

# Indira Gandhi National Tribal University Amarkantak (M.P.)



## SYLLABI

**B.Sc. (Hons.) Courses**

*Offered by*

**FACULTY OF SCIENCE**  
*(Effective from 2015-16)*

## 1. CHOICE BASED CREDIT SYSTEM

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of the country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent years have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing their examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students. Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## 2. DIFINITION OF KEYWORDS

- i) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
- ii) **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
- iii) **Course:** Usually referred to as 'papers', is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.
- iv) **Credit Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.
- v) **Credit Point:** It is the product of grade point and number of credits for a course.

- vi) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- vii) **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
- viii) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.
- ix) **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
- x) **Programme:** An educational programme leading to award of a Degree, diploma or certificate.
- xi) **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
- xii. **Semester:** Each semester will consist of **15-18 weeks of academic work** equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.
- xiii) **Transcript or Grade Card or Certificate:** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

### 3. TYPES OF COURSES

Courses in a programme may be of three kinds: Core, Elective and Foundation.

#### 3.1) Core Course

There will be a Core Course in every semester. This is the course to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

#### 3.2) Elective Course

Elective course is a course that can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be "**Generic Elective**" focusing on those courses, which add generic proficiency to the students. An elective may be "**Discipline centric**" or may be chosen from an unrelated discipline, also called as "Open Elective."

### 3.3) Foundation Course

The Foundation Courses may be of two kinds: *Compulsory Foundation* and *Elective Foundation*. The “Compulsory Foundation” courses are the courses based upon the content that leads to Knowledge enhancement, are mandatory for all disciplines. The “Elective Foundation” courses are value-based and are aimed at man-making education.

### 4. ACADEMIC YEAR

An academic year consists of two semesters -

Odd Semester (I, III and V<sup>th</sup> Semesters) : July - December

Even Semester (II, IV and VI<sup>th</sup> Semesters) : January - May

### 5. PROGRAMME & COURSES

The generalized sequence of CBCS would be -

Programme → Course (Paper) → Unit → Sub. Unit → Credits

#### 5.1) Under-Graduate Programme Structure (I –IV Semesters)

Distribution		Credits	Credit Distribution	
			Theory	Practical
Core	Subject – I	6	4	2
	Subject – II	6	4	2
	Subject- III	6	4	2
Foundation Course	English Communication/	2	2	
	Computer Education			
	Environmental Science			
	Value Education			
<b>Total</b>		<b>20</b>		
<b>Grand Total (I+II+III+IV)</b>		<b>80</b>		

*For semester (V& VI) the program structure will be decided by the concerned departments*

## **6. EVALUATION & DISTRIBUTION OF MARKS**

### **6.1) Continuous Internal Assessment (CIA): Forty (40) marks**

#### **I. 1<sup>st</sup> Mid-Semester Examination: Maximum Marks 10**

Duration of Examination: One Hour

Pattern of Question Paper:

Five (05) Objective Type Questions; each carrying one (1) mark

One (01) Short Answer Type Question of five (05) marks

#### **II. 2<sup>nd</sup> Mid-Semester: Maximum Marks 10 (as described above)**

#### **III. Assignment (minimum one): Maximum 15 Marks**

#### **IV. Regularity in the Class: Maximum five (05) Marks**

Award of marks based on attendance will be determined as below:

<b>Attendance</b>	<b>Marks</b>
90% and above	5 Marks
85 to 89.9%	4 Marks
80 to 84.9%	3 Marks
76 to 79.9%	2 Marks
75 to 75.9%	1 Mark
Below 75%	Zero

**Note:** Total Marks of CIE will be 40 (i.e., 10+10+15+5). A candidate must have to secure minimum 50% marks (i.e., 20 out of 40 marks). Failing so, s/he shall not be allowed to appear in End Semester Examination.

Marks for two mid-semester examinations could either be awarded as aggregate scored by the candidate in the two exams or as best of two. The department may adopt suitable model.

## 6.2) End Semester Examination (ESE)

### V. Theory Paper:

Maximum Marks: 60 (Sixty)

Duration of Examination-Three Hours

Question Paper Pattern: The paper will be set so to cover all units/sections of the syllabus. As below-

Section	Type	Total No.	No. of questions to be answered	Marks for Each Question	Total Marks
A	Objective/MCQs/Very Short Answer Type Questions	10 (two questions from each unit)	10	01	10
B	Long Answer Type Questions (one out of two questions from each unit)	05 (one question from each unit)	5 (from all five questions)	10	50
<b>Total</b>					<b>60</b>

### VI. Practical Examination:

Duration of Examination: Four Hours

Question Paper Pattern -

Q.1. Major Experiment	Principle/ Theory	02
	Procedure/Performing of the experiment/Dissections	10
	Results and discussion	03
	<b>Sub. Total</b>	<b>15</b>
Q.2. Minor Experiment	Principle/ Theory	02
	Procedure and implementation	05
	Result	03
	<b>Sub. Total</b>	<b>10</b>
Q.3	Spotting (05 in numbers, each carrying 2 marks)	<b>10</b>
Q.4	Viva-voce	<b>05</b>
Q.5	Record/ File/ Herbarium	<b>05</b>
<b>Total</b>		<b>50</b>

**6.3** Total marks of each question paper will be 100 (hundred) for theory paper [i.e., 60 (ESE) + 40 (CIA)] and 50 (fifty) for practical paper (Grand Total: **150, Hundred-Fifty**), irrespective of their credits.

## 7. ATTEDANCE

A candidate shall only be eligible to appear in the end-semester examination if s/he has secured a minimum of 75% attendance as prescribed in the university ordinance.

## 8. GRADING

Each course shall be graded (refer table below) on the basis of marks obtained, on scaled marks of 100, during a semester. There shall be absolute grading where mark obtained (out of 100) by a student in a course is converted to a Grade on a 10-point scale.

**Table:** Showing marks to grade conversion

<b>Marks (%)</b>	<b>Letter Grade</b>	<b>Grade Points</b>
89.5-100	O (Outstanding)	10
79.5-89.4	A+ (Excellent)	09
69.5-79.4	A (Very Good)	08
59.5-69.4	B+ (Good)	07
49.5-59.4	B (Pass)	06
0-49.4	F (Fail)	00
	Ab (Absent)	00

## 9. TRANSITORY PROVISIONS

Notwithstanding anything contained in these regulations, the university reserves the right and power to make necessary modification as and when needed.

# Indira Gandhi National Tribal University Amarkantak (M.P.)



## SYLLABI

(Based on CBCS Pattern)

**Department of Botany**  
**Faculty of Science**

*(Effective from 2015-2016)*



IGNTU, Amarkantak offers graduate and post-graduate Botany courses with an intake capacity of 60 and 10 students, respectively. Different programs are designed in a way to promote an all-encompassing study of plants, including microbes. The complete curriculum (including graduation and post graduation) consists of classical studies ranging from morphology to taxonomy; specialized knowledge such as ecology, physiology, biochemistry to molecular biology. Ecological importance of plants, their biotechnological application and potential of plants in promoting entrepreneurship amongst students have also been highlighted. We hope that the programme will open up a range of career opportunities for students.

**Objectives of the programme:**

Upon completion of the course candidates shall have achieved the following objectives:

1. A detailed knowledge of structure, function and application of plants and microorganisms.
2. Facilitate the applications of plants in industry, academics as well as in environmental protection.
3. Help in understanding the current trends in plant science research.
4. Promote an ability to design, undertake and interpret a research project.
5. Laboratory experiments will help in skills development amongst students.

**Salient Features:**

1. Tribal-centric syllabus
2. In-depth interactive lectures
3. State of the art lab exercises
4. Enhance writing & presentation skill

**Indira Gandhi National Tribal University  
Amarkantak (M.P.)**



**SYLLABI**

**Department of Botany  
Faculty of Science**

**B. Sc. (Hon's.) Programme in Botany**

*(Based on CBCS Pattern; Effective from 2015-2016)*

# B.Sc. (Hons.) Course Structure

## Semester – I

Course Code	Title	Credits
BBT 101	Microbiology & Phycology	4
BBP 101	Laboratory work based on course BBT 101	2
	Total	<b>6</b>

## Semester – II

Course Code	Title	Credits
BBT 201	Fungi, Lichen & Bryophytes	4
BBP 201	Laboratory work based on course BBT 201	2
	Total	<b>6</b>

## Semester – III

Course Code	Title	Credits
BBT 301	Pteridophytes, Gymnosperms & Paleobotany	4
BBP 301	Laboratory work based on course BBT 301	2
	Total	<b>6</b>

## Semester – IV

Course Code	Title	Credits
BBT 401	Biology of Angiosperms (Morphology, Anatomy & Embryology)	4
BBP 401	Laboratory work based on course BBT 401	2
	Total	<b>6</b>

## Semester – V

Course Code	Title	Credits
BBT 501	Cytogenetics & Evolution	4
BBT 502	Taxonomy of Angiosperms	4
BBT 503	Ecology	4
BBT 504	Bioenergetics, Metabolism & Physiology	4
BBP 501	Lab work based on course BBT 501 and 502	2
BBP 502	Lab work based on course BBT 503 and 504	2
BBP 503	Field Study/Local trip	2
	Total	<b>22</b>

## Semester – VI

Course Code	Title	Credits
BBT 601	Economic Botany & Plant Pathology	4
BBT 602	Biochemistry & Molecular Biology	4
BBT 603	Biostatistics, Bioinformatics & Instrumentation	4
BBT 604	Plant Biotechnology	4
BBP 601	Lab work based on course BBT 601 and 602	2
BBP 602	Lab work based on course BBT 603 and 604	2
BBP 603	Review based dissertation	2
	Total	<b>22</b>
<b>Grand Total (I + II + III + IV + V + VI Semesters)</b>		<b>68</b>

## BBT 101: Microbiology & Phycology

Credit – 04

<b>Unit – I</b>	<b>12h</b>
A brief account of archaea and mycoplasma Structure of a bacterial cell: capsule and slime, flagella, cell wall, cell membrane, genetic material, plasmid and endospore	
<b>Unit – II</b>	<b>12h</b>
Bacterial nutrition and genetic recombination (transformation, conjugation and transduction), Techniques in microbiology, culture and growth of microorganisms, significance of bacteria	
<b>Unit – III</b>	<b>12h</b>
<b>Viruses:</b> Nature, structure, transmission, multiplication and economic importance Prions, viroids, bacteriophages (Lysogenic and lytic cycles)	
<b>Unit – IV</b>	<b>12h</b>
A general introduction to algae, including their vegetative structure, reproduction, ecology and economic importance, classification of algae	
<b>Unit – V</b>	<b>12h</b>
A study of reproduction and life cycle of the following genera: Cyanophyceae: <i>Oscillatoria</i> , <i>Nostoc</i> , <i>Scytonema</i> Chlorophyceae: <i>Volvox</i> ; <i>Oedogonium</i> Phaeophyceae: <i>Ectocarpus</i> Rhodophyceae: <i>Polysiphonia</i>	

### Suggested Readings:

1. Elements of Microbiology, Michael J. Pelczar, 5th Ed, Tata McGraw Hill
2. Prescott's Microbiology, Joanne Willey, Linda Sherwood, Chris Woolverton, 8<sup>th</sup> edn, Tata McGraw Hill.
3. Brock Biology of Microorganisms, Madigan MT, Martinko JM, Dunlap PV, Clark DP, (2012), 13th edition, Pearson Education Inc.
4. General Microbiology, Stainier RY, Ingraham JL, Wheelis ML, Painter PR, (2009), 5th edition, McMillan Press Ltd., Hound Mills
5. Foundation in Microbiology, Talaro KP, Chess B, (2011), 8th edition, McGraw-Hill
6. A Text Book of Botany, Authors - Singh, Pandey and Jain, Rastogi Publication, Meerut (A combined book for Algae, Fungi, Brophyta & Pteridophyta)
7. NCERT publications
8. College Botany, Gangulee HC, Kar AK, Vol. II- 2011, New Central Book Agency, Kolkata (A combined book for Algae, Fungi, Brophyta & Pteridophyta)
9. Phycology, Lee RE, 2008, Cambridge University Press, Cambridge
10. Algae, Vashista & Vashista, S Chand Publication, New Delhi
11. Cryptogamic Botany, G L Smith

**BBP 101:** Lab work based on course BBT 101

**Credit: 02 (60h)**

**Microbiology:**

1. Line drawings/ Photographs of Lytic and Lysogenic Cycle
2. Types of Bacteria to be observed from temporary/permanent slides/photographs
3. Gram staining
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

**Phycology:**

Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*, *Vaucheria*, *Ectocarpus*, *Sargassum* and *Polysiphonia*, through temporary preparations and permanent slides.

## BBT 201: Fungi, Lichen & Bryophytes

Credit - 04

**Unit - I** **12h**

**A general introduction to fungi:** structure, asexual and sexual reproduction, classification of fungi

**Unit - II** **12h**

The life histories of the following genera:

Mastigomycotina: *Albugo*

Zygomycotina: *Mucor*

Ascomycotina: *Peziza*

Basidiomycotina: *Agaricus*, *Puccinia*

Deuteromycotina: *Cercospora*

**Unit - III** **12h**

**Lichens:** Occurrence, general structure and reproduction with special reference to *Parmelia*, economic importance of lichens in general

**Unit – IV** **12h**

A general account of bryophytes including their classification, evolution of sporophytes, economic importance of bryophytes

**Unit – V** **12h**

Study of the life histories of the following representative genera (developmental details are not required) –

Hepaticopsida – *Riccia*, *Marchantia*

Anthocerotopsida – *Anthoceros*

Bryopsida – *Sphagnum*, *Funaria*

### Suggested readings:

1. Introductory Mycology, Alexopoulos CJ, Mims CW, Blackwell M (1996), John Wiley & Sons (Asia) Singapore. 4<sup>th</sup> edition.
2. Introduction to Fungi, Webster J & Weber R (2007), Cambridge University Press, Cambridge. 3<sup>rd</sup> edition.
3. Text Book of Fungi and Their Allies, Sethi IK & Walia SK (2011), Macmillan Publishers India Ltd.
4. Fungi & Plant Diseases: Mundukar
5. Bryophyta, Vahishta, Sinha, Kumar, S. Chand Publication, New Delhi.
6. Introduction to Bryophytes, Vander-Poorteri, 2009, COP
7. An introduction to Embryophyta (Vol. I): Bryophyta. Parihar NS (1991), Central Book Depot, Allahabad
8. Bryophyta, Watson GD

**Fungi:**

1. Microscopic observation of unicellular, coenocytic/septate mycelium, asocarps & basidiocarps
2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides
3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of sexual stage from permanent slides/photographs
4. *Peziza*: sectioning through ascocarp
5. *Puccinia*: sections/ mounts of spores on wheat and permanent slides of both the hosts
6. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*
7. *Albugo*: asexual phase study through section/temporary mounts and sexual structures through permanent slides.

**Lichens:**

Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates, study of thallus and reproductive structures (soredia and apothecium) through permanent slides, Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs).

**Bryophytes:**

1. *Riccia*: Morphology of thallus
2. *Marchantia*: Morphology of thallus, whole mount of rhizoids & scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides)
3. *Anthoceros*: Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide)
4. *Sphagnum*: Morphology of plant, whole mount of leaf (permanent slide only).



## BBT 301: Pteridophytes, Gymnosperms & Paleobotany

Credit: 04

**Unit –I** **12h**

General account and classification of Pteridophytes, distribution in India, Stellar system and its evolution in Pteridophytes

**Unit – II** **12h**

Life history of the following genera - *Rhynia* (Psilophyta), *Lycopodium*, *Selaginella* (Lycophyta), *Equisetum* (Athrophyta), *Marsilea* (Filicophyta)

**Unit – III** **12h**

General accounts, distribution and classification (cf. Sporne) of the Gymnosperms

**Unit – IV** **12h**

Life history of the following genera – *Cycas*, *Pinus* and *Ephedra*

**Unit – V** **12h**

Elementary knowledge of paleobotany, geological era, processes of fossilization, types of fossils, *form genera* and reconstruction of fossil plants, contribution of Prof. Birbal Sahni

### Suggested Reading:

1. An Introduction to Pteridopyta, Rashid A, 2nd edition, 2011 (Reprint), Vikas Publishing House Pvt. Ltd., Noida
2. The Biology and Morphology of Pteridophytes, NS Parihar (1996), Central Book Depot, Allahabad
3. Pteridophyta, Vashistha PC, Sinha AK, Kumar A (2010), S. Chand. Delhi, India
4. Morphology of Gymnosperms, Sporne KR, B.I. Publication, New Delhi
5. Gymnosperms. Bhatnagar SP, Moitra A (1996). New Age International (P) Ltd Publishers, New Delhi, India
6. Morphology of Gymnosperms. JM Coulter, CJ Chamberlain (1977), University of Chicago Press.

**Pteridophytes:**

1. *Psilotum*: Study of specimen, transverse section of synangium (permanent slide)
2. *Selaginella, Lycopodium*: Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), rhizophore, longitudinal section of strobilus (permanent slide)
3. *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

**Gymnosperm:**

4. *Cycas*: Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide)
5. *Pinus*: Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide)
6. *Ephedra/Gnetum*: Morphology (stem, male & female cones), transverse section of stem (temporary slide)

**Paleobotany:**

Fieldwork and collection/observation of fossils.

**BBT 401: Biology of Angiosperms**  
(Morphology, Anatomy & Embryology)

**Credit - 04**

**Unit – I** **12h**

Board outlines of morphology of vegetative parts (root, stem, leaf) and their modifications, anatomical arrangement of reproductive organs of angiosperms

**Unit – II** **12h**

Structure of cell wall, pit and plasmodesmata; tissues and tissues systems, anatomy of dicot and monocot root, stem and leaf, organization of root and shoot apex

**Unit – III** **12h**

Types of vascular bundles, structure, function and seasonal activities of cambium, an account of normal primary structure and secondary growth in herbaceous and woody plants, annual rings

Anomalous secondary growth as exemplified by stems of *Boerhaavia*, *Chenopodium*, *Bignonia* and *Dracaena*, leaf abscission

**Unit – IV** **12h**

Microsporogenesis: formation of male gametophytes, Megasporogenesis - development of embryo sac, types of embryo sac

**Unit – V** **12h**

Double fertilization and triple fusion, endosperm- Types of endosperms and development of embryo.

**Suggested Readings:**

1. Taxonomy of Angiosperms, Singh V & Jain DK, Rastogi Publication, Meerut.
2. Angiosperms -Taxonomy, Emrbyology and Anatomy, Pandey BP, S. Chand & Co., New Delhi
3. Embryology of Angiosperms, Bhojwani SS & Bhatnagar SP, Vikash Publishing House, New Delhi
4. Integrative Plant Anatomy. Dickison WC, (2000), Harcourt Academic Press, USA.
5. Plant Anatomy, Fahn A, (1974), Pergmon Press, USA.
6. Plant Anatomy, Mauseth JD, (1988), The Benjammin/Cummings Publisher, USA.
7. Anatomy of Seed Plants, Esau K (1977), John Wiley & Sons, Inc., Delhi.

**Morphology:**

1. Study of morphological details through permanent slides/temporary stain mounts/ museum specimens with the help of suitable examples.
2. Study of root, stem and leaf modification with the help of suitable examples.

**Anatomy:**

Study of anatomical details through permanent slides/temporary stain mounts/ museum specimens with the help of suitable examples.

1. Apical meristem of root, shoot
2. Distribution and types of parenchyma, collenchyma and sclerenchyma
3. Xylem: Tracheary elements-tracheids, vessel elements; thickenings, perforation plates, xylem fibres
4. Phloem: Sieve tubes-sieve plates, companion cells, phloem fibres
5. Root: monocot, dicot, secondary growth
6. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels
7. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).

**Embryology:**

Anatomical details of anther, study of embryo (temporary slides), type of embryo, embryo sac and endosperm (permanent slide)

## BBT 501: Cytogenetics & Evolution

Credits: 04

### Unit – I 12h

Cell theory, Germplasm theory, ultra structure of plant cell –Mitochondria, Chloroplast, Nucleus & Cytoskeleton, plasma membrane (fluid-mosaic model),

### Unit - II 12h

Cell cycle, cell division (Mitosis, Meiosis), genetic significance of meiosis, structure of eukaryotic chromosome, euchromatin and heterochromatin, special types of chromosomes - Polytene and Lampbrush chromosomes

### Unit – III 12h

**Mendel's laws of inheritance:** Law of segregation, law of independent assortment, deviations from Mendel's laws (Neo-Mendelism), Test and Back crosses

### Unit – IV 12h

**Interaction of genes:** Intragenic and intergenic interactions, complimentary genes, duplicate genes, incomplete dominance, lethal genes and epistatic genes, linkage and crossing over, sex determination in plants

### Unit – IV 12h

**Theories of organic evolution:** inheritance of acquired characters (Lamarckism), natural selection (Darwinism), de Vries mutation theory, synthetic theory.

### Suggested Readings:

1. A Text Book of Cytology, Genetics and Evolution, Gupta, PK, Rastogi Publication, Meerut
2. Cell and Molecular Biology, Robertis EDP De & Robertis EMF De, Walters Kluwer (India) Pvt. Ltd
3. Cell Biology, Karp G, (2010), 6th edition, John Wiley & Sons, U.S.A.
4. Becker's World of the Cell, Hardin J, Becker G, Skliensmith LJ, (2012), 8th edition, Pearson Education Inc. USA.
5. The Cell: A Molecular Approach, Cooper GM, Hausman RE, (2009), 5th edition, ASM Press & Sunderland, Washington, DC; Sinauer Associates, MA.
6. Principles of Genetics, Gardner EJ, Simmons MJ, Snustad DP, John Wiley & Son, India
7. Genetics: Classical to Modern, Gupta PK (2007), Rastogi Publication, Meerut
8. Principles of Genetics, Snustad DP, Simmons MJ, (2010), 5th edition, John Wiley & Sons Inc., India.
9. Concepts of Genetics, Klug WS, Cummings MR, Spencer CA, (2012), 10th edition, Benjamin Cummings, USA.
10. Introduction to Genetic Analysis, Griffiths AJF, Wessler SR, Carroll SB, Doebley J, (2010), 10th edition, W.H. Freeman and Co., USA.
11. Variation and Evolution in Plants, Stebbins GL,

## BBT 502: Taxonomy of Angiosperms

Credit: 04

### Unit – I 12h

History of Plant taxonomy with special reference to India, principles and rules of plant nomenclature (ICN), ranks and names, typification, author citation, valid publication, rejection of names, principle of priority and its limitations, names of hybrids

### Unit - II 12h

Concept of taxa (family, genus, species), categories and taxonomic hierarchy, species (taxonomic, biological, evolutionary) and population concepts, speciation.

### Unit - III 12h

Outline classification of Bentham and Hooker, Engler and Prantal and Hutchinson's with their principle, merits and demerits

### Unit -IV 12h

A detailed account of following families: Ranunculaceae, Brassicaceae, Papavaraceae, Malvaceae, Fabaceae, Rubiaceae, Asteraceae, Asclepiadiaceae, Cucurbitaceae, Acanthaceae, Solanaceae, Convolvulaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Poaceae, Droseraceae, Balanophoraceae

### Unit - V 12h

Herbarium concept and techniques, Botanical Survey of India, some national and regional Floras of India, Role of botanical garden

### Suggested Readings:

1. Taxonomy of Angiosperms, Singh V & Jain DK, Rastogi Publication, Meerut
2. Plant Systematics - Theory and Practices, Gurucharan Singh, (2012), 3<sup>rd</sup> edition, Oxford and IBH. Publishing Co. New Delhi
3. Plant Systematics: A Phylogenetic Approach, Judd WS, Christopher S, Campbell, Kellogg AE, Stevens PF, 1999, Sinauer Associates Inc. Publishers.
4. Plant Systematics, Simpson MG, 2006 Elsevier Academic Press.
5. An Introduction to Plant Taxonomy, Jeffrey C, (1982), Cambridge University Press, Cambridge.
6. Handbook of field and herbarium methods: Jain & Rao, Today and Tomorrow Publication.

**Cytology:**

1. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*/*Crinum*
2. Study different stages of mitosis and meiosis through temporary squash preparation.

**Genetics:**

1. Mendel's laws through seed ratios.
2. Laboratory exercises in probability and chi-square analysis.
3. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
4. Photographs/Permanent Slides showing Polytene and Lampbrush chromosomes.

**Evolution:**

Study of Lamarckism and Darwinism with suitable photographs.

**Taxonomy:**

1. Study of vegetative and floral characters of the selected families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).
2. Field visit to local areas
3. Mounting of a properly dried and pressed specimen of 10 wild plant species with herbarium label (to be submitted in the record book).

## BBT 503: Ecology

Credit: 04

### Unit – I 12h

Introduction to ecology, levels of organization (individuals, populations, ecosystems), autecology and synecology, Abiotic environment: atmosphere, temperature, water, light and soil (structure and soil profile)

### Unit – II 12h

**Biotic environment:** Interaction between plants, animals and man, interactions among plants growing in a community, interactions among plants and microorganisms  
Plant adaptations in response to water availability (Hydrophytes, Xerophytes and Halophytes).

### Unit – III 12h

**Population ecology:** Population characteristics (density, dispersion, age structure, natality, mortality Survivorship curves, growth curves), Ecotypes and Ecads  
**Community Ecology:** Analytical and synthetic characters (frequency, density, cover, IVI, life forms, biological spectrum, phenology, sociability)

### Unit - IV 12h

**Ecosystem ecology:** Ecosystem structure (abiotic and biotic components, food chain (grazing and detritus), food web, ecological pyramids; ecosystem function (models of energy flows), Biogeochemical cycles (carbon and phosphorus)

### Unit – V 12h

**Ecological succession:** General process, mechanism and pattern (hydrosere and xerosere), types and pattern

#### Suggested Readings:

1. Fundamentals of Ecology, Odum EP, (2005), 5<sup>th</sup> edition, Cengage Learning India Pvt. Ltd., New Delhi.
2. Basic Ecology, Odum EP, Saunders College Pub.
3. Ecology and Environment, Sharma PD, (2010), 8<sup>th</sup> edition, Rastogi Publications, Meerut, India.
4. Fundamental Processes in Ecology: An Earth Systems Approach, Wilkinson DM, (2007), Oxford University Press. USA.
5. Concepts of Ecology, Kormondy EJ, (1996), 4<sup>th</sup> edition, PHI Learning Pvt. Ltd., Delhi, India.



## BBT 504: Bioenergetics, Metabolism & Plant Physiology

Credit: 04

### Unit - I

12h

Laws of thermodynamics and their application in biology, concept of standard free energy ( $\Delta G^0$ ) change, properties of water as biological solvent, ATP as the sources of biological energy and other high energy phosphates

### Unit – II

12h

Anabolic and catabolic pathways

Respiration: Glycolysis, TCA cycle, electron transport, oxidative phosphorylation

### Unit – III

12h

**Water relation & mineral nutrition of plants:** Osmotic and water potential, water absorption, water loss (transpiration, guttation), mechanism of opening and closing of stomata, mineral nutrition, transport across membrane, transport of solutes

### Unit – IV

12h

**Photosynthesis:** Absorption of light, transfer of light energy, electron transport, photophosphorylation, C3, C4 and CAM pathways of carbon fixation, photorespiration

### Unit – V

12h

Plant Growth Regulators (Auxins, gibberlins, cytokinins, ABA, ethylene), Photoperiodism and Vernalization.

### Suggested Readings:

1. Plant Physiology, Taiz L, Zeiger E, (2015), Sixth Edition, Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, USA.
2. Introduction to Plant Physiology, Hopkins WG, Hunter NPA (2011), Fifth Edition, John Wiley & Sons, USA.
3. Plant Physiology & Biochemistry, Srivastava HS, (2008), Rastogi Publications, Meerut, India.

**BBP 502:** Laboratory work based on course BBT 503 and 504

**Credit: 02 (60h)**

**Plant Ecology:**

1. Study of morphological adaptations of hydrophytes and xerophytes.
2. Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobancha*) Epiphytes, Predation (Insectivorous plants).
3. Determination of minimal quadrat size for the study of herbaceous vegetation in the university campus, by species area curve method (species to be listed).
4. Quantitative analysis of herbaceous vegetation in the university campus for frequency and comparison with Raunkiaer's frequency distribution law.
5. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus

**Plant Physiology:**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the effect of light intensity and carbon dioxide on the rate of photosynthesis.
7. To compare the rate of respiration in different parts of a plant.

**BBP 503:** Field study: visit to local areas, collection of materials, and preparation of excursion report

**Credit: 02**

## **BBT 601: Economic Botany & Plant Pathology**

**Credit: 04**

**Unit – I** **12h**

Plants and human civilization, concept of Centers of Origin, crop domestication and loss of genetic diversity, Green Revolution and its consequences

**Unit – II** **12h**

A general description of important cereal (Wheat, Rice, Sorghum), legume (Gram & Moong), wood (Teak, Sal and Seesham), beverages and fiber-yielding (Cotton, Jute) plants of central India

**Unit – III** **12h**

Plant pathology: Definition and scope, terms and concepts, disease inciting organism, general symptoms, modes of infection, Host- Pathogen relationships, disease cycle and environmental relation, physiology of parasitism

**Unit – IV** **12h**

Mechanism of plant disease transmission and development in host plants, defense mechanism in plants, prevention and control plant diseases, role of quarantine,

**Unit – V** **12h**

Causal organism, symptoms, disease cycle and control measures of the following plant diseases: (Late Blight of Potato, White Rust of Crucifers, Black Rust of Wheat, Tikka disease of Groundnut, Citrus Canker, Yellow Vein Mosaic of Bhindi)

**Suggested Readings:**

1. Economic Botany: Principles & Practices, Wickens GE, (2001), Kluwer Academic Publishers, The Netherlands.
2. Plant Pathology, Agrios GN, Academic Press, London.
3. Plant Pathology and Plant Pathogens, Lucas JA, (1998) Wiley-Blackwell, CRC Press.
4. Economic Botany in Tropics: Kochhar and Swaminathan

## BBT 602: Biochemistry & Molecular Biology

Credit: 04

### Unit – I 12h

Structure, classification and functions of carbohydrates (esp. starch, cellulose), proteins and lipids

### Unit – II 12h

Enzymes: general properties, nomenclature, classification and mode of action (Lock & Key, Induced Fit models), factors affecting enzyme activity

Concept of holoenzymes, apoenzymes, coenzymes and cofactors

### Unit – III 12h

Structure of DNA, nature of genetic material, Watson & Crick's model, A, B and Z form of DNA, Replication of genetic material in prokaryotes, DNA damage and repair

### Unit – IV 12h

RNA structure and function (mRNA, rRNA, t-RNA), secondary and tertiary structure, Concept of Central Dogma: basic concept of transcription, reverse transcription.

### Unit – V 12h

Genetic code and basic mechanism of translation, post-translational modification, protein folding

### Suggested Readings:

1. Molecular Cell Biology, Lodish, Baltimore, 7th edition, W. H. Freeman & Co.
2. Principles of Biochemistry, Lehninger, Nelson, Cox, McMillan Worth Publishers.
3. Biochemistry, Christopher, Von Holde, Ahern, Pearson Education.
4. Biochemistry, Voet, Voet, John Wiley and Sons, Inc. USA.
5. Harper's Review of Biochemistry, Murray RK et al., Prentice-Hall International Inc.
6. Biochemistry: Jain JL, S. Chand & Co.
7. Molecular Biology of the Gene, Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R, (2007), 6th edition, Pearson Benjamin Cummings, CSHL Press, New York, USA.

**BBP 602:** Laboratory work based on course BBT 601 and 602

**Credit: 02 (60h)**

**Economic Botany:**

1. Habit sketch and micro-chemical tests of: Wheat, Rice and Gram
2. Specimen, whole mount of seed to show lint and fuzz, whole mount of fiber of Cotton and Jute
3. Study of wood samples

**Plant Pathology:**

1. Sectioning of plant diseased plant parts of diseased prescribed in theory papers (temporary slides)
2. Permanent slides showing infection and various stages of causal organisms
3. Local field trip to collect diseased plants

**Plant Biochemistry:**

1. Qualitative analysis of carbohydrate, protein and lipids (biochemical tests)

**Molecular Biology:**

1. DNA estimation by diphenylamine reagent/UV Spectrophotometry
2. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication)
3. Estimation of RNA through Orcinol method
4. Estimation of protein by Bradford Method
5. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs
6. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
7. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II Introns; Ribozyme and Alternative splicing.

## BBT 603: Biostatistics, Bioinformatics & Instrumentation

Credit: 04

### Unit – I 12h

**Biostatistics:** Importance and application, tabulation and classification of data, frequency distribution and graphical distribution of data, measures of central tendencies: Mean, Median and Mode, sampling methods.

### Unit – II 12h

**Measures of Dispersion:** Mean deviation, variance, standard deviation, standard error and coefficient of variation, hypothesis testing: Student's t-test and Chi-square test, R x C Contingency table

### Unit – III 12h

**Bioinformatic:** Objectives and scopes, sequence databases, sequence analysis of protein and nucleic acids, FASTA, BLAST

### Unit –IV 12h

**Microscopy:** principles and applications of simple and compound Microscope, scanning and transmission electron microscopy

### Unit – V 12h

**Spectroscopy:** Principles and practice, UV & VIS spectrophotometry

**Centrifugation:** Principles and separation of organelles.

### Suggested Readings:

1. Statistical Methods, Snedecor GW, Cochran, WG, 8<sup>th</sup> edition, East-West Press
2. Biomtery: Sokal RR, Rohlf, F.J., Freeman Press
3. Biostatistical Analysis, Jarr JH, Pearson Press
4. Principles & Techniques of Biochemistry and Molecular Biology, Wilson J, Walker, 7th edition, Cambridge Univ Press. UK
5. An Introduction to Practical Biochemistry, Plummer DT, 3rd edition, Tata-McGraw Hill
6. Modern Experimental Biochemistry and Molecular Biology, Boyer R, Benjamin & Cummins, 2ed edition, Publication.

## BBT 604: Plant Biotechnology

Credits: 04

### Unit – I 12h

Composition of media, nutrient and hormone requirements (role of vitamins and hormones).  
Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, artificial seeds, cryopreservation)

### Unit – II 12h

**Gene manipulating enzymes:** Restriction Endonucleases (Types I-IV, biological role and application), ligases, alkaline phosphatases

### Unit – III 12h

**Gene Cloning:** Recombinant DNA, bacterial transformation and selection of recombinant clones, PCR-mediated gene cloning, cloning vectors (plasmid, cosmid, BAC, YAC, shuttle vector), construction of genomic and cDNA libraries, screening DNA libraries, complementation, colony hybridization

### Unit – IV 12h

**Methods of gene transfer:** *Agrobacterium*-mediated, Direct Gene Transfer by electroporation, microinjection, microprojectile bombardment.  
Selection of transgenics - selectable marker and reporter genes

### Unit – V (Application of Biotechnology) 12h

Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Biosafety concerns, bioethics.

#### Suggested Reading:

1. Gene Cloning and DNA Analysis: An Introduction, 6th Ed, T. A. Brown
2. Genomes 3, 3rd Ed, T.A. Brown
3. Plant Tissue Culture: Theory and Practice, Bhojwani SS, Razdan MK, (1996), Elsevier Science Amsterdam. The Netherlands.
4. Molecular Biotechnology- Principles and Applications of Recombinant DNA, Glick BR, Pasternak JJ, (2003), ASM Press, Washington.
5. Plant Biotechnology & Genetics: Principles, Techniques and Applications. Stewart CN Jr, (2008), John Wiley & Sons Inc. USA.

**BBP 602:** Laboratory work based on course BBT 603 and 604

**Credit: 02 (60h)**

1. Statistical problems to measure central tendencies
2. Use of computer software to draw various types of graphs
3. Queering of online databases
4. Preparation of MS medium.
5. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of Tobacco, *Datura*, *Brassica* etc.
6. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
7. Construction of restriction map of circular and linear DNA from the data provided.
8. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
9. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.

**BBP 603:** Dissertation based on literature review.

**Credit: 02**


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The syllabus of B.Sc. (Hon's) is hereby approved in a meeting of the members of the Board of Study for the Department of Botany, IGNTU, Amarkantak (M.P.), on this date of March 7<sup>th</sup>, 2016, Monday.


Prof. S. P. Adhikary \*  
(Member, External Expert)



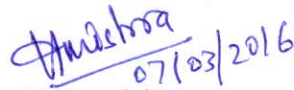
Prof. R. P. Sinha  
(Member, External Expert)



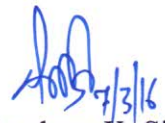
Prof. R. R. Rao  
(Member, Special Invitee)




Prof. A. K. Shukla  
(Member)



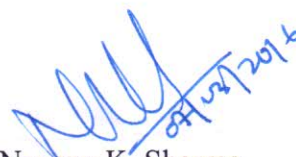
Dr. V.K. Mishra  
(Member)



Dr. Prashant K. Singh  
(Member)



Dr. Ravindra Shukla  
(Member)



Prof. Naveen K. Sharma  
(Chairman)

\* Due to his busy schedule Professor S.P. Adhikary could not attend the meeting, however, he send his consent and comments through e-mail (attached herewith).