Syllabus for

UG0805-Three/Four Year Bachelor of Science (Botany)

(From the Academic Year 2024-25 onwards)

(Syllabus as per NEP-2020 and Choice Based Credit System)

For Semester - I and II

Examination 2024-25

(For students - admitted in the year 2024)

University of Rajasthan,

Jaipur-302004

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Vision:

To create potential and competent professionals in Botany through the courses with practical training and advanced technical skills; equipped with knowledge and aptitude for higher education and research.

Mission:

- Dissemination of global demand- based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally viable solutions in the field of plant science.

Programme Outcomes:

PO1. Developing the potential for vertical career growth in plant sciences, academic and service sectors and related fields.

PO2. Development of in-depth analytical and critical thinking, so that students would be able to identify and solve the problems with the help of botany.

PO3. Proficient knowledge in the major domains of plant sciences including plant identification, plant diseases, microbiology, Plant biotechnology etc.

PO4. Students can successfully learn tools and techniques related to plant research.

PO5. After completion of course, students would be able to execute their professional roles in society as botanist, plant taxonomist, plant pathologist, etc.

PO6. Students will be able to learn skills to work as a team with the people from multidisciplinary environment.

PO7. To design and develop sustainable solutions to major biological problems by applying appropriate tools.

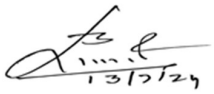
PO8. To develop skills, attitude and values required for self-directed, lifelong learning and

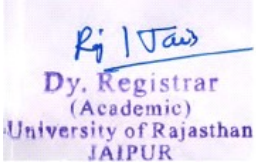
Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

professional development.

PO9. Acquire knowledge and understanding of norms and ethics in the field of botany.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)
		



Name of University	**University of Rajasthan, Jaipur**
Name of Faculty	**Science**
Name of Discipline	**Botany**
Type of Discipline	**Major**
List of Programmes where offered as Minor Discipline	**----------**
Offered to Non-Collegiate Students	**No**

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0805-Three/Four Year Bachelor of Science (Botany)								
				Botany	**Credits**			
#	**Level**	**Semester**	**Type**	**Title**	**L**	**T**	**P**	**Total**
1.	5	I	MJR	**UG0805 - BOT-51T-151 - Cell Biology and Diversity of Plant Kingdom-I**	4	0	0	4
2.	5	I	MJR	**UG0805 - BOT-51P-152 - Practical-I**	0	0	2	2
3.	5	I	MJR	**UG0805 -BOT-51T-153 - Microbiology**	4	0	0	4
4.	5	I	MJR	**UG0805 - BOT-51P-154 -Practical-II**	0	0	2	2
5.	5	II	MJR	**UG0805 - BOT-52T-155 - Genetics, Plant Breeding and Diversity of Plant Kingdom-II**	4	0	0	4
6.	5	II	MJR	**UG0805 - BOT-52P-156 - Practical-I**	0	0	2	2
7.	5	II	MJR	**UG0805 - BOT-52T-157 - Molecular Biology**	4	0	0	4
8.	5	II	MJR	**UG0805 - BOT-52P-158 - Practical-II**	0	0	2	2
9.	6	III	MJR	**UG0805 - BOT-63T-251 - Plant Biochemistry and Physiology**	4	0	0	4
10.	6	III	MJR	**UG0805 - BOT-63P-252 - Practical-I**	0	0	2	2
11.	6	III	MJR	**UG0805 - BOT-63T-253 - Ecology and Plant Resource Utilization**	4	0	0	4
12.	6	III	MJR	**UG0805 - BOT-63P-254 - Practical-II**	0	0	2	2
13.	6	IV	MJR	**UG0805 - BOT-64T-255 - Fundamentals of Plant Pathology**	4	0	0	4

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

UG0805-Three/Four Year Bachelor of Science (Botany)								
				Botany	Credits			
#	Level	Semester	Type	Title	L	T	P	Total
14.	6	IV	MJR	**UG0805 - BOT-64P-256 - Practical-I**	0	0	2	2
15.	6	IV	MJR	**UG0805 - BOT-64T-257 - Fundamentals of Analytical Techniques**	4	0	0	4
16.	6	IV	MJR	**UG0805 - BOT-64P-258 - Practical-II**	0	0	2	2
17.	7	V	MJR	**UG0805 - BOT-75T-351 - Plant Biotechnology-I**	4	0	0	4
18.	7	V	MJR	**UG0805 - BOT-75P-352 Practical-I**	0	0	2	2
19.	7	V	MJR	**UG0805 - BOT-75T-353 - Systematics of Angiosperms**	4	0	0	4
20.	7	V	MJR	**UG0805 - BOT-75P-354 – Practical-II**	0	0	2	2
21.	7	VI	MJR	**UG0805 - BOT-76T-355 - Plant Biotechnology-II**	4	0	0	4
22.	7	VI	MJR	**UG0805 - BOT-76P-356 - Practical-I**	0	0	2	2
23.	7	VI	MJR	**UG0805 - BOT-76T-357 Morphology and Anatomy of Angiosperms**	4	0	0	4
24.	7	VI	MJR	**UG0805 - BOT-76P-358 - Practical-II**	0	0	2	2
25.	8	VII	MJR	**UG0805 - BOT-87T-451- Environmental Biology**	4	0	0	4
26.	8	VII	MJR	**UG0805 - BOT-87P-452 - Practical-I**	0	0	2	2
27.	8	VII	MJR	**UG0805 - BOT-87T-453 - Embryology of Angiosperms**	4	0	0	4
28.	8	VII	MJR	**UG0805 - BOT-87P-454 - Practical-II**	0	0	2	2
29.	8	VIII	MJR	**UG0805 - BOT-88T-455 - Biostatistics and Evolution**	4	0	0	4
30.	8	VIII	MJR	**UG0805 - BOT-88P-456 - Practical-I**	0	0	2	2
31.	8	VIII	MJR	**UG0805 - BOT-88T-457 - Applied Botany**	4	0	0	4
32.	8	VIII	MJR	**UG0805 - BOT-88P-458 - Practical-II**	0	0	2	2

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Examination Scheme

1. 1 credit = 25 marks for examination/evaluation
2. For Regular Students there will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components-Continuous assessment (20% weightage) and (End of end-semester examination) EoSE (80% weightage).
3. For Regular Students,75% Attendance is mandatory for appearing in the EoSE.
4. To appear in the EoSE examination of a course/subject a regular student must appear in the mid-semester examination and obtain at least a "C" grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a "C" grade in the CA and EoSE examination of a Course/Subject.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Examination Scheme for Continuous Assessment (CA)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

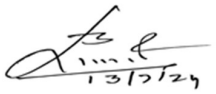
S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1.	Mid-term Exam	*50%*		15	10	10	5	5	5	5	5
2.	Assignment	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
3.	Attendance	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

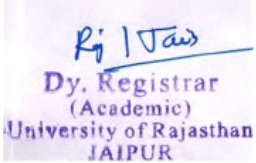
Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned.
2. For continuous assessment no remuneration will be paid for paper setting, evaluation, invigilation etc.
3. For continuous assessment Paper setting and Evaluation responsibility will be of teacher concern.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.
5. Colleges are advised to keep records of continuous assessment, attendance etc.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)
		



Examination Scheme for EoSE for Semester-I

CA – Continuous Assessment EoSE – End of Semester Examination

Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-51T-151 - Cell Biology and Diversity of Plant Kingdom-I	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-51P-152 – Practical-I	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks
Theory	BOT-52T-153 - Microbiology	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-52P-154 - Practical-II	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Syllabus
UG0805-Three/Four Year Bachelor of Science (Botany)

Semester-I
BOT-51T-151 - Cell Biology and Diversity of Plant Kingdom-I

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
I	BOT-51T-151	Cell Biology and Diversity of Plant Kingdom-I				5	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	Major	4	2	6	No	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline		------					
Prerequisites		Biology Courses of Senior Secondary level					

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Objectives of the Course	➢ To understand the structural organization and functions of organelles in the cell. ➢ To differentiate between prokaryotic and eukaryotic cells and plant and animal cells. ➢ To gain understanding on Nucleic acids and chromosome organization. ➢ To understand cell cycle and analyze different stages of mitosis and meiosis. ➢ To understand microscopic to macroscopic view of the Algae and Fungi. ➢ To be able to differentiate algal and fungal members. ➢ To understand difference between Hepaticopsida, Anthocerotopsida and Bryopsida. ➢ To be able to identify and know about Lichens.

Detailed Syllabus
BOT-51T-151 - Cell Biology and Diversity of Plant Kingdom-I

Programme outcomes:

- CO1: Describe the ultrastructure and functions of cell organelles in eukaryotic and prokaryotic cells.
- CO2: Explain chromosome number, morphology, and special types like lampbrush and polytene chromosomes.
- CO3: Understand the structure and function of DNA and RNA, and key experiments proving DNA as genetic material.
- CO4: Learn stages of mitosis and meiosis, and recognize chromosome aberrations and types of mutations.
- CO5: Comprehend plant kingdom hierarchy and characteristics, classification, and life histories of algae, lichens, fungi, and bryophytes.

Unit – I

Ultrastructure of Cell and Cell Organelles: Eukaryotic and Prokaryotic cell structure; Ultrastructure and functions of different cell organelles (Cell wall, Plasma membrane, Nucleus, Mitochondria, Chloroplast, Ribosome, Peroxisomes, Lysosome, Golgi bodies and Endoplasmic Reticulum); Basic idea of Mitochondrial and Chloroplast genome.

Chromosome organization: Chromosome Number, Morphology, nucleosome model of chromosome organization, Special types of chromosomes: Lamp brush and Polytene chromosomes.

15 Lectures

Unit – II

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Nucleic Acids: DNA as genetic material (Griffith's transformation experiment and Hershey and Chase blender experiment); Structure of DNA (Watson and Crick Model); Structure and function of different types of RNA (rRNA, mRNA, tRNA, snRNA).

Cell Division: Basic idea of Cell cycle; Different stages of mitosis; Different stages of Meiosis I and Meiosis II, synaptonemal complex, chiasmata formation and crossing over.

Structural and numerical aberrations in human chromosomes and ploidy in plants: Deletion, Duplication, Translocation, Inversion, Aneuploidy and Polyploidy. **Mutations**: Types of Mutations, Spontaneous and induced Mutations, Physical and Chemical mutagens.

15 Lectures

Unit -III

Introduction to Plant Kingdom: Basic idea of hierarchy in all groups of plants.
Algae: General characteristics, Classification (Fritsch) upto classes. Diverse Habitat. Range of thallus structure. Reproduction (Vegetative, Asexual, Sexual); Economic importance. Life history of: Cyanophyceae- *Nostoc;* Chlorophyceae- *Volvox;* Xanthophyceae- *Vaucheria;* Phaeophyceae- *Ectocarpus;* Rhodophyceae-*Polysiphonia.*

Lichens- General characters, habitat, morphology, reproduction and Ecological and economic importance. **15 Lectures**

Unit -IV

Fungi: General characteristics; Thallus organization; types of hyphal forms, Heterokaryosis and Parasexuality; Nutrition and reproduction; economic importance. Classification **(**Alexopoulos**).** Life history of: Zygomycota- *Rhizopus*; Ascomycota- *Peziza*; Basidiomycota- *Puccinia*.
Bryophytes: General characteristics; affinities with Algae and Pteridophytes; Reproduction (Vegetative and Sexual); Alternation of generations and evolution of sporophytes. Classification (Proskauer, 1957); Structures of gametophyte & sporophyte and life history (Development details not included) of: Hepaticopsida- *Marchantia*, Anthocerotopsida- *Anthoceros* and Bryopsida- *Funaria*.

15 Lectures

Suggested Books and References:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6thEd.). New York: Garland Science.
- Cooper, G. M., and Hausman, R. E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM; Sunderland.
- Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York.
- Veer Bala Rastogi. **Genetics.** Medtech.
- Veer Bala Rastogi. **A Textbook of Cell Biology and Genetics.** Kedarnath Ramnath

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

- Alexopoulos, C.J. and Mims, C.W.: **Introductory Mycology**, John Wiley and Sons, New York, 2000.
- Singh, Pande and Jain**. A Textbook of Botany,** Rastogi publications.
- Dube, H.C.: Fungi, Rastogi Publications, Meerut, 1989.
- Vashishtha, B.R. **Botany for Degree Students-Fungi**, S. Chand & Co., New Delhi, 2001.
- Gilbart, M. Smith: **Cryptogamic Botany, Vol. I & II (2nd Ed.)** Tata McGraw Hill. Publishing Co., Ltd., New Delhi, 1985.
- Puri. P.: **Bryophytes**, Atmaram& Sons. Delhi, Lucknow, 1985.
- Aneja, K.R.: **Experiments in Microbiology, Plant Pathology and Biotechnology**. New Age International (P) Ltd., Publishers, New Delhi 2003.
- Pandey B. P. (2022) **Algae, Bryophytes and Lichens**. S Chand Publication.
- Latest research articles/review articles relevant to the respective topics will be provided to the students by the concerned faculty.

Suggested E-resources:

Online Lecture Notes and Course Materials:

1. **https://youtu.be/K2teJ6-DBLw**
2. nptel.ac.in

B.Sc. Botany Semester-I Practical-I Syllabus

BOT-51P-152

Cell and Cell Organelles

- Study of electron microphotographs of prokaryotic and eukaryotic cell.
- Study of electron microphotographs of virus, bacteria and eukaryotic cells for comparative study of cellular organization.
- Study of cell structure in Onion, *Hydrilla* and *Spirogyra*.
- Study of plastid for pigment distribution in *Lycopersicon*, *Cassia* and *Capsicum*.

Nucleic Acids, Cell Division and Chromosomes

- Isolation of Genomic DNA from Onion/Banana/Pineapple/etc.
- Demonstration of Gel-electrophoresis

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

- Study of permanent slides/photographs of different stages of mitosis and meiosis, sex chromosomes, polytene chromosome and salivary gland chromosomes.
- Study of different stages of mitosis and meiosis in root-tip cells and flower buds respectively of onion.
- Calculate the mitotic index of onion root tip cells.
- Study of induced aberrations in onion root tips employing chemicals and plant extracts.

Algae and Lichen

- **Algae:** Study of morphology and anatomy of *Nostoc*, *Volvox, Vaucheria, Ectocarpus* and *Polysiphonia* (vegetative and reproductive structures) by preparing temporary slides and studying permanent slides.
- **Lichens:** Study of growth forms of lichens (crustose, foliose and fruticose)

Fungi

- **Fungi:** Microscopic observation of vegetative and reproductive structures of *Rhizopus*, *Peziza* and *Puccinia* through preparation of temporary slides and permanent slides.

Bryophyta

- **Bryophytes**: Study of morphology, anatomy, vegetative and reproductive organs of *Marchantia*, *Anthoceros* and *Funaria* by preparing temporary slides and studying permanent slides.
- Study of renowned Indian scientists in the fields of phycology (M.O. P Iyengar), mycology (K. C. Mehta), bryology (S. R. Kashyap) and lichens (D. D. Awasthi).
- Make a list of national and international institutes of repute in the fields of cytology, phycology, mycology, bryology and lichens.

Any other exercise based on theory syllabus.

UNIVERSITY OF RAJASTHAN

B.Sc. Botany Semester-I Practical-I

Scheme of Practical Examination and Distribution of marks

BOT-51P-152 **Max. Marks: 10*+40** **Min. Marks: 4*+16**

Time: **4 Hours**

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Exercise	Regular	Ex-students
1. Exercise based on Cell biology/ Nucleic Acids.	**4**	**6**
2. Make a suitable acetocarmine preparation of the given material. Draw a well-labelled diagram of any one stage of nuclear division.	**4**	**6**
3. Make a suitable stained preparation of the given material **A**. Draw a labelled diagram and identify giving reasons **(Algae).**	**4**	**6**
4. Make a suitable stained preparation of the given material **B**. Draw a labelled diagram and identify giving reasons (**Fungi).**	**4**	**6**
5. Make a suitable stained preparation of the given material **C** (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons (**Bryophyte).**	**4**	**6**
6. Comment upon the spots- identify giving reasons (1 to 5).	**10**	**15**
7.Viva-voce	**5**	**5**
8. Record	**5**	**-**
Total	**10*+40=50**	**50**
***Internal marks for regular students only**		
Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Learn, understand and develop skill and hands on training in basics of cell biology.
2. Acquire basic knowledge of hereditary material and chromosomes.
3. Know all the kind of plant groups and understand relationships between them.
4. Understand diversity of lower plant presents on various habitats.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

5. Identify microscopic to macroscopic view of the plants.
6. Apply the economic importance of lower plants in their endeavours.
7. Promote shared learning through practical classes, presentations and assignments.

Syllabus
UG0805-Three/Four Year Bachelor of Science (Botany)

Semester-I
BOT-51T- 153 - MICROBIOLOGY

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
I	BOT-51T- 153	MICROBIOLOGY				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Intermediate level	Major	4	2	6	No	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline		---					
Prerequisites		Biology Courses of Senior Secondary level					
Objectives of the Course		➢ The objective of the course is to make students aware of the diversity, distribution and characteristic features of various microorganisms. ➢ The course also aims to make students aware of the indispensable role of microorganisms in the environment, biotechnology, fermentation, medicine and other industries important to human welfare. ➢ In addition to this, the course shall also prepare students for higher education in microbiology-related disciplines.					

Detailed Syllabus

BOT-51T- 153 - MICROBIOLOGY

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Course outcome:

- CO1: Understand the contributions of prominent scientists in microbiology.
- CO2: Comprehend standard microbiological culture techniques.
- CO3: Acquire knowledge of the principles underlying microbial classification.
- CO4: Learn the rules of bacterial nomenclature and taxonomy for prokaryotic microorganisms, including major phyla of bacteria and archaea.
- CO5: Gain knowledge of virus structure, replication, various forms of viruses, and insight into mycoplasma.
- CO6: Acquire knowledge of nutritional requirements of microbes and applications of microbiology

UNIT-I

History of Microbiology: History of development of microbiology, Spontaneous generation versus biogenesis, major contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, and contribution of Indian microbiologists.

Virus: Characteristics and Classification of Viruses (Baltimore), Cryptograms, structure with special reference to TMV, Bacteriophage, Multiplication of Viruses (Lytic and Lysogenic). Viroids, Virusoids, Prions. **15 Lectures**

UNIT-II

Bacteria: General Characteristics, Classification by Bergey's Manual, Cell structure, Cell-wall: Composition and detailed structure of Gram positive and Gram-negative cell walls, mechanism of Gram's staining, endospore formation, Asexual Reproduction and Sexual Recombination (Conjugation, Transformation and Transduction), Archaebacteria and Eubacteria.

Mycoplasma: General Characteristics, Morphology and Reproduction.

15 Lectures

UNIT-III

Microbial Nutrition and Growth: Nutritional types of microorganisms, growth factors, culture media-synthetic and complex, types of media; isolation of pure cultures, growth curves, mean growth rate constant, generation time; influence of environmental factors on growth of microbes:

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

effect of pH, temperature, solute, oxygen concentration, pressure and radiations. Sterilization, disinfection and antiseptics. Use of physical methods (heat, low temperature, filtration, radiation) and chemical agents (phenolics, halogens, heavy metals, sterilizing gases) in microbial control.

15 Lectures

UNIT-IV

Applications of Microbiology: Importance of microbes in agriculture and food industries. Basic design of fermenter, continuous and discontinuous culture. Preparation of fermented food products (yogurt, curd and cheese). Preparation of alcoholic beverages (wine and beer). Treatment of waste water (Municipal treatment plant) and Sewage, Bioremediation.

15 Lectures

Suggested Books and References:

- Pelczar, M.J. (2001) **Microbiology,** 5th edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.
- J. Willey, L. Sherwood & C. Woolverton. (2017). **Prescott's Microbiology**. McGraw Hill international.
- M. J Chan, ECS Krieg & NR Pelczar. (2004). **Microbiology,** McGraw Hill. International. J. G. Cappuccino, and N. Sherman. (2013). **Microbiology: A Laboratory manual**, Benajamin/Cummings.
- M. T. Madigan, J. M. Martinko & D. A. Stahl, Brock. (2010). **Biology of Microorganisms,** Pearson Education International.
- Latest research articles/review articles relevant to the respective topics will be provided to the students by the concerned faculty.

Suggested E-resources:

Online Lecture Notes and Course Materials:

1. Vidhya Mitra Integrated E-Content Portal
2. eGyanKosh-Introductions to Microbiology
3. e-Krishi Shiksha- Introduction Microbiology
4. NPTEL :: Biotechnology - Microbiology

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

B.Sc. Botany Semester- I Practical-II Syllabus

BOT-51P- 154

1. Preparation of the liquid culture media for the growth of microorganisms.
2. Preparation of the solid culture media for the growth of microorganisms
3. Study of physical methods of sterilization.
4. Study of chemical methods of sterilization.
5. Study of bacterial cultures using streak plate culture method.
6. Study of bacterial cultures using pour plate culture method.
7. Study of bacterial cultures using serial dilution method.
8. Simple Staining of bacteria.
9. Perform Gram staining.
10. Demonstration of antibiotic resistance in bacteria.
11. Study of the growth curve of bacteria.
12. Study of the effect of pH and temperature on bacterial growth.
13. Measurement of microbial cell using micrometry.
14. Study of different shapes of TMV, Bacteriophage, Viroids, Bacteria, Mycoplasma using permanent slides/pictographs.
15. Any other exercise based on theory syllabus.

UNIVERSITY OF RAJASTHAN

B.Sc. Botany Semester- I- Practical -II

Scheme of Practical Examination and Distribution of marks

BOT-51P- 154 **Max. Marks: 10*+40** **Min. Marks: 4*+16**

Time: **4 Hours**

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Exercise	Regular	Ex-students
1. Exercise A	**5**	**8**
2. Exercise B	**5**	**8**
3. Exercise C	**5**	**7**
4. Exercise D	**5**	**7**
5. Comment upon the spots- identify giving reasons. (1 to 5)	**10**	**15**
6. Viva-voce	**5**	**5**
7. Record	**5**	**-**
Total	**10*+40=50**	**50**
***Internal marks for regular students only**		
Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. To understand about general characteristics and structural details of various microbes.
2. To understand about various microbiological techniques including sterilization, media preparation, maintenance of microbial culture and staining.
3. Students will learn about various parameters required for optimum growth of microbes.
4. To understand various commercial applications of microbiological techniques.
5. Economic importance of Microbes
6. Acquire skills in several laboratory methods
7. Study of gram staining, microscopy, and biochemical assays.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Examination Scheme for EoSE for Semester-II

CA – Continuous Assessment EoSE – End of Semester Examination

Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-52T- 155 - Genetics, Plant Breeding and Diversity of Plant Kingdom-II	**CA**	**01 Hr**	**CA**	**20 Marks**	**CA**	**08 Marks**
		EoSE	**03 Hrs**	**EoSE**	**80 Marks**	**EoSE**	**32 Marks**
Practical	BOT-52P-156 - Practical-I	**CA**	**1 Hr**	**CA**	**10 Marks**	**CA**	**04 Marks**
		EoSE	**04 Hrs**	**EoSE**	**40 Marks**	**EoSE**	**16 Marks**
Theory	BOT-52T-157 - Molecular Biology	**CA**	**01 Hr**	**CA**	**20 Marks**	**CA**	**08 Marks**
		EoSE	**03 Hrs**	**EoSE**	**80 Marks**	**EoSE**	**32 Marks**
Practical	BOT-52P-158 - Practical-II	**CA**	**1 Hr**	**CA**	**10 Marks**	**CA**	**04 Marks**
		EoSE	**04 Hrs**	**EoSE**	**40 Marks**	**EoSE**	**16 Marks**

The theory question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

PART-B: 60 Marks
Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Syllabus
UG0805-Three/Four Year Bachelor of Science (Botany)

Semester-II
BOT-52T- 155 - Genetics, Plant Breeding and Diversity of Plant Kingdom-II

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
II	BOT-51T- 153	Genetics, Plant Breeding and Diversity of Plant Kingdom-II				5	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	Major	4	2	6	No	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline		---					
Prerequisites		Botany Course of Foundation or Introductory Level					

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Objectives of the Course	➢ To understand Mendel's laws and its deviations. ➢ To impart knowledge on DNA replication, Mendel's laws of inheritance ➢ To understand functions of genes, linkage and crossing over and mutations. ➢ To be able to apply knowledge of Plant breeding methods in crop improvement. ➢ To learn about institutes and scientists in the field of crop improvement. ➢ To understand morphology and anatomy of Pteridophytes and Gymnosperms. ➢ To understand reproduction in Pteridophytes and Gymnosperms. ➢ To have a basic idea of Fossil plants.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Detailed Syllabus

BOT-52T-155 – Genetics, Plant Breeding and Diversity of Plant Kingdom-II

Programme outcomes:

- CO1: Understand Mendel's laws of inheritance and their exceptions.
- CO2: Recognize different types of gene interactions, quantitative and qualitative inheritance and cytoplasmic inheritance.
- CO3: Gain knowledge of the history, objectives, and methods of plant breeding for crop improvement, along with famous plant breeders.
- CO4: Learn the general characteristics, affinities with other plant groups, economic importance, and classification of pteridophytes and gymnosperms.
- CO5: Study the life histories of specific examples and the significance of heterospory, seed habit, the evolution of stele and plant fossils.

Unit – I

Genetic inheritance: Mendel's laws of inheritance and their exceptions; Allelic (incomplete dominance, co-dominance, lethality) and Non-allelic interactions (complementary genes, epistasis and duplicate genes); Multiple allelism (ABO blood groups in men); Quantitative inheritance (Grain color in wheat). **Cytoplasmic inheritance:** Plastid inheritance (leaf variegation in *Mirabilis jalapa*); Mitochondrial inheritance (Cytoplasmic male sterility in plants).

Plant breeding: History and objectives of plant breeding; relevance of mode of reproduction to plant breeding; their effect on generating and fixing genotypic variation. Types of crop plants for plant breeding (self-pollinated, cross-pollinated and vegetatively propagated crop plants). General idea of methods of selection in crop improvement. **15 Lectures**

Unit – II

Plant introduction: purpose, types (primary and secondary), procedure, merits, demerits and achievements. Acclimatization.

Hybridization: Meaning, objectives, types, procedure, various methods of emasculation, Hybrid Vigor, applications. Inbreeding depression and its practical applications. Role of mutation and polyploidy in plant breeding (with examples); Green revolution.

Plant breeding work done on wheat and rice in India, Plant introduction agencies in India (NBPGR, FRI, BSI). Famous Indian and International plant breeders and their contributions. National and International agricultural research institutes. **15 Lectures**

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Unit -III

Pteridophytes: General characteristics; Affinities with bryophytes & gymnosperm; Heterosporyand seed habit; Evolution of stele in Pteridophytes; Economic importance. Classification (Riemers,1954); Study of life history of fossil Pteridophyte – *Rhynia*. Life history of Psiloptopsida- *Psilotum;* Lycopsida- *Selaginella*; Sphenopsida- *Equisetum*; Pteropsida- *Marsilea*.

15 Lectures

Unit-IV

Gymnosperms: General characteristics; Affinities with Pteridophytes and Angiosperms, Distribution; Economic importance. Classification (Sporne, 1965); Life history of Cycadopsia- *Cycas*; Coniferopsida- *Pinus*; Gnetopsida- *Ephedra*.

Paleobotany: Introduction, Basic concept and significance, Geological time scale; Types of Fossils.

15 Lectures

Suggested Books and References:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6thEd.). New York: Garland Science.
- Cooper, G. M., and Hausman, R. E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM; Sunderland.
- Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York.
- Lodish, HF. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). **Molecular Cell Biology** (8th Ed.). New York: W.H. Freeman.
- Gupta P.K. **Cell and Molecular Biology** 2018. 5th edition Rastogi Publication India.
- Veer Bala Rastogi. **Genetics.** Medtech.
- Veer Bala Rastogi. **A Textbook of Cell Biology and Genetics.** Kedarnath Ramnath
- B. D. Singh. **Plant Breeding: Principles and Methods,** Kalyani Publishers.
- Choudhary, H.K. **Elementary Principles of Plant Breeding**. Oxford and IBM Publishing Co., New Delhi, 1989.
- Singh, R. B.: **Text Book of Plant Breeding**, Kalyani Publishers, Ludhiana (1999).
- Singh, Pande and Jain**. A Textbook of Botany,** Rastogi publications.
- B.R. Vashishta and P.C. Vashishta. **Botany for Degree Students: Pteridophyta - Vascular Cryptogams),** S.Chand (G/L) & Company Ltd.
- B.R. Vashishta and P.C. Vashishta. **Gymnsperms (Botany for Degree Students),** S.Chand (G/L) & Company Ltd.
- Latest research articles/review articles relevant to the respective topics will be provided to the students by the concerned faculty.

Suggested E-resources:

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Online Lecture Notes and Course Materials:

1. **https://youtu.be/K2teJ6-DBLw**
2. nptel.ac.in

B.Sc. Botany Semester-II Practical-I Syllabus

BOT-52P-156

Practicals related to Genetics-

- To solve genetic problems based upon Mendel's laws of inheritance: Monohybrid cross, Dihybrid cross, Back cross and test cross.
- Induction of polyploidy using colchicine.

Practicals related to Plant Breeding-

- Emasculation, Bagging and Tagging
- Study of Famous Indian and International plant breeders and their contributions.
- Study of National and International agricultural research institutes.

Pteridophytes-

- **S**tudy of vegetative and reproductive stages of *Selaginella*, *Equisetum* and *Marsilea* by preparing temporary slides and studying permanent slides.

Gymnosperms-

- Study of Vegetative and reproductive stages of *Cycas*, *Pinus* and *Ephedra* by preparing temporary slides and studying permanent slides.

Fossil plant- *Rhynia.*

Any other exercise based on theory syllabus.

UNIVERSITY OF RAJASTHAN

B.Sc. Botany Semester-I Practical-II

Scheme of Practical Examination and Distribution of marks

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

BOT-52P-156 **Max. Marks: 10*+40** **Min. Marks: 4*+16**

Time: **4 Hours**

Exercise	Regular	Ex-students
1. Exercise-based on Genetics.	**5**	**7**
2. Exercise-based on Plant Breeding.	**5**	**7**
3. Make a suitable stained preparation of the given material **A** (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons (**Pteridophyte).**	**5**	**8**
4. Make a suitable stained preparation of the given material **B** (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons (**Gymnosperm**).	**5**	**8**
5. Comment upon the spots- identify giving reasons (1 to 5).	**10**	**15**
6. Viva-voce	**5**	**5**
7. Record	**5**	**-**
Total	**10*+40=50**	**50**
***Internal marks for regular students only**		
Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Learn, understand and develop skill and hands on training in basics of genetics and plant breeding.
2. Acquire basic knowledge of Mendel's laws of genetics.
3. Learn and understand inheritance and various types of gene interactions.
4. Understand basic methods of plant breeding and crop improvement.
5. Identify the role of gene interactions in phenotype development.
6. Apply plant breeding methods for crop improvement.
7. Learn about institutes and scientists in the field of crop improvement.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

8. Understand characteristic feature and life cycle pattern of pteridophytes and gymnosperms.
9. Apply the economic importance and evolutionary concepts of pteridophytes and gymnosperms.
10. Comprehend information about fossil plants.
11. Promote shared learning through practical classes, presentations and assignments.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Syllabus
UG0805-Three/Four Year Bachelor of Science (Botany)

Semester- II
UG0805 - BOT-52T-157-Molecular Biology

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
II	BOT-52T-157	Molecular Biology				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Intermediate level	Major	4	2	6	No	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline		------					
Prerequisites		Botany Course of Foundation or Introductory Level					
Objectives of the Course		➢ To understand structure of nucleic acid (DNA and RNA). ➢ To understand DNA organization in chromosomes and the mechanism of DNA replication. ➢ To understand the genetic code and structure of gene. ➢ To understand molecular mechanism of transcription and translation. ➢ To understand gene regulation at all levels, and the structure-function relationships of nucleic acids and proteins. ➢ To provide the students practical skills in molecular biology.					

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Detailed Syllabus
BOT-52T-157 - Molecular Biology

Course outcome:

- CO1: Gain foundational knowledge of the central dogma of molecular biology and its significance, including chemical and molecular processes within cells.
- CO2: Develop a strong understanding of the structure and functions of nucleic acids and proteins, and their roles in cell growth, division, and development.
- CO3: Illustrate the structural organization of genes and comprehend genome organization.
- CO4: Demonstrate proficiency in understanding genetic code concepts and features.
- CO5: Acquire a solid foundation in the replication, transcription and translation of genetic material in prokaryotes.

Unit-I

Nucleic Acids: Discovery of Nuclein by Fredrich Miescher. Nucleic Acids as genetic material; Experiments by Griffith, Hershey and Chase, Avery, McLeod and McCarty. Building blocks of nucleic acid: Nucleotide, Nucleoside, Ribose sugar, Purine, Pyrimidine, phosphate.

DNA and RNA: Structure of DNA and RNA, Watson and Crick's model of DNA, DNA types (A, B, Z type), RNA structure and functions (tRNA, mRNA, rRNA, miRNA and siRNA)

15 Lectures

Unit-II

Nucleosome: Chromatin structure; Euchromatin and Heterochromatin.

DNA Replication: Semi-conservative mode of DNA replication; bidirectional and semi-discontinuous replication. Various models of DNA replication including rolling circle, D-loop (mitochondrial), theta mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Okazaki fragments. Enzymes involved in DNA replication.

15 Lectures

Unit-III

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Central Dogma of Life: Concept of Central dogma; Salient features of genetic code, deciphering the genetic code (Contribution of Nirenberg and H.G. Khorana). Gene, ORF, Intron, Exon, Gene expression. Prokaryotic and eukaryotic gene structure.

Transcription in prokaryotes: mechanism, initiation, elongation and termination. Introduction to split genes, splicing and Ribozymes.

15 Lectures

Unit-IV

Translation in prokaryotes: Ribosome structure and assembly, charging of tRNA, aminoacyl tRNA synthetases; Mechanism; initiation, elongation and termination. Inhibitors of protein synthesis.

Gene regulation in Prokaryotes: Operon concept: inducible and repressible operon; regulation of lactose (lac) and tryptophan (trp) in *Escherichia coli*; attenuation regulation.

15 Lectures

Suggested Books and References:

- Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). **Molecular Biology of the Gene,** Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. **Cell and Molecular Biology**. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Karp, G. 2010. **Cell and Molecular Biology: Concepts and Experiments.** 6th edition. John Wiley & Sons. Inc.
- Snustad, D.P. and Simmons, M.J. (2010). **Principles of Genetics.** John Wiley and Sons Inc., U.S.A. 5th edition.
- **The World of the Cell.** 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009**). Concepts of Genetics.** Benjamin Cummings. U.S.A. 9th edition.
- Russell, P. J. (2010**). i-Genetics- A Molecular Approach.** Benjamin Cummings, U.S.A. 3rd edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). **Introduction to Genetic Analysis.** W. H. Freeman and Co., U.S.A. 10th edition.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

- Latest research articles/review articles relevant to the respective topics will be provided to the students by the concerned faculty.

Suggested E-resources:

Online Lecture Notes and Course Materials:

1. https://onlinecourses.nptel.ac.in/noc24_bt07/preview
2. https://nptel.ac.in/courses/102106025
3. https://archive.nptel.ac.in/courses/102/106/102106096/

B.Sc. Botany Semester- II Practical-II Syllabus

BOT-52P-158

1. Preparation of LB medium and raising *E. Coli*.
2. Isolation of DNA from bacterial or plant samples.
3. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
4. Separation of DNA using Agarose gel electrophoresis.
5. Determination of DNA fragment size comparing with DNA marker using Agarose gel electrophoresis.
6. Perform or digitally demonstrate DNA amplification by PCR.
7. Perform or digitally demonstrate Southern Blot Hybridization.
8. Perform or digitally demonstrate Northern Blotting.
9. Perform or digitally demonstrate Western Blotting.
10. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments).
11. Study of semiconservative replication of DNA through micrographs/schematic representations.
12. Any other exercise based on theory syllabus.

UNIVERSITY OF RAJASTHAN

B.Sc. Botany Semester-II Practical-II

Scheme of Practical Examination and Distribution of marks

BOT-52P-158 **Max. Marks: 10*+40** **Min. Marks: 4*+16**

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

Time: **4 Hours**

	Regular	**Ex students**
1. Exercise A	**5**	**8**
2. Exercise B	**5**	**8**
3. Exercise C	**5**	**7**
4. Exercise D	**5**	**7**
5. Comment upon the spots- identify giving reasons. (1 to 5)	**10**	**15**
6. Viva-voce	**5**	**5**
7. Record	**5**	**-**
Total	**10*+40=50**	**50**
***Internal marks for regular students only**		
Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

- Develop sufficient knowledge about the characteristics of the genetic material and structure of DNA and RNA.
- Recognize DNA organization in chromosomes and molecular mechanism of DNA replication, and transcription.
- Understand characteristic and importance of genetic code and molecular mechanism of translation.
- Understand molecular structure of the gene and regulatory mechanisms for gene expression.
- Understand the structure, function, and variations in DNA and RNA.
- Have insights into the various models for chromatin organization.
- Understand step wise processes of replication, transcription and translation.
- Develop knowledge and understanding of the operon concept and gene regulation mechanisms.
- Understand the role of protein and its modification in DNA packaging.
- Have knowledge about the differentiation of molecular mechanism of replication, transcription and translation.
- Understand the role of protein/transcriptional factor in gene regulation.

Signature of Dean	**Signature of BoS Convenor**	**Signature Of DR (Academic-II)**

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR

- Develop acumen about the variation in gene regulation processes.
- Use scientific methods, and critical thinking skills to ask questions and solve problems.

Signature of Dean	Signature of BoS Convenor	Signature Of DR (Academic-II)