DEPARTMENT OF MICROBIOLOGY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

MINUTES

The minutes of the meeting of the Academic Committee of Department of Microbiology held in the Department of Microbiology of the Dr. Bhimrao Ambedkar University, Agra on 12th February 2022 at 11:00 AM. The following members were present:

1. Dr. Bhawana Sharma, Scientist 'C'
   Department of Immunology, NJIL & OND, Agra
2. Dr. Davesh Jadon,
   Department of Botany R.B.S.College, Agra
3. Dr. Seema Bhadauria, Principal, B.V.R.I. Bichpuri, Agra
4. Dr. Surabhi Mahajan, Department of Microbiology,
   Dr. Bhimrao Ambedkar university, Agra
5. Prof. Bhupendra Swarup Sharma, Dean Life sciences,
   Dr. Bhimrao Ambedkar University, Agra

1. The Academic Committee considered, approved and adopt the Syllabus of Microbiology as proposed by the UP Government under NEP 2020 as one of the subject at UG level in B.Sc.to be implemented from the session 2021-22 (Appendix – I).

2. The Academic Committee considered and approved revised Ordinances (Point number 14) of the Department of Microbiology (Appendix – II)

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DR.BHIMRAO AMBEDKAR UNIVERSITY

DEPARTMENT OF MICROBIOLOGY

School Of Life Sciences, Khandari Campus, Agra.

Dated: 14 Feb.,2022

To

The Asstt. Registrar (Academic)
Dr. Bhimrao Ambedkar University,
Agra.

Sir,

Please find enclosed herewith the minutes of the meeting of Academic Committee of the Department of Microbiology held on Feb. 12, 2022. It is requested that it may please be placed before the Academic Council / Executive Council for approval at the earliest.

Thanking you

Yours faithfully,

B.S.Sharma
Dean

Faculty of Life Science
Dr. Bhimrao Ambedkar University, Agra

Encls. :

1. Minutes of the Academic Committee
2. Syllabus of .Microbiology for B.Sc., Àppendix- I
3. Revised Ordinance of the Department of Microbiology, Appendix -II

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DEPARTMENT OF MICROBIOLOGY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

ATTENDANCE SHEET

The Academic Committee of Department of Microbiology held in the Department of Microbiology School of Life Sciences, Dr. Bhimrao Ambedkar University, Agra on February, 12, 2022 at 11.00 a.m.

1. Dr. Bhawana Sharma, Scientist 'C', Department of Immunology, NJIL & OMD, Agra	External Expert	12/2/2022
2. Dr. Davesh Jadon, Department of Botany R.B.S.College, Agra	External Expert	12.02.22
3. Dr. Seema Bhadauria, Principal, B.V.R.I. Bichpuri, Agra	Internal Expert	12.02.22
4. Dr. Surabhi Mahajan, Department of Microbiology, SLS, Dr. Bhimro Ambedkar University, Agra	Special Invitee	12/02/22
5. Prof. Bhupendra Swarup Sharma, Dean, School of Life sciences, Dr. Bhimro Ambedkar University, Agra	Convener	12/2/22

DEPARTMENT OF MICROBIOLOGY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

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   Dr. Bhimrao Ambedkar university, Agra
5. Prof. Bhupendra Swarup Sharma, Dean Life sciences,
   Dr. Bhimrao Ambedkar University, Agra

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2. The Academic Committee considered and approved revised Ordinances (Point number 14) of the Department of Microbiology (Appendix – II)

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APPENDIX - I

Department of Higher Education, Government of Uttar Pradesh, Lucknow

National Education Policy-2020

Common minimum syllabus for U.P. State Universities

Certificate Course in Microbial Techniques, Diploma in Microbial Technology and B.Sc. Microbiology

Semester wise titles of the papers for B.Sc. (Microbiology)

Year	Semester	Course Code	Paper Title	Theory /Practical	Credits
1	I	**B080101T**	General Microbiology	Theory	04
		B080102P	Experiments in Basic Microbiology	Practical	02
	II	**B080201T**	Agriculture and Environmental Microbiology	Theory	04
		B080202P	Experiments in Agriculture and Environmental Microbiology	Practical	02
2	III	**B080301T**	Basic Biochemistry and Microbial Physiology	Theory	04
		B080302P	Experiments in Basic Biochemistry and Microbial Physiology	Practical	02
	IV	**B080401T**	Molecular Biology and Microbial Genetics	Theory	04
		B080402P	Experiments in Molecular Biology and Microbial Genetics	Practical	02
3	V	**B080501T**	Medical Microbiology	Theory	04
		B080502T	Immunology	Theory	04
		B080503P	Experiments in Medical Microbiology & Immunology	Practical	02
	VI	**B080601T**	Food Microbiology	Theory	04
		B080602T	Industrial Microbiology	Theory	04
		B080603P	Experiments in Food & Industrial Microbiology	Practical	02

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Proposed Year wise Structure of UG Program in Microbiology

Programme/ Year	Sem.	Course code	Paper title	Credits	Teaching hours
1 **Certificate Course in Microbial Techniques**	I	**B080101T**	General Microbiology	4	60
		B080102P	Experiments in Basic Microbiology	2	60
	II	**B080201T**	Agriculture and Environmental Microbiology	4	60
		B080202P	Experiments in Agriculture and Environmental Microbiology	2	60
2 **Diploma in Microbial Technology**	III	**B080301T**	Basic Biochemistry and Microbial Physiology	4	60
		B080302P	Experiments in Basic Biochemistry and Microbial Physiology	2	60
	IV	**B080401T**	Molecular Biology and Microbial Genetics	4	60
		B080402P	Experiments in Molecular Biology and Microbial Genetics	2	60
3 **Degree in Bachelor of Science**	V	**B080501T**	Medical Microbiology	4	60
		B080502T	Immunology	4	60
		B080503P	Experiments in Medical Microbiology & Immunology	2	60
	VI	**B080601T**	Food Microbiology	4	60
		B080602T	Industrial Microbiology	4	60
		B080603P	Experiments in Food & Industrial Microbiology	2	60

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Subject prerequisite

To study MICROBIOLOGY at undergraduate, a student must have Biology in Class 12.

Programme Objectives (POs)

1. The programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of Microbiology.
2. The programme includes details of important microorganisms of agricultural, medical and industrial importance, biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.
3. The practical courses have been designed to equip the students with the laboratory skills in microbiology. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data
4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas that involve microbiology, biochemistry, biotechnology and molecular biology and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students
5. The students will be exposed to a wide range of careers that combine microbiology, environment, industry and medical.

Certificate Course in Microbial Techniques	
B. Sc. I Programme Specific Outcomes (PSOs)	
PSO1	Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.
PSO2	Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PSO4	Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.
PSO5	The certificate course will enable students to apply for technical positions in government and private labs/institutes.

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Diploma in Microbial Technology	
B.Sc. II Programme based outcomes	
PSO 1	Students will develop familiarity and understanding of the microbiology concepts as relevant to various areas such as biochemistry, microbial physiology, molecular biology and genetics.
PSO 2	Students will exhibit reasonable abilities in the utilization of instruments, advances and techniques common to microbiology, and apply the logical strategy and theory testing in the plan and execution of examinations.
PSO3	Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.
PSO4	Students will be able to describe how microorganisms obtain energy, metabolism, reproduction, survival, and interactions with their environment, hosts, and host populations.
PSO5	Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate a broad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.
PSO2	Students will learn about various biotechnological applications of microorganisms as well as industrially relevant substances developed by microorganisms. They'll learn about the special role microbes play in genetic modification technologies.
PSO3	Students will learn and develop good laboratory practices in a microbiological laboratory, as well as be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.
PSO4	Students will learn about experimental methods, hypothesis creation and testing, and experiment design and execution. Students can develop their critical thinking skills as well as their ability to read and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.
PSO5	The Degree courses will enable students to go for higher studies in Microbiology and Allied subjects leading to Post Graduation and Ph.D. degrees.

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Detail Syllabus of

B.Sc. I Year

or

Certificate in Microbial Technology

Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: MICROBIOLOGY		
Course Code: B080101T	**Course Title:** General Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- To understand the history, relevance of microbiology and classification of microbes.
- To learn and understand the microbial diversity in the living world.
- To understand the working of various microscopes and their applications.
- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
- To demonstrate and understanding of bacterial, fungal, cyanobacterial, algal, viral and rickettesial classification, culturing, reproduction and significance.
- To learn different methods of staining of microbes.
- To understand, learn and gain skill of isolation, culturing and maintenance of pure culture.
- To enable the students to get sufficient knowledge in principles and applications of bio-instruments.
- To help students gain knowledge about antibiotics and other chemotherapeutic agents.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Introduction, history and scope of Microbiology** History, scope, branches of microbiology and relevance of microbiology; Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De; Position of microorganisms in the living world. 5 kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms- bacteria, archaea, eukarya; Bergey's manual and introduction to classification of bacteria.	8
II	**Bacterial morphology** Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria. **The viruses** General properties and structure of animal viruses: Influenza, HIV; plant viruses: TMV; bacterial viruses: Lambda Phage and T4 bacteriophage; general features of Prions and Viroids. **Fungi** General characteristics, classification & reproduction of Saccharomyces, Aspergllus. **Protozoa** General characteristics, classification & reproduction of Giardia, Entamoeba	10
III	**Techniques in microbiology I** Principles of microscopy, construction and application of-	6

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	Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy ,Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM	
IV	**Techniques in microbiology II** Principles, construction and application of centrifuge; bacteriological Incubator & Incubator Shaker; Laminar flow; Colourimeter & Spectrophotometer (UV-Vis)	6
V	**Sterilization techniques and control of microorganisms** Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration; Filtration- Seitz filter, membrane filter, HEPA filter; Radiation- Ionizing and non- ionizing; Chemical methods- Alcohols, aldehydes, phenols, halogens, metallic salts, ethylene oxide.	7
VI	**Isolation, cultivation and preservation of microorganisms** Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique, and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure culture	8
VII	**Stains and staining techniques** Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Ziehl Neelsen staining; Structural staining- cell wall, capsule, endospore and flagella staining.	7
VIII	**Biostatistics** Introduction to biostatistics – definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic biodiagrams.	8

Suggested Readings:

1. Alexopoulas C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
3. Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
4. Benson Harold J., Microbiological Applications, WCB Mcgraw-Hill, New York.
5. Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
6. Baveja C.P., Textbook of microbiology APC 6th edition.
7. Dubey R.C.. and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
8. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
9. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.

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11. Sharma P.D., Microbiology, Rastogi Publications.
12. Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9th edition, Pearson Education.
13. Suggestive digital platforms web links-
    - https:/www.classcentral.com/tag/microbiology
    - https://cmp.berkeey.edu/bacteria/bacteria.html
    - https://www.livescience.com/53272-what-is-a-virus.html
    - https://www.slideshare.net/sardar1109/algae-notes-1
    - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
    - https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
    - https://microbenotes.com/laminar-flow-hood
    - https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject biology in class 12th.

Suggested Continuous Evaluation Methods:
House Examination/Test: 10 marks
Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/Participate: 5 Marks

Further Suggestions: None

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Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: MICROBIOLOGY		
Course Code: B080102P	**Course Title:** Experiments in Basic Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.
- Practical skills in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose.
- To prepare slides and stain to see the microbial cell.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 0-0-2

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1.	• Good labroratory practice in Microbiology and safety measures. • Cleaning and sterilization of glassware and equipments. • Study of aseptic technique- preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum.	12
2.	• Study of instruments- Microscope, autoclave, hot air oven, laminar airflow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colourimeter, spectro photometer.	12
3.	• Preparation of different culture media- nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture. • Enumeration of bacteria using spread plate and pour plate techniques. • Isolation of bacteria by pour plate, spread plate and streak plate method.	12
4.	• Staining of bacteria- 1. Simple staining- methylene blue 2. Gram's staining 3. Acid fast staining 4. Ziehl Neelsen staining 5. Giemsa staining 6. Structural staining- capsule, endospore. 7. Staining of fungi using lactophenol and cotton blue.	12
5.	Study of permanent slide and life materials • Bacteria- Staphylococci, Streptococcoci, Bacillus sp., Vibrio,	12

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	Azospirillum • Protozoans- *Amoeba, Paramaecium, Trypanaosoma, Plasmodium, Entamoeba hystolytica.* • Helminths- *Fasciola, Taeniasolium, Ascaris.* • Fungi- *Mucor, Rhizopus, Penicillium, Aspergillus, Alternaria.* • Cyanobacteria- *Chlorella, Spirulina, Nostoc, Anabaena.*	

Suggested Readings:

1. Microbiology: A laboratory manual by J. Cappucino and C.T. Welsh. 11th edition, Pearson education, USA. 2016
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultiation, New Age International, New Delhi.
3. Dubey R.C.. and Maheshwari D.K., Textbook of practical microbiology, S Chand Publications.
4. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology, 5th edition McMillan.
5. Lab Virtual links-
   - https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32196
   - https://www.labster.com/microbiology-virtual-labs/
   - https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject biology in class 12th

Suggested Continuous Evaluation Methods:

Further Suggestions: None

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Programme/Class: Certificate	**Year:** First	**Semester:** Second
Subject: MICROBIOLOGY		
Course Code: B080201T	**Course Title:** Agriculture and Environmental Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- Get acquainted with natural habitats of diverse protection.
- Understand how microbes interact among themselves and with higher plants and animals with the help of various examples.
- Become aware of the important role microbes play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.
- Gain in depth knowledge of different types of solid waste, liquid waste and their management.
- Get familiar with problems of pollution and applications of clear up technologies for the pollutants.
- Know about the diverse microbial populations in various natural habitats like soil, air, water.
- Gain knowledge of the bio-fertilizer and their types.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Microorganisms and their habitats** Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersion of microbes; Animal Environment: Microbes in/on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low nutrient level; Microbial succession in decomposition of plant organic matter.	8
II	**Microbial Interactions** Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza (types and its applications).	8
III	**Biogeochemical cycling** Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle.	8

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IV	**Waste management** Solid waste management: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: composition and strength of sewage (BOD & COD), primary, secondary, (oxidation pond, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.	**8**
V	**Microbial Bioremediation** Principle and degradation of common pesticides, organic (hydrocarbon, oil spills) and inorganic matter, biosurfactants.	**6**
VI	**Water potablity** Treatment and safety of drinking water; Methods to detect potability of water sample: Standard qualitative procedure- MPN test/Presumptive test, confirmed and completed test for faecal-coliforms Membrane filter technique, Presence/Absence test fecal coliform.	**6**
VII	**Biofertilizer** Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative; Mode of application; Advantages and Disadvantages.	**8**
VIII	**Biopesticides** Introduction and definition; Types of biopesticides; Integrated pest management (IPM); Mode of action; Factor influencing; Applications, advantages& disadvantages.	**8**

Suggested Readings:

1. Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
2. Alexopoulas C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
3. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi
4. Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
5. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi.
6. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
8. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
9. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
11. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.
12. Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.
13. Suggestive digital platforms web links-
    - https://www.classcentral.com/tag/microbiology
    - https://www.mooc-list.com/tags/biotechnology
    - https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
    - https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health

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• https://collegelearners.com/ebooks/agricultural-microbiology-pdf-free-download
This course can be opted as an elective by the students of following subjects: Open for all
Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology
Suggested Continuous Evaluation Methods: **House Examination/Test:** 10 marks **Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar:** 10 Marks **Class performance/Participate:** 5 Marks
Further Suggestions: None

Programme/Class: Certificate	**Year:** First	**Semester:** Second
Subject: MICROBIOLOGY		
Course Code: B080202P	**Course Title:** Experiments in Agriculture and Environmental Microbiology	

Course Outcomes:

The student at the completion of the course will be able to:

- To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.
- Practical skill in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose.
- To prepare slides and stain to see the microbial cell.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 0-0-2

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	• To analyse soil- pH, moisture, water holding capacity.	8
2	• Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28° C & 45° C) • Isolation of bacteria and fungi from rhizosphere and rhizoplane. • Isolation of bacteria & fungi from air environment by exposure plate method. • Isolation of Rhizobium sp. from leguminous root nodule.	16
3	• To determine BOD of waste water sample. • Bacteriological examinaiton of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test.	12 .

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4	• Specimen study of plant pathogens. 1. Black rust of wheat 2. White rust of crucifer 3. Leaf curl of tomato 4. Downy mildew 5. Red rot of sugarcane	**10**
5	Study of permanent slide and life materials • *Cladosporium* • *Helmithosporium* • *Mucor* • *Curvularia* • *Alternaria* • *Geotrichurn* • *Trichoderma* • *Rhizopus*	**14**

Suggested Readings:

1. Agrios A.G. Plant Pathology, Elsevier Academic Press, New Delhi, 2006.
2. Atlas RM and Batha R (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba Cp (2009). Environmental Microbiology. 2nd edition, Academic Press.
4. Subba Rao NS. (1999). Soil Microbiology, 4th edition. Oxford & IBH Publishing Co. New Delhi.
5. Virtual Lab Links-
   - https://vlab.amrita.edu/?sub=3&brch=73
   - https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
   - https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

Further Suggestions: None

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Detail Syllabus of

B.Sc. II Year

or

Diploma in Microbial Technology

Programme/Class: Diploma	**Year:** Second	**Semester:** Third
Subject: MICROBIOLOGY		
Course Code: B080301T	**Course Title:** Basic Biochemistry and Microbial Physiology	

Course Learning Outcomes:

Upon successful completion of the course, the student:

- Will have understanding of the basic principles of thermodynamics applied to biological systems
- Will be conversant with the structures of carbohydrates, lipids, proteins and nucleic acids
- Will comprehend the basic concepts of enzyme biochemistry including enzyme kinetics, and will become aware of different variants of enzymes found in living cells.
- Will be acquainted with the diverse physiological groups of bacteria/archaea and microbial transport systems.
- Will have an in-depth knowledge of patterns of bacterial growth, bacterial growth curve, calculation of generation time and specific growth rate, and effect of the environment on growth.
- Will apprehend how biochemical pathways are used by bacteria for energy generation and conservation during growth on glucose under aerobic and anaerobic conditions
- Will be familiar with the physiology of nitrogen fixation and assimilation of inorganic nitrogen by bacteria and understand how interactions between microbes and the environment affect cellular physiology.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week):**L-T-P:**4-0-0

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of thermodynamics and bioenergetic** Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions and coupled reactions	6
II	**Water & Carbohydrates** Structure and properties of water, Handerson Hasselbalch equation, Ionic product of water, pH and buffers. Structure & classification of carbohydrates, carbohydrates metabolism: glycolysis, fermentation, Pentose phosphate pathway (PPP), Entner Doudoroff pathway, Krebs Cycle, Electron transport chain (ETC)- Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis	12
III	**Proteins** **Structure & Classification-** Protein structure: primary, secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary-human hemoglobin as an example. Forces involved in protein folding	6
IV	**Lipids & Nucleic acids** Structure and classification of lipids. Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physic-chemical properties of DNA. RNA types- rRNA, mRNA, tRNA.	6

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V	**Enzymology concepts:** Concepts of holozymes, apoenzyme, cofactors, prosthetic group, coenzyme, metal cofactors; Classification of enzymes; Active site and activation energy; Lock and key hypothesis, induced fit hypothesis; enzyme kinetics; Allosteric enzymes-cooperativity; Enzyme inhibition: competitive and noncompetitive	6
VI	**Microbial nutrient uptake and transport:** Microbial classification based on nutrient and energy source; Nutrient uptake mechanisms-passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport, antiport, group translocation; Iron uptake	8
VII	**Microbial growth and effect of environmental factors on growth** Bacterial growth curve and kinetics-Generation time and specific growth rate; Diauxic growth and synchronous growth; Batch, Fed batch and continuous cultures; Chemostat and turbidostat	8
VIII	**Stress physiology and Nitrogen metabolism** Effect of oxygen, pH, osmotic pressure, heat shock on bacteria; Microbial adaptation to Environment-Temperature, pH, Oxygen, Pressure, Salt, Water activity; Extremophiles application in industry; Dissimilatory nitrate reduction, Nitrogen fixation	8

Suggested Readings:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sons inc., publication.
2. Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press, Cambridge.
3. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
4. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.
5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. Biochemistry 8th edition. W. H. Freeman.
6. Suggestive digital platforms web links-
   - https://lipidnanostructuresgroup.weebly.com
   - https://www.labster.com/microbiology-virtual-labs
   - https://www.microbiologybook.org
   - https://www.cpe.rutgers.edu/courses/current/lf0401wa.html
   - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
   - https://www.futurelearn.com/courses/introduction-to-microbiology

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject "Agriculture and Environmental Microbiology" in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods
House Examination/Test: 10 marks

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Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks **Classperformance/Participate:** 5Marks
Further Suggestions: None

Programme/Class: Diploma	**Year:** Second	**Semester:** Third
Subject: MICROBIOLOGY		
Course Code: B080302P	**Course Title:** Experiment in Basic Biochemistry and Microbial Physiology	

Course Outcomes:

After completing the course, the student will be able to:

- Understand the structures of carbohydrates and their main properties, as well as conduct chemical tests to detect their presence in samples.
- Would have acquired practical knowledge of biochemical techniques for proteins and will be familiar with the use of a spectrophotometer.
- Understand the fundamental principles of enzyme biochemistry, including enzyme kinetics, at the end of the course.
- Will have a thorough understanding of bacterial growth patterns, bacterial growth curves, generation time and basic growth rate calculations, and the impact of the environment on growth.
- Will learn about the fermentation process in microbes.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week):**L-T-P:**0-0-2

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Use and calibration of pH meter and preparation of buffers. Preparation of stock and working solutions. Handling of pipettes and micropipettes and checking their accuracy.	4
2	**Qualitative tests** Carbohydrates: Molisch's Test, Fehling's Test, Benedict's Test, Iodine Test) Amino acids and Proteins: Ninhydrin test, Biuret test, Lowry test. Lipids: Solubility Test, Translucent Spot Test, Emulsification Test.	20
3	Quantitative estimation of carbohydrate by anthrone method. Quantitative estimation of proteins by Lowry's method Determination of the acid value of a fat	10
4	Amylase production, H_2S production, Urease production test, IMViC test	10
5	Effect of temperature and pH on growth of E. coli, Effect of carbon and nitrogen on microbial growth.	8
6	Demonstration of carbohydrate fermentation, indole production, catalase test; oxidase test.	8

Suggested readings:

1. Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume 1, 1991, Wiley.
2. S. K. Sawhney, Randhir Singh,Introductory Practical Biochemistry, 2000, Narosa.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring

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Harbour Laboratory press.
4. Maloy SR, Cronan JE and Friefelder D, Microbial Genetics 2nd EDITION., 2004, Jones and Barlett Publishers
5. Larry Snyder. Molecular Genetics of Bacteria: 3rd (third) Edition.
6. Digital links
   - http://www.mooc.list.com/tag/molecular-biology
   - http://www.mooc.list.com/course/microbiology.sayloro
   - https://lipidnanostructuresgroup.weely.com
   - http://www.mooc.list.com/microbial
   - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject "Agriculture and Environmental Microbiology" in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

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Further Suggestions: None

Programme/Class: Diploma	**Year:** Second	**Semester:** Fourth
Subject: MICROBIOLOGY		
Course Code: B080401T	**Course Title:** Molecular Biology and Microbial Genetics	

Course Outcomes:

At the end of the course, the student will be able to:

- Distinguish in prokaryotic cellular structure and functional components of cells, as well as the dissimilarities in genome organization between prokaryotes and eukaryotes.
- Describe the replication, transmission, and action mechanisms of chromosomal and extrachromosomal genes and sequences.
- Recognize and distinguish genetic regulatory mechanisms at various levels
- Gain an understanding of how internal and external signals regulate gene expression, influence microbial diversity, and shape microbial communities and their environments.
- Describe the processes that lead to mutations and other genetic changes.

Credits:4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week):**L-T-P:**4-0-0

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of the genome organization** – DNA/and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cot curves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes.	6

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II	**DNA Replication in Prokaryotes and Eukaryotes-** Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication, Replication of chromosome ends.	6
III	**Transcription in Prokaryotes and Eukaryotes** Concept of transcription unit. General transcription process in prokaryotes and eukaryotes; Post-Transcriptional modification in eukaryotes, Aternative splicing mechanism,RNA interference	8
IV	**Translation in prokaryotes and eukaryotes** Ribosome structure, tRNA structure and processing, Mechanisms of translation in both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity of translation	8
V	**Regulation of gene expression** in prokaryotes and eukaryotes Overview of regulation of gene expression, Regulation of gene expression by DNA methylation, histone acetylation and histone methylation mechanisms; Transcription control mechanisms, Inducible Operon System, Repressible Operon System, Translation control mechanisms.	10
VI	**Plasmids in prokaryotes and eukaryotes** Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids.	6
VII	**Bacterial gene exchange processes-** Mechanisms of Genetic Exchange, Horizontal gene transfer, Transformation; Conjugation; Transduction, Complementation.	8
VIII	**Mutations, mutagenesis and repair** Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism	8

Suggested Readings:

1. Watson, J. et. Al. 2004. Molecular Biology of the Gene,5th Edition, CSHL Press, New York.
2. Conn, E., & Stumpf, P. 2009.Outlines of Biochemistry, 5Th Ed. Wiley India Pvt. Limited.
3. T A Brown.2001. Essential Molecular Biology. Oxford University Press, USA
4. Brock, T.D. 1990. The Emergence of Bacterial Genetics, Cold Spring Harbor Lab Press.
5. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press.
6. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press
7. Suggestive digital platforms web links-
   - https://www.classcentral.com/tag/microbiology
   - http://www.mooc.list.com/tag/molecular-biology
   - http://www.mooc.list.com/course/microbiology.sayloro
   - https://lipidnanostructuresgroup.weely.com
   - http://www.mooc.list.com/microbial
   - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject "Basic Biochemistry and Microbial Physiology" in III Semester of Diploma course in Microbial Technology

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Suggested Continuous Evaluation Methods **House Examination/Test:** 10 marks **Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar:** 10 marks **Class performance/Participate:** 5Marks
Further Suggestions: None

Programme/ Class: Diploma	**Year:** Second	**Semester:** Fourth
Subject: MICROBIOLOGY		
Course Code: B080402P	**Course Title:** Experiment in Molecular Biology and Microbial Genetics	

Course Outcomes:

The student at the completion of the course be able to:

- understand the fundamentals of molecular biology and genetic research.
- use some basic equipment in a molecular biology laboratory.
- extract genomic DNA from microbes using molecular biology techniques
- measure DNA and verify purity using UV spectrometer and electrophoresis.
- understand the basic principle of plasmid isolation and their conformations using electrophoresis.
- understand the mutagenic effect of chemical and physical agents and perform test to identify mutagenic effect of chemicals

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-2

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Isolation of genomic DNA from *E. coli* and analysis by agarose gel electrophoresis.	8
2	Estimation of DNA using diphenylamine reagent.	8
3	Resolution of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) and visualization using coomassie dye.	10
4	Replica plating method: Preparation of master and replica plates. Isolation of Histidine auxotrophs	10
5	Isolation of plasmid DNA from *E. coli*. Study the different conformations of plasmid DNA through agarose gel electrophoresis	8
6	Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on bacterial cells.	8
7	Demonstration of Ames test.	8

Suggested readings:

1. Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TX Wiley-Blackwell.
2. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press.
4. Digital links:

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• https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/ames-test • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/
This course can be opted as an elective by the students of following subjects: Open for all .....
Course prerequisites: To study this course, a student must have had the subject "Basic Biochemistry and Microbial Physiology" in III Semester of Diploma course in Microbial Technology.
Suggested Continuous Evaluation Methods .....
Further Suggestions: None

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Detail Syllabus of

B.Sc. III Year

Microbiology

Programme / Class: Bachelor of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080501T	**Course Title:** Medical Microbiology	

Course outcomes:
Upon completion the students will learn:

- The historical development of medical microbiology
- The importance of microorganisms in life.
- The microorganisms associated with various infectious diseases.
- The treatment strategies followed for the infectious diseases.
- Antibiotic resistance
- Processes of sample collection and processing

Credits: 4	**Core :**Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**History of Medical Microbiology** Contribution of pioneers in the field of Medical Microbiology, Normal Microflora of human body: skin, mouth, alimentary canal and gintourinary tract	7
II	**Bacterial diseases** Diseases caused by certain bacterial pathogens *Staphylococcus aureus, Streptococcus pneumoniae, Mycobacterium tuberculosis, Salmonella typhi, Vibrio cholera*	8
III	**Viral diseases** Diseases caused by certain viruses Human Immunodeficiency Virus, Hepatitis Virus, Influenza virus, Herpes virus	8
IV	**Parasitic diseases** Diseases caused by protozoa *Giardia* sp., *Plasmodium* sp., *Leshmania* sp., and *Entamoeba* sp.	7
V	**Pathogenic fungal disease I** Dermatophytes- *Trichophyton, Microsporum* Filamentous fungi causing subcutaneous infection by Mucor, *Rhizopus* and *Aspergillus*	8
VI	**Pathogenic fungal disease II** Systemic mycoses caused by Blastomyces, Histoplasma and Yeast like fungi: *Candida* and *Cryptococci*	8

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VII	**Antibiotics and Chemotherapeutics** Historical development of chemotherapeutic and antibiotic substances, Major antimicrobial agents, Mode of action of chemotherapeutic and antibiotic substances.	8
VIII	**Antibiotic resistance, Sample collection and processing** Drug resistance, Mechanism of antibiotic resistance, Antibiotic susceptibility assay. Collection and transport of appropriate clinical sample specimen for clinical diagnostics	6

Suggested Readings:

1. Annadurai, A. A textbook of Immunology and Immunotechnology. S. Chnd
2. Ananthanarayanan R and Panicker C K. Textbook of Microbiology. Orient Longman.
3. Baveja, CP. Text book of Microbiology. Arya publications.
4. Ken S.Rosenthal, Patrick R.Murray, and Michael A.Pfaller. Medical Microbiology 7th Edition, Elsevier
5. Karen C.Carroll, Geo.Brooks, Stephen Morse, and Janet Butel.Jawetz, Melinck, &Adelberg's Medical Microbiology, Lang
6. Suggestive digital platforms web links-
   https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials
   https://vlab.amrita.edu/?sub=3&rch=73
   https://www.mooc-list.co/tags/pathology
   https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject "Molecular Biology and Microbial Genetics" in IV Semester of Diploma course in Microbial Technology

Suggested Continuous Evaluation Methods:
House Examination/ Test: 10 marks
Written Assignment/ Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/ Participate: 5 Marks

Suggested equivalent online courses:

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Further Suggestions:
None

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Programme / Class: Bachelor of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080502T	**Course Title:** Immunology	

Course outcomes:
Upon completion the students will learn

- The historical development of immunology
- The components of immune system, Immune responses, features of antigen and antibody, hypersensitivity responses
- Applications of antibody in diagnosis and therapy, and antigen-antibody reactions.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rule

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of Immunology** History of immunology, Physical and physiological barriers, Innate and Acquired immunity, Organs and Cells of Immune system.	7
II	**Complement System** Complement System Proteins, Complement System Activation by Classical, Alternate and Lectin Pathway	8
III	**Immunity** Humoral and Cell Mediated Immunity, Active And Passive Immunity	8
IV	**Antigen & Immunogens** Antigen Characteristics, Types of Antigens, Adjuvants, Immunogenicity and Antigenicity, Cytokines,	7
V	**Immunoglobulins and MHC and their role** Classes of immunoglobulin, structure and function, Major Histocompatibility Complex: Types, Antigen Presentation through MHC class I and class II molecules	9
VI	**Hypersensitivity** Types of Hypersensitivity, Mechanism of hypersensitivities with examples	5
VII	**Immune Response** Antibody dependent Cell mediated Cytotoxicity, Phagocytosis, Inflammation and Inflammatory response mechanism.	6
VIII	**Applications of Immunoglobulins** Applications of antibody in diagnosis and therapy; *In vitro* serological test methods: Antigen-Antibody Reactions: Agglutination and immunodiffusion; ELISA and RIA.	10

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Suggested Readings:

1. Kindt, Goldsby and Osborne. Kuby's Immunology. WH Freeman& Company,
2. Roitt I,Brostoff, J and Male D.Immunology, 6th edition, 2001, Mosby, London.
3. Ramesh SR, Immunology. Mc Graw Hill Publications.
4. Madhavee LP, A Textbook of Immunology, S Chand Publisher.
5. Reddy R, Textbook of Immunology, 3rd edition, AITBS Publisher.
6. Digital links
    - https://www.mcgill.ca/microimm/undergraduate-programs/courses
    - https://oline.creighton.edu/program/medical-microbiology-and-immunology-ms

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject **Molecular Biology and Microbial Genetics** in IV Semester of Diploma course in Microbial Technology

Suggested Continuous Evaluation Methods:
House Examination/Test: 10 marks
Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/Participate: 5 Marks

Suggested equivalent online courses:

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Further Suggestions:
None

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Programme / Class: Bachelors of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080503P	**Course Title:** Experiments in Medical Microbiology & Immunology	

Course outcomes:

Upon completion of the practical course in medical microbiology and immunology the students will learn about

- The preparation of culture media, microorganisms associated with human body, characterization of microorganisms associated with disease.
- Antigen- antibody interaction
- Learning of the application of antibodies for diagnostic purposes, antibiotic sensitivity test and resistance transfer.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:0-0-2**

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Preparation of blood agar, chocolate agar, and other media required for medically important microorganisms	6
2	Isolation and characterization of skin normal microflora	6
3	Isolation of bacteria from teeth crevices	6
4	Demonstration of α and β haemolysis on blood agar medium.	8
5	Demonstration of serological tests: blood groups, Rh factor determination, pregnancy test, Widal, VDRL, ELISA	12
6	Demonstration of pathogenic fungi in mycoses lesion	8
7	Antibiotic sensitivity test and MIC determination	6
8	Demonstration of antibiotic resistance transfer from resistant to sensitive microorganism	8

Suggested Readings:

1. Hudson L, and Hay FC, Practical Immunology, 3rd edition, Wiley.
2. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology, 3rd edition, ASM. Ed.3; 1986.
3. Talwar GP and Gupta SK, A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi
4. Aneja KR, Experiments in Microbiology, Plant Pathology and Biotechnology, Ist edition, New Age International Publisher
5. Randhawa VS, Practicals and Viva in Medical Microbiology, Harcourt India Pvt. Ltd.
6. Digital Links

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- http://www.vlab.co.in
- http://www.vlab.iitb.ac.in
- http://www.onlinelabs.in
- http://www.vlab.amrita.edu
- http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject "Molecular Biology and Microbial Genetics" in IV Semester of Diploma course in Microbial Technology.

Suggested Continuous Evaluation Methods:

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Suggested equivalent online courses:

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Further Suggestions:

Programme/Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B08060IT	**Course Title:** Food Microbiology	

Course outcomes:

- Upon completion the students will learn about the role of Microorganism in food Microbiology.
- Learn the symptoms of deteriorated food.
- Assimilate knowledge about Microbial Examination of food.
- Learn about food preservation techniques.
- Will get sufficient knowledge regarding analysis of milk.
- Will be able to monitor food quality.

Credits: 4	**Core :** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Introduction to food & nutrition.** History, Development and Scope of food microbiology; Concept of food and nutrients; Physiochemical properties of food; Importance and types of	8

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	microorganisms in food (bacteria, mold and yeast); Food as a substrate for microorganism- Intrinsic and extrinsic factors that affect growth and survival of microbes in food, natural flora and source of contamination of foods in general.	
II	**Microbial spoilage of various foods** Principal; Spoilage of vegetables, fruits, meats, eggs, milk and butter, bread, canned foods.	6
III	**Microbial examination of food** DMC, viable count, examination of faecal Streptococci. Food quality monitoring, Biosensors and Immunoassays.	6
IV	**Food Preservation** Basic Principles, Methods (heating, freezing, dehydration, chemical preservatives, radiation). Modern technologies in food preservation, Packaging material.	8
V	**Fermented foods:** Fermented dairy products (cheese, butter, yoghurt), Kefir; Other Fermented foods- Soya sauce, Saurkraut, Dosa, Tempeh; Probiotics: health benefits, types of microorganisms used, probiotic foods available in market.	8
VI	**Food borne diseases (Causative agents, foods involved, symptoms and preventive measures)** Food intoxication- Staphylococcus aureus, Clostridium botulinum and Mycotoxins; Food infections- E.coli, Salmonellosis, Bacillus cereus, Sheigellosis, Listeria.	8
VII	**Microorganisms and milk** Physical and chemical properties of milk; Milk as a substrate for microorganisms; Microbiological analysis of milk – Rapid Platform test, standard plate count, MBRTtest, alkaline phosphatase enzyme test, DMC; Method of preservation of milk and milk product, pasteurization sterilization and dehydration.	8
VIII	**Food sanitization and control** HACCP, Indices of food sanitary quality and sanitisers; Microbiological quality standard of food.	8

Suggested Readings:

1. Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.
2. R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill
3. Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)
4. Varnam A.H. & Evans M G – Food borne pathogens. Wolfe Publishing House, London
5. B.D. Singh (2015) Biotechnology, Kalyani Publisher
6. Prajapati (2007) Fundamentals of Dairy microbiology, Indian Council of Agricultural Research, New Delhi
7. Andrew Proctor (2011) Alternatives to conventional food processing. RSC Publisher
8. Arun K. Bhunia & Bibek Ray, Fundamental Food Microbiology, 5th Ed., CRC Press

Suggestive digital platforms web links –

- Doyle. Michael P, Gonzalez-francisco Diez, Food Microbiology : Fundamentals and frontiers, 5th edition, Hill Colin, available on Wiley online Library.
- http://www.vlab.co.in

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• http://www.vlab.amrita.edu • http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques
This course can be opted as an elective by the students of following subjects: Open for all But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry & B.Sc. Agriculture, B.Sc. Biology
Course prerequisites: To study this course, a student must have had the subject **Medical Microbiology & Immunology** in V Semester of Degree in Bachelor of Science.
Suggested Continuous Evaluation Methods : **House Examination/Test :** 10 marks **Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar:** 10 Marks **Class performance/Participate:** 5 Marks
Suggested equivalent online courses:
Further Suggestions: **None**

Programme/Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B080602T	**Course Title:** Industrial Microbiology	

Course outcomes :

- Develop understanding about IPR in industry
- Understand role of microorganism in industry
- Know about Processing & selection of best microbial strains for the industry
- Gain fundamental knowledge of fermentation process
- Gain knowledge about production of various pharmaceutical products or industrially important product

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rule

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**

Unit	Topics	Total No. of Lectures/ Hours (60)
I	History & Multidisciplinary nature of Industrial microbiology. A typical Bio process: Introduction, advantages & limitations. Patents and intellectual property rights.	7

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II	Taxonomic diversity of industrially useful bacteria & fungi. Important characteristics of microbes used in Industrial Microbiology, Isolation techniques. Concept & examples of microorganisms classified as Generally Regarded as Safe (GRAS).	8
III	Exploitation of microorganism and their products, Screening, Strain development strategies, Immobilization methods.	8
IV	Fermentation: Media, Raw material, Antifoaming agents, Buffers. Equipments, Fermenter design. Types of fermentation – Single, Batch, Continuous.	7
V	Down-stream processing steps: Detection and assay of the product, Recovery (intercellular and extracellular product). Purification (solvent extraction & chromatography)	9
VI	Production of Alcohol (industrial alcohol, wine, beer, whiskey), Organic acid (Citric acid), Antibiotic (Penicillin)	7
VII	Production of Vitamin (B12), Enzyme (Amylase), Amino acid (Glutamic acid), Hormones (Insulin), Vaccine (Hepatitis B).	6
VIII	Biofuel (Methane), Production of Biofertilizers & Biopesticides, Biotransformation of steroids.	8

Suggested Readings:

1. Industrial Microbiology (2000) by AH Patel, Macmillan Publishers India
2. Biology of Industrial microorganism (1981) by Arnold L. Domain, Bejamin/ cummings Pub. Co.
3. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
4. Industrial Microbiology by Casida LE, New age International (P) Ltd.

Suggestive digital platforms web links

- http://foodhaccp.com/foodsafetymicro/onlineindex.html
- http://www.cpe.rutgers.ed/courses/current/If0401wa.html

This course can be opted as an elective by the students of following subjects: Open for all
But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Biology & B.Sc. Agriculture

Course prerequisites: To study this course, a student must have had the subject "Medical Microbiology & Immunology" in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods:
House Examination/Test: 10 marks
Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/Participate: 5 Marks

Suggested equivalent online courses:
https://www.classcentral.com/course/swayam-food-microbiology-and-food-safety-17609

Further Suggestions:
None

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Programme/ Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B080603P	**Course Title:** Experiments in Food & Industrial Microbiology	

Course outcomes:

- Understand the instruments, techniques & Lab discipline
- Develop skill for identifying microbes used in industry
- Upon completion student will learn about the process of fermentation & design of bioreactors, a major part of pharmaceutical industry
- Will learn about the culture of microorganisms used in Food & Industrial microbiology.

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:0-0-2**

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Study of Bioreactor & its essential parts	4
2	Necessity & procedure of writing SOPs for instruments used in large scale production	6
3	Isolation and microscopic observation of industrially important microorganism	8
4	Isolation and characterization of microorganism used in Dairy industry	8
5	Isolation and characterization of Yeast used in Bakery/distillery/winery	8
6	Isolation & identification of important microorganism of food microbiology	8
7	Bacteriological analysis of food products	8
8	Determination of the quality of milk by MBRT	2
9	Bacterial examination of milk – Alcohol test	4
10	Preservation methods	4

Suggested Readings:

7. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
8. Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., New Delhi.

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9. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
10. W.F. Harrigan, Laboratory methods in Microbiology, Publisher – Elsevier
11. Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press
12. Brain McNeil & Harvey (2008), Practical Fermentation Technology, John Wiley & Sons Ltd.
13. Digital links
    - http://www.vlab.co.in
    - http://www.vlab.iitb.ac.in
    - http://www.onlinelabs.in
    - http://www.vlab.amrita.edu
    - http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques
    - http://foodhaccp.com/foodsafetymicro/onlineindex.html
    - http://www.cpe.rutgers.ed/courses/current/If0401wa.html

This course can be opted as an elective by the students of following subjects: Open for all
.....

Course prerequisites: To study this course, a student must have had the subject "Medical Microbiology and Immunology" in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods:
.....

Suggested equivalent online courses:
.....

Further Suggestions:

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DEPARTMENT OF MICROBIOLOGY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

APPENDIX - II

Amendment in the following existing Ordinance of the Department of Microbiology

Existing Ordinance	**Proposed Ordinance**
14. The academic Committee shall consists of: (1) All the Professors of the Department (2) One reader, of the Department by the for the one year, in order of seniority (3) One lecturer of the Department. By rotation for one year in order of the seniority (4) Two experts in the subjects not in the service of the university or its affiliated colleges, to be nominated by the Vice-Chancellor for a period of two years	14: the Academic Committee shall consists of: (1) All the professors of the Department (2) One Associate Professor of the Department by rotation for one year, in order of the seniority (3) One Assistant Professor of the Department. By rotation for one year in order of the seniority (4) Two experts in the subjects not in the service of the university or its affiliated colleges, to be nominated by the Vice-Chancellor for a period of two years **Add** (5) One teacher of relevant/allied subject of the affiliated postgraduate colleges, where research is being conducted, to be nominated by the Vice-Chancellor on the recommendation of the Head of the Department for a period of a one year. The Head of the Department shall be the Chairman of the Academic Committee

The Academic Committee considered and approved to the amendment in the existing ordinance of the department in Point number 14 (Appendix II)

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Faculty of ... Science
Dr. Bhimrao Ambedkar University

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डॉ० भीमराव आंबेडकर विश्वविद्यालय, आगरा

विभाग .....

संचिका संख्या .....

सहायक कुलसचिव(शैक्षिक)/कुलसचिव

कृपया स्कूल ऑफ लाइफ साइंस, खन्दारी परिसर, आगरा की संलग्न पत्रावली का अवलोकन करने का कष्ट करें, जिसके अर्न्तगत Dean Faculty of Life Science द्वारा School of Life Science विभाग में सम्पन्न हुई Deptt. of Microbiology की एकेडेमिक कमेटी दिनांक 12 फरवरी, 2022 एवं Deptt. of Botany की एकेडेमिक कमेटी दिनांक 17 फरवरी, 2022 की संस्तुतियों को आगामी विद्या परिषद् में प्रस्तुत करने हेतु निर्देशित किया गया है। संस्तुतियाँ निम्नवत् है:–

1. दिनांक 12.02.2022 को सम्पन्न हुई **Deptt. of Microbiology** की संस्तुतियाँ निम्नवत् है:–

   "1. The Academic Committee considered, approved and adopt the Syllabus of Microbiology as proposed by the UP Government under NEP 2020 as one of the subject at UG level in B.Sc. to be implemented from the session 2021-2022. (Appendix-1)

   2. The Academic Committee considered and approved revised Ordinances (Point number 14) of the Departement of Microbiology.(Appendix-1)"

2. दिनांक 17.02.2022 को सम्पन्न हुई **Deptt. of Botany** की संस्तुतियाँ निम्नवत् है:–

   "The Academic Committee conidered, approved and adopt the Syllabus of Seed Techonology as proposed by the UP Government under NEP 2020 as one of the subject at UG level in B.Sc. to be implemented from the session 2021-2022. (Appendix-1)"

आप सहमत हों तो उक्त संस्तुतियों को विद्या परिषद के प्रस्तुत करने की प्रदान करने का कष्ट करें।

Kumari 10/05/2022
प्रभारी(शैक्षिक विभाग)

M. Singh 10.05.22

10.5.22

कुलपति जी

11/05/22

16 MAY 2022

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DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

MINUTES

The minutes of the meeting of the Academic Committee of Department of Botany held in the Department of Botany of the Dr. Bhimrao Ambedkar University, Agra on 17 February 2022 at 12:30 PM. The following members were present:

S. No.	Name	Designation	Signature
1.	Prof. Shamsul Hayat	External expert	
2.	Dr. Deepa Bisht	External expert	
3.	Prof. Rajendra Sharma	Internal expert from college/retd. teacher	
4.	Dr. R. K. Agnihotri	Internal expert / Head & Convenor	
5.	Prof. B. S. Sharma	Dean, School of Life Sciences	17/02/22

1. The Academic Committee considered, approved and adopt the Syllabus of Seed Technology as proposed by the UP Government under NEP 2020 as one of the subject at UG level in B.Sc. to be implemented from the session 2021-22 (Appendix – I).

17/2/22

DR.BHIMRAO AMBEDKAR UNIVERSITY

School Of Life Sciences, Khandari Campus, Agra.

Dated: 18 Feb.,2022

To

The Asstt. Registrar (Academic)
Dr. Bhimrao Ambedkar University,
Agra.

Sir,

Please find enclosed herewith the minutes of the meeting of Academic Committee of the Department of Botany held on Feb. 17, 2022. It is requested that it may please be placed before the Academic Council / Executive Council for approval at the earliest.

Thanking you

Yours faithfully,

18/2/22

B.S. Sharma

DEAN
Faculty of Life Science
Dr. Bhimrao Ambedkar University, Agra

Encls. :

1. Minutes of the Academic Committee
2. Syllabus of Seed Technology for B.Sc., Appendix- I

18/2/22

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DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

ATTENDANCE SHEET

The Academic Committee of Department of Botany held in the Department of Botany, School of Life Sciences, Dr. Bhimrao Ambedkar University, Agra on 17 February, 2022 at 12.30 p.m.

S. No.	Name	Designation	Signature
1.	Prof. Shamsul Hayat	External expert	
2.	Dr. Deepa Bisht	External expert	
3.	Prof. Rajendra Sharma	Internal expert from college/retd. teacher	
4.	Dr. R. K. Agnihotri	Internal expert / Head & Convenor	
5.	Prof. B. S. Sharma	Dean, School of Life Sciences	17/2/22

DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY
AGRA

MINUTES

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4.	Dr. R. K. Agnihotri	Internal expert / Head & Convenor	
5.	Prof. B. S. Sharma	Dean, School of Life Sciences	17/02/22

1. The Academic Committee considered, approved and adopt the Syllabus of Seed Technology as proposed by the UP Government under NEP 2020 as one of the subject at UG level in B.Sc. to be implemented from the session 2021-22 (Appendix – I).

17/2/22

Semester-wise Titles of the Papers in B.Sc. (Seed Technology)

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits
Certificate Course In Seed Morphology and Crop improvement					
FIRST YEAR	I	B210101T	Seed Morphology and development	Theory	4
		B210102P	Experiments on Seed Morphology and development	Practical	2
	II	B210201T	Plant breeding and crop improvement	Theory	4
		B210202P	Techniques of Cytology and plant breeding	Practical	2
Diploma in Seed Physiology and Seed Production					
SECOND YEAR	III	B210301T	Seed Physiology and Biochemistry	Theory	4
		B210302P	Basic experiments of Seed Physiology and Biochemistry	Practical	2
	IV	B210401T	Seed Production and Certification	Theory	4
		B210402P	Principles And Techniques Of Seed Production	Practical	2
Bachelor of Science					
THIRD YEAR	V	B210501T	Seed Pathology and Entomology	Theory	4
		B210502T	Seed processing, Storage and legislations	Theory	4
		B210503P	Studies on major diseases of crop plants	Practical	2
		B210504R	*Project-I	Practical	3
	VI	B210601T	Biotechnology and seed development	Theory	4
		B210602T	Seed Farm management and marketing	Theory	4
		B210603P	Experiments on Biotechnology and Farm Management	Practical	2
		B210604R	*Project-II	Practical	3

SUBJECT: SEED TECHNOLOGY

SUBJECT PREREQUISITES:

1. To study Seed Technology, a student must have had the subject Biology/Biotechnology learnt at 10+2 level.
2. Keen interest in plants and plant-related research, Potential in mathematics, biology and chemistry.
3. Skills and aptitude for scientific study and research.
4. Creativity and good comprehension while working on scientific procedures and research.
5. Computer aptitude.

COURSE INTRODUCTION

Introduction:

Seed Technology is a science dealing with the methods of improving genetic and physical characteristics of seed. Study of seed technology is necessary for two reasons.

Firstly, the introduction of hybrids and high yielding varieties of crop plants of immense importance has necessitated great care in the maintenance and preservation of seed.

Secondly, if seed production is to evolve as a prime enterprise, instead of a byproduct as it has been characteristically handled down through the centuries.

Development of seed enterprise is absolutely necessary in the context of modern agriculture. It is the quickest way of increasing agricultural production. Much of our success in increasing food production has been due to the development of seed enterprise over the past decade. Seed demand at present is strong and expected to continue expanding. Indian economy depends on agriculture and about 60 % of Indian population depends on agriculture. For quality production the farmers need quality seeds or propagating materials. Unless the farmer gets seeds, which are genetically pure and possess other desired qualities namely, high germination percentage and vigour, high purity, sound health etc. he cannot obtain the expected yields.

The quality material is provided to the farmers by the seed industries established throughout the country. These industries are in continuous demand for the knowledgeable, trained, talented Seed Technologists.

These industries provide Career opportunities to the graduate and post graduate students in the following ways:

- Management of seed enterprise (Govt./Semi govt. undertakings and private seed companies).
- State and Central Seed Testing Laboratories.
- Seed certification agencies.
- Seed law enforcement agencies.
- Training/Extension centers.
- Research institutes.

The course focuses on training students in plant breeding, tissue culture, seed health testing techniques, testing

for purity of seeds, crop improvement, protection and storage techniques. Seed technology is of prime importance because-

- Seed is a carrier of new technologies.
- Seed is a basic tool for secured food supply.
- Seed is the principal means to secure crop yields in less favorable production areas.
- Seed is a medium for rapid rehabilitation of agriculture in cases of natural disaster.

The proposed syllabus lays more stress on practicals as compared to theory. It will concentrate on experimental practice, and theoretical aspects. The teaching Centre at the college will develop trained manpower for the industries, and employments will be generated. Students can also become entrepreneurs. Trained and competent teachers with experience in industry would be ideal to teach the subject. Besides such teachers, persons from industry could contribute to the course.

Objectives to be achieved:

- To promote the possibility of self-employment.
- To bridge up the gap between knowledge based conventional education and market demands and to provide an alternative to those pursuing higher education.
- To enrich students' training and knowledge that would be useful in the seed industry so that the farmers will get quality seeds
- To introduce the concepts of experimental design in Seed Technology
- To inculcate sense of job responsibilities, while maintaining social and environment awareness
- To help students build-up a progressive and successful career in industries with a biotechnological perspective

The new curriculum of B.Sc.in Bio (Seed Technology) offer essential knowledge and technical skills to study seed in a holistic manner. Students would be trained in all areas of plant biology using unique combination of core, elective and vocational papers with significant inter-disciplinary components.

B.Sc. Seed Technology program covers academic activities within the classroom sessions along with practical concepts in laboratory sessions. Infield, out station activities and projects are also required to be organized for real-life experience and learning.

PROGRAMME OUTCOMES (POs)

Transformed curriculum shall develop educated outcome-oriented candidature, fostered with discovery-learning, equipped with practice & skills to deal practical problems and versed with recent pedagogical trends in education including e-learning, flipped class and hybrid learning to develop into responsible citizen for nation-building and transforming the country towards the future with their knowledge gained in the field of seed science.

PO 1	CBCS syllabus with a combination of general and specialized education shall introduce the concepts of breadth and depth in learning.
PO2	Shall produce competent seed technologist who can employ and implement their gained knowledge in basic and applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and environment to provide sustainable development.

PO 3	Will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solution, improve practical skills, enhance communication skill, social interaction, increase awareness in judicious use of plant resources by recognizing the ethical value system.
PO 4	The training provided to the students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with graduate preparation for national as well as international competitive examinations, especially UGC-CSIR NET , UPSC Civil Services Examination, IFS, NSC, FCI, FRI etc.
PO 5	Certificate and diploma courses are framed to generate self- entrepreneurship and self-employability, if multi exit option is opted.
PO 6	Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants their domestication and propagation.

PROGRAMME SPECIFIC OUTCOMES (PSOs) :

B.Sc. I Year / Certificate Course in Seed Morphology and Crop Improvement

This Programme imparts knowledge on various fields of seed technology through teaching, interactions and practical classes. It shall maintain a balance between the traditional seed science which was more an art than science and modern science for shifting it towards the frontier areas of molecular biology and use of biotechnology. This syllabus has been drafted to enable the learners to prepare them for self-entrepreneurship and employment in various fields including academics as well as competitive exams. Students would gain wide knowledge in following aspects:

1. Students will be acquainted with the fields like plant morphology, plant breeding and crop improvement.
2. Diversity of seed morphology, Biochemical nature and reproductive behavior.
3. Different techniques of quality seed production to fulfill the need of society.
4. Economic value of plants and their use in Human Welfare.
5. Skill development among students for entrepreneurship.

PROGRAMME SPECIFIC OUTCOMES (PSOS) :

***B.Sc. II Year (Diploma Course in* Seed Physiology and Seed Development)**

This course provides a broad understanding of identifying, growing and using plants .This course is primarily aimed to introduce people to the richness of crop plant diversity found in surrounding areas. Lecture sessions are designed to cover fundamental topics concerning plant physiology and seed development. Practical sessions are organized following theory for easy

understanding of the various aspects such as-

1. Parts of the plants, structural organization of floral parts and diversity therein.
2. The course will cover conventional topics in Field of plant physiological and biochemical changes from beginning to maturity of seed.
3. The course is designed to become a commercial crop grower, florist, and protected cultivator, pharmacologist & seed scientist.
4. Quality seed will help to fulfill the need of common people.
5. Increase in quantity and quality will help to eradicate poverty.
6. It will help to develop entrepreneurship among young students.

Programme specific outcomes (PSOs) :

B.Sc. III Year / Bachelor of Science

The learning outcomes of three years graduation course are aligned with program learning outcomes but these are specific to-specific courses offered in a program. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

1. seed production, seed processing, seed treatments, seed storage, Seed pathology and seed entomology
2. Students will be acquainted with, Seed legislation and Seed Storage.
3. Farm Management & Marketing will improve the production to meet the growing demand of population.
4. This course is suitable to produce expertise in seed selection and production.
5. Understanding of various analytical techniques of seed technology, use of plants as industrial raw material.
6. It will develop self-confident and knowledgeable personnel's. seed marketing
7. The course will motivate students in the field of research as well as guide to become a successful entrepreneur.
8. It will develop self-awareness to enrich decision making ability among the students.
9. Personal development will increase the clarity and effectiveness in knowing themselves and their strengths.
10. Develop good skills in laboratory such as observation and evaluation by the use of modern toolsand technology.

PROPOSED YEAR WISE STRUCTURE OF B. Sc. IN SEED TECHNOLOGY (CORE / ELECTIVE COURSES & PROJECTS)

Subject: Seed Technology

Course/ Entry –Exit levels	Year	Sem.	Paper 1	Credit/ hrs	Paper 2	Credit/ hrs	Paper 3	Credit/ hrs	Research Project	Credit/	Total Credits /hrs/
Certificate Course in Seed Morphology & Crop Improvement	I	I	**Seed Morphology and development**	4/60	**Basics of Seed Morphology and development**	2/60			Nil	Nil	6/120
		II	**Plant breeding and crop improvement**	4/60	**Cytological and plant breeding techniques**	2/60	--		Nil	Nil	6/120
Diploma in Seed Physiology and Seed Production	II	III	**Seed Physiology and Biochemistry**	4/60	**Basic experiments of Seed Physiology and Biochemistry**	2/60	--		Nil	Nil	6/120
		IV	**Seed Production Principle and Procedure**	4/60	**Principles and techniques of seed production**	2/60	-		Nil	Nil	6/120
Bachelor of Science	III	V	**Seed Pathology and entomology**	4/60	**Seed processing ,Storage and legislations**	4/60	**Studies on major diseases of crop plants and seed processing**	2/60	***Project-I**	3/45	13/205
		VI	**Biotechnology and seed development**	4/60	**Seed Farm Management and entrepreneurship**	4/60	**Experiments on biotechnology for seed development and farm management**	2/60	***Project- II**	3/45	13/205
Comments	**Total Credits/Hrs / lectures: (Credits can be earned from On-line Portals of UGC to create Academic Bank and 15% of the topics of each paper can be taught by on-line/ Virtual/ ICT based as per choice of the Institution) * Suggestive List of Projects mentioned in Detailed Paper Syllabus**										**50/890**

Seed Technology Course is One of the Major Subjects for Biology Students and Minor or Elective for students of other faculties.

Second Major Subject Can be Zoology/ Biotechnology /Microbiology/Botany
Third Major Subject can be from Science or Any other faculty of UGC / (Arts/ Agriculture/ Education/ Commerce).

Fourth Subject is Minor or Elective to be selected from any one of other Faculties as per student's own interest.One Vocational Course has to be opted from the list given in Syllabus as per NSDC guidelines
One Co-curricular Course is compulsory

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Internal Assessment & External Assessment

Internal Assessment	Marks	External Assessment	Marks
Class Interaction	5	Viva Voce on Practicals	10
Quiz	5	Report of Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10
Seminar	7	Table work / Experiments	45
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ Field Excursion/ Lab Visits/Industrial training)	8	Practical Record File	10
TOTAL *** Field Excursion/ Lab Visits/Industrial trainingIs compulsory**	25		75

DETAIL SYLLABUS
FOR
CERTIFICATE COURSE IN
SEED MORPHOLOGY AND CROP IMPROVEMENT
OR
B.Sc.-I

CERTIFICATE COURSE IN SEED MORPHOLOGY AND CROP IMPROVEMENT / B.Sc.-I		
Programme: ***Certificate Course In Seed Morphology and Crop Improvement***	Year: I	Semester: I/Paper-I
Subject: **Seed Technology**		
Course Code: **B210101T**	Course Title: **Seed Morp[illegible]gy and [illegible]pment**	

Course outcomes: After the completion of the course the students will be able to:

1. Student should be able to understand the concept of seed technol[illegible]
2. Student should be able to identify seeds identification based on m[illegible]hological c[illegible]cters.
3. Student should get knowledge about reproduction in plants, seed s[illegible]cture and d[illegible]opment.
4. Understanding the theoretical orientation of seed development.
5. Familiarization with Seed Technology and morphology of seed a[illegible]nts developme[illegible]

Key words: Seed Technology Seed morphology and Seed development.

	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60 hrs)
I	**A-Introduction to Indian ancient** Vedic and heritage Seed Technology/Science and contribution of Indian Seed Technologists in context with the holistic development of modern science and technology, has to be taught, practiced and assessed via class interaction/ assignments / self-study mentioned under Continuous Internal Evaluation (CIE). **B-Introduction to Seed Technology** Scope and Role of Seed Technology in agriculture. Concept of Seed, Definition and types (based on endosperm, number of cotyledons and viability), difference between Seed and Grain, Importance of seed to human. Morphology of crop and seed for identification of following crops- Potato, Onion, Jowar, Wheat, Soybean & Sugarcane.	8
II	**Important Crop Families** Classification of crops (based on season, lifecycle, uses), Major crops families belonging to the Dicotyledons and Monocotyledons. Fabaceae-(*Phaseolus*, *Glycine*) Brassicaceae-(*Brassica, Raphanus*), Solanaceae-(Brinjal, Tomato), Poaceae -(Jowar, Maize).	8
III	**Reproductive Biology** Structure of Dicotyledonous and Monocotyledonous flowers- Unisexual (Cucurbits and Maize) and Bisexual (Beans and Jowar); Monoecious, Dioecious Plants.	7
IV	**Mode of reproduction in plants –** (a). Asexual. (b). Sexual Reproduction. (c). Flower Structure, Placentation & Types of Ovules... Effect of environmental factors on floral biology.	7

V	**Development of Gametophytes** Structure of anther, structure and development of male gametophyte. Structure of ovule, Structure and development of female gametophyte. Autogamy, Allogamy.	7
VI	**Pollination and Embryo development** Pollination and their types, pollinating agents, Fertilization, Endosperm and Embryo development, Immature and physiologically mature seeds. Apomixis , & Polyembryony	8
VII	**Seed structure and Development** Structure of Dicotyledon and Monocotyledon seeds, external and internal characters e.g. Cotton, Pea, Castor and Maize. Seed ripening and maturation process. Factors affecting seed setting Storage of reserve food in seeds.	7
VIII	**Development of seeds and fruits** Parthenogenesis and Parthenocarpy, Seed- monoauxic, diauxic. Seed ripening and maturation process. Factors affecting seed setting. Storage of reserve food in seeds.	8

This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture,

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination//Research Orientation assignment)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts etc.

CERTIFICATE COURSE IN *SEED MORPHOLOGY AND CROP IMPROVEMENT* / B.Sc.-I

Programme: ***Certificate Course in seed Morphology and Crop Improvement***	Year: I	Semester: I/Paper-II

Subject: **Seed Technology**

Course Code:**B210202P**	Course Title: **Basi Se d orphology and elopme t**

Course outcomes: After the completion of the course the students ill be abl ces for see denti tion.

1. Understand the instruments, techniques, lab etiquettes and ood lab pr
2. Practical skills in the field and laboratory experiments in se technolog
3. Learn to identify different angiospermic seeds and plants.
4. Can initiate his own Plant & Seed Diagnostic Clinic.
5. Can start own enterprise on production.

Credits:**2**	Core pulsory
Max. Marks: **25+75**	Min. g Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Selection of minimum three topic from each section as per availability of plant/facility	No. of Lectures (60 hrs)
I	Floral study of important monocot and Dicot families as -. Studies of inflorescence, floral management, floral morphology of some important crop plants like cotton, caster, pea, cucurbits, mustard and capsicum *Phaseolus*, *Glycine*, *Brassica, Raphanus*), Brinjal, Tomato), Jowar, Maize.	8
II	Morphological and anatomical studies of some important Dicot and Monocot Seeds Pea, Beans, Gram, Castor, Cucumber, Lagenaria, Maize, Wheat, Paddy, Mustard, Ladyfinger, Spinach,	8
III	Morphology of seedlings and adult plants. Types of seed germination. Seed identification techniques of different species belonging to Monocots and Dicots grown in localities.	8
IV	Adult plant morphology for the identification of any two varieties of the following crops – Soybean, Sugarcane, Jowar etc. Phenol test and peroxides test.	7
V	Identification of crop varieties based on morphological diff es. (Cereals, pulses,)	7

VI	Morphological description of seeds, seedling, flower, fruits of the given specimen.	8
VII	Physical and chemical indices of seed maturity.	8
VIII	Phenol/ Peroxides / Gibberellic Acid test of given seeds ongin iffe nt categories.	6

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

References

1-Practical Manual of Plant Morphology by S Sundara Rajan

2-Practical Botany Vol II by Benre and Kumar

3-Plant Breeding and Genetics Practical Manual by Kaushik Kumar Panigrahi

4-Principles and Procedures of Plant Breeding: Biotechnological and Conventional Approaches by G S Ghahal and S S Ghosal

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination//Research Orientation assignment)	8
	25

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector SkillCouncils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science).
Facilities: Smart and Interactive Class

Facilities: Smart and Interactive Class, wifi facility
Other Requisites: Videos, Books, CDs, Flora, Access to On-line resources, Display Charts.

Programme /Class: B.Sc.-I/ *Certificate Course in seed morphology and Crop improvement*	Year: **I**	Semester: **II** Paper-I
Subject: **Seed Technology**		
Course Code: **B210201T**	Course Title: **Plant Breeding and Crop Improvement**	

Course outcomes:

1. Student should understand the concept and various aspects of plant breeding.
2. Student should learn the genetic basis of plant breeding and various methods of hybridization in plants.
3. Student should learn about resources of seeds along with centers of origin.
4. Learn different methods of hybridization.
5. Learn different concepts in plant breeding.
6. Student can be an entrepreneur in seed production.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic-Plant breeding and crop improvement	Lectures (60hrs)
I	**Plant Exploration and Plant Introduction** Plant Exploration: Centers of origin, Center of genetic diversity. Plant Introduction and Acclimatization: Concept, objectives, types, merits and demerits, achievements.	7
II	**Concepts in Plant Breeding** Plant breeding: Introduction, History, Objectives and important achievements in crop improvement. Plant breeding methods (Introduction and acclimatization, Selection).	8
III	**Genetic basis of Plant breeding** Genetic basis of crop improvement: brief account of Mendelian principals of inheritance, gene interactions, Gene and Environment, Inheritance of quantitative traits	8
IV	**Mutation Breeding** Mutation breeding, (with suitable examples and achievements). **Male Sterility**: Definition, methods of induction, applications and achievements. **Self-Incompatibility**: Definition, types, mechanisms, methods of induction, applications and examples. Institutes practicing plant breeding in India. (2-3 examples).	8
	Selection Methods of Plant Breeding Concept, procedure, merits, demerits and achievements of Selection, Mass Selection, Pure-line Selection and Clonal Selection.	7
VI	**Hybridization and hybrid seed production** Introduction, concept, objectives, merits and demerits. Techniques of hybridization: Selection and evaluation of parents, emasculation bagging and tagging, pollination, collection and storage of F 1 seeds and growing of F1 generation. Hybridization in cross pollinating crops, development of inbred lines, effect of selfing, single cross and double cross hybrids. Hybridization in self-pollinated crops. Cereals, Pulses, fruits etc.	7
VII	**Heterosis** **Inbreeding and Heterosis**-Definition, types, basis and uses. Inbreeding Depression Hybrid, Synthetic and composite varieties. **Mutation breeding**-Procedure, Precautions, application and achievements. Plant breeding for disease resistance.	8

VIII	**Hybrid seed production of** Maize, Bajra, Jowar, Cotton, Sunflower, Groundnut with respect to following points - Source of seed o Selection of field (Land requirement) o Isolation distance o Sowing o Cultural practices (Fertigation, Irrigation, plant protection) o Rouging o Harvesting and threshing.	7

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
2. बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
3. उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
4. बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
5. कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्स

References

Breeding Asian Field Crops, Fehlman JH, Borthakur D, Oxford and IBH publishing company, New Delhi(1972)

Elementary Basic of plant breeding, Chaudhari HK, Oxford & IBH Publishing Company, New Delhi(1984)

Plant Breeding Principles and Methodology, Singh BD, Kalyani Publishers, New Delhi (2018)

Plant Breeding, Chopra VL, Oxford &IBH Publishing Company, New Delhi(2008) Principles and practices of plant breeding, Sharma JR, Tata McGraw Hill Publishing Company, New Delhi(1994)

Principles and practices of plant breeding, Sharma JR, Tata McGraw Hill Publishing Company, New Delhi (1994)

Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi

Plant breeding-B.D Singh, Kalyani Publishers, New Delhi

Essentials of Plant Breeding- Phundan Singh, 2008

Experimental Seed Science and Technology -Umarani et. al. 2006., Agrobios, Jodhpur

Seed Technology- Agrawal, 2005. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

Principles of crop production-Reddy, 2008. Kalyani Publishers, New Delhi

A text book of Botany- Pandey, 2010. S. Chand and Company Ltd., New Delhi

College Botany- Santra and Chatterjee, 2007., New Central Book Agency (P) Ltd., Kolkata

A Class book of Botany- Dutta, 1983., Oxford University Press, Calcutta

V. L. Chopra, - Plant Breeding Theory and Practices Oxford IBH Pvt.Ltd.

V. L. Chopra, - Plant Breeding Field crops Oxford IBH Pvt. Ltd. New Dehli. 2001

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination//Research Orientation assignment)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 4 from Sector SkillCouncils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities: Smart and Interactive Class, wifi facility
Other Requisites: Videos, Books, CDs, Flora, Access to On-line resources, Display Charts.

Programme/Class: : ***Certificate Course In Seed Morphology and crop improvement***	Year:**I**	Semester: **II** **Paper-II (Practical)**
Subject: **Seed Technology**		
Course Code: **B210202P**	Course Title: **Techniques of cytology and plant breeding**	

Course outcomes: The student will gain knowledge on-

1. Gain knowledge on cytological techniques of fixation ,Staining and mounting
2. Learn about Mendelian principles
3. Gain knowledge on Plant breeding techniques in self and cross pollinated crops
4. Techniques of hybrid seed production.
5. Mitosis and meiosis.

Credits: **2**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Topic	No. of Lectures
I	Experiments on plant identification, Studies on independent assortment. Using seeds of different shapes and colour Seed hardiness Separation and counting of seeds in each class Finding a ratio among different categories Seed structure/tests.	8
II	Mendalian principals and exercise on monohybrid and dihybrid experiments. Exercise on quantitative and qualitative characters. Experiments on methods of crossing (Self Pollination Cross Pollination)	7
III	Cytological techniques for the study of chromosomes in plants Preparation and uses of pretreatment solution (Colchicine, B-HO.PDB) Fixatives Preservatives Stains (Aceto orein, Acetocarmine, Propinocarmine, Feulgen etc.)	8
IV	Study of Mitosis and Meiosis, Study of Somatic Chromosomes in shoot tip and root tip meristems.	7
V	Emasculation, Self-pollination and cross pollination Seed production planning for hybrids and varieties	7
VI	Experiments on selection methods (Pure line selection, Mass selection, and Clonal selection Study of tools and equipment required for plant breeding	8
VII	Demonstration of hybridization techniques in crops (any two suitable crops with self and cross pollination). Wheat, Maize, Rice, Potato, Sugarcane	8

VIII	Computation of areas and seed. Visit of foundation and certified seed plots study of the techniques of seed production	7

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज़ तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्स

1. Breeding Asian Field Crops, Fehlman JH, Borthakur D, Oxford and IBH publishing company, New Delhi (1972)
2. Elementary Basic of plant breeding, Chaudhari HK, Oxford & IBH Publishing Company, New Delhi (1984)
3. Plant Breeding Principles and Methodology, Singh BD, Kalyani Publishers, New Delhi (2018)
4. Plant Breeding, Chopra VL, Oxford &IBH Publishing Company, New Delhi (2008) Principles and practices of plant breeding, Sharma JR, Tata McGraw Hill Publishing Company, New Delhi (1994)
5. Principles and practices of plant breeding, Sharma JR, Tata Mc Graw Hill Publishing Company, New Delhi (1994)
6. Chromosome technique by A Sharma.

This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Ma
Class Interaction	
Field work /Virtual/E-learning /Participation in group discussions	
Industrial or Central laboratory training of two weeks in summer/winter (Compulsory)	

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class

Other Requisites: Microscopes, Stains, Dissection box, , Permanent slides, Autoclave,incubator, Oven, laminar flow cabinet, balance

Suggested equivalent online courses:

Swaym,Swayamprabha etc

https://www.omicsonline.org/journal-plant-genetics-breeding.php
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442525/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7177917/
https://www.mdpi.com/journal/agronomy/sections/crop_breeding_genetics
https://acsess.onlinelibrary.wiley.com/doi/abs/10.2135/cropsci2005.11.0404gas
https://www.researchgate.net/publication/43257381_Improving_Lives_50_Years_of_Crop_Breeding_Genetics_and_Cytology_C-1
https://www.wur.nl/en/Education-Programmes/master/MSc-programmes/MSc-Plant-Sciences/Specialisations-of-Plant-Sciences/Plant-Breeding-and-Genetic-Resources.htm
http://eprints.stiperdharmawacana.ac.id/105/1/%5BGeorge_Acquaah%5D_Principles_of_Plant_Genetics_and_%28BookFi%29.pdf
http://www.fao.org/3/i2388e/i2388e.pdf

Detail Syllabus ofB.Sc.-II Year or Diploma in Seed Physiology and Seed Production

Diploma in Seed Physiology and Seed Production

Diploma in Seed Physiology and Seed Production		
Programme /Class: *Diploma in Seed Physiology and Seed Production*	Year: **II**	Semester: **III** Paper-I
Subject: **Seed Technology**		
Course Code: **B210301T**	Course Title: **Seed Physiology and Biochemistry**	

Course outcomes:

After the completion of the course the students will be able to:

1. The Students should understand the physiological processes involved in seed development.
2. The students should be able to understand the concept, causes and mitigating measures of seed dormancy.
3. The students should be able to understand the process of Seed germination.
4. The students should be aware of the latest technologies used for seeds
5. Learning Outcomes: After the completion of Unit –
6. The Students will be able to: Understand the physiological processes involved in seed development. Understand the biochemistry of seed.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Chemical composition of Seed** Chemical composition of seed. Synthesis of food reserves (carbohydrates, proteins and lipids). Seed vigour, its measurement and crops productivity	7
II	**Physiology of seed development** Physiology of seed development, seed ripening and maturation process, stimulators, inhibitors phenolic compounds, enzymes, hormonal activities, .	8
III	**Seed Dormancy** Concept, types and causes of seed dormancy and its overcoming, improvement of seed germination with chemical treatments and irradiations. Methods of breaking seed dormancy. Advantages and disadvantages of seed dormancy.Seed viability, Seed longevity Seed storage:	8
IV	**Seed Storage** Introduction, types of seed storage, factors affecting, seed deterioration during storage. Methods to minimize seed aging and deterioration	7
V	**Seed Germination** Concept, types and requirements of seed germination, process, factor: affecting seed germination and viability, chemical changes during seed storage and germination,.	8

VI	**Biochemical changes during seed germination** Metabolism of storage product during seed germination, respiratory pathways during seed germination.. Seedling abnormalities and their causes.	7
VII	**Concept of Advance Seed** Seed longevity behavior: orthodox and recalcitrant seed, Seed pelleting and coating (Artificial or synthetic seed production, embryo rescue technique). Micro propagation: techniques, significance, use, scope and limitations.	8
VIII	**Micropropagation** Micro propagation techniques, its significance, uses, scope and limitations. • Biochemical methods, electrophoresis, phenol colour, perxidase test, GA3 test RELP maps.	7

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्स

References-

1. Methods of Breeding, Hayes HK, Immer FR, Smith DC, Mc Graw Hill. Book Co. International, New York (1955)
2. Physiology and Biochemistry and Seed dormancy and Germination, Khan AA, North Holland, Amsterdam
3. Plant Breeding Principles and Methodology, Singh BD, Kalyani Publishers, New Delhi (2018)
4. Principles of Plant Breeding, Allard RW, John Millon and Sons Inc.,New York(1999)
5. Seed Physiology: Development, Murray DR, Academic Press, New York (1985)
6. Seed Science and Technology, Joshi AK, Singh BD, Kalyani Publishers New Delhi (2017)
7. Seed Technology, Agarwal R L, Oxford and IBHJ Publication, New Delhi(1995)
8. 8.Plant Physiology by S N Pandey
9. 9.Plant Physiology by V Verma
10. 10.Plant Physiology and Biochemistry by S K Verma
11. 11.Plant Phsiology by Devlin N Witham,CBS Publisher,N Delhi
12. Plant Physiology by Salisburry and Ross CBS Publications N Delhi

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture,

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination//Research Orientation assignment)	8
	25

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities: Smart and Interactive Class
Other Requisites: : Video collection, Books, CDs, , Access to On-line resources, DisplayCharts.

Suggested online links-
https://medcraveonline.com/APAR/biology-of-seed-development-and-germination-physiology.html
https://www.cambridge.org/core/journals/seed-science-research
https://brill.com/abstract/journals/ijps/29/1-4/article-p133_12.xml
https://www.iari.res.in/
https://icar.org.in/
http://www.du.ac.in/
https://agris.fao.org/agris-search/search.do?recordID=US1997071967
https://www.hzu.edu.in/uploads/2020/10/Handbook-of-Seed-Physiology-Applications-to-Agriculture.pdf
https://www.springer.com/gp/book/9781461446927

Programme/Class: : *Diploma in seed physiology and seed production*	Year: **II**	Semester: **III** **Paper-II (Practical)**
Subject: **Seed Technology**		
Course Code: **B210302P**	Course Title: **Basic experiments of seed physiology and Biochemistry**	
Credits: **2**		**Core Compulsory**
Max. Marks: **25+75**		Min. Passing Marks:

Course Outcome-

After the completion of the course the students will be able to:

1. Understand the role of Physiological and metabolic processes for plant growth and development.
2. Learn the symptoms of Mineral Deficiency in crops and their management.
3. Assimilate Knowledge about Biochemical constitution of plant parts.
4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Topic* *(Perform Any three experiments from each unit as per facility)	No. of Lectures (60Hrs)
I	Experiments on testing the biochemical composition of seed. 1. Total carbohydrate estimation in seed. 2. Total protein estimation of seed. 3. Total nitrogen estimation of seed.	7
II	Seed structure and seed cost in relation to dormancy and hardiness.	8
III	1. Seed viability test. 2. Seed leachate conductivity test 3. Accelerating ageing test.	8
IV	Methods of breaking of dormancy for germination.	7
V	1. Experiments on factors affecting seed germination, temperature, moisture, light, 2. Experiments on membrane permeability, diffusion, osmosis and inhibitors.	7
VI	1. Demonstration of respiration in germinated seedlings using potometer 2. Calculation of respiratory quotient in germinating seeds.	7
VII	1. Experiments on artificial seed production 2. Micro propagation of some valuable crops	8
VIII	1. Immature embryo dissection techniques. 2. Culture medium preparation for the culture of Immature, abortive embryo for rescue	8

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc.Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology.

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Botanical Excursion- compulsory	12
Assignment	8
Total	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class
Other Requisites: : Video collection, Books, CDs, Field visit, Access to On-line resources, Display Charts

Lab Requisites:
Microscopes (Compound, Stereo) Dissection box, stain, Grinder, physiology and biochemistry apparatus and chemicals.

Programme /Class: *Diploma in Seed Physiology and Seed Production*	Year: **II**	Semester: **IV-Paper-I**
Subject: **Seed Technology**		
Course Code: **B210401T**	Course Title: ***Seed Production and Certification***	

Course outcomes:

Key words: Seed Physiology, Seed morphology S d dor y, Seed ge .

After the completion the students will be able to understand the concept of-

1. Seed Physiology and factors affecting quality of seeds.
2. The process of hybrid seed production.
3. The concept and application of genetic purity of varieties.
4. The procedures utilized for seed production
5. The Seed dormancy and its application in seed germination.
6. Certification of seed for future uses.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic -Seed Production and Certification	No. of Lectures (60hrs)
I	**Seed Definition** – Difference between seed and grain. Genetic purity of varieties: concept, factors responsible for their deterioration. Methods of maintenance of genetic purity. System and methods of production of nucleus, breeder, foundation and certified seed	8
II	**Factors affecting seed set** – temperature, relative humidity, day length, wind velocity and directions of flowering, anthesis, pollen viability, stigma receptivity, nutrition and irrigation.	7
III	**Male sterility**, its genetics and use in hybrid seed production. • Self incompatibility – its genetics and use in hybrid seed production. Improvement of pollination and seed production in forage legumes. • Improvement of pollination for hybrid seed production.	7
IV	**Methods of seed production** procedure of major crops with special reference to requirement, isolation, agronomic management, rouging, harvesting and threshing of : Sunflower and Groundnut ,Mung and Soybean, Jowar, Maize, Rice and wheat ,Brinjal and Tomato, Sugarcane	8
V	**Weed characteristic, classification**, crop weed competition, losses benefit and weed control of major kharif and ravi crops.	6

VI	**Seed Certification:** Concept & History – Classes of seed and phases of seed certification. Seed certification agency – its organization. Seed certification standards. -Land requirements and isolation distance. Principles of field inspection.- Techniques of field inspection of seeds production plots of varieties and hybrids of cereals, pulses, oilseeds, forage and fibre crops, potato and vegetables. Inspection at harvesting, threshing processing. Sampling for seed quality evaluation.	9
VII	**Issue of certificates and tags, sealing**. • Testing of genetic purity of seed in grow out test, particularly of cotton. • Revalidation of seed lots. • Interstate seed certification. • New seed policy (1998), Provisional Seed certification. • Seed quality control organization in India. • Composition and function of Central Seed Committee, Central control Sub-Committee on crop standards, Notification and release, Central Seed Certification Board, State Seed Committee. • Management of Seed Certification Programme.	7
VIII	**Seed Certification Internationally; Organization** of Economic Co-operation and Development Seed Certification Schemes. • Future trends in Seed Certification. • Plant variety protection – plant breeder's rights. Seed production organization in India: Agencies responsible for seed production. Indian and International seed industry. • Planning, organizing and managing a seed production programme .National Seed Corporation (NSC) and State Seed Corporation (SSC), any private seed organization and their role in seed industry e.g. MAHICO, MAHABEEJ etc •	8

References

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्स

1. Methods of Breeding, Hayes HK, Immer FR, Smith DC, Mc Graw Hill. Book Co. International, New York (1955)
2. Physiology and Biochemistry and Seed dormancy and Germination, Khan AA, North Holland Amsterdam
3. Plant Breeding Principles and Methodology, Singh B D, Kalyani Publishers, New Delhi (2018)
4. Principles of Plant Breeding, Allard RW, John Millon and SonsInc., New York (1999)
5. Seed Physiology: Development, Murray DR, Academic Press, New York (1985)
6. Seed Science and Technology, Joshi AK, Singh BD, Kalyani Publishers New Delhi (2017)
7. Seed Technology, Agarwal RL, Oxford and IBHJ Publication, New Delhi(1995)
8. Plant Physiology by S N Pandey
9. Plant Physiology by V Verma
10. Plant Physiology and Biochemistry by S K Verma
11. Plant Phsiology by Devlin N Witham, CBS Publisher, N Delhi
12. Plant Physiology by Salisburry and Ross CBS Publications N Delhi

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology,

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Botanical Excursion- compulsory	12
Assignment	8
Total	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities: Smart and Interactive Class, models, charts ,field visit ,farm visit and seminars

Suggested equivalent online resources:

https://ndl.iitkgp.ac.in
https://eorganic.org/node/394
https://www.online.colostate.edu/certificates/seed-technology/
https://agritech.tnau.ac.in/seed_certification/pdf/A%20Manual%20on%20Seed%20Production%20and%20Certification.pdf
https://seednet.gov.in/
https://agricoop.nic.in/en/divisiontype/seeds
https://seedalliance.org/2021-organic-seed-production-online-course/

Programme : *Diploma in Seed Physiology and Production*	Year: II	Semester: IV Paper-II
Subject: **Seed Technology**		
Course Code: **B210402P**	Course Title: **Principle and Techniques of Seed production**	

Course outcomes: After the completion of the course the students will be able to:

1. Know about the commercial products produced from plants.
2. Know about morphology of flowers
3. Gain the knowledge about cultivation practices of some economic crops.
4. Hybrid seed production techniques.
5. Know production techniques of different kind of seeds

Credits: **2**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-2**

Unit	Topic (Perform minimum at least three experiments from each unit)	No. of Lectures (60hrs)
I	Morphology of flower, seed and fruit of common flowering plants. Floral Biology of crop plants as per theory (any five crops belonging to five families)	8
II	Study of pollen morphology. Pollen Fertility test and gametophytes development. Field visits to different seed production farms /units, seed Production Company (At least two visits).	8
III	Emasculation of various crops e.g. Maze, Cotton and Wheat. • Study of pollen grains, morphology, and fertility and in vitro and in vitro germination, pollination, fertilization.	7
IV	Seeds productions practice of cereals, pulses, oilseeds and fiber crops. Visit of nucleus seed plots and study of maintenance of varieties, visit of foundation and certified seed plots and techniques of seed production should be based on the mapping as well as laboratory work on the rock samples collected during the fieldwork.	7
V	Preparation of agro-climatic maps of India for soil, crops and climate conditions.	7
VI	Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices	8
VII	Fertilizers applications raising of nursery of vegetable & spices, vegetable and spices seed extraction. Harvesting & preparation for market. Economics of vegetables and spices cultivation.	8
VIII	Identification and control mechanism of major weeds of different crops with reference to Cereals, Pulses, Oil, Sugar crop of locality..	7

Suggested Readings: ***Course Books published in Hindi may be prescribed by the Universities.***

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्स

Reference books

1-Principles of Seed Technology-Practical Manual by Dr E V Divakara Sastry,Dr.Dhirendra Singh,Dr S S Rajput
2-Seed Technology –A Practical Manualby J K Sharma ,Westville Publishing house
3-Seed Technology by Dhirendra Khare and M S Bhale,Sceintific publishers
4-Seed Technology by Ratan Lal Agrawal,Oxford IBH Publishing Company
5-Principles of Seed Technology by Phundan Singh,Kalyani Publishers

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma,

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts

Lab requisites: Repository of economic products, Microscopes/ Botanical /Herbal Garden, TLC, Spectrophotometer.

Suggested equivalent online courses:

https://ndl.iitkgp.ac.in

DETAIL SYLLABUS OF
B.Sc.-III YEAR
or
BACHELOR OF SCIENCE
(SEED TECHNOLOGY)

BACHELOR OF SCIENCE (B.Sc. (SEED TECHNOLOGY)		
Programme/Class: ***Bachelor of Science***	Year: **III**	Semester: **V** **Paper-I**
Subject: **SEED TECHNOLOGY**		
Course Code: **B210501T**	Course Title- **Seed Pathology and Entomology**	

Course outcomes:

After the completion of the course the students will be able to:

1-Understand the basic concept of pathology.

2-Understand the basic concept of Seed disease management

3-Undestand the storage insect and loss of food grain.

4-Undestand the Integrated Disease Management.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Introduction of Seed Pathology** Introduction of Plant pathology. Symptoms of major plant diseases. History of plant disease. History-objective and importance of seed pathology. Economic significance of epidemic and seed borne disease; seed borne fungi, bacteria, viruses and nematodes,	7
II	**Seed borne diseases and storage fungi** Mechanisms of seed borne disease transmission, factors influencing seed borne diseases transmission, seed treatment, procedures and equipment quarantine for seed, ecological relationship of seed borne micro-organisms, national and international cooperation in seed pathology. Seed borne pathogens *Alternaria*, *Ustilago*. *Colletotrichum.etc*. Control measures of seed borne pathogens	8
III	**Seed health** Seed health Test, Dry seed Examination, Storage fungi and their harmful effect on seeds. Factor affecting storage fungi. Isolation and identification of storage fungi and their control measures.	7
IV	**Toxins affecting seeds** Mycotoxins-Types and effects. Different types of fungal mycotoxins that affect seeds. Factors affecting mycotoxins productions. Detection of mycotoxins. Control measures for mycotoxins.	7
V	**Introduction of Seed Entomology** Definition ,History of insect pest, Relation of insects and plants , Insects as vector of plant diseases Role of insects in seed production ,stages of insect development, ecological factors governing insect development and population buildup, important insect-pests of seed crops, their nature of damage, and management in Rice, Wheat; Chickpea, pigeon pea, peas, mung, mustard and important vegetable crops,.	8

VI	**Importance of Insects in Seed development** Insect pollinations and their role in cross pollinators, Harmful insect of crop plants-Termite, Grasshopper, Rice weevil, Khapra beetle, Lemon butterfly, Mustard aphid etc. Beneficial insect of crop plants-Honey bee, Silk moth, Lac insect etc.	8
VII	**Storage entomology** Definition, Introduction to storage entomology, Pest problem in seed storage, Study of any two storage grain pest with respect to their life cycle, way of infestation/damage, symptoms and control measures. Control of harmful insects .	7
VIII	**Seed Protection** Insecticides. Fumigants and method of fumigation. Insecticidal poisoning and their treatment. Insecticidal machinery-Sprayers, Dusters, Fumigators. Integrated Pest Management. Control of insects by mechanical, physical, chemical and quarantines, Pre harvests sanitation, insect pests of storage and their nature of damage and losses. Types of equipments and their principles. • Safe handling, maintenance and use of machines. • Rodents and their control in field and seed godowns.	8

Suggested Readings:

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन

Other Course Books published in Hindi may be prescribed by the Universities.

Reference Books recommended in English-

1-Handbook of Entomology by T V Prasad,Nrw Vishal Publications
2-Principles of Seed Patgology by V K Agrawal,James B Sinclair,,CRC Press
3- Fundamrntal of Entomology Vol I By Nripendre Laskar,Jay dev Ghosh ,Suprakash palMoulita Chatterjee,Debranjan Chkaborty
4-Seed Pathgology Paul Neelgaard Vol I
5-Elements of Fundamental Entomology by Gajendra Singh,Satpathy S N,Sarkar Kripa,Kalyani Publishers N Delhi
6-Seed Technology and Seed Pathology by Uma Shankar Singh,Anmol Publucations Pvt Ltd.

- Anonmyous, Hand Book of Agriculture, ICAR, New Delhi
- Krishnasamy et al., 2004. Compendium on Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore
- K. P., 2009., A Text Book of Applied Entomology, Kalyani Publishers, Ludhiana
- Dahiya B. S. and Rai K. N. 1997. Seed Technology, Kalyani Publishers, Ludhiana

- Aneja K. R. 2009. Experiments in microbiology, plant pathology and biotechnology, New Age International (P) Limited Publishers.
- Kozlowski, T.T. 1972. Seed Biology, Vol. 1 Academic Press, London.
- Justice, O.L. and L.N. Basu. 1978. Principles and Practices of Seed Storage. Castle HousePublications Ltd, Great Britain.
- Copeland, L .O and McDonald. 1995 . Principles of Seed Science and Technology, Chapman and Hall, New York, USA.
- ISTA . 1999 . Seed Science and Technology , Vol. 27 , Supplement , Rules , International Seed Testing Association , Zurich , Switzerland .
- Seed Health Technology B.P. Singh Mathur & Upadhyaya Paul - Near Guard
- Seed processing Billy R. Greeg. Alvin. G. Lavv'S.S. Virde and .l.S. Balis. Published by National S~eds Corporation. Nev,,' Delhi and \1ississippi State University. and USAID.
- Post Harvest Tl.' chnology of Cereals, Pulses and Oil Seeds.: A. Chakravarty \
- Hand Book of Agriculture::. Indian council of Agricultural Research. Krishi B.havan. New Delhi.
- Farm Power and Machinery Management, Hunt. D. 1986. Vth edition. IOWA State. U.S.A.

Farm .management Decision. Operation, Control. John E Kadlee, Prentice Hall, Inc Englewood, Chill's, New Jersey, U.S.A.

Agricultural Marketing in India. S.S. Acharya. Oxford and 1.,8.1-1.. Publisher New Delhi.

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment andClass Tests

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector SkillCouncils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://ndl.iitkgp.ac.in

https://libguides.utk.edu/c.php?g=188546&p=1246067

https://www.entsoc.org/resources/education/online-courses

https://sites.google.com/a/uasd.in/ecourse/plant-pathology

http://www.fao.org/3/i3253e/i3253e.pdf

http://www.unishivaji.ac.in/syllabus/science/BSc/Bsc-III/BSc%20III%20Seed%20Tech%202010_NP_2299078.pdf

https://www.iari.res.in/

Programme/Class: *Bachelor of Science*	Year: **III**	Semester: **V** **Paper-II**
Subject: **SEED TECHNOLOGY**		
Course Code: **B210502T**	Course Title: **Seed Processing, Storage and Legislations**	

Course outcomes:

1. To learn about the concepts and significance of seed quality control.
2. To know about various aspects related to seed certification and seed legislation.
3. To have the knowledge of national and international seed quality control organizations and seed certification agencies.

Credits: **4**	**CC / Elective**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Place and importance of seed** processing pathway of seed improvement. Concept and objectives of seed processing, physical characteristics used to separate seeds, basic flow pattern in seed processing	7
II	**Preparing Seed for Processing**: The scalper, the debearder, the scarifer maize, sheller licensing of machines. Seed Drying: importance and advantages of seed drainage, moisture content recalcitromit / orthodox and methods of seed moisture measurement theory of seed moisture measurement, theory of seed drying, methods of seed drying (wet dry seeds), and advantage of mechanical drying over sun drying equipment, dehumidification and drying of heat sensitive seeds, relative humidity and equilibrium moisture contents of seeds.	7
III	**Cleaner cum grader** The air screen cleaner cum grader, vibrating action on a seed separating screen, penetration and cetention of seeds on a screen, selection of screen for seed separation, adjustment of air screen cleaners for improved efficiency, cleaning of air seed cleaning machines	8
IV	**Seperators** Indented disc and indented cylinder separator, construction and operation of intended disc separator, construction and operation of indented cylinder separators, adjustments of indented disc and indented cylinder separators Specific gravity separation: Parts of the machine, stratification and separation of seeds on the separating deck, adjustments of specific gravity separators, starting and operating acquiesces, separation problems and their rectification, recleaning the middling product. The stoner, aspirators and pneumatic separator	7
V	**Surface texture separation:** The roll mill, parts of the machine, separating action and the adjustments, cleaning roll mills. Affinity for liquid separation, the magnetic separators, the separating action. Quality control and measurement of machine performance in seed processing plants, indicate of machine performance, sampling of product of reject from seed handling machines, seed blending. Electronic cocowi sortex working principal.	8

VI	**Seed Treatment:** Seed treatment equipment, slurry seed treater, mist-o-matic seed treater, Labeling of treated seeds and related precautions, storage of treated seeds, machine operators and seed users safety. Site selection for seed processing plant on a seed production farm, layout of machines in a seed processing plant.	8
VII	**Packaging and marketing** seeds, bagger, weigher, bag closing, portable and conveyor type bag closers, leveling and maintaining lot identity, lot numbers, seed pellets, handling and stacking, maintenance of seed processing records. Seed storage structure: Construction, operation and maintenance, insulation, storage aeration, air conditioning, dehumidification and stacking, moisture and heat roofing of seed storage structures, seed storage management	7
VIII	**Seed Legislation** • Seed legislation, seed certification. • Indian Seeds Act, Seed Rules and Seed Order. • Seed Inspector – Qualifications duties and responsibilities.	8

Suggested Readings:

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन

Other Course Books published in Hindi may be prescribed by the Universities.

Principles os Seed Technology by Phundan Singh
Seed Technology by Agrawal R L ,Oxford IBH Publishing Co.Pvt Ltd
Seed Handbook Processiung and Storage by Babasaheb B Desai
Advances in seed Production and Management by Tiwari Ajay Kumar
Principla and Practices of Seed Storage By Oren L. Justice and Louis N. Bass

Handbook of Agriculture- Indian Council of Agricultural Research, New Delhi
- Umaraniet. al. 2006. Experimental Seed Science and Technology, Agrobios, Jodhpur
- Singh, 2009. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi
- Agrawal, 2005. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
- Reddy, 2008. Principles of crop production. Kalyani Publishers, New Delhi
- Pandey, 2010. A text book of Botany. S. Chand and Company Ltd., New Delhi
- Santra and Chatterjee, 2007. College Botany, New Central Book Agency (P) Ltd., Kolkata
- Dutta, 1983. A Class book of Botany, Oxford University Press, Calcutta.

This course can be opted as an elective by the students of following subjects:
Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech)
Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:
https://ndl.iitkgp.ac.in
https://www.carolinafarmstewards.org/wp-content/uploads/2012/05/SeedProcessingandStorageVer_1pt3.pdf
https://annamalaiuniversity.ac.in/studport/download/agri/gen/resources/SST%20623%20SEED%20PROCESSING%20AND%20STORAGE.pdf
https://eorganic.org/node/392
https://www.cicr.org.in/pdf/legislation_seed_quality.pdf
http://seednet.gov.in/material/prog-schemes.htm
https://agritech.tnau.ac.in/seed/seedconcepts.html
https://agritech.tnau.ac.in/seed_certification/pdf/A%20Manual%20on%20Seed%20Production%20and%20Certification.pdf
https://aggie-horticulture.tamu.edu/faculty/davies/pdf%20stuff/ph%20final%20galley/Chap%206%20-%20M06_DAVI4493_08_SE_C06.pdf

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Programme /Class: *Bachelor of Science*	Year:	Semester: V **Paper-III**
Subject: **SEED TECHNOLOGY**		
Course Code: **B210503P**	Course Title: ***Studies on Major Diseases of Crop plants***	

Course outcomes:

After the completion of the course the students will be able to:

1. Understand the identification of seed pathogen and mechanism to control them.
2. Understanding of entomology will help to protect crop as well as food grain.
3. Understand the harmful effect of chemicals on human as well as on biodiversity.

Credits: 2	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week) **0-0-2**

Unit	Topic* *(Perform any three from each unit based on facility)*	No. of Lectures (60hrs)
I	Experiments based on identification of seed pathology. Disease cycle of few diseases caused by Bacteria, Viruses, Fungi, Nematodes. Characters of important seed borne pathogens. (Any five)	8
II	Examination of suspensions obtained from washings of seed,Viability test- space germination test and tetrazolium test. Infection sites studied by planting seed components	8
III	Detection of important seed borne fungi-various detection methods Detection of important seed borne bacteria- various methods. Detection of important seed borne viruses-various methods.	8
IV	Studies on disease cycle of few common crop diseases of local crops. For example-Wheat, Maize. Rice, Gram, Pea, Castor, barley etc.	8
V	Exercise based on nematology, Identification, reproductive cycle and control measures External morphology of insect, type of mouth-parts antenna & legs. Identification of important storage and dry fruit pests and their control. Detection of seed borne insects.	7
VI	Few experiments on ecofriendly or bio control of seed pathogen for example Seed Fungi, Insects etc.	7
VII	Fumigation-principle and practical application. Types of insecticide formulations, their preparation & safe use.	7

VIII	Plant protection equipments, their safe handling & use. Collection and submission of stored product pests. Visits to warehouse & godowns and market.	7

Suggested Readings:

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन

1. Neergaard – Seed Pathology vol.I & II.
2. Agarwal.V.E. & Sincelair, J.B.-Principles of seed pathology Vol.I & II.
3. K.A. Jeffs-Seed treatment.
4. C.J. Alexopoulus – Introductory mycology.
5. J.P.Shrivastava – An Introduction to fungi.
6. R.W. Marsh – Systemic Fungicides.
7. Y.L.Nene & M.J. Thapliyal –Fungicides in plant disease control.
8. Mary Noble & M.J. Richardson – An annolated list of see borne diseases.
9. S.C. Vyas –Systematic Fungicides.
10. Metcalf & Flint –Desructive & useful Insects.
11. J.B. Free – Insect pollination of field crops.
12. A.S. Atwal – Agricultural Entomology.
13. D.S. Bindra- Plant Protection and equipments.
14. Billy R. Gregg, Alvin G.Law,S.S. Virde,J.S. Balis-Seed Processing.
15. S.M. Henderson & R. Perry –Agricultural process Engineering.
16. Carl W. Hall – Drying Farm crops.
17. A Chakravarty- Post Harvest Technology & cereals ,pulses & oil seeds.
18. Waren L. Melabe,Julien C. Smith & Peter Harviot – Unit operation in chemical engineering.
19. ICAR – Handbook of Agriculture.
20. Hunt D. – Farm power & machinery management.
21. John E. Kadlec – Farm management, decision operation control.
22. Michael D. Boehlje & Verman R. Eidman –Farm management.
23. S.S. Johl & T.R. Kator – Fundamentals of farm management.
24. A.S. Kahlona Karam Singh – Economics of farm management in India.
25. V.T. Raju & D.V. Rao – Economics of Farm production & management.
26. S.S. Acharya – Agricultural marketing in India.
27. Prem Singh and Arya – Vegetable breeding and seed production; Kalyani Publ. Ludhiana.

This course can be opted as an elective by the students of following subjects:
Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ /Gardening)

Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts
Lab requisites: Electrophoresis units, Gelrocker, UV-transilluminator, Vortex Mixer, Shaker, CVT, HiMedia Biotechnology &Molecular biology Kits/Chemicals, Micropipettes, Elisa reader/Microtitre Reader

Suggested equivalent online courses:

https://ndl.iitkgp.ac.in
https://www.apsnet.org/edcenter/resources/commonnames
https://www.apsnet.org/edcenter/disimpactmngmnt/casestudies/Pages/PlantDiseaseDiagnosis.aspx
https://www.agric.wa.gov.au/pests-weeds-diseases/diseases/crop-diseases
https://www.britannica.com/science/plant-disease
https://www.iihr.res.in/division-crop-protection
https://ausveg.com.au/biosecurity-agrichemical/crop-protection/overview-pests-diseases-disorders/fungal-diseases/
https://www.planetnatural.com/pest-problem-solver/plant-disease/

Programme/Class: **Bachelor of Science**	Year: **III**	Semester: V / **Project-II/ Paper-IV**
Subject: **Seed Technology**		
Course Code: **- B201504R**	Course Title: **Project in Seed Technol g / or Pre-graduation**	

Course outcomes:

- Project work will supplement field experimental learning and deviations from cl s om and laboratory transactions.
- project work will enhance the capability to apply gained knowledge and understanding o cting, solving and decision-making processes.
- It will promote creativity and the spirit of enquiry in learners.
- They will learn to consult Scientists, libraries, laboratories and herbariums and learn im ce of discussions, Botanical & field trips, print and electronic media, internet etc. along with data docu ation, compilation, analysis & representation in form of dissertation writing.
- It will enhance their abilities, enthusiasm, and interest.

Credits: **03**	Cor mpulsory
Max. Marks: **25+75**	Min. Passing arks: .....

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-3**.

Suggestive List Of PROJECTS

1. Rural Areas: Flora of a city/ village, Biodiversity of Village, Soil & seed testing service provision to farmers,
2. Industrial waste management
3. Plant Disease identification in farms, nurseries and orchards.
4. Science Communication by Creating science documentaries of innovators, Internet Science (Social media, Websites, Blogs, You tube, Podcast etc.)
5. Science Outreach Talks and Public Sensitization for plant Disease Management.
6. Photochemistry of medicinal plants & their antimicrobial, nutraceutical and antioxidant properties
7. Study of pollen grains in different flowers
8. Plant disease cycle and management of Fungal, Bacterial and Viral Diseases.
9. Aware to farmers for good quality seed production
10. Survey of plant disease cycle study.
11. Project on organic farming.
12. Modern tools and techniques in seed technology
13. Etc

Refer: libraries, journals, Memoirs, encyclopedias', herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects: **Open to all**

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Seminar	10
Thesis/dissertation	10
	25

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.
Facilities: Smart and Interactive Class,computational facilities,Farm field

- बीज प्रौधोगि मजबकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्
- Neergaard – Seed Pathology vol.I & II.
- Agarwal.V.E. & Sincelair, J.B.-Principles of seed pathology Vol.I & II.
- K.A. Jeffs-Seed treatment.
- C.J. Alexopoulus – Introductory mycology.
- J.P.Shrivastava – An Introduction to fungi.
- R.W. Marsh – Systemic Fungicides.
- Y.L.Nene & M.J. Thapliyal –Fungicides in plant disease control.
- Mary Noble & M.J. Richardson – An annolated list of see borne diseases.
- S.C. Vyas –Systematic Fungicides.
- Metcalf & Flint –Desructive & useful Insects.
- J.B. Free – Insect pollination of field crops.
- A.S. Atwal – Agricultural Entomology.
- D.S. Bindra- Plant Protection and equipments.
- Billy R. Gregg, Alvin G.Law,S.S. Virde,J.S. Balis-Seed Processing.
- S.M. Henderson & R. Perry –Agricultural process Engineering.
- Carl W. Hall – Drying Farm crops.
- A Chakravarty- Post Harvest Technology & cereals ,pulses & oil seeds.
- Waren L. Melabe,Julien C. Smith & Peter Harviot – Unit operation in chemical engineering.
- ICAR – Handbook of Agriculture.
- Hunt D. – Farm power & machinery management.
- John E. Kadlec – Farm management, decision operation control.
- Michael D. Boehlje & Verman R. Eidman –Farm management.
- S.S. Johl & T.R. Kator – Fundamentals of farm management.
- A.S. Kahlona Karam Singh – Economics of farm management in India.
- V.T. Raju & D.V. Rao – Economics of Farm production & management.
- S.S. Acharya – Agricultural marketing in India.
- Prem Singh and Arya – Vegetable breeding and seed production; Kalyani Publ. Ludhiana.

Programme/Class: *Bachelor of Science*	Year: **III**	Semester: **VI** **Paper-I**
Subject: **Seed Technology**		
Course Code: **B210601T**	Course Title: **Biotechnology and Seed Development**	

Course outcomes: After the completion of the course the students will be able:

1. Acquire knowledge on ultrastructure of cell.
2. Understand the structure and chemical composition of chromatin and concept of cell division.
3. Understand the concept of 'one gene one enzyme hypothesis' along with molecular mechanism of mutation.
4. Genetic engineering and crop improvement with respect to quality and quantity of produce.
5. Production of GMO plants.
6. Understanding of National and International laws regarding seed science.

Credits: **4**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60hrs)
I	**Introduction to Biotechnology** Definition, Branches, scope Experimental techniques in Biotechnology, Electrophoresis, PCR ,.SDS-PAGE ,.RFLP ,.RAPDs ,. DNA finger printing ,. ELISA. and Importance in Agriculture and food production	8
II	**Methods of gene cloning** –in vivo gene cloning - vectors used in gene cloning (Plasmid vectors, lamda (λ) phage vectors, cosmids and expression vectors), selection of vectors. DNA polymorphism, Use of various enzymes in recombinant DNA technology	7
III	**Techniques in restriction mapping**, Southern, Northern, Western, Blotting techniques and applications	8
IV	**Technique of Micro propagation** in development of crop plants . Tissue culture in Banana , Anther culture , Embryo culture ,. Cybrids , hybrids seeds and Synthetic seeds and its applications	7
V	GMO and Transgenics e.g. Bt cotton and Golden Rice, technique and applications	8
VI	**Organic farming**-Development and Procedures of certification. Scope of Organic farming in present context.	7
VII	**Intellectual Property Rights (IPR)** a. Introduction b. History c. Intellectual Property d. Protection of IPR (Trade secrets, Patents, and copyright.) e. Plant Breeder's Rights	8
VIII	**Biotechnology in welfare of humanity** as a mean off food security. Conservation of genetic diversity. World trade organization, Introduction to ICAR and IARI.	7

Suggested Readings:

- बीज प्रौधोगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लीकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लीकेशन्स
- बीज प्रौधोगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लीकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लीकेशन्

Other Course Books published in Hindi may be prescribed by the Universities.

1. Cell Biology And Genetics (Hindi) 2/e PB Gupta P K (Hindi) rastogi Publications
2. P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
3. PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas University
4. Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 9788177544732Edition : 03Year : 2018Author : Dr. Purohit SS , Mathur S
5. Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani PubishersISBN: 9789327246070, 9327246071
6. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #:978-81-301-0066-1SunilD Purohit & Gotam K Kukda, Apex Publishing House
7. Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House
8. Padap Prajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shukl (Author)Pointer Publishers, Jaipur
9. PLANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI
10. Introduction to plant biotechnology ,Chawla HC (2004) (Science Publ) Plant pigments and their manipulation ,Davies K (Ed) (2004) – Annual plant revies, vol 14 (Blackwell Publ)
11. Plant Biotechnology and agriculture. Prospects for the 21st century (Academic press). Altman A, Hasegawa PM (Ed) (2012)
12. Plant Tissue Culture: Theory & Practice (Elsevier) . Bhojwani SS. &Razdan MK 1996
13. Biocatalysis and agricultural biotechnology (CRC Press) Hou CT, Shaw JF (2009)
14. Plant Biotechnology: the genetic manipulation of plants (Oxford Press) . Slater A, Scott NW, Fowler MR (2008)

15. Fungal Biotechnology (IK International) Rai M (2009)
16. Plant cell and tissue culture (Springer) Vasil IK, Thorpe TA (1994)
17. Textbook of Biotechnology ,,by H K Das 4th edition
18. M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird & IBH Publishing Co.Pvt. Ltd.,New Delhi
19. H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.Sc. Food Science,

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Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course pre-requisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/Math/Statistics/Chemistry/ Computer Science)
Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:
https://www.cytology-iac.org/educational-resources/virtual-slide-library
http://sbc.ucdavis.edu/
http://sbc.ucdavis.edu/About_US/Seed_Biotechnologies/?sitemap=yes
http://www.fao.org/3/y2722e/y2722e1f.htm
https://www.isaaa.org/resources/publications/agricultural_biotechnology/download/Agricultural_Biotechnology.pdf
https://www.usda.gov/topics/biotechnology/biotechnology-frequently-asked-questions-faqs
https://www.annualreviews.org/doi/full/10.1146/annurev.energy.31.031405.091314
https://www.birac.nic.in/seedFund.php
https://www.oecd.org/chemicalsafety/biotrack/biotech-update-issue-39-june-2021.pdf
https://www.upov.int/edocs/pubdocs/en/upov_pub_354.pdf

Further Suggestions:
Access to Statistics, Chemistry, Math and Biotechnology resources will be required

Programme/Class: **Bachelor of Science**	Year: III	S er: VI Pa II
Subject: **Seed Technology**		
Course Code: **B201602T**	Course Title: **Seed Farm Manageme.it d Marketing**	

Course outcomes:

1. Farm management to increase productivity.
2. Proper utilization of natural resourses.
3. Entrepreneurship development among students.
4. Use of machinery and proper management will increase the ec nic standard of f ners.

Credits: **4**	**Core Cor ory/Elective**
Max. Marks: **25+75**	Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**	

Unit	Topic	No. of Lectures (60 hrs)
I	Introduction of Farm management, scope, basic principles in farm management, decision making operation and control.	7
II	Decision Making Approach: Decision making based on production, cost and conical investment, cost analysis, law of diminishing return, opportunity cost, cost profitable combination of inputs and outputs.	8
III	Planning & Management of Crops, Building and Machinery: Concepts pertaining to various crops production operations viz village, irrigation, sowing, plant protection, harvesting and threshing, maintenance of soil fertility, weeds and their control, mixed cropping, multiple cropping and dry land farming.	7
I V	Machinery selection and their management, determination of field's capacity and field efficiency, machinery adjustments. Consideration in farm buildings, implement shed, storage, structure	7
V	Farm Business Analysis: Analysis: Field sice, factors affecting profit and economic size of farm. Budget and record keeping. Farm budgeting, procedures and uses. Farm efficiency measures, farm records and their uses	7
VI	Farm planning, Construction of in farm buildings, implement shed, strong structures. 3.2. Farm business analysis, farm size, factors affecting profit and economic size of farm. 3.3. Farm budgeting procedure and uses, farm efficiency measures, farm records & their uses. 3.4. Farm surveys, data collection & analysis. 3.5. Acquisition & management of land labour & capital.	8

VII	Marketing- Basic concepts, supply & demand, price equilibrium, seed transportation, storage, cost & returns, cost processing, packing and marketing, Organization for seed marketing, seed markets in India, structure & working.	8
VIII	Seed market surveys, seed industry in relation to global market, concept of WTO, GATT, IPR, PBR.. Projections of supply and demand for different kinds of seeds in India – seed pricing Breeder / Foundation / Certified Seeds	8

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Chart

Suggested equivalent online books:

https://ndl.iitkgp.ac.in
http://www.fao.org/3/ca1494en/CA1494EN.pdf
https://www.britannica.com/topic/farm-management
http://eagri.org/eagri50/GPBR112/pdf/lec31.pdf
http://www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/Study[illegible]Mater[illegible]Econ1[illegible]M.pdf
https://eos.com/blog/farm-management-software-is-a-key-to-successful-farming/
https://www.manage.gov.in/publications/farmerbook.pdf
https://www.mdpi.com/2073-4395/10/2/207/pdf
https://www.farmmarketid.com/marketing-to-farmers/
https://agritech.tnau.ac.in/

Programme/Class: *Bachelor of Science*	Year: **III**	Semester: **VI** **Paper-III**
Subject-Seed Technology		
Course Code: **B210603P**	Course Title: **Experiments on Biotechnology for Seed Development and Farm Management**	

Course outcomes: After the completion of the course the students will be able:

1. To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding on field, conserving and depolluting the environment.
2. Can be employed in environment impact assessment companies & start his own venture

Credits: **2**	**Core Compulsory**
Max. Marks: **25+75**	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): 0-**0-2**

Unit	Topic	No. of Lectures(60hrs)
I	Isolation of plant genomic . Peroxidase isozyme profiling for varietal identification. Restriction digestion of DNA.	7
II	Vectors of Genetic engineering-Plasmid,(Ti plasmid, Ri plasmid), Lambda Phage, Cosmid, Phasmid etc.	8
III	Separation and detection of specific proteins using Western blotting Demonstration of PCR facility and DNA fingerprints (Photographs)	7
IV	Preparation of culture media. (1P) Sterilization of media and glassware. Inoculation and culture of explants.	8
V	Micro propagation of Banana. Collection and filling of application forms for patent filing Isolation and culture of Protoplast.	8
VI	Study of seed –pre-cleaner, maize sheller & dehusker. Study of air screen cleaner cum grader. , Study of magnetic separator. Study of specific gravity separator. Study of seed treatment machines. Study of seed packaging equipment. Study of bucket elevator, screw conveyers and pneumatic elevators. Measuring performance of seed processing machines.	8
VII	Study of threshing machine and its use. Determination of field capacity & field efficiency. Soil sampling for fertility & moisture content.	7
VIII	Study of farm implements viz. Weeders, hoes, harrow. Cost analysis. .Farm planning & budgeting. , Record keeping. ,Visit to a seed processing & storage complex and familiarization with different machines	7

Suggested Readings: as in papers above:

Course Books published in Hindi may be prescribed by the Universities.

Application of Biotechnology in Agriculture

History, scope and development of Biotechnology by Saurabh Bhatia

Practical Biotechnology by H N Th .Supr Das and gat K mar

Biotechnology by R C Dubey

Biotechnology By B D Singh

Biotechnology by P G Gupta

Biotechnology by R P Singh

Farm management and Resource Economics by Dtr E David Chella Baskar ,Dr S Usha Nandhini

Modern technique of Farm Management edited by Anil Kumar Poonam Kashyap Chandra Bhanu Sanjeev Kumar A.S. Panwa, ICAR-Indian Institute of Farming Systems Research Modipuram, Meerut - 250 110 (U.P.), India

Farm Managrment by By Ronald Kay and William Edwards and Patricia Duffy

Course pre-requisites:

To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display ChartsLab requisites: Biotech instruments, environmental lab instruments.

Suggested equivalent online books:

https://ndl.iitkgp.ac.in

https://www.isaaa.org/resources/publications/agricultural_biotechnology/download/Agricultural_Biotechnology.pdf

https://www.mdpi.com/2073-4395/10/2/207/pdf

http://www.fao.org/3/y2722e/y2722e1f.htm

https://www.annualreviews.org/doi/full/10.1146/annurev.energy.31.031405.091314

https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-34581998000300004&lng=pt&nrm

http://sbc.ucdavis.edu/

https://agricoop.nic.in/en/divisiontype/seeds

http://www.youtube.com/watch?v=IY3mfgbe-0c

https://www.ncbi.nlm.nih.gov/books/NBK217989/

https://www.storey.com/books/whole-farm-management/

http://repositorio.iica.int/bitstream/11324/6794/1/BVE18039980i.pdf

http://nsdl.niscair.res.in/jspui/bitstream/123456789/649/1/edited%20Farm%20managment.pdf

https://www.manage.gov.in/publications/farmerbook.pdf

https://krishi.icar.gov.in/jspui/bitstream/123456789/25682/1/Farm%20Management%20Book.pdf

Further Suggestions: Access to Statistics, Chemistry, Math and Biotechnology resources will be required

Programme/Class: **Bachelor of Science**	Year: **III**	Semester: **VI /Project-II/ Paper-IV**

Subject: **Seed Technology**

Course Code: - **B210604R**	Course Title: **Project in Seed Technology for Graduation**

Course outcomes:

After completing this course a student will have:

- Project work will supplement field experimental learning and de tions from classroom ar oratory transactions.
- project work will enhance the capability to apply gained knowle nd understanding f r cting, solving and decision-making processes.
- It will promote creativity and the spirit of enquiry in learners.
- They will learn to consult Scientists, libraries, laboratories and indus ips along with documentation, compilation, analysis & representation in form of dissertation writing.
- It will enhance their abilities, enthusiasm, and interest.

Credits: **03**	Core: **Compulsory**
Max. Marks: **25+75**	Min. Passing Marks: .....

Total No. of Lectures-Tutorials-Practical (in hours per week): **0-0-3**.

SUGGESTIVE LIST OF PROJECTS

Prepare beds for growing nursery for herbs, shrubs and trees.
Develop Green house facility in college and grow plants Develop hydroponics facility in college and grow plants.
Develop botanical garden in the college with labelling
Vertical gardens, roof gardens.
Culture & art of making bonsai.
Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer Aided Designing)
Phytochemical Analysis of Medicinal plants
Bio composting and Vermicomposting.
Performing Aromatherapy by essential Oils
Ecofriendly management of Diseases
Farm management and productivity for different crops
Breeding techniques for different crops.

Refer: libraries, journals, Memoirs, encyclopedias', herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects:

This course can be opted as an elective by the students of following subjects: Open to all

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 fromSector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: All listed under all papers of the course.

Suggested equivalent online courses:

https://tnau.ac.in/seed-centre/research-projects/
https://www.uasbangalore.edu.in/index.php/farm-trials/80-research/103-seeds-2
http://www.jau.in/coa/index.php/department/seed-science-and-technology
http://www.aau.ac.in/colleges/departments/college-of-agriculture/seed-science-and-technology-programme/about/1/114
https://www.ubkv.ac.in/seed-technology-and-plant-physiology/
https://www.iht.edu.in/post-graduate-diploma-in-seed-nursery-and-quality-planting-material-production/

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RAJEEV KUMAR
Digitally Signed By: Registrar

http://www.vspuniversity.ac.in/sst/index.html
https://www.cimmyt.org/news/hands-on-experience-in-seed-production/
http://agriculture.ku.ac.ke/index.php/academic-programs/graduate/93-programmes/postgraduate-programmes/168-master-of-science-seed-technology-and-trade
https://www.crops.org/membership/divisions/c04
https://reeis.usda.gov/web/crisprojectpages/0007964-seed-testing.html

Continuous Internal assessment

Internal Assessment	Marks
Class interaction	05
Thesis/Dissertation	10
Seminar	10
Total	25