1	Ability Enhancing Elective course selected from Basket	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER III	MBOTCC-10	Cell Biology & Cytogenetics	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-11	Molecular Biology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-12	Recombinant DNA Technology	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-13	Plant Ecology & Environmental Science	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTCC-14	Practical 3 (Based on MBOTCC 10, 11, 12 & 13)	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTAECC-2	Human Values & Professional Ethics and Gender sensitization	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER IV	MBOTEC-1	Subject specific elective	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTEC-2	Subject specific elective	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTDSE-1	Opt a Course from other Department	5	100	30	70	45% in CIA 45% in ESE	Qualifying

M.Sc. Botany
(Semester-I)

MBOTCC-1: Phycology, Mycology and Bryology (5 Credits)

Time: 3hrs Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

Thallus organization of algae, Cell ultra-structure and Reproduction: Vegetative, asexual and sexual
Role of pigments, reserve food, cell wall, flagella, eye spot and pyrenoids in classification and evolution of algae
Use of algae as food, feed and in industry
Indian phycologists and their contributions

Unit II

Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta

Unit III

Lichen: General Account, Classification, Distribution, Morphology, Anatomy, Reproduction & Economic importance
General characters of fungi, cell ultra structure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic), reproduction: vegetative, asexual and sexual; heterothallism, heterokaryosis and parasexuality
Classification of fungi: Recent trends

Unit IV

Brief account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina
Phylogeny of fungi
Fungi in industry, medicine and as food
Fungi as biocontrol agents

Unit V

Classification and general features of Marchantiales and Jungermanniales, Anthocerotales, Sphagnales and Polytrichales
Evolutionary trends in sporophytes
Vegetative propagation and perennation
Mechanism of dehiscence of capsules and dispersal of spores
Conducting tissues in Bryophytes
Economic importance of Bryophytes

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M.Sc. Botany
(Semester-I)

MBOTCC-2: Microbiology and Plant Pathology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

General introduction; History and scope of microbiology; theory of spontaneous generation
Methods of microbiology: Sterilization-Different types of sterilization (moist heat, dry heat, filtration, radiation and chemicals)
Diversity of microorganisms: Archaea, Bacteria, Cyanobacteria, Phytoplasma, Rickettsia

Unit II

Structure of bacteria: Ultra structure of Gram positive and Gram negative bacteria; reproduction (vegetative, asexual and genetic recombination); Nutritional classification of bacteria; economic importance of bacteria

Viruses: Nature, characteristics and ultrastructure of Virions (TMV and Bacteriophages), multiplication (Lytic and Lysogenic cycles) and transmission of viruses; economic importance; a brief account of Viroids and Prions

Unit III

Agriculture Microbiology: Biological nitrogen fixation and Biofertilizer
Industrial Microbiology: Industrial production of organic acids (citric acid), antibiotics (penicillin) and enzymes (amylase)

Unit IV

Classification of Plant disease and appearance of symptoms due to different microbes
Role of enzyme and toxin in pathogenesis
Effect of infection on the physiology of host with special reference to photosynthesis, respiration, nitrogen metabolism and osmoregulation
Host defence mechanism with special reference to structural and biochemical defence

Unit V

Seed pathology with special reference to seed-borne mycoflora, mycotoxin and its hazard Quarantine regulation and seed certification
Rhizosphere and rhizoplane microflora and its significance in soil borne disease
Etiology, symptoms and control measures of the following plant diseases:
Rust of linseed, Leaf blight of maize, Tikka disease of groundnut, Bunchy top of banana, black tip of mango, Yellow vein mosaic of bhindi, Little leaf of brinjal and Citrus canker

M.Sc. Botany
(Semester-I)

MBOTCC-2: Microbiology and Plant Pathology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

General introduction; History and scope of microbiology; theory of spontaneous generation
Methods of microbiology: Sterilization-Different types of sterilization (moist heat, dry heat, filtration, radiation and chemicals)
Diversity of microorganisms: Archaea, Bacteria, Cyanobacteria, Phytoplasma, Rickettsia

Unit II

Structure of bacteria: Ultra structure of Gram positive and Gram negative bacteria; reproduction (vegetative, asexual and genetic recombination); Nutritional classification of bacteria; economic importance of bacteria

Viruses: Nature, characteristics and ultrastructure of Virions (TMV and Bacteriophages), multiplication (Lytic and Lysogenic cycles) and transmission of viruses; economic importance; a brief account of Viroids and Prions

Unit III

Agriculture Microbiology: Biological nitrogen fixation and Biofertilizer
Industrial Microbiology: Industrial production of organic acids (citric acid), antibiotics (penicillin) and enzymes (amylase)

Unit IV

Classification of Plant disease and appearance of symptoms due to different microbes
Role of enzyme and toxin in pathogenesis
Effect of infection on the physiology of host with special reference to photosynthesis, respiration, nitrogen metabolism and osmoregulation
Host defence mechanism with special reference to structural and biochemical defence

Unit V

Seed pathology with special reference to seed-borne mycoflora, mycotoxin and its hazard Quarantine regulation and seed certification
Rhizosphere and rhizoplane microflora and its significance in soil borne disease
Etiology, symptoms and control measures of the following plant diseases:
Rust of linseed, Leaf blight of maize, Tikka disease of groundnut, Bunchy top of banana, black tip of mango, Yellow vein mosaic of bhindi, Little leaf of brinjal and Citrus canker

M.Sc. Botany
(Semester-I)

MBOTCC-3: Pteridophyta, Gymnosperm & Paleobotany (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit- I

Classification of Pteridophytes
Detailed general features: vegetative and reproductive, with special reference to development, characterization, position and kind of protection provided to the spore producing organs of the sporophytes and sexuality of the gametophytes in the following classes/orders:
Psilopsida – Psilotales
Lycopsida – Lycopodiates, Selaginellales and Isoetates
Special discussion has to be made about:
Stelar evolution within Lycopodiales
Gametophytic variations and evolution in Lycopodiales and
Heterospony *vs.* seed habit, with special reference to Selaginellales

Unit- II

Sphenopsida –Equisetales (only a brief account)
Pteropsida
Characterization, classification and distinction between Eusporangiate,
Protoleptosporangiatae and Leptosporagiatae
Structure, reproduction and Phylogenetic considerations of the followings:
Eusporangiate – Ohioglossales
Protoleptosporangiatae – Osmundales
Leptosporangiatae – Marsiliales , Salviniales and Filicales
Special reference has to be made about the followings:
Cytology *vs.* phylogeny of ferns
Role of polyploidy in evolution of ferns
Economic importance of pteridophytes

Unit-III

Characteristic features, distribution and economic importance of gymnosperms
Classification of Gymnosperms
Comparative morphology, anatomy, reproductive structures and interrelationships of the following living orders
Cycadales
Ginlgoales
Taxales

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Unit- IV

Coniferales: Characteristic features, families of modern conifers, their distinguishing features, evolution of female cone with reference to "transition conifers" as evolutionary line between cordaitales and coniferales

Comparative account of reproductive structures of Ephedrals, Gnetales, angiospermic features within the group

Evolutionary trend in sporophytic and gametophytic structures

Unit-V

Types and Nomenclature of fossils; Fossilization process and geological time-scale; Principles and objectives of fossil study

Comparative morphology, anatomy, reproductive structure and affinities of the following fossil groups:

- Psilophytales
- Lepidodendrales
- Cycadaeoidales
- Cordaitales
- Pentoxylales

M.Sc. Botany
(Semester-I)

MBOTCC-4: Practical 1 (Based on MBOTCC 1, 2 & 3) (5 Credits)

Time: 5hrs

Marks: 70

1. Principles and use of different sterilization instruments like autoclave, oven, Laminar air flow system etc.
2. Preparation of media (Potato Dextrose Agar).
3. Isolation of fungi from soil.
4. Identification of fungal isolates.
5. Preparation of Nutrient Agar (NA)media.
6. Isolation of bacteria from water.
7. Characterization of bacterial isolate by Gram's staining.
8. Counting of fungal spore by haemocytometer.
9. Temporary slide preparation and study of common Algae.
10. Temporary slide preparation and study of common Fungi.
11. Study of vegetative habit, anatomy and reproductive morphology of common Bryophyta (*Marchantia*, *Anthoceros* etc.).
12. Study of vegetative habit, anatomy and reproductive morphology of common Pteridophyta (*Psilotum*, *Lycopodium*, *Ophioglossum*, *Marsilea* etc.).
13. Study of vegetative habit, anatomy and reproductive morphology of common Gymnosperm (*Cycas*, *Pinus*, *Ginkgo*, *Gnetum* etc.).
14. Study of common fungal diseases- Rust of linseed, Blight of potato, Rust of wheat, Stem gall of coriander, Downy mildew, Powdery mildew etc.

M.Sc. Botany
(Semester-I)

MBOTCC-5: Biofertilizer Technology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit-I

Introduction to biofertilizers - Structure and characteristic features of the following biofertilizer organisms: Bacteria: *Azospirillum, Azotobacter, Rhizobium* and *Frankia; Cyanobacteria: Anabaena, Nostoc*; Fungi: *Glomus etc.*.

Unit-II

Nitrogenous Biofertilizers: Bacteria - Isolation and purification of *Azospirillum* and *Azotobacter*, mass multiplication of *Azospirillum* and *Azotob*acter, formulation of inoculum of *Azospirillum* and *Azotobacter*, application of inoculants of *Azospirillum* and *Azotobacter*. Isolation and purification of *Rhizobium*, mass multiplication and inoculum production of *Rhizobium*, Methods of application of *Rhizobium* inoculants.

Unit-III

Isolation and purification of Cyanobacteria- Mass multiplication of cyanobacterial bioinoculants - Trough or Tank method, Pit method, Field method; methods of application of cyanobacterial inoculum. *Azolla* - mass cultivation and application in rice fields.

Unit-IV

Mycorrhizae - Ecto and endomycorrhizae and their importance in agriculture. Isolation of AM fungi - Wet sieving method and sucrose gradient method. Mass production of AM inoculants and field applications. Isolation and Purification of phosphate solubilizers. Mass multiplication and field applications of phosphate solubilizer (*Pseudomonas striata*).

Unit-V

Biofertilization processes -Decomposition of organic matter and soil fertility and vermicomposting
Biofertilizers: Storage, shelf life, quality control and marketing

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M.Sc. Botany
(Semester-II)

MBOTCC-6: Taxonomy, Anatomy & Embryology (5 Credits)

Time: 3hrs Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit-I

Classification: A historical account of Pre-Linnaean, Linnaean, Post-Linnaean and Pre-Darwinian Natural Systems and Post-Darwinian Phylogenetic Systems
Contemporary Systems: Arthur Cronquist, Armen Takhatajan, Robert F. Thorne and Rolf M.T. Dahlgren.

Unit II

Concept of taxa: Species, sub-species, variety and form; genus, family and higher categories
Concept of characters: 'Good' and 'Bad' characters, correlation of characters, character weighting And variation
Botanical nomenclature: Binomial system and International Code of Botanical Nomenclature (ICBN)

Unit III

Post Mendelian approaches: An introduction to Genecology, Experimental taxonomy, Cytotaxonomy, Biosystematics, Palynotaxonomy, Chemotaxonomy, Numerical Taxonomy/Taximetrics & Molecular Systematics

Unit IV

Differentiation, polarity, symmetry, factors affecting differentiation and morphogenesis
Meristems: Types
Organization of Shoot Apical Meristem (SAM)
Organization of Root Apical Meristem (RAM)
Differentiation of epidermis with special reference to stomata
Anomalous secondary growth
Nodal, Floral and Seed Anatomy – A phylogenetic consideration
Anatomy in relation to taxonomy

Unit V

Development of ovule, megasporogenesis and organization of female gametophytes (embryo sacs)
Pollen-Pistil interaction
Double fertilization and post fertilization changes leading to formation of seed, development of embryo, endosperm and seed coat
Polyembryony and Apomixis
Role of embryology in Taxonomy

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M.Sc. Botany
(Semester-II)

MBOTCC-7: Physiology & Biochemistry (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit- I

Osmotic relations; Transport phenomenon in plants: Transport of water and organic solutes, mechanism of xylem transport, mechanism of phloem transport, phloem loading and unloading

Unit- II

Energy transduction mechanism in plants: Photosynthesis: Difference between two pigment systems, Light reaction and dark reaction, water oxidizing complex; carbon fixation in C_3 and C_4 plants
N_2 fixation: Non-symbiotic and Symbiotic

Unit- III

Plant growth and development: Growth hormones and growth regulators, mode of action of auxin, transport of auxin, physiological role of auxin
Gibberellin: Mode of action and physiological role
Cytokinin: Physiological role and mode of action

Unit-IV

Enzymology: Enzymes: structure and classification, cofactors, coenzymes, prosthetic groups, isoenzymes, allosteric enzymes, multienzymes, mechanism of enzyme action, properties of enzymes

Unit-V

Biochemical Energetics: Glycolysis, TCA cycle, ETS, oxidative phosphorylation, photorespiration; Difference between oxidative phosphorylation and photophosphorylation

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M.Sc. Botany
(Semester-II)

MBOTCC-8: Plant tissue culture, ethanobotany, biodiversity & biometry (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

Cell and Tissue culture: Laboratory equipments; General techniques of aseptic manipulation; Composition of culture media and its preparation Callus culture, suspension culture and single cell culture
Organ culture: *In vitro* culture of vegetative and reproductive parts Clonal propagation
Plant protoplasts: Isolation, culture methods and plant regeneration
Role of tissue culture in crop improvement

Unit II

Traditional ethnobotanical knowledge base: Traditional knowledge base of Indian ethnic and local communities and their practices
Ethnopharmacology: Medical and paramedical use of plants in aboriginal of pro-literate societies in the world
Ethnoecology: Use of local biodiversity by aboriginal people for sustenance

Unit III

Biodiversity concept: Origin of the term, themes of biodiversity concept
Benefits of Biodiversity: Direct economic benefits to mankind, genetic resources, essential ecosystem services
Types of Biodiversity: Genetic, species and ecosystem diversity, distribution at global and national level. Assessment and inventory based on recommendation of IUCN, Biodiversity conventions and Biodiversity Act 2002
Patterns of loss of Biodiversity: Red lists, Red Data Book and Green Book
Red Data Categories: Extinct, endangered, vulnerable and threatened species.
Causes of biodiversity loss and extinction: Natural, genetic and ecological causes; human impacts including development pressure; Habitat loss, encroachments and overexploitation of resources
Repercussions of loss biodiversity including future climate change

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Unit- IV

Conservation of Biodiversity (Phytodiversity)
Distinctions between preservation and conservation, Conservation potential index, Protocols for conservations, Traditional conservation practices
In situ and *ex situ* conservation
Patenting, Intellectual property right, Biosafety protocols
People's movements for biodiversity conservation

Unit-V

Biometry
Distribution and measurement of variation, Mean, Median, Mode, Standard deviation, standard error, coefficient of variability, test of significance- t test, F- test (analysis of variants); Measurement of correlation coefficient, Application of chi-square test for testing hypothesis

MBOTCC-9: Practical 2 (Based on MBOTCC 5, 6, 7, 8 & 9) (5 Credits)

Time: 5 hrs

Marks: 70

1. Preparation of culture media for growth of *Rhizobium*, *Azotobacter* and *Nostoc*.
2. Production microbial Biofertilizers: *Rhizobium*, *Azotobacter* and *Nostoc*.
3. Family description of some locally available Plants.
4. Anamalous secondary growth of some common plants (*Tinospora*, *Boerhaavia*, *Nyctanthes*, *Aristolochia*, *Amaranthus*).
5. Staining of Xylem and Phloem elements.
6. Study of stigma by squash method
7. Study of pollen germination
8. Mounting and study of embryo and endosperm.
9. Separation of chlorophyll pigment by paper chromatography.
10. Determination of water potential using plasmolytic method.
11. Estimation of protein by Lowry method.
12. Study of alpha-amylase in germinating seedlings.
13. Separation of amino acids by TLC.
14. Preparation of MS media for plant tissue culture.
15. Ex-plant culture and callus initiation.
16. Taxonomy and significance of some important medicinal plant.

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M.Sc. Botany
(Semester-III)

MBOTCC-10: Cell Biology & Cytogenetics (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

Cell theory and organization of the cell (Prokaryotic and Eukaryotic)
Ultrastructure chemical composition of the following:
Cell wall, Plasma membrane, Cytoplasm and cytoplasmic organelles (origin, ultrastructure & function: Plastids, Mitochondria, Endoplasmic reticulum, ribosomes, Golgi complex, Lysosomes, Peroxisomes and Centrosomes

Unit-II

Nucleus: Nuclear membrane, nuclear pore, nucleolus and karyolymph
Cell division, Cell cycle and apoptosis, Control mechanism, cytokinesis and cell plate formation

Unit-III

Chromosome: Organization and special types
Mendelian genetics
Gene interaction
Sex determination

Unit-IV

Extranuclear inheritance
Chromosomal aberration, polyploidy-types and role in speciation
Mutations- Molecular mechanism, induction by physical and chemical mutagens

Unit- V

Population Genetics
Microscopy: Phase contrast microscopy, Electron microscopy (SEM and TEM), Fluorescence microscopy
Microdensitometry

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M.Sc. Botany
(Semester-III)

MBOTCC-11: Molecular Biology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

Organization of DNA: Nucleic acids as hereditary material; Structure and forms of DNA and RNA, double helix, supercoiling of DNA, Packaging of DNA in Prokaryotes and eukaryotes

Unit II

DNA replication: DNA replication models; Mechanism of DNA replication
DNA damage and repair mechanism: Different types of DNA damage and repair mechanisms; Diseases caused due to impairment in repair mechanism

Unit III

Transcription: Importance of DNA binding Proteins, RNA polymerase-types, structure and functions; Mechanism of Transcription in prokaryotes & Eukaryotes; Processing of RNA: m-RNA processing, 5' capping, 3' polyadenylation, splicing r-RNA & t- RNA processing
Genetic code: Cracking of code; characteristics

Unit IV

Translation: Machinery and mechanism in prokaryotes and eukaryotes; role of t RNA & ribosome; Post translational modification of proteins such as phosphorylation, adenylation, acylation and glycosylation

Unit-V

Regulation of gene expression: Prokaryotes- Positive and negative control, inducible and repressible operons, lac operon, trp operon
Eukaryotes- Regulation at DNA, transcription, translation and post translational level
Antisense technology: Molecular mechanism of antisense molecules, application of antisense technologies.

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M.Sc. Botany
(Semester-III)

MBOTCC-12 Recombinant DNA Technology (5 Credits)

Time: 3hrs Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

rDNA technology: Techniques used in RDT: Polyacrylamide and agarose gel electrophoresis Blotting techniques: Southern, Northern and Western blotting Polymerase chain reaction and its applications, DNA sequencing: Various methods of DNA sequencing

Unit II

Core techniques and essential enzymes; Restriction enzymes-types and cleavage pattern; DNA ligase- types and ligation of DNA molecule *in vitro*
Cloning vectors: Plasmids (natural, pBR322, Ti plasmid vectors), phages, cosmid, artificial chromosome vector; Shuttle vectors; Expression vector

Unit III

Passenger DNA: Different strategies used for isolation/synthesis of gene; Organ chemical synthesis of gene; Construction of genomic and cDNA libraries
Construction of rDNA: Different strategies for construction of rDNA (Use of restriction enzymes, Linkers, Adaptors, Homopolymer tailing)

Unit IV

Selection strategies: Different methods for selection of clone (antibiotic resistant markers, colony hybridization, plaque hybridization, immuno screening)
Methods of DNA transfer in suitable host: electroporation, electrofusion, microinjection, particle gun method, direct uptake of DNA ($CaCl_2$ method), liposomes as transforming vehicle
Expression of foreign gene

Unit V

Application of rDNA technology: In medicine, agriculture and environment protection
DNA finger printing: Methodology and its application
Intellectual property rights, bioethics and patenting: IPR, sovereignty rights, CBD, bioethics and patenting
Safety of recombinant DNA technology: Restriction and regulation for the release of GMOs; Social and ethical issue

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(Semester-III)

MBOTCC-13: Plant Ecology and Environmental Biology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit- I

Organism and population concept; Natality; Mortality; Density; Rate of population increase; r and k selection; Age and sex ratio; Aggregation
Interactions among populations: Commensalism, Amensalism, Mutualism, protocooperation and Symbiosis, predation and parasitism, competition
Intraspecific and interspecific
Plant adaptations

Unit- II

(i) Community Structure:
Qualitative character : Physiognomy, Phenology, Sociability, Vitality, Raunkiaer's life forms
Quantitative Character : Frequency, Density, Abundance, Cover and basal area
Synthetic character : Presence and Constance, Fidelity, Importance value Index
Methods of studying plant community: Quadrates, Transects, Bisect, Plotless method
Classification of communities: Physiognomic classification, Floristic classification, Dynamic system, Continum concept

(ii) Community dynamics:

Concept of Succession, Nudation, Invasion, Competition and reaction, Stabilization and Climax, Xerosere and Hydrosere and their seral stage

Unit-III

Ecosystem: Abiotic and biotic components; Ecological pyramids; Structural organization of grassland, forest and aquatic ecosystem
Ecosystem energetic: Laws of thermodynamics, Productivity, energy food chain and ecosystem budget; Biogeochemical cycles

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Unit-IV

Environmental Pollutions: Air, Water, Soil, waste radioactive and noise pollution; Global warming; green house effect; O_3 depletion; Climate change

Unit-V

Environmental Awareness: Man and Biosphere (MAB); International Union for Conservation of Nature and Natural Resources (IUCN); United Nations Environment Programme (UNEP); World Environmental Day; Wildlife Preservation Act (1972); Indian Forest Conservation Act (1989)

MBOTCC-14: Practical 3 (Based on MBOTCC 5, 6, 7, 8 & 9) (5 Credits)

Time: 5 hrs

Marks: 70

1. Principle and use of different modern instruments used in Botany.
2. Cytological techniques: Preparation of cytological stains, fixation of sample etc.
3. Mitotic slide preparation of common plant.
4. Meiotic slide preparation of common plant.
5. Karyotype analysis.
6. Calculation of chiasma frequency.
7. Isolation of antibiotic resistant mutant by auxanography technique.
8. Isolation of genomic DNA from cauliflower.
9. Spectrophotometric estimation of DNA by diphenyl method.
10. Separation of DNA by agarose gel electrophoresis.
11. Demonstration of amplification of DNA using PCR.
12. Study of local vegetation by quadrate method.
13. Study of ecological adaptations (Morphological and anatomical) in plants.
14. Water analysis for pollution studies (Dissolved Oxygen, BOD, Dissolved Carbon dioxide, Chloride, Alkalinity etc.)

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List of Elective Courses (EC)

1. Cytogenetics and Crop Improvement
2. Applied Microbiology and Plant Pathology
3. Environmental Biology

M. Sc. Botany
(Semester-IV)

Option I

It consist of Core Elective papers

MBOTEC-1: Cytogenetics and Crop improvement (5 credits)
MBOTEC-2: Practical based on MBOTEC-1 (5 credits)

MBOTEC-1: Applied Microbiology and Plant Pathology (5 credits)
MBOTEC-2: Practical based on MBOTEC-1 (5 credits)

MBOTEC-1: Environmental Biology (5 credits)
MBOTEC-2: Practical based on MBOTEC-1 (5 credits)

Or any other Elective Core papers decided by BOCS and duly approved by competent bodies of the University

Option II

MBOTEC-1: Any theory paper of Core Elective
MBOTEC-2: Practical/ Project Work/ Dissertation and Viva-voce

M.Sc. Botany
(Semester-IV)

MBOTEC-1: Cytogenetics and Crop improvement (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I

Haploidy- Origin, production, cytological behaviour and genetic uses
Aneuploidy and polyploidy-Origin, classification, production, cytological behaviour and genetic uses; Role of polyploidy in evolution and speciation; Evolution of karyotypes
Chromosome banding pattern: Techniques, functional differentiation of chromosome segments, their chemical nature, significance and effect

Unit II

Mutations: Spontaneous and induced; physical and chemical mutagens- classification, mode of action; molecular basis of gene mutations; site directed mutagenesis; role of mutations in crop improvement
Cytoplasmic inheritance and maternal effect
Transposons: Structure and types of transposons (Prokaryotic and Eukaryotic); Mechanism of transposition (replicative and non-replicative); Retroposons; Application of transposon

Unit- III

Role Cytogenetics in crop improvement.
Epigenetics: Introduction; histone code; base modification; paramutations in maize; Epigenetics and Lamarckism; Epigenome and epigenomics.
Genetic diseases of human; Eugenics

Unit IV
Role Cytogenetics in crop improvement.
Genetic basis of evolution and speciation
Incompatibility
Centres of diversity of cultivated plants

Unit V
A Brief account of classical methods of plant breeding
Modern techniques of plant breeding: Hybrids *vs* cybrids, protoplast fusion and somatic hybridization (parasexual hybridization techniques) and a brief idea of
Terminator gene technology
Heterosis and heterosis breeding
Breeding for disease and drought resistance

MBOTEC-2: Practical based on MBOTEC-1 (Cytogenetics and Crop improvement) (5 Credits)

M.Sc. Botany
(Semester-IV)

MBOTEC-1: Applied Microbiology and Plant Pathology (5 Credits)

Time: 3hrs

Marks: 70

The question paper will consist of 7 questions divided into 3 sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10x2=20 marks).
Section B: Question No. 2 will also be compulsory and comprise five short answer types questions (one from each Unit) and students will have to attempt only four questions (4 x 5=20marks).
Section C: Five long answer types questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10=30 marks).

Unit I
Fermentation technology: Scope and prospects
Microbial Metabolites: Primary and secondary metabolites; Production of organic acids (citric acid), amino acid (Glutamic acid) and Vitamin (Vitamin B_{12})
Production of antibiotics (Streptomycin)
Enzymes production and their commercial applications: Amylases, Proteases Renin

Unit II
Biochemical activity of microorganisms in milk
Fermented dairy products: yogurt and cheeses
Microorganisms as food; Single cell proteins (SCP), Edible mushroom (Button and Oyster), Fermented beverages: Production of wine and beer

Unit III

Treatment of solid wastes: Composting & Land filling
Wastewater treatment methods: Oxidation pond, Trickling filter, Activated sludge methods; Anaerobic treatment of wastewater
Waste water treatments by plants
Bioremediation and biogas production

Unit IV

History, classification and importance of plant pathology
Chemical and biological management of plant disease control
Integrated pest management (IPM)
Biopesticides: Bacterial, viral and fungal biopesticides and their and applications

Unit V

Selected plant diseases with special reference to symptoms, etiology and disease management
Cereals: blast of rice, Karnal bunt of wheat
Fruits & Vegetables: Downy mildew of cucurbits, Bacterial spots of tomato, downy mildew of grapes
Pulses: Wilt of arhar, powdery mildew of pea
Oil seeds: Rust of linseed
Fibre crop: Wilt of cotton
Spices & condiments: Stem galls of coriander, leaf spot of turmeric, smut of onion & leaf curl of chilli
Sugarcane: Whip smut of sugarcane, grassy shoot disease of sugarcane,
Tea, Coffee & Tobacco: Blister blight of tea, leaf rust of coffee & leaf blight of tobacco

MBOTEC-2: Practical based on MBOTEC-1 (Applied Microbiology and Plant Pathology) (5 Credits)

M.Sc. Botany
(Semester-IV)

MBOTEC-1 Environmental Biology (5 Credits)

Time: 3 hrs. **Marks: 70**

The question paper will consist of 7 Questions divided into 3 Sections.
Section A: Question No.1 will be compulsory comprising ten objective types questions (two from each Unit) each carrying two marks (10 x 2 = 20 marks).
Section B: Question No.2 will also be compulsory and comprise five short types questions (one from each Unit) and students will have to attempt only four questions each carrying four marks (4 x 5 = 20 marks).
Section C: Five long answer type questions are to be set (one from each Unit) of which any three questions are to be answered (3 x 10 = 30 marks).

Unit I

Biodiversity: Concepts, Types, Levels, Process of loss, Values and uses, Economic appraisal, Conservation of endangered plant species.
Structure and Function: Tropical dry deciduous forest, Grassland, Savanna and Wetland ecosystems.
Biogeochemical cycling:

a. Hydrological cycle
b. Global carbon cycle
c. Global nitrogen cycle
d. Sulphur cycle

Unit II

Biosphere Reserves.
Energy flow in Ecosystems.
Ecological energetics of Ecosystems.
Energy utilization by green plants.
Primary production: Its measurement and range.
Ecological efficiency.
Food chains, Food web, Trophic level.
Energy Flow Models,
Loss and Conservation of energy.
Landscape Ecology: Concepts, Structure, Management and Conservation.

Unit III

Pollution: Water pollution, Air pollution, Soil pollution, Noise pollution and Radiation pollution: Sources, Effects and Control measures.
Biodegradation of pollutants.
Eutrophication.
Biomagnification.
Bioremediation
Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

Unit IV

Acid rain: Effect on Human Chemistry, Forests, Lakes and Streams.
Green house gases: Green house effect, Trends and Global balance of CO_2, CFC, NO_2, CH_4.
Global Warming.
Ozone hole.
Plant indicators.
Ecotoxicology: Terrestrial and Aquatic toxicology.
Ecological restoration of degraded ecosystems:

a. Concepts, Aims and Objectives.
b. Restoration of degraded forests, Agroecosystems, Savanna, Coal mine spoil, Grassland and wetlands.
c. Post-restoration system management.
d. Keynote species: Concepts and related terms, Useful contribution and conservation policy.

Unit V

Deforestation and Desertification:

a. Causes and Rates of deforestation.
b. Local, Regional and Global effects of deforestation.

Biological control.
Biomass burning: Global Biomass burning, Environmental impact and monitoring efforts.

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MBOTEC-2: Practical based on MBOTEC-1. (Environmental Biology)

(5 Credits)

AECC-1

A- Environmental Sustainability (3 Credit)

B- Swachha Bharat Abhiyan Activities (2 Credits)

Each credit requires 10 hours of teaching- learning for theory and 20 hours for practical assignment field work.

A-Unit -1 Environmental ethics & ecosystem: Concept of sustainable development with reference to human values in western and Indian perspective, sustainable development & conservation of natural resources (Nature, factors, structure, development and people participation) development, environment- rural and urban, concept of Ecosystem.

A-Unit -2 Development and its effect on environment: Environment Pollution - water, air, noise etc. due to Urbanisation, Industrial civilization, Concept of Global Warming , Climatic Change, Green House Effect, Acid rain, Ozone layer depletion. Menace of encroachment of exotic plants particularly parthenium and trees with special reference to impact on habit & habitat on indigenous flora & fauna.

A-Unit -3 Concept of Bio-diversity and its conservation: Environmental Degradation and conservation. Govt. Policies, Social effects and role of social reforms in this direction. Role of science in conservation of environment concept of Three 'R' (reduce, reuse, recycle). Need of environmental education and awareness programme and ecological economics.

B-Unit -4 Swachha Bharat Abhiyan: The concept of Swachhata as personal, Gandhian approach towards social and environmental moral values & concept of swachhata and its relation to moral upgradation of society and freedom struggle. Awareness Programme related to Swachhata. Role of 'Swachchagrahis' in Swachha Bharat Abhiyan.

Sanitation and hygiene, why sanitation is needed, santation and human rights, plantation, value of nature, concept of community participation and role of state agencies. Case study of Sanitation, effects of cleanliness, diseases - infectious and vector – born Idea of spread of diseases through body and other biological fluids and excreta.

B-Unit-5 Assignment/Practical/field work based on unit-4

or

Alternative to unit-4 and unit-5 a student can also enrol for Swachha Bharat Internship programme of MHRD.

AECC – 2 **Credit - 5**

Human Values and Professional Ethics (3 Credits)

Gender Sensitization (2 Credits)

(One credit requires ten hours of theory and twenty hours of practical/assignment/field work)

Unit – 1: Variety of Moral Issues, Principals of Ethics and Morality:-

Understanding the Harmony in the Society (society being an extension of family), Integrity, Work Ethic, Courage, Empathy, Self Confidence, Professional Ideas and Virtues. Ethics as a Subset of Morality, Ethics and Organizations, Duties and Rights of employees and employers.

Unit – 2: Holistic approach to corporate ethics:-

Vendantic Ethics – Tagore, Vivekanand, Gandhi and Aurobindo on Ethics, Ethics in Finance, Business and Environment. Professional Rights, Intellectual Property Rights, Corporate Responsibility. Social Audit and Ethical Investing, Computer and Ethics.

Unit – 3: Professional Ethics:-

Augmenting Universal Human Order, Characteristics of people-friendly and eco-friendly production, Strategy for Transition from the Present State to Universal Human Order, At the Level of Individual- as Socially and Ecologically Responsible Technologists and Managers, At the Level of Society- as Mutually Enriching Institutions and Organizations. Case studies of typical holistic technologies and management patterns.

Unit – 4: Gender – An Overview:-

Gender: Definition, nature and evolution, culture, tradition, historicity; Gender spectrum: biological, sociological, psychological conditioning; Gender based division of labour – domestic work and use value.

Unit – 5: Gender – Contemporary perspectives

Gender justice and human rights: international perspectives, Gender : constitutional and legal perspectives, media & gender, Gender: emerging issues and challenges.

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Generic Elective (GE) course	
Course title: Human Rights	
Course code: GE-1	**Credit 5** **(There shall be 5 units each consisting of one credit)**
Course offered in: Semester- IV	
Course content:	

Unit	Topics
I	**Conceptual Aspects of Human Rights** a. Meaning and Concept of Human Rights b. Human Rights, Natural Rights, Civil Rights, Political Rights and Legal Rights.
II	**Evolution of the Concept of Human Rights** a. Magna Carta, The united state declaration of Independence: The French Declaration of the Rights of Man and the Citizen: United state Bill of Rights: Geneva Convention of 1864: Universal declaration of Human Rights, 1948. b. International Bill of Rights, Significance of Universal Declaration of Human Rights International Covenant on Civil and political Rights, International Covenant on Economic, Social and cultural Rights.
III	**Diversity, Multiculturalism and Human Rights** a. Value of Diversity: Collective Cultural Rights and the Idea of Universal Human Rights: Multiculturalism and Minority Rights: protection and promotion of Human Rights in Multicultural Societies. b. Beyond Universal Human Rights: Universalism of human Rights: Nation-State and the Right to national Self-Determination: state Sovereignty and the Politics of Universal Human rights.
IV	**Theoretical aspects of Human rights.** a. Theories of Human rights-Liberal Perspective-Locke, Rousseau, J.S. Mill, Marxian Perspective-Marx, Gramasci b. Feminist Perspective of Human Rights.
V	**Assignment / Field Work based and Unit I, II, III and IV.**

Ability Enhancement Course (AEC) or Skill Enhancement Course (SEC)	
Course title: : Environmental Law and Policy	
Course code: AEC-1/SEC-1	**Credit 5** **(there shall be 5 units each consisting of one credit)**
Course offered in: Semester- II	
Course description: Law and policy plays a major role in the conservation and management of natural resources as well as pollution control. This course intends to introduce the students to the vast field of Environmental Law and Policy. The course would be divided into three broad areas. The first part would cover the basic concepts and principles of Environmental Law. This would include judicial precedents, which now forms an essential part of environmental jurisprudence. The second part would be divided into specific introductory modules on forests and wild life including bio-diversity related laws; Air and Water related laws including mega projects and marine laws; and laws relating to hazardous substances. The third part would discuss the role of judiciary including the National Green Tribunal in protecting the environment.	
Course objectives: 1. To provide an overview of the law and policies relating to environment both at the national and international level. 2. To critically analyse the implementation of these laws and the role of adjudicatory bodies in the field Of environment.	
Course content:	
Unit	**Topics**
I	**Introduction:** Environment: meaning and components Environment *vs* Development debates, trigger events, business and environmental law, a brief introduction to SDGs. Introduction to environmental laws in India; Constitutional provisions, an overview of the laws General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine.
II	**Forest, Wildlife and Biodiversity related laws:** Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence. Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Dolphin, Tiger, Elephant, Rhino
III	**Air and Water Laws** National Water Policy Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Legal framework on Air pollution: Air Act,1981; EPA, 1986 as amended to date including rules and notifications issued under it.
IV	**Environment protection laws and large Projects** Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA. Marine laws of India; Coastal zone regulations, Wetland conservation.
V	**Judicial remedies and the role of National Green Tribunal** Role of judiciary in environmental protection; Infrastructure projects and the Indian judiciary.

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Learning outcomes:

On completion of this course, the students would:

1. Have a strong foundation to undertake specialized courses in the field of environmental laws and policy
2. Develop an inter-disciplinary approach to the issues relating to environment.

Assignments:

1. Environmental laws in India
2. Evolution and Jurisprudence of Forest and Wildlife laws
3. Legal framework on Air pollution
4. Biological Diversity law
5. Role of judiciary in environmental protection
6. Air Laws
7. Water Laws
8. Wetland conservation etc.