

To
Sri Sanjiv Kumar
OSD (Universities)
Raj Bhawan, Patna.

Date: 13/06/2018

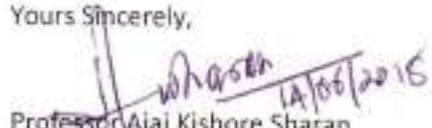
Sub: Implementation of Choice Based Credit system (CBCS) in the year 2018-20.


Sir,

With reference to your letter No. BSU (regulation) – 20/2018-1510/GS(I), Dt. 05.06.2018, a meeting of the panel of experts in Botany was held on 13.06.2018 at 10:30 am, to finalize the curriculum of Master of Science (Botany) degree and suggested some improvement in the syllabus in the light of operative Regulations. We hereby enclose the improved syllabus.

With regards,

Yours Sincerely,

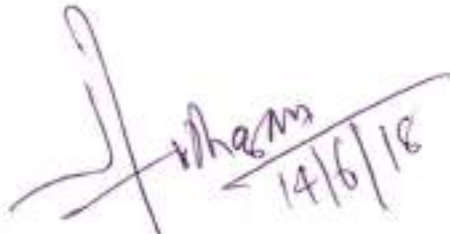

Professor Ajai Kishore Sharan
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Patna University, Patna

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

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Associate Professor
Department of Botany
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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

/ Both Project work/ Internship

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

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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.

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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
	MBOTAEC-1	Environmental Sustainability & Swachhha 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, Ethnobotany, 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
	MBOTAEC-2	Human Values & Professional Ethics and Gender sensitization	5	100	50	50	45% in CIA 45% in ESE	Qualifying
SEMESTER IV	MBOTE-1	Subject specific elective	5	100	30	70	45% in CIA 45% in ESE	Marks decid class/ CGPA
	MBOTE-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

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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

Lycoposida – 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,

Protileptosporangiate and Leptosporangiate

Structure, reproduction and Phylogenetic considerations of the followings:

Eusporangiate – Ohioglossales

Protileptosporangiate – Osmundales

Leptosporangiate – Marsiliales , Salviniiales 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 Ephedrales, 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


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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.

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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 *Azotobacter*, 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 Takhtajan, 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 Genealogy, 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. Anomalous 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-11: 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 (CaCl₂ 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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M.Sc. Botany
(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, protocoooperation 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, Continuum 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; O₃ 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 quadrat 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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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)

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: Project dissertation and Viva-voce

Option III

MBOTEC-1 and MBOTEC-2: Combined together and act as Project dissertation and Viva-voce carrying 200 marks (10 Credits).

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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 B₁₂)

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 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)**