

**DEPARTMENT OF HIGHER EDUCATION
U.P. GOVERNMENT,
LUCKNOW**

**National Education Policy-2020
Common Minimum Syllabus
For all U.P. State Universities and
Colleges For the first three years of
Higher Education (UG)**



**PROPOSED STRUCTURE OF SYLLABUS
SEED TECHNOLOGY
(*FACULTY OF SCIENCE*)**



National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities/ Colleges
SUBJECT: SEED TECHNOLOGY

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Syllabus Developed by:

S.No.	Name	Designation	Department	College/University
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2.	Dr. Pankaj Kumar	Associate Professor	Department of Botany	U P College, (Autonomous) Varanasi (<i>M G K V P University, Varanasi</i>)
3.	Dr. Shyam Babu Verma	Assistant Professor	Department of Genetics and Plant Breeding	U P College, (Autonomous) Varanasi (<i>M G K V P University, Varanasi</i>)

Semester-wise Titles of the Papers in B.Sc. (Seed Technology)					
Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits
<i>Certificate Course In Seed Morphology and Crop improvement</i>					
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
<i>Diploma in Seed Physiology and Seed Production</i>					
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
<i>Bachelor of Science</i>					
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

SYLLABUS DEVELOPED BY

S. N	Name & email	Designation	Department	College/ University
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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 tools and 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	Credi t/ hrs	Paper 2	Credit/ hrs	Paper 3	Credit s/hrs	Research Project	Credit/ hrs	Total Credits /hrs/
<i>Certificate Course in Seed Morphology & Crop Improvement</i>	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
<i>Diploma in Seed Physiology and Seed Production</i>	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
<i>Bachelor of Science</i>	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	*Proje ct-I	3/45	13/205
		VI	Biotechnology and seed development	4/60	Seed Farm Managemen t and entrepreneu rship	4/60	Experiments on biotechnology for seed development and farm management	2/60	*Proje ct- 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.

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 training Is 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: <i>Certificate Course In Seed Morphology and Crop Improvement</i>		Year: I Semester: I/Paper-I
Subject: Seed Technology		
Course Code: B210101T	Course Title: Seed Morphology and Development	
<p>Course outcomes: After the completion of the course the students will be able to:</p> <ol style="list-style-type: none"> 1. Student should be able to understand the concept of seed technology. 2. Student should be able to identify seeds identification based on morphological characters. 3. Student should get knowledge about reproduction in plants, seed structure and development. 4. Understanding the theoretical orientation of seed development. 5. Familiarization with Seed Technology and morphology of seed and its development. <p>Key words: Seed Technology Seed morphology and Seed development.</p>		
		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	<p>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).</p> <p>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.</p>	8
II	<p>Important Crop Families Classification of crops (based on season, lifecycle, uses), Major crops families belonging to the Dicotyledons and Monocotyledons. Fabaceae-(<i>Phaseolus</i>, <i>Glycine</i>) Brassicaceae-(<i>Brassica</i>, <i>Raphanus</i>), Solanaceae-(Brinjal, Tomato), Poaceae -(Jowar, Maize).</p>	8
III	<p>Reproductive Biology Structure of Dicotyledonous and Monocotyledonous flowers- Unisexual (Cucurbits and Maize) and Bisexual (Beans and Jowar); Monoecious, Dioecious Plants.</p>	7
IV	<p>Mode of reproduction in plants – (a). Asexual. (b). Sexual Reproduction. (c). Flower Structure, Placentation & Types of Ovules... Effect of environmental factors on floral biology.</p>	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: **Basics of Seed Morphology and Development**

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

1. Understand the instruments, techniques, lab etiquettes and good lab practices for seed identification.
2. Practical skills in the field and laboratory experiments in seed technology.
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 Compulsory

Max. Marks: **25+75**

Min. Passing 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, castor, pea, cucurbits, mustard and capsicum (<i>Phaseolus</i> , <i>Glycine</i> , <i>Brassica</i> , <i>Raphanus</i>), 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 differences. (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 belonging to different 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 Skill Councils / 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: <ol style="list-style-type: none"> 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.

Suggested Readings:

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

1. बीज प्रौद्योगिकी . राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
2. बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
3. उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
4. बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
5. कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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 Skill Councils / 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: : <i>Certificate Course In Seed Morphology and crop improvement</i>	Year: I	Semester: II Paper-II (Practical)
Subject: Seed Technology		
Course Code: B210202P	Course Title: Techniques of cytology and plant breeding	
<p>Course outcomes: The student will gain knowledge on-</p> <ol style="list-style-type: none"> 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 hardness 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
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Suggested Readings:

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

- बीज प्रौद्योगिकी . राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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	Marks
Class Interaction	6
Field work /Virtual/E-learning /Participation in group discussions	7
Industrial or Central laboratory training of two weeks in summer/winter (Compulsory)	12
	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: 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

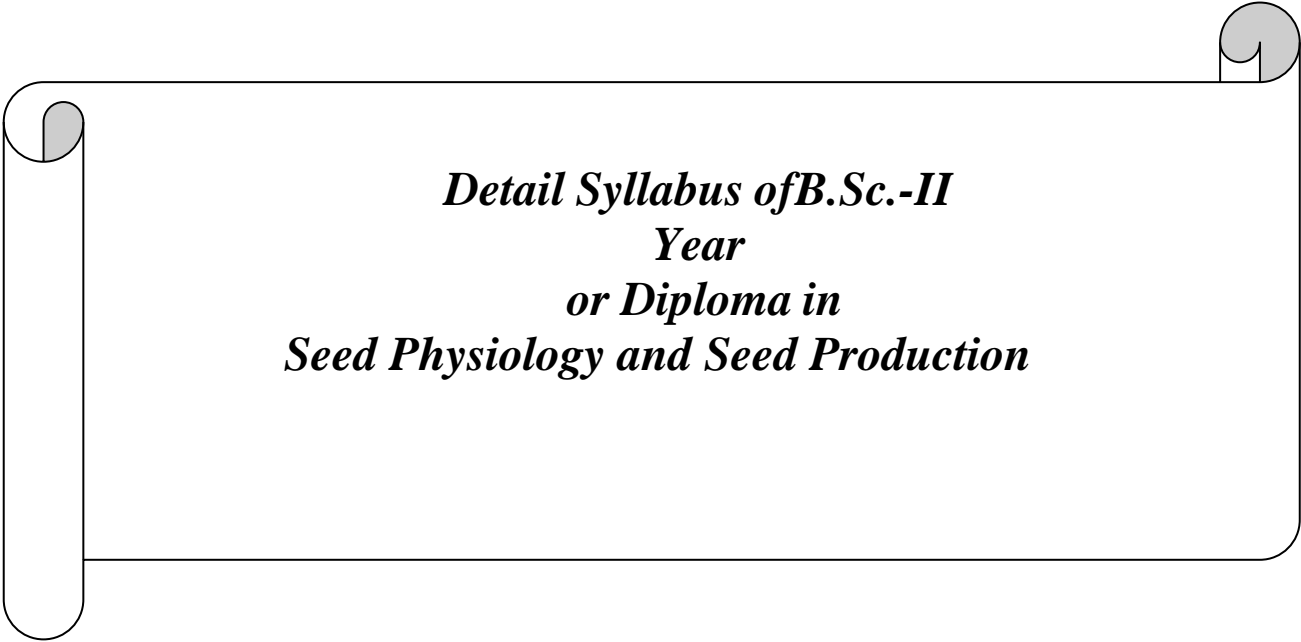
<https://access.onlinelibrary.wiley.com/doi/abs/10.2135/cropsci2005.11.0404gas>

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.stiperdarmawacana.ac.id/105/1/%5BGeorge_Acquaah%5D_Principles_of_Plant_Genetics_and_%28BookFi%29.pdf

<http://www.fao.org/3/i2388e/i2388e.pdf>

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***Detail Syllabus of B.Sc.-II
Year
or Diploma in
Seed Physiology and Seed Production***

Diploma in Seed Physiology and Seed Production

<i>Diploma in Seed Physiology and Seed Production</i>		
Programme /Class: <i>Diploma in Seed Physiology and Seed Production</i>	Year: II	Semester: III Paper-I
Subject: Seed Technology		
Course Code: B210301T	Course Title: Seed Physiology and Biochemistry	
<p>Course outcomes: After the completion of the course the students will be able to:</p> <ol style="list-style-type: none"> 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, peroxidase test, GA3 test RELP maps.	7

Suggested Readings:

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

- बीज प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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 Physiology by Devlin N Witham,CBS Publisher,N Delhi
12. Plant Physiology by Salisbury 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, Display Charts.

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:			
<ol style="list-style-type: none"> 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: <i>Diploma in Seed Physiology and Seed Production</i>		Year: II	Semester: IV-Paper-I
Subject: Seed Technology			
Course Code: B210401T		Course Title: <i>Seed Production and Certification</i>	
Course outcomes:			
Key words: Seed Physiology, Seed morphology Seed dormancy, Seed germination.			
After the completion the students will be able to understand the concept of-			
<ol style="list-style-type: none"> 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 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 प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ0 ओ0बी0वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर0एस0 लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी0के0सहगल डी0के0भारद्वाज कल्याणी पब्लिकेशन्स

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 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 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 Physiology by Devlin N Witham, CBS Publisher, N Delhi
12. Plant Physiology by Salisbury 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 : <i>Diploma in Seed Physiology and Production</i>		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: <ol style="list-style-type: none"> 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 प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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: <i>Bachelor of Science</i>	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-Understand the storage insect and loss of food grain.		
4-Understand 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 <i>Alternaria, Ustilago, Colletotrichum.etc.</i> 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 प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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,Debranjn 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 House Publications 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 .I.S. Balis. Published by National S~eds Corporation. Nev,, ' Delhi and \lississippi State University. and USAID.
- Post Harvest Tl.' hcnology 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 and Class 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 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

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-I>

II/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:			
<ol style="list-style-type: none"> 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 <ul style="list-style-type: none"> • Seed legislation, seed certification. • Indian Seeds Act, Seed Rules and Seed Order. • Seed Inspector – Qualifications duties and responsibilities. 	8

Suggested Readings:

- बीज प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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

Principles of Seed Technology by Phundan Singh

Seed Technology by Agrawal R L, Oxford IBH Publishing Co. Pvt Ltd

Seed Handbook Processing and Storage by Babasaheb B Desai

Advances in seed Production and Management by Tiwari Ajay Kumar

Principles 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: III	Semester: V Paper-III
Subject: SEED TECHNOLOGY			
Course Code: B210503P		Course Title: Studies on Major Diseases of Crop plants	
<p>Course outcomes: After the completion of the course the students will be able to:</p> <ol style="list-style-type: none"> 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*	No. of Lectures (60hrs)	
<i>(Perform any three from each unit based on facility)</i>			
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
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Suggested Readings:

- बीज प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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. Alexopoulos – 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 annotated list of seed 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-agricultural/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 Technology for Pre-graduation	
Course outcomes:		
<ul style="list-style-type: none"> • Project work will supplement field experimental learning and deviations from classroom and laboratory transactions. • project work will enhance the capability to apply gained knowledge and understanding for selecting, 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 importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data 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		
<ol style="list-style-type: none"> 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 प्रौद्योगिकी मजबूती .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स
- 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. Alexopoulos – 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 annotated list of seed borne diseases.
- S.C. Vyas –Systematic Fungicides.
- Metcalf & Flint –Destructive & 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 Harriot – 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: <i>Bachelor of Science</i>		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: <ol style="list-style-type: none"> 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 प्रौद्योगिकी .राजेश कुमार सिंह राजीव कुमार सिंह कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी . डॉ० ओ०बी०वर्मा कल्याणी पब्लिकेशन्स
- उन्नत बीज तकनीक. अक्षय भूकर विनोद सिंह मोर सलवीर सिंह जाखड़ कल्याणी पब्लिकेशन्स
- बीज प्रौद्योगिकी के सिद्धान्त –महक सिंह आर०एस० लोहिया कल्याणी पब्लिकेशन्स
- कृषि कीट विज्ञान. पी०के०सहगल डी०के०भारद्वाज कल्याणी पब्लिकेशन्स

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 Publishing ISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas University
4. Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 9788177544732 Edition : 03 Year : 2018 Author : Dr. Purohit SS , Mathur S
5. Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani Publishers ISBN: 9789327246070, 9327246071
6. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #:978-81-301-0066-1 Sunil D 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 reviews, 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,

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	Semester: VI Paper-II
Subject: Seed Technology			
Course Code: B201602T		Course Title: Seed Farm Management and Marketing	
Course outcomes:			
<ol style="list-style-type: none"> 1. Farm management to increase productivity. 2. Proper utilization of natural resources. 3. Entrepreneurship development among students. 4. Use of machinery and proper management will increase the economic standard of farmers. 			
Credits: 4		Core Compulsory/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 (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	
IV	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 Charts

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%20Materials/AgEcon122FS
M.pdf](http://www.hillagric.ac.in/edu/coa/AgriEcoExtEduRSocio/Study%20Materials/AgEcon122FS
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:			
<ol style="list-style-type: none"> To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding on field, conserving and depolluting the environment. 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 Thatoi, Supriya Das and Swagat Kumar Das

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 Management 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	
<p>Course outcomes: After completing this course a student will have:</p> <ul style="list-style-type: none"> • Project work will supplement field experimental learning and deviations from classroom and laboratory transactions. • project work will enhance the capability to apply gained knowledge and understanding for selecting, 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 industry trips along with data 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		
<p>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 (ComputerAided 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.</p>		
Refer: libraries, journals, Memoirs, encyclopedias, herbaria, Museums, etc.		
<p>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</p>		
<p>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: All listed under all papers of the course.</p>		
<p>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/</p>		

<http://www.jspuniversity.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