SECTION VII

FACULTY OF AGRICULTURE

General Information

Disciplines

- Animal Science Unit
- Agricultural Biotechnology
- Agricultural Meteorology
- Agronomy
- Entomology
- Extension Education
- Food Science & Technology
- Floriculture & Landscaping
- Forestry and Natural Resources
- Fruit Science
- Plant Breeding & Genetics
- Plant Pathology
- Soil Science
- Vegetable Science
- Course curriculum for B.Sc. (Hons) Agri. 4 year Programme
- Course curriculum for B.Sc. (Hons) Agri 2+4 year Programme for first two years
- Course curriculum for B.Tech.(Food Technology) 4 year Programme
- Course curriculum for B.Tech. (Biotechnology) 4 year Programme
- Course curriculum for Diploma in Agriculture 2-year Programme
- Course curriculum for Diploma in Hybrid Seed Production Technology (Two semesters)
Agricultural education on scientific lines was started in India in the beginning of twentieth century. The Punjab Agricultural College and Research Institute, Lyallpur, was established in 1906 and admission to a 3-year diploma course was started in 1909. Teaching was in the local language Urdu and the diploma awarded was called Licentiate in Agriculture (L. Ag.). This college was affiliated to Panjab University, Lahore, in 1917 and the diploma course was replaced by a 4-year degree course leading to B.Sc. in Agriculture. Admission to the degree programme was based on merit and the seats were allocated to different commissionaries proportionate to the population. Subsequently the candidates were selected on merit according to the Communal Award.

During the first two years of 4-year degree programme, primarily courses on basic sciences and humanities were taught. However, agriculture with substantial emphasis on field practicals formed part of the instructions from first year of the degree programme. There was a university examination at the end of two years and a certificate was awarded to the successful candidates who passed as Fellows of Science in Agriculture (F.Sc. Agri.). Only those students who passed this examination were allowed to continue further studies for B.Sc. (Agri.) degree.

After independence in August 1947, a “Refugee College” was opened in November, 1947 in a part of the building of Khalsa College, Amritsar, for the migrated students and the staff appointed by the East Punjab Government. Different persons acted as Officers-in-Charge of the college. In the meantime, building of the Malwa Khalsa High School, Ludhiana, was rented by the Government to start the college as an independent institution. An advance team of four faculty members was sent to Ludhiana to take charge of the building. Dr Dalip Singh was appointed the first Principal of the college which opened at Ludhiana in September 1949 with 40 students.

One thousand and five hundred acres of evacuee land of Haibowal and the adjoining villages like Sunet, Rajpura, etc. near Ludhiana was allotted to the college by the Government for establishing a teaching and research institute at the present site of the Punjab Agricultural University. The foundation stone was laid by Sh Ajit Prasad Jain, Union Minister for Food and Agriculture, GOI on 23 September 1955 and the college started functioning in the new building in September 1958.

The Government Agricultural College, Ludhiana was headed by various principals, namely, Dr Dalip Singh (July 1949 to April 1952), Sh H. R. Saini (April to August 1952 and November 1952 to January 1953), Sh B. S. Sahney (August 1953 to July 1954), Dr M. R. Madhok (August to November 1952, January to August 1953 and August 1954 to October 1957), Dr S. S. Purewal (October 1957 to July 1960), Dr Kishan Singh Bedi (February to July 1960) and Dr Sardar Singh (November 1960 to June 1962).

With the establishment of Punjab Agricultural University in 1962, the college was headed by the Deans of the Faculty of Agriculture, namely, Dr Gursham Singh (June 1962 to September 1966), Dr A. S. Atwal (September 1966 to November 1973 and, again, from October 1975 to July 1979), Dr Sukhdev Singh (November 1973 to February 1974), Dr N. S. Randhawa (February 1974 to October 1975), Dr K.S. Gill (August 1979 to February 1983), Dr G.S.Gill (February 1983 to May 1984), Dr D.S. Dev (September 1985 to September 1989), Dr K.S. Aulakh (September 1989 to May 1994), Dr M.S. Bajwa (August 1994 to June 1998), Dr P. S. Sidhu (June 1998 to March 2001), Dr M.S. Tiwana (June 2001 to May 2005), Dr G. S. Chahal (July 2005 to January 2008), Dr M. S. Aulakh (February 2008 to August 2010), Dr. D. S. Cheema (January 2011 to February 2013), Dr. H.S.Dhaliwal (March 2013 to February 2017), Dr. S.S. Kukal (May 2017 to August 2020).
Before the establishment of PAU, the B.Sc. (Agri.) programme was organized on the old annual system of the Panjab University, Lahore/Solan/Chandigarh. Under the new regulations of the Panjab University, Chandigarh, introduced in 1961, two concurrent programmes were offered viz. 5-year programme after matriculation and 4-year programme after pre-university or higher secondary. The number of students admitted to the two programmes was 80 and 170, respectively. The aggregate marks obtained in four years out of maximum were shown on the transcript of B.Sc. (Agri.) graduate in order to indicate the consistency of the performance of the students.

After the establishment of PAU, a new educational system was introduced with the collaboration of Ohio State University, Columbus (USA). The trimester system of education with complete internal assessment was introduced for M.Sc. and Ph.D. programmes in 1963 and for B.Sc. (Agri.) programme in 1964. The students who were already enrolled in these programmes were allowed to continue their studies according to the previous regulations in vogue. The number of students admitted was increased to approximately 250 per year but subsequently in 1974, the admission capacity was stabilized around 170 per year. A separate programme for admitting 25 inservice Nepalese students was also started.

At the time of independence in 1947, some M.Sc. and one Ph.D. student who were earlier registered with the Panjab University, Lahore, continued their research for the fulfilment of their degree requirements as private candidates. The Panjab University also framed rules for registering postgraduate students to complete their degrees based on thesis research. In 1961, new rules were framed which required such students to appear in three theory papers and practicals having a maximum of 400 marks, which they had to clear and the marks so obtained were added to the thesis marks which were awarded out of 300.

Under the ICAR programme of establishing centres of postgraduate education in the country, the College of Agriculture was also approved as one of such centres. Simultaneously, the regulations were modified by the Panjab University, Chandigarh and weightage to the thesis research was reduced. There were 450 maximum marks for theory and practicals, and 250 for thesis research. Another important feature introduced was the provision to admit regular students and the registered private candidates (only the teachers) were allowed to appear in the examinations and submit the thesis.

This system of education had just stabilized when the Formation of the Agricultural University Act was passed in October 1961. The previous system was continued for one year under the PAU, so that the already admitted students could complete their degrees. The new trimester system of education and the consequent rules and regulations became operative in July 1963 under the ‘Statutes of the Punjab Agricultural University.’ Regular admissions to M.Sc. and Ph.D. programmes in the existing departments of the College of Agriculture were made from August 1963.

In the Department of Agriculture, Punjab, the teaching and research was entrusted to various subject-matter Heads of Sections who were also designated as College Professors. With the establishment of PAU, these sections were upgraded as university departments and were headed by full professors. The chronological establishment of the Departments in the College of Agriculture was as under:

- Department of Agronomy (1963)
- Department of Animal Science (1963) Shifted to GADVASU in 2006]
- Department of Entomology (1963)
• Department of Extension Education (1963)
• Department of Horticulture (1963)
• Department of Plant Breeding (1963) [Now Department of Plant Breeding and Genetics]
• Department of Plant Pathology (1963)
• Department of Soil Science (1963)
• Department of Food Science and Technology (1969)
• Department of Vegetable Crops, Landscaping and Floriculture (1974) 
  (Now department of Vegetable Science)
• Department of Forestry and Natural Resources (1979)
• Department of Agrometeorology (1981) [Now Department of Climate Change and Agricultural Meteorology (2012)]
• Department of Animal Nutrition and Forages (1991) [Shifted to GADVASU in 2006]
• Department of Seed Science and Technology (1991)
• Department of Floriculture and Landscaping (1994)
• School of Agricultural Biotechnology (2008)

In May 1998, the Departments of Animal Science and Animal Nutrition were shifted to the College of Veterinary Science. The Department of Seed Science and Technology was upgraded to Directorate of Seed Science and Technology under Director of Research in July 1999. The Department of Agrometeorology was merged with the Agronomy Department and a new Department of Agronomy and Agrometeorology was created in March 2002. The Department of Home Science Extension Education of the College of Home Science was shifted to the College of Agriculture and merged with Department of Extension Education in November 2002. Later, the Department of Genetics and Biotechnology from the College of Basic Sciences and Humanities was shifted to the College of Agriculture and merged with Department of Plant Breeding and the new Department of Plant Breeding, Genetics and Biotechnology was created in September 2003. The Department of Forestry and Natural Resources was merged with Department of Agronomy & Agrometeorology and new Department of Agronomy, Agrometeorology and Forestry was created in June 2006. The Department of Business Management of the College of Basic Sciences and Humanities was shifted to the College of Agriculture in November, 2006. The Department of Foods & Nutrition of the College of Home Science and Department of Processing & Food Engineering of the College of Agricultural Engineering were shifted to the College of Agriculture and merged with Department of Food Science & Technology and new Department of Food Science & Engineering was created in December, 2006. The Departments of Vegetable Crops and Floriculture & Landscaping were merged and a new department named as Vegetable Crops, Floriculture and Landscaping was created in April, 2007. The merger of Departments were again dissolved in 2007 and all these Departments were demerged for efficient working.

Due to inherent complexities of switching over from one system to another, the transitional period from the conventional annual system of external examinations to the trimester system, with complete internal assessment, was inevitably a difficult one. In fact, the College of Agriculture was the first in India to successfully adopt the new system. With the hard work of faculty and the patience and cooperation of students, complete switch over to the new system was accomplished by the academic year 1968-69. The innovations in agricultural education and the rules and regulations framed to suit local conditions were accepted by the students. Most of these rules were subsequently adopted by other State Agricultural Universities in India.

By way of background, in 1963-64, the existing subjects as taught under the old annual system were hurriedly sub-divided into trimester courses for undergraduate and postgraduate programmes. Based
on experience during the formative years, the course curriculum was rationally revised and operationalized in 1969. This revision was concurrent with the needs of the agricultural revolution which was already ushered in the state.

During seventies, agriculture in Punjab witnessed very rapid changes. The farmers became progressive and made heavy demands on agricultural education to meet the requirements of knowledge for intensive use of inputs, farm mechanization and diversification of agriculture. Hence the progressive agriculture in Punjab called for dynamic agricultural educational programme and the curricula. A critical revision of the various courses for B.Sc. (Agri.) programme was made which took almost one year. The new programme became operative in August 1973. The most significant feature of this programme was that the earlier concept of offering one major subject to the students in the final year, representing one of the thirteen departments, was changed and the disciplines were combined according to the professional specializations. The six new areas of elective subjects were: Crop Sciences; Animal Sciences; Soil Sciences; Plant Protection; Economics, Sociology and Extension Education; and Food Science, Technology and Nutrition. The new degree was renamed as B.Sc. (Agri.) with ‘Honours’ in one of these six specialized areas. The first batch students of B. Sc. (Agri.) Hons. were Graduated in 1976.

In 1974, “Earn While You Learn” schemes in the respective electives for the final year students were started. Revolving funds were created in various departments to meet the cost of inputs which were supplied to the students on loan from the common pool. When the produce was ready, they were encouraged to sell it in the market. The income from the saving of labour and innovative use of inputs was shared by the students. These activities included poultry farming, floriculture, food technology, nursery growing, dairy farming and vegetable growing. At present this scheme is operative only in Crop Production Courses (CPC) under the department of Agronomy.

The fourth revision of the course curricula for B.Sc. (Hons.) Agri. was made in 1982 by maintaining the essential features of the degree programme and incorporating the recommendations of the second Deans’ Committee of the ICAR and the National Commission on Agriculture.

Consequent upon the decision of the university to switch over from the trimester to semester system of education from the academic session 1988-89, the course curricula for undergraduate and postgraduate programmes were revised, updated and reoriented. The practical component of the curricula was considerably strengthened. The minimum qualification for admission to B.Sc. (Hons) Agri. was raised to 10+2 with science group (medical or non-medical streams) and later on the agriculture stream was also included. The revised curricula in the light of the recommendations of third Deans’ Committee of ICAR and the syllabi for National Eligibility Test conducted by ASRB (for PG Programmes) had been implemented with effect from academic session 1998-99. The recommendations of fourth Deans’ Committee were implemented for all UG programmes with effect from academic session 2009-10. At present, the recommendations of fifth Deans’ Committee have also been implemented for all UG programmes with effect from academic session 2016-17. The salient features of B.Sc. (Hons.) Agri. programme are:

- The component of basic sciences has been strengthened and new courses in the fields of Agri-business Management, Agrochemicals and Plant Products, Genetics, Biotechnology, Economics, Crop Physiology and Economic Zoology have been introduced.
- The Plant Clinic component, which is a unique feature of the course curricula of this College, has been updated to provide hand-on experience to the students in the diagnosis and management of plant diseases, pests, nutrient deficiencies and phytotoxicities.
• More emphasis has been laid on modern information technology, computer applications, integrated pest management, environmental science and international trade. The physical facilities for imparting instructions effectively have been improved by equipping the classrooms with permanent fixtures of audio visual aids (Multimedia) during 2004.
• Smart class rooms have been developed for imparting effective lectures and quality education.
• Vocational training in specialized fields such as Apiculture, Sericulture, Fish Culture, Mushroom Production, etc. has been introduced so as to promote self-employment of agricultural graduates.
• The agricultural engineering component has been strengthened with increased emphasis on farm machinery and its maintenance, farm structures and irrigation engineering.
• Special emphasis has been laid on project planning and evaluation to train the students for working as consultants in private and public sector undertakings and organizations dealing with agribusiness enterprise.
• In the final year Rural Agricultural Work Experience (RAWE) and Experiential Learning Programme (ELP) has been introduced to focus on understanding and solving practical problems of agricultural production in rural settings and to get hands-on-experience and develop entrepreneurship skills among the students.

The latest revision of course curricula of M.Sc. and Ph. D. in the light of guidelines suggested by ICAR to bring about uniformity in syllabus at national level has been implemented from the academic session 2004-05, which has again been revised by National Core Group Chaired by Dr J. C. Katyal. It has been implemented with effect from academic session 2010-11.

One year degree programme in Bachelor of Education was started in 1977 for B.Sc. Agri.(Hons), B.Sc. (Home Science) and B.Tech. (Agri. Engg.) graduates of PAU. A two year Diploma in Dairy Technology was started in 1979 in order to provide technicians for the newly established Milk Chilling Centres and Milk Processing Plants in the state. This programme was discontinued in 1991 due to lack of employment opportunities. The one year certificate course for Agricultural Sub Inspectors was modified into a two year Diploma in Agriculture in 1983, with an option to the students to terminate studies at the end of one year certificate course or to complete the diploma course. With the establishment of an ‘Institute of Agriculture’ at Gurdaspur in 1993, this diploma course was shifted there. In 1985 four year B.Sc. (Forestry) programme was started but it was discontinued in 1987. One year ‘Certificate Course in Pesticides and Fertilizers’ was started in 1993. This was, however, discontinued in 1998 due to lack of employment opportunities for these students. Thereafter, the college started new Diploma programmes in Apiculture, Pest Management, Food Technology & Seed Production from the academic year 2005-06 which were discontinued from academic session 2007-08.

Apart from B.Sc. (Hons) Agri the college now offers M.Sc. programme in 13 disciplines and Ph.D. programmes in 10 disciplines. Keeping in view the sustainability of agricultural production in Punjab, new programmes at undergraduate and postgraduate level were initiated as B Sc.(Hons) Agri 2+4 year programme after Matric (2008-09) wherein the students attend first two years of their degree programme at Institutes of Agriculture located at Bathinda and Gurdaspur; B.Tech (Biotechnology) 4-year programme; B Tech. (Food Technology) 4-year programme (Both under self supporting system after 10+2 medical or non-medical streams); Two year Diploma Course in Agriculture at College of Agriculture, PAU campus, Ludhiana and Regional Research Station,Faridkot (2016-17); One year Diploma course in Hybrid Seed Production Technology (2013-14); PG programmes started were M.Sc Biotechnology (2008-09), Ph.D Biotechnology (2009-10), Ph D Floriculture & Landscaping (2010-11).
Realising the tremendous potential of biotechnology in increasing agricultural productivity, the University established an independent ‘School of Agricultural Biotechnology’ on April 24, 2008. The School is equipped with basic infrastructural research facilities for carrying out research on various aspects of Agricultural Biotechnology. There is a separate building named after Food Laureate, Dr G. S. Khush, with 18 laboratories for conducting research on plant tissue culture, plant transformation, molecular biology, molecular cytogenetics, genomics laboratories and temperature, humidity and light controlled facility apart from a fully functional Bioinformatics Centre. A Super Computer has recently been installed in the University for conducting research related to Computational Biology in Biotechnology. The School has collaborations and funding from the John Innes Centre, Norwich, UK.; University of Nottingham, England; University of Tokyo, Japan; IRRI, Philippines; Ohio State University, USA; University of Zurich, Switzerland; Texas A & M University, USA; Kansas State University, USA; University of Sydney, Australia and ICGEB, New Delhi.

Wheat genome sequencing project is a globally ambitious research programme in which 16 countries are involved under the umbrella of IWGSC (International Wheat Genome Sequencing Consortium). India has been entrusted with the responsibility of sequencing of Chromosome 2A, which is about 900 Mb and is 2.5 times larger than the whole rice genome. Dept. of Biotechnology (DBT), Ministry of Science and Technology, Government of India funded this collaborative programme to the PAU, National Research Centre on Plant Biotechnology (NRCPB) New Delhi and University of Delhi South Campus (UDSC), New Delhi with a total budget of Rs 34 crore for a period of three years. PAU is the lead centre with a total budget of Rs 18 crore.

School of Climate Change and Agricultural Meteorology has recently been established in 2012 upgrading the Department of Agricultural Meteorology with the objectives to undertake focused research on developing suitable technologies for sustaining natural resources and agricultural productivity under changing climate scenario and to impart quality education to undergraduate and postgraduate students on different aspects of agricultural meteorology. Scientists from allied disciplines of Agronomy, Soil Science, Entomology, Plant Pathology and Soil and Water Engineering have been associated to conduct the research work in field of climate change.

Punjab Agricultural University established with a grant from ICAR, a State-of-the-art facility named as Electron Microscopy &Nano-Science Laboratory (EMN Lab) in 2007 having Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Energy Dispersive X-ray Spectroscope (EDS), and Scanning Probe Microscope (SPM), Optical Upright Research Microscope, Ultracut Microtome and Cryo Attachment, and Ion Sputter Coater facilities. The latest high resolution imaging tools in the EMN Lab for imaging particles as small as 1 nanometer (1 billionth of a meter) would enable scientists to develop technologies relevant to agriculture and food systems. It also facilitates research in basic biological, biomedical, chemical and material sciences to support the future needs of precision agricultural research.

The Old Boys’ Association (renamed as Alumni Association) of the College was reactivated in 1968 when the regular students offered to contribute Rs.2/ - per trimester. Directory of the alumni who graduated in various years was prepared for circulation and republished in 1990. The Association also started a quarterly magazine of its own under the name of “AGALUMNUS” This Association has published many books and Laboratory Manuals for improving the quality of agricultural teaching. A book bank was started in the college out of funds contributed by students. The books are issued to students on loan basis for a semester.
The student advisement which formed an essential and desirable feature of the trimester system of education has been considerably strengthened under the semester system. The advisors devote considerable time advising the students about curricular, co-curricular, social and emotional problems and serve as guides, mentors, role models and ‘guardians-on-the-campus’ for their advisees. With wise counselling and guidance by the faculty accompanied by receptive and proactive policies of the college, the defaults of the students have been considerably reduced facilitating timely completion of their degrees. The College has established a centrally located Placement and Counselling Cell, to provide the students with access to wide range of temporary and permanent jobs by organizing campus interviews or through building their competence to face interviews, personality development and coaching for various competitive examinations.

The students’ interest are taken care of by providing them ample opportunities to exercise choice for courses in various fields of specialization. Within the confines of their limits, the autonomy of the teachers is assured, which is so essential under the system of internal evaluation. In order to ensure full coverage of the course contents, lecture outlines and references to the books and other relevant literature are distributed to the students in the beginning of the semester. The lesson plans and lectures of undergraduate courses on multimedia have been introduced for teaching from academic session 2004-05. Every student admitted to Bachelor’s degree (w.e.f. academic session 2012-13) course is required to participate in any one of the three fold programmes namely NCC, NSO and NSS for first four semesters of their studies which was earlier for two semesters.
ANIMAL SCIENCE

Diploma courses

LPM 51 Elementary Livestock and Poultry Production 3+1 Sem. II


Undergraduate Courses

AS 201 Livestock and Poultry Management 2+1 Sem I / II

(For students of B.Sc. (Hons) Agriculture and B.Tech. Biotechnology)


AGRICULTURAL BIOTECHNOLOGY

PROGRAMMES
1. M.Sc. Biotechnology
2. Ph.D. Biotechnology

COURSE REQUIREMENT

M.Sc.

Field of Specialization

Required Courses

Supporting Courses

Minor Fields

Deficiency courses for students with elective other than Plant Breeding, Genetics and Biotechnology

Ph.D.

Field of Specialization

Required Courses

Supporting Courses

Minor Fields

Deficiency Courses for students with M.Sc. (Agri.) in discipline other than Biotechnology

Courses as recommended by the Student's Advisory Committee.
DESCRIPTION OF COURSE CONTENTS

Diploma courses

Biotech. 51  Elementary Plant Tissue Culture  1+1  Sem. II

Undergraduate Courses

Biotech. 101 Cell Biology  2+0  Sem. I

Biotech. 102 Molecular Biology  2+1  Sem. II

Biotech. 103 Introduction to Biotechnology  2+1  Sem. I
Practical: Orientation to the laboratories: glass houses, screen houses, transgenic facilities and field area. General guidelines for working in biotechnology laboratory. Familiarization with basic
equipments used in biotechnology. Selection of chemicals (different grade), buffer preparation, calculations and scientific notations used in laboratories.

**Biotech. 104 Plant Tissue Culture**  
2+1  Sem. II  

**Biotech. 106 Electronics and Instrumentation in Biotechnology**  
1+1  Sem. II  

**Biotech. 202 Introductory Bioinformatics**  
2+1  Sem. I  
Biotech. 201 Recombinant DNA Technology 2+1 Sem. II

Biotech. 203 Plant Genetic Transformation 2+1 Sem. II

Biotech. 204 Classical and Molecular Cytogenetics 2+1 Sem. II

Biotech. 206 Fundamentals of Plant Biotechnology 2+1 Sem. II
(For students of B.Sc. (Hons) Agriculture)

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<td>Biodiversity definition, importance and geographical causes for diversity. Species and population biodiversity, maintenance of ecological biodiversity hot spots in India. Convention on biological diversity. Cartagena protocol of bio-safety. Risk management for GMOs. Bio-safety guidelines, rules and regulations and regulatory frame work for GMOs in India. Introduction to Intellectual Property,</td>
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Biotech. 306 Computational Biology 2+1  Sem. II

Biotech. 307 Micropropagation Technologies 1+2  Sem. II

Biotech. 308 Food Biotechnology 2+1  Sem. II
(For students of B.Tech. Food Technology)

Biotech. 309 Nutrigenomics 3+0  Sem. II
(For students of B. Sc. (Hons) Nutrition and Dietetics)

Biotech. 310 Applications of Genomics and Proteomics 2+1 Sem. II

Biotech. 311 Molecular Breeding 2+1 Sem. II

Biotech. 312 Epigenetics and Gene Regulation 3+0 Sem. II

Biotech. 313 Programming for Bioinformatics 2+2 Sem. II
Introduction - operating systems, programming concepts, algorithms, flow chart, programming languages, compiler and interpreter; Computer number format - Decimal, Binary, Octal and
Hexadecimal. C-language: History, constant, variables and identifiers, character set, logical and relational operators, data input and output concepts; Decision making: if statement, if-else statement, for loop, while loop, do-while loop, arrays and functions, file handling. PERL-language - Introduction, variables, arrays, string, hash, sub-routines, file handling, conditional blocks, loops string operators and manipulators.

Practical: Constant, variables and identifiers, logical and relational operators, Programs related to arithmetic operations, arrays and file handling in C. Pattern matching and regular expressions in PERL, Sequence handling in PERL demonstrating string, array and hash. Shell programming - concepts and types of UNIX shell, Linux variables, if statements, control and iteration, arithmetic operations, concepts of awk, grep and sed. Sequence manipulations using shell scripting.

**Biotech. 314 Next Generation Sequencing and Data Analysis 2+1**
**Sem. II**
Introduction to first, second and third generation sequencing technologies; NGS Terminology; Applications of sequencing technologies. NGS Sequence file formats, data quality evaluation, pre-processing of data: quality control, adapter clipping, quality trimming; de-multiplexing. Bacterial genome assembly; Assessment of genome assembly, Tools for prokaryotic gene prediction (PROKKA); functional annotation (Blast, KEGG, BLAST2GO); domain and motif analysis (PFAM, interpro) Short read mapping tools (BWA, Bowtie); Visualization tools for genome assembly and mapped reads; data submission to SRA.

Practical: NGS sequence files format (FASTQ/BED/BAM/GFF), quality control (FastQC), adapter clipping (cutadapt), trimmomatic, Prokaryotic genome assembly (SPADES/soapdenovo), Gene prediction (PROKKA), Functional annotation (Blast/BLAST2GO/PFAM/interpro), Read mapping (BWA/Bowtie), Visualization of mapped reads (IGV/Tablet).

**Biotech. 491 In-house Skill Development in Plant Biotechnology 0+20/0+20**
**Sem. I**
B. Tech (Biotech.) students will register for either Biotech. 491 or Biotech. 492 in 7th semester. They will be demonstrated and imparted hands on training on different tissue culture, molecular biology and bioinformatics techniques at School of Agricultural Biotechnology.

**Biotech. 493 Project Formulation, Execution and Presentation 0+10**
**Sem. II**
The students (2 or 3) will be allotted to each faculty member of School of Agricultural Biotechnology and associated faculty member for Project Formulation, Execution and Presentation.

**Biotech. 494 Entrepreneurial Development in Biotechnology 0+10**
**Sem. II**
Modules:
1. Micropropagation
2. DNA fingerprinting
3. Genetic purity for maintenance breeding
4. Marker assisted selection
5. Database Management skills

**Postgraduate Courses**
**Biotech. 501 Plant Tissue Culture and Genetic Transformation 2+1**
**Sem. I**
Plant cell and tissue culture its importance and history. Culture media for callus, suspension, nurse, root, meristem, etc. In vitro differentiation. Plant growth regulators. Molecular basis of plant organ differentiation. Various aspects of plant tissue culture micropropagation, anther and microspore culture, somaclonal variation, embryo rescue, wide hybridization, in vitro mutagenesis, in vitro fertilization and in vitro germplasm


**Biotech. 502 Principles of Biotechnology** 2+0 Sem. II


**Biotech. 503 Principles in Structural and Functional Genomics** 3+0 Sem. I


**Biotech. 504 Techniques in Structural and Functional Genomics** 0+2 Sem. I


**Biotech. 505 Techniques in Molecular Biology-II** 0+2 Sem. II

Construction of gene libraries. Synthesis and cloning of cDNA and RTPCR analysis. Real time PCR and interpretation of data. Molecular markers (RAPD, SSR, AFLP etc) and their analysis. Case study of SSR markers (linkage map, QTL analysis etc). SNP identification and analysis. Microarray studies and use of relevant software. Proteomics (2D gels, mass spectrometry, etc.). RNAi (right from designing of construct
to the phenotyping of the plant). Yeast 1 and 2-hybrid interaction. Generation and screening of mutants. Transposon mediated mutagenesis.

**Biotech. 506 Molecular Cell Biology**

3+0 Sem. I


**Biotech. 507/ Micro. 504 Industrial Microbiology**

2+1 Sem. II


Practical: Isolation, maintenance and improvement of industrial important organisms. Production of alcohol, beer, citric acid, lactic acid and their recovery; Study of bio-reactors. Production of biofertilizers and biogas. Demonstration of activity of immobilized enzymes/cells.

**Biotech. 508 Nanobiotechnology**

3+0 Sem. II


**Biotech. 509 Bioinformatic Tools and their Applications in Agriculture**

2+1 Sem. I & II


Practical: HTML, Biological databases, Protein and Gene Information Resources, Hidden Markov Models, Bayesian estimation and Gibbs sampling, PAM and BLOSUM matrices, Needleman and Wunsch algorithm. Tutorials on bisection, iteration, secant and Newton-Raphson methods, Gauss elimination, Jacobi’s and Gauss-Siedel iteration methods, numerical differentiation and numerical integration.

**Biotech. 601 Advances in Genetic Engineering and Transformation** 2+0 Sem. II

**Biotech. 602 Advances in Plant Molecular Biology** 2+0 Sem. I

**Biotech. 603 Advances in Crop Biotechnology** 2+0 Sem. II
Conventional versus non-conventional methods for crop improvement. Present status and recent developments on molecular marker systems. Transformation and genomic tools for crop improvement. Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency, quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc). Edible vaccines. Molecular breeding- constructing molecular map. Integrating genetic, physical and molecular maps. Diversity assessment and phylogenetic analysis. Molecular tagging of genes/traits. Selected examples on marker assisted selection of qualitative and quantitative traits. Discussions on application of molecular markers and genomic tools for the genetic enhancement in some major field and horticultural crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane, banana, grapes and papaya etc.

**Biotech. 604 Advances in Functional Genomics and Proteomics** 2+0 Sem. I

**Biotech. 605/Micro. 605 Advances in Microbial Genetics and Biotechnology** 2+0 Sem. II

**Biotech. 606 Commercial Plant Tissue Culture** 2+0 Sem. I

**Biotech. 607 Advances in Bioinformatics** 0+2 Sem. I

**Biotech. 591 Seminar**

**Biotech. 600 Master's Research**

**Biotech. 700 Ph.D. Research**
AGRICULTURAL METEOROLOGY

PROGRAMMES
1. M.Sc. Agricultural Meteorology
2. Ph.D Agricultural Meteorology

COURSE REQUIREMENT

M.Sc.

Field of Specialization
Climate Change, Microclimate Modifications, Crop Modeling, Crop-weather-pests interactions.

Required Courses
Agromet. 501, Agromet. 502, Agromet. 503, Agromet. 504, Agromet. 505

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem

Minor Fields
Agronomy, Entomology, Plant Pathology, Soil Science, Math., Vegetable Science or any other as approved by the Dean, Postgraduate Studies

Deficiency courses for students with elective other than Agronomy, Soil Science, Forestry
As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.

Field of Specialization
Climate Change, Microclimate Modifications, Crop Modeling, Crop-weather-pests interactions.

Required Courses
Agromet. 601, Agromet. 602, Agromet. 603

Supporting Courses
Stat. 515 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem

Minor Fields
Agronomy, Entomology, Plant Pathology, Soil Science, Math., Vegetable Science or any other as approved by the Dean, Postgraduate Studies

Deficiency courses for students with M.Sc.(Agric.) in a discipline other than Agricultural Meteorology
Agromet. 501, Agromet. 502, Agromet. 503, Agromet. 504, Agromet. 505 and other courses as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma courses

**Agromet. 51 Elementary Agro-climatology** 1+1 Sem. II

Undergraduate Courses

**Agromet. 102 Introductory Agrometeorology and Climate Change** 1+1 Sem. II

**Agromet. 301 System Simulation and Agroadvisory** 2+1 Sem. II

Postgraduate Courses

Agromet. 501 General Meteorology and Climatology 2+1 Sem. I

Practical: Agromet observatory-different classes of observatories. Site selection and installation procedures for meteorological instruments. Measurement and recording of weather parameters. Climatic normals, weather chart preparation and identification of low and high pressure systems. Statistical techniques for computation of normals, moving average, Markov chain model etc.

Agromet. 502 Applied Agricultural Meteorology 2+1 Sem. II


Agromet. 503 Micrometeorology 2+1 Sem. II

Fundamentals of measurement techniques. Theory and working principles of barometers, thermometers, psychrometers, hair hygrometer, thermohygrograph, radiation and temperature instruments, pressure bomb apparatus, precipitation and dew instruments, wind instruments, porometer, photosynthesis system, leaf area meter, soil thermometers and soil heat flux plates. Automatic weather station. Computation and interpretation of data.

Practical: Working with the above instruments in the meteorological observatory, taking observations of relevant parameters. Exposure and operation of meteorological instruments/equipments in agromet observatories. Computation and interpretation of the data.
Agromet. 505 Soil Water Balance Climatology           2+1      Sem.II
Practical: Measurement and evaluation of radiation components. Computation and comparison of evapotranspiration by different methods - energy balance method, aerodynamic method, Penman method, remote sensing and other methods. Measurement of wind and temperature profiles near the ground

Agromet. 506 Crop Weather Models                     2+1      Sem. I
Practical: Working with statistical and simulation models, DSSAT models, BRASSICA etc.

Agromet. 507 Weather Modification and Risk Management Strategies          2+0      Sem. II

Agromet. 508 Principles of Remote Sensing and their Applications in Agriculture         2+1      Sem. I
Agromet. 509 Applied Agricultural Climatology 2+1 Sem. II


Agromet. 601 Advanced Weather Forecasting 3+0 Sem. I


Agromet. 602 Analytical Tools and Methods for Agricultural Meteorology 3+0 Sem. II


Agromet. 603 Strategic Use of Climate Information 3+0 Sem. II

Awareness and history of climate-related disasters. Hazards and their relation to agricultural production risks and their mitigation. Selection of appropriate land use and cropping patterns - history and environmental issues, success and difficulties experienced by farmers and outlook for possible alternatives. Agro-meteorological aspects for making more efficient use of agricultural inputs. Selection of livestock management - history related to environmental issues. Adoption of microclimate modification techniques. Protection measures against extreme climate-history of protection measures against extreme climate in the continent/region/country/sub region concerned, successes and difficulties experienced by
farmers with present protection measures, outlook for present protection measures and possible alternatives. Trends in protection methods against extreme climate.

**Agromet. 604 Climate Change and Sustainable Development 2+0 Sem.I**


**Agromet. 605 Advanced Micrometeorology 2+0 Sem.II**


**Agromet. 606 Agrometeorological Data Base Management and e-Services 2+1 Sem.I**

Data, information and types of data-climate, soil and crop data. Importance of database management, data requirements, collection and recording. Data structure/format and quality control of data. Techniques of climatic data generation and missing data. Introduction to different software for database management. Processing and analysis of data and data products. Value addition of data and data products- data users, public, commercial, academic / research. Availability, accessibility and security of data. Evaluating the cost of data.

Practical: Types of instruments and data recording. AWS data retrieval, storage and transfer. Exposure to different software for Agromet data analysis; exposure to Statistical software. Temporal and spatial analysis of data; exposure to GIS. Value addition to data. Uploading and downloading data, password and security of data. E-management of data.

**Agromet. 591 Seminar**

**Agromet. 600 Master's Research**

**Agromet. 700 Ph.D. Research**
AGRONOMY

PROGRAMMES
1. M.Sc.
2. Ph.D.

COURSE REQUIREMENT M.Sc.

Field of Specialization
Agroecology, Crop Ecology, Crop Nutrition, Crop Physiology, Crop Production, Water Management, Weed Science

Required Courses
Agron.501, Agron. 502, Agron. 503, Agron. 504, Agron.505

Supporting Courses
Stat.421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem

Minor Fields
Agrometeorology, Chemistry, Botany, Soil Science, Forestry & Natural Resources, Microbiology or any other as approved by the Dean, Postgraduate Studies

Deficiency courses for the students with elective other than Agronomy, Soil Science and Forestry
As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.

Field of Specialization
Agroecology, Crop Ecology, Crop Nutrition, Crop Physiology, Crop Production, Water Management, Weed Science

Required Courses
Agron. 601, Agron. 602, Agron. 603, Agron. 604

Supporting Courses
Courses from subject matter fields (other than minor) relating to area of special interest and research problem

Minor Fields
Agrometeorology, Chemistry, Botany, Soil Science, Forestry & Natural Resources, Microbiology or any other as approved by the Dean, Postgraduate Studies

Deficiency courses for students with M.Sc.(Agri.) in a discipline other than Agronomy
Agron.501, Agron. 502, Agron. 503, Agron. 504, Agron.505 and other courses as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma courses

Agron. 51 Elementary Agriculture 1+1 Sem. I
Practical: Identification of various crops and seed. Study of germination of different types of crop seeds. Familiarization of important agricultural implements and hand tools, weeds, fertilizers.

Agron. 52 Elementary Agronomy 2+1 Sem. I

Agron. 53 Crop Production – I 2+1 Sem. I
Important kharif crops – rice, maize, bajra, cotton, sugarcane, moong, mash, red gram, soybean, groundnut, sesamum, mentha, turmeric and fodder crops, their importance, improved varieties, cultural practices, harvesting and threshing.
Practical: Identification of important kharif crops, their seeds and weeds. Field practices like seedbed preparation, seed treatment, preparation of sugarcane seed sets, sowing, transplanting, thinning, earthing up, hoeing, fertilizer and herbicide application, propping, maturity indexing and harvesting.

Agron. 54 Crop Production – II 2+1 Sem. II
Important Rabi crops – wheat, winter maize, gram, lentil, rapeseed and mustard, sunflower, safflower, celery and fodder crops, their importance, improved varieties, cultural practices, harvesting and threshing.
Practical: Identification of important rabi crops, their seeds and weeds. Field practices like seedbed preparation, seed treatment, sowing, transplanting, thinning, earthing up, hoeing, fertilizer and herbicide application, maturity indexing and harvesting.

Undergraduate Courses

Agron. 101 Fundamentals of Agronomy 3+1 Sem. I
distribution of crops. Crop management technologies in problematic areas. Harvesting and threshing of crops.


**Agron. 102 Principles of Agronomy**

1+1  
Sem. II

(For students of B. Tech. Agri. Engineering)


**Agron. 103 Crop Production Technology**

2+1  
Sem. I

(For students of B.Tech. Biotechnology - In collaboration with Department of Soil Science)


**Agron. 105 Crop Production Practices**

2+1  
Sem. I

(For students of B. Tech. Food Technology - In collaboration with Department of Fruit Science & Vegetable Science)

Classification of crops. Effect of different weather parameters on crop growth and development. Principles of tillage. Soil-water-plant relationship. Crop rotation, cropping systems, relay cropping and
mixed cropping. Crop production technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, etc. Crop production technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, etc. Crop production technology for major pulse crops viz., pigeon pea, cowpea, gram, green gram, black gram, etc. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, etc. Crop production technology for major spices and cash crops viz., cumin, coriander, fennel, ginger, garlic, sugarcane etc. Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc. Horticulture - Scope of horticultural crops. Soil and climatic requirements for fruits and vegetables, nursery raising and management. Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc., Major varieties, time of transplanting, spacing, inter-culturing, fertilizer and water requirement, time and method of harvest, maturity index, yield potential, cost of cultivation, income from production, etc. Crop production technology for major vegetable crops viz., potato, onion, tomato, chilli and other green and leafy vegetables: Major varieties, sowing time, method of sowing, spacing, inter-culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.

Practical: Examination of soil profile in the field, Introduction to different equipments utilized in a weather observatory. Identification of seed of different agricultural crops and their varieties. Study of seed viability and germination test. Identification of different weeds and methods of their control. Use of different inter-culturing equipments. Study of water requirement of different crops. Fertilizer application methods and equipments. Judging maturity time for harvesting of crop. Identification and description of important fruit and vegetable crops. Preparation of nursery. Study of different garden tools. Practices of pruning and training in some important fruit crops.

Agron. 201  Production Technology for Kharif Crops 1+1 Sem. I
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of kharif crops. Cereals- rice, maize, sorghum, pearl millet and finger millet; pulses- pigeon pea, mung bean and urdbean; oilseeds- groundnut and soybean; fibre crops- cotton and jute; forage crops- maize, sorghum, bajra, cowpea, cluster bean and Napier-bajra hybrid.

Agron. 202  Production Technology for Rabi Crops 1+1 Sem. II
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops. Cereals - wheat and barley; pulses- chickpea, lentil, peas; oilseeds- rapeseed, mustard and sunflower; sugar crops- sugarcane; medicinal and aromatic crops- lemon grass and citronella; forage crops- berseem, lucerne and oat.
Agron. 203 Farming System and Sustainable Agriculture  

Agron. 301 Practical Crop Production-I (Kharif Crops)  
Crop planning. Raising field crops in multiple cropping system-field preparation, seed treatment, nursery raising, sowing, nutrient, water, weed, insect-pest and disease management of crops, harvesting, threshing, drying, winnowing, storage and marketing of produce with emphasis on seed production, mechanization, resource conservation and integrated nutrient, weed, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation and net returns per student and as well as per team of 8-10 students.

Agron. 302 Practical Crop Production-II (Rabi Crops)  
Crop planning. Raising field crops in multiple cropping system-field preparation, seed treatment, nursery raising, sowing, nutrient, water, weed, insect-pest and disease management of crops, harvesting, threshing, drying, winnowing, storage and marketing of produce with emphasis on seed production, mechanization, resource conservation and integrated nutrient, weed, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation and net returns per student and as well as per team of 8-10 students.

Agron. 303 Rainfed Agriculture and Watershed Management  

Agron. 304 Principles of Organic Farming  
(In collaboration with Department of Soil Science, Entomology and Plant Pathology)


Agron. 305 Weed Management 2+1 Sem. II
(Regular course)


Agron. 491 Agro-industrial Attachment: Seed Industries/Herbicide Formulations 0+4 Sem. I

Agron. 492 Experiential Learning in Organic Production Technology 0+20 Sem. II

Postgraduate Courses
Agron. 501 Modern Concepts in Crop Production 3+0 Sem. I

Agron. 502 Fertilizer Use in Crop Production 2+0 Sem. I
Crop response to fertilizer-effect on germination, growth and nutrient removal. Problems of supply and availability of nutrients, relation between nutrient supply and crop growth. Organic farming - basic concepts

Agron. 503 Principles and Practices of Weed Management 2+1 Sem.II

Agron. 504 Principles and Practices of Water Management 2+1 Sem. I

Agron. 505 Field Plot Techniques 2+1 Sem.II
Planning field experiments-objectives, selection of field and treatment. Conduct of the experiment, precautions during sowing, management, harvesting and threshing. Sampling. Recording biometrical observations. Sources of error in the field experiments and methods of reducing it. Optimum plot size and number of replications. Selection of experimental designs. Rotational experiments. Experiments to study the effect of years and locations. Compilation, presentation and interpretation of the data. Factorial experiments and interaction effects. Different tests of significance. Correlation and response functions.
Transformation of data. Practical: Actual layout of field experiments. Critical examination of experiments scientific journals. Compilation and interpretation of the given data. Missing plots and analysis of variance results. Use of computers for analysis of data.

**Agron. 506 Agronomy of Major Cereals and Pulses**

Origin, history, area, production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of kharif and rabi cereals and pulses (rice, maize, sorghum, millets, wheat, barley), important grain legumes (pigeonpea, mungbean, urdbean, chickpea and lentil).


**Agron. 507 Agronomy of Oilseed, Fibre and Sugar Crops**

Origin and history, area and production, classification, morphology, phenology, physiology, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of kharif and rabi oilseed crops (Groundnut, sesame, castor, sunflower, soybean, rapeseed and mustard, linseed, etc.), fibre crops (Cotton, jute, sunhemp etc.) and sugar crops (Sugar-beet and sugarcane etc.).


**Agron. 508 Agronomy of Medicinal, Aromatic and Under-utilized Crops**


Practical: Identification of crops based on morphological and seed characteristics. Raising of herbarium of medicinal, aromatic and under-utilized plants. Quality characters in medicinal and aromatic plants. Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants.

**Agron. 509 Agronomy of Fodder and Forage Crops**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, bajra, guar, cowpea, oats, barley, berseem, senji, lucerne etc. and forage crops like, napier grass, panicum, lasiuras, cenchrus etc. Year-round fodder production and management, preservation and utilization of forage and pasture crops. Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting
quality of hay and silage. Use of physical and chemical enrichments and biological methods for improving nutrition. Value addition of poor quality fodder. Economics of forage cultivation uses and seed production techniques.

Practical: Farm operations in raising fodder crops. Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops. Anti-quality components like HCN in sorghum and such factors in other crops. Hay and silage making and economics of their preparation.

Agron. 510 Cropping Systems and Organic Farming 3+0 Sem. II

Agron. 511 Dryland Farming and Watershed Management 2+1 Sem II

Practical: Seed treatment, seed germination and crop establishment in relation to soil moisture contents, moisture stress effects and recovery behaviour of important crops, estimation of moisture index and aridity index. Spray of anti-transpirants and their effect on crops, collection and interpretation of data for water balance equations, water use efficiency, preparation of crop plans for different drought conditions. Study of field experiments relevant to dryland farming, visit to dryland and soil conservation research stations and watershed projects.

Agron. 512 Conservation Agriculture 2+0 Sem. II
Conservation agriculture definition, status and prospects. Its role towards natural resources management and sustainability concerns. Concept of conservation agriculture and their fulfillment using tillage and crop residue management, efficient cropping systems, water and nutrients management, and integrated pest management. Relevance of conservation agriculture under changing climatic conditions.
Impact of conservation agriculture on soil health and crop productivity. Conservation agriculture under rainfed / dry land farming.

**Agron. 601 Advanced Trends in Agronomy**  
2+0  Sem. I  

**Agron. 602 Advanced Crop Ecology**  
2+0  Sem.I  

**Agron. 603 Advanced Irrigation Management**  
2+0  Sem.II  

**Agron. 604 Advanced Weed Management**  
2+0  Sem.II  
Agron. 605 Advanced Crop Growth and Productivity  2+0  Sem.I

Agron. 606 Integrated Farming Systems for Sustainable Agriculture  2+0  Sem. II
Farming systems- concept, classification of farming systems according to type of rotation, intensity of rotation, degree of commercialization, water supply, enterprises. Concept of sustainability in farming systems, efficient farming systems, natural resources - identification and management. Production potential of different components of farming systems; interaction and mechanism of different production factors, stability in different systems through research. Eco-physiological approaches to intercropping. Simulation models for intercropping, soil nutrient in intercropping, preparation of different farming system models. Evaluation of different farming systems. New concepts and approaches of farming systems and cropping systems and organic farming, case studies on different farming systems. Role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system for sustainable agriculture.

Agron. 607 Stress Crop Production  2+0  Sem. I
Stress and strain terminology, nature and stress injury and resistance, causes of stress. Low and high temperature stress- freezing, heat injury and resistance in plants, measurement of freezing tolerance, chilling injury and resistance in plants, practical ways to overcome the effect of low temperature stress through soil and crop manipulations. Water deficit stress and its effect on growth and development, water deficit injury and resistance, practical ways to overcome effect of water deficit stress through soil and crop, manipulations. Excess water and salt stress, its effects on crop plants and practical ways to overcome these through soil and crop manipulations. Mechanical impedance of soil and its impact on plant growth, measures to overcome soil mechanical impedance. Environmental pollution-air, soil and water pollution, and their effect on crop growth and quality of produce, ways and means to prevent environmental pollution.

Agron. 591 Seminar
Agron. 600 Master's Research
Agron. 700 Ph.D. Research
ENTOMOLOGY

PROGRAMMES
1. M.Sc.
2. Ph.D.

COURSE REQUIREMENTS

M.Sc.
Field of Specialization: Economic Entomology, Insect Ecology, Insect Physiology, Insect Taxonomy, Insect Toxicology
Required Courses: Ent.501, Ent.502, Ent.503, Ent.504, Ent.505
Supporting Courses: Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem
Minor Fields: Biochemistry, Biotechnology, Chemistry, Nematology, Plant Breeding & Genetics, Plant Pathology or any other as approved by Dean, Postgraduate Studies
Deficiency Courses for students with the elective other than Crop Protection: As recommended by Student’s Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.
Field of Specialization: Economic Entomology, Insect Ecology, Insect Physiology, Insect Taxonomy, Insect Toxicology
Required Courses: Ent. 601, Ent.602, Ent.603
Supporting Courses: Courses from subject matter fields (other than minor) relating to area of special interest and research problem.
Minor Fields: Biochemistry, Biotechnology, Chemistry, Nematology, Plant Breeding & Genetics, Plant Pathology, or any other as approved by Dean, Postgraduate Studies
Deficiency Courses for students with M.Sc. (Agri.) in a discipline other than Entomology: Ent.501, Ent.502, Ent.503, Ent.504, Ent.505, and other courses as recommended by student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

**Ent. 51 Elementary Agricultural Entomology**  
2+1 Sem. I


**Ent. 52 Useful Insects**  
2+1 Sem. II

Insects of commercial importance. Apiculture, sericulture and lac culture. Pollinators. Predators, parasitoids and scavengers. Insects as food; Medicinal and aesthetic value of insects.


Undergraduate Courses

**Ent. 201 Fundamentals of Entomology**  
3+1 Sem. I


Practical: Collection and preservation of insects including immature stages. Morphology and anatomy of Grasshopper/Blister beetle. Different types of antennae, mouthparts, legs and wings. Wings venation and wing coupling apparatus. Types of larvae and pupae. Study of characters of orders -
Ent.-Pl. Path. 202 Principles of Integrated Insect-pest and Disease Management 2+1 Sem. II


Ent.-Pl. Path. 203 Fundamentals of Crop Protection 2+1 Sem. I (For students of B. Tech. Biotechnology)


Ent. 301 Pests of Crops and Stored Grains and their Management 2+1 Sem. I
Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of major arthropod pests of various field, vegetable, fruit, plantation and ornamental crops, and spices and condiments. Stored grain losses -role of physical, biological, mechanical and chemical factors. Insects, mites, rodents, birds and microorganisms associated with stored grains and their management. Principles of grain store management. Storage structures and methods of grain storage. Warehousing Development and Regulatory Authority; Warehousing (Development and Regulation) Act.


**Ent. 302 Management of Beneficial Insects**  
2+1  
Sem. II


**Ent. 491 Agro-industrial Attachment**  
0+4  
Sem. I

(i) Commercial Honey Production, Hive and Apicultural Equipment and Honey Processing Manufacturing Units; Honey Trading, Processing, Packaging, Exporting and Marketing Units.

**Ent. 492 Experiential Learning in Commercial Apiculture**  
0+20  
Sem. II

**Ent-Pl.Path. 491 Agro-Industrial Attachment**  
0+4  
Sem I

i. Pesticide and Biopesticide Industries
ii. Biocontrol Agents Production Units
iii. Plant Quarantine Station
iv. Virus free Potato Tuber Production Units

**Ent-Pl.Path.492:Experiential Learning in Production Technology for Bioagents**  
0+20  
Sem II
Postgraduate Courses

Ent. 501 Insect Morphology and Systematics 2+1 Sem.I

Ent. 502 Insect Anatomy and Physiology 2+1 Sem.I

Ent. 503 Classification of Insects 2+1 Sem.I
History of insect classification and its importance. Introduction to phylogeny of insects. Classification of Superclass Hexapoda including all the classes with special emphasis on Class Insecta. Distinguishing morphological characters alongwith the habits and habitats of insects belonging to economically important families of all the orders of Class Insecta.
Practical: Collection and preservation of insects. Identification of insects upto family level. Field visits to collect insects of different orders.

Ent. 504 Insect Ecology 2+1 Sem.II

Ent. 505 Toxicology of Insecticides 2+1 Sem. II
Definition, importance, scope, basic principle of insecticide toxicology and its relationship with other disciplines. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids,
neonicotinoids, oxadiazines, phenylpyrazoles, botanicals and new promising compounds etc. Criteria, methods, problems and solutions of bioassay. Evaluation of insecticide toxicity, joint action of insecticides, synergism, potentiation and antagonism, factors affecting toxicity of insecticides, selectivity and phytotoxicity. Insecticide metabolism, pest resistance to insecticides, mechanisms and types of resistance, insecticide resistance management and pest resurgence. Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides, safe use of insecticides, diagnosis and treatment of insecticide poisoning.

Practical: Insecticide formulation and mixtures, quality control of pesticide formulations. Working out doses and concentrations of pesticides for laboratory and field evaluation for their bioefficacy, bioassay techniques, probit analysis, evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Preparation of working standard solutions of pesticides, Sampling, extraction, clean-up and estimation of insecticide residues by various methods, calculations and interpretation of data, visit to toxicology laboratories, good laboratory practices.

**Ent. 506 Biological Control of Insect Pests**  
2+1  
Sem. I


**Ent. 507 Plant Resistance to Insects**  
2+1  
Sem. II


**Ent. 508 Integrated Pest Management**  
2+1  
Sem. I


Ent. 509/Pl.Path.509/Nem. 509 Molecular Approaches in Plant Protection 2+1 Sem.II


Ent.510/Pl.Path.510/ Nem. 510 Quarantine in Plant Protection 2+0 Sem.II

Ent. 511 Insect Vectors of Plant Pathogens  
Sem.II  
2+1


Ent. 512 Commercial Entomology  
Sem.II  
2+1


Ent. 513 Storage Entomology  
Sem. II  
2+1


Ent. 514 General Acarology  
Sem.II  
1+1

History of acarology. Importance of mites and ticks as a group. Introduction to morphology and biology of mites and ticks. Broad classification of major orders and important families of Acari including diagnostic characteristics. Economic importance of mites. Seasonal occurrence and nature of damage of mite

Practical: Collection and extraction of mites from different habitats. Preparation of mounting media and slide mounts. External morphology of mites. Identification of mites up to family level using keys. Studying different rearing techniques for mites.

**Ent. 601 Advanced Insect Systematics**  
2+0  Sem.II


**Ent. 602 Advanced Insect Physiology**  
2+0  Sem.II


**Ent. 603 Advanced Insect Pest Management**  
2+0  Sem.II

Database management and computer programming, simulation techniques and system analysis and modelling. Case histories of national and international programmes, their implementation, adoption and criticisms, global trade and risk of invasive pests. Advances in application of behavior modifying chemicals, insect growth regulators, genetic engineering and other biotechnological strategies for management of insect pests. Strategies for pesticide resistance management and resurgence in insects. Scope and limitations of bio-intensive and ecological based IPM programmes. Applications of IPM to farmers' real time situations. Dynamism of IPM under changing cropping systems and climate; insect pest management under protected cultivation. Advances in pesticide application technology.

**Ent. 604 Advanced Insect Ecology**  
2+0  Sem. I


**Ent.605 Advanced Biological Control**  
2+0  Sem.II  
(Pre-requisite Ent.506)

and parasitoids in biological control. Genetics of ideal traits in biocontrol agents for introgressing and for progeny selections. Breeding techniques of biocontrol agents

**Ent. 606 Advanced Insecticide Toxicology**  
2+1  Sem. I

Practical: Sampling, extraction, clean-up and estimation of insecticide residues by various methods, calculations and interpretation of data, biochemical and biological techniques for detection on insecticides resistance in insects.

**Ent. 607 Advanced Host Plant Resistance**  
2+0  Sem.II
(Pre-requisite Ent.507)


**Ent. 608 Insect Behaviour**  
2+0  Sem. II

Evolution and inheritance of insect behaviour. Innate and learned behaviour patterns. Orientation - forms of primary and secondary orientation including taxes and kinesis. Responses to environmental stimuli; role of visual, olfactory and auditory signals. Biological functions of insect behaviour such as locomotion, feeding, host selection and location, escape, defense, reproduction, dispersal and migration. Activity rhythms and biological clocks. Genetic and hormonal control of insect behaviour. Regulation of insect population through behavioural manipulations. Inter- and intra-specific communication. Insect societies. Nest founding and construction, brood care, defense and caste determination in social insects.

**Ent.591 Seminar**

**Ent. 600 Master's Research**

**Ent.700 Ph.D. Research**
EXTENSION EDUCATION

PROGRAMMES
1. M.Sc.
2. Ph.D.

COURSE REQUIREMENTS

M.Sc.
- **Field of Specialization**: Communication and Adoption of Innovations, Farmers' Training and Education, Extension Administration.
- **Required Courses**: Ext.501, Ext.502, Ext.503, Ext.504, Ext.505, Ext.506
- **Supporting Courses**: Stat.421, Stat.522, PGS 501 and other courses from subject-matter fields (other than minor) relating to area of special interest and research problem.
- **Minor Fields**: Any agricultural subject depending upon the student's interest and research problem.
- **Deficiency courses for students with elective other than Agri-Business Management, Economics and Extension Education**: As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.
- **Field of Specialization**: Communication and Adoption of Innovations, Farmers' Training and Education, Extension Administration.
- **Required Courses**: Ext.601, Ext.602, Ext.603
- **Supporting Courses**: Stat.526 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.
- **Minor Fields**: Any agricultural subject depending upon the student's interest and research problem.
- **Deficiency courses for students with M.Sc. (Agri.) in a discipline other than Extension Education**: Ext.501, Ext.502, Ext.503, Ext.504, Ext.505, Ext.506, Stat.522 and other courses as recommended by Student's Advisory Committee.
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Ext. 51 Elementary Extension Education 2+2 Sem. II

Undergraduate Courses

Ext. 101 Agricultural Heritage 1+0 Sem. I
Introduction of Indian agricultural heritage, status of farmers in society; advice by sages to kings on their duties towards farmers, soil management in ancient, medieval & pre-modern India and its relevance in modern day sustainable agriculture, heritage of crop & water management, plant growth and development & plant protection through vrikshayurveda and traditional knowledge. Heritage of medicinal plants and their relevance today, seed health in ancient & medieval history and its relevance to present day agriculture, description of Indian civilization and agriculture by travellers from China, Europe and United States, our journey in agriculture, green revolution and its impact and concerns, vision for the future.

Ext. 201 Fundamentals of Agricultural Extension Education 2+1 Sem. I
Practical: Acquaintance with university extension system. Group discussion exercise. Handling and use of audio-visual equipment - digital camera and LCD projector. Preparation and use of AV aids. Preparation of extension literature - leaflet, booklet, folder, pamphlet, news stories and success stories. Presentation skills and microteaching exercises. Visit to village to understand the problems of villagers/farmers. Understanding PRA techniques and their application in village development planning. Study of organization and functioning of DRDA and other development departments at district level. Visit to NGOs and learning from their experience in rural development. Exposure to mass media - visit to community radio and television studio for understanding the process of programme
production. Script writing, writing for print and electronic media, developing script for radio and television.

RAWE 401 (General Orientation and On-campus training) 0+1 Sem I
RAWE 402 (Village Attachment) 0+8 Sem I
RAWE 403 (KVK and Research Station Attachment) 0+5 Sem I
RAWE 404 (Plant Clinic) 0+2 Sem I

Postgraduate Courses

Ext. 501 Development Perspectives of Extension Education 1+1 Sem.I

Practical: Studying on-going rural development programmes. Visits to KVK, NGO and extension centers of State Agricultural University and state development departments to study their objectives, organizational set up and activities. Report preparation and presentation.

Ext. 502/HECM 502 Development Communication and Information Management 2+1 Sem.II
Communication-concept, meaning, importance, models, theories and types. Communication delity, credibility, empathy, feedback and factors affecting communication process. Communication skills. Characteristics and role of key communicators in development. Expert system in selected enterprises. Role of ICT in communication. Social networks and development. Effective oral communication, public speaking, non-verbal communication, writing skills and soft skills. Participative communication-meaning, importance, process and determinants. Development communication-concept, nature and significance. Recent advances in communication- print and electronic, internet, e-mail, fax, mobile, interactive video and teleconferencing, computer and computer networking (PAN, LAN, CAN, MAN, WAN), AGRINET, e-Governance.

Practical: Exercises in oral and written communication. Planning and use of different communication approaches. Practical hands on experience in recent advances in print and electronic media.

Ext.503/HECM 503 Participatory Programme Management 1+1 Sem.II
Conceptual framework of extension programme. Planning - key concepts and importance in planned change. Participatory planning - concept, importance, process. Techniques of participatory planning-RRA, PRA and PLA and their application in extension. Approaches of participatory planning - cooperative, democratic, bottom up and down. Project management techniques - PERT, CPM, SWOT analysis, obtaining technical and monetary support from GOs and NGOs. Importance and ways of people's participation in programme planning. Concept and formation of farmers and women SHGs. Implementation and evaluation - concept, importance and techniques.

Ext. 504 Diffusion and Adoption of Innovations 1+1  Sem.I
Practical: Case studies in individual and community adoption process. Content analysis of adoption studies. Identification of adopter categories of a selected technology. Studying attributes of current farm technologies. Identification of opinion leaders. Sources of information at different stages of adoption. Studying factors affecting rate of adoption. Presentation of reports on adoption and diffusion of innovations.

Ext.505/Econ.506/Soc.506/HECM 501 Research Methodology for Social Sciences 2+1  Sem.I

Ext. 506 Human Resource Development 2+1  Sem.II
Practical: Visits to different training organizations to review their on going activities and facilities. Analysis of training methods used for imparting training to farmers and extension personnel. Evaluation of a training programme. Studying human resource development in an organization in terms of performance, organizational development, employee's welfare and improving quality of work life and human resource information.

Ext.507 Entrepreneurship Development and Management in Extension 2+1 Sem.II


Ext.508 Perspectives of Distance Education 2+0 Sem.I


Ext. 509 Market Led Extension Management 1+1 Sem.II

(In collaboration with Deptt. of Economics and Sociology, COBSc.&H)


Practical: Identification and analysis of different marketing sources for agricultural commodities. Developing strategy for an effective market intelligence system and marketing plan to suit rural situation. Visits to APEDA and Apni Mandi to study their processes and procedures related to market-led extension.

Ext. 510 Visual Communication 1+1 Sem.I

Role, characteristics and functions of visuals and graphics in communication. Theories of visual perception. Classification and selection of visuals. Designing message for visuals, graphic formats and devices. Presentation of scientific data. Principles and production of low cost visuals. Photographs, reprographic
and computer based visuals. Digitized video material in multimedia production. Designing visuals for print, TV and video. Scanning, pre-testing and evaluation of visuals.


Ext. 511 / HECM 506 Gender Sensitization for Empowerment 2+0 Sem.I

Gender sensitization-meaning, need and importance of empowering women. Gender in community diversity and its implication for empowerment. Gender perspectives in development of women, social characteristics, desegregated roles, responsibilities, resources, constraints and opportunities. Economical, educational and anthropological parameters in gender perspectives. Gender dimensions and methodologies for empowerment. Gender analysis framework-context, activities, resources, tools and programme action profile. Training aids for gender sensitization. Empowerment through gender specific technologies, household technology interface. Socio-cultural interface and women as consumer of technologies. Gender issues and development-health and nutrition, violence, governance, educational media.

Ext. 601 Advances in Agricultural Extension 2+0 Sem.II


Ext. 602/HECM 602 Scaling Techniques for Behavioural Research 2+1 Sem.II


Ext.603 Advances in Training Technology 3+0 Sem.I

Paradigm shift in training and learning scenario. Training need assessment, approaches, designs and models. Designing an effective training programme and training session. Harmonizing training needs, course objectives, content and methods. Designing experiential training sessions, simulation exercises and openness in training transaction, managing dilemmas, ambivalence, conflicts and confusion for trainers and trainees. Recent training techniques for understanding and facilitation of team building. Group dynamics, motivation and empowerment. Laboratory methods, micro-lab process work and sensitivity training. Thematic Appreciation Test, inventories, cases as training tools. Participatory training techniques.

**Ext.604 Organizational Development** 2+0  Sem.II

**Ext.605 Advanced Instructional Technology** 2+0  Sem.I

**Ext.606 Theory Construction in Social Sciences** 2+0  Sem.I

**Ext.607 Transfer of Technology in Agriculture** 2+0  Sem.II
Transfer of technology (TOT) and transfer of technology systems. Knowledge generating system. Knowledge disseminating and consuming system. Input supplying agencies system. Appropriateness of communication media in the system of technology transfer. New communication strategy for transfer and adoption of agricultural technology. Extension training in transfer of technology. Analysis of constraints in transfer of technology. Agencies or departments involved in TOT. Role of extension professionals in TOT. Attributes of technology in relation to TOT process. TOT to resource poor farmers. Role of key communicators or local leaders in TOT. Private and public partnership in TOT. TOT system in USA, Asian and European countries.

**Ext.608/HECM 606 Advanced Media Management** 2+1  Sem.I
(In collaboration with Deptt. of Agril. Journalism, Languages & Culture, COBSc.&H)
organizational structure of radio and television in public and private sectors. Concept, history and role of FM radio, community radio and TV in transfer of technology. Functions of various departments and personnel - production, marketing, financial, managing the station/channel.

Practical: Visit to print, electronic and new media organizations to understand the designing, media development, organizational management, functions, problems etc.

Ext.591 Seminar
Ext.600 Master's Research
Ext.700 Ph.D. Research
FLORICULTURE AND LANDSCAPING

PROGRAMMES
1. M.Sc.
2. Ph. D.

COURSE REQUIREMENTS

M.Sc.
Field of Specialization: Floriculture, Landscaping
Required Courses: Flori. 501, Flori. 502, Flori. 503, Flori. 504
Supporting Courses: Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to the area of special interest and research problem.
Minor Fields: Plant Breeding & Genetics, Biotechnology, Horticulture, Soil Science, Botany or any other as approved by Dean, Postgraduate Studies.
Deficiency courses for the students with elective other than Horticulture: As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.
Field of Specialization: Floriculture, Landscaping
Required Courses: Flori. 601, Flori. 602, Flori. 603
Supporting Courses: Courses from subject matter fields (other than minor) relating to area of special interest and research problem.
Minor Fields: Plant Breeding & Genetics, Biotechnology, Horticulture, Soil Science, Botany or any other as approved by Dean, Postgraduate Studies.
Deficiency courses for other students with M. Sc. (Agri.) in a discipline other than Floriculture and Landscaping: Flori. 501, Flori. 502, Flori. 503, Flori. 504 and courses as recommended by Student's Advisory Committee.
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Flori. 51 Landscaping and Floriculture 1+1 Sem. II

Undergraduate Courses

Flori. 202 Production Technology for Ornamental Crops and Landscaping 1+1 Sem. II

Flori. 301 Landscape Gardening 2+1 Sem. II

Flori. 491 Agro-industrial Attachment 0+4 Sem. I
(i) Commercial Flower Nurseries
(ii) Flower Marketing Firms
(iii) Flower Seed Production and Landscaping Units

Flori. 492 Experiential Learning in Commercial Floriculture and Landscaping 0+20 Sem.II
Postgraduate Courses

Flori. 501 Production Technology of Flowers 3+1 Sem.I


Flori. 502 Breeding of Flower Crops and Ornamental Plants 2+1 Sem.II


Flori. 503 Landscaping and Ornamental Gardening 2+1 Sem.I

Practical: Study of violation of art and landscape principles. Identification and analysis of plant material for their use in landscaping. Propagation techniques of ornamentals. Maintenance of plant material including indoor plants. Study tours to gardens and arboretums.
Flori. 504 Landscape Designs (Pre-requisite: Flori. 503)  2+2  Sem.II
Practical: Site analysis of various landscape projects. Use of drawing scale, lettering, plotting, reading and interpretation of maps on different scales. Preparation of landscape designs of various types of buildings, roads, parks, sport centers, picnic spots, and camping grounds. Display of plants for interior decoration. Preparation of cost estimates for landscaping and maintenance. Study tours. Introduction to CAD.

Flori. 505 Protected Floriculture  2+1  Sem.II
(Collaboration: Deptt. of Soil and Water Engineering)

Flori. 506 Value Addition in Flowers  2+1  Sem.I

Flori. 507 Turfing and Turf Management  2+1  Sem.I
Status and prospects of turf grass. Site selection and evaluation. Physical, chemical and biological properties of soil for turf grass establishment. Turf grasses - Types, species, varieties, hybrids. Selection of
grass for different locations. Grouping according to climatic requirement- adaptation. Turfing for roof gardens. Preparatory operations. Growing media used for turf grasses. Turf establishment methods, seeding, sprigging/dibbling, plugging, sodding/turfing, turf plastering, hydro-seeding. Turf management - Irrigation, nutrition, special practices - aerating, rolling, soil top dressing. Use of plant growth regulators (PGRs) and micronutrients. Turf mowing- mowing equipments, weed control. Biotic and abiotic stress management in turfs. Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, tennis, etc.


Flori. 508 CAD for Outdoor and Indoor Landscaping

Applications of CAD in landscape garden designing, 2D drawing by AUTOCAD, Basics of Photoshop software in garden designing. Toolbars and Icons, File handling functions, Modifying tools. Dimension concepts, Hyper linking, Making layout. Dimensioning and detailing of designs, Visualization tools for landscape preview, Data management, plotting and accessories for designing.


Flori. 601 Advances in Flower Production Technology


Flori. 604 Advances in Pre and Post-harvest Management of Ornamentals 3+0 Sem.II

Flori. 605 Advances in Nursery Production and Management 2+0 Sem.I

Flori. 606 Advances in Protected and Precision Floriculture 2+0 Sem.II
Flori. 607 Planning and Management of Parks 2+0 Sem.II
Recreational parks - history, importance, scope and their role in outdoor recreation and nature conservation. Biotic regions of the world. Types of distribution of vegetation in India. Bio-aesthetic planning, lanning and designing of Botanical gardens, amusement and zoological parks. Maintenance of historical and archeological sites, recreational gardens, Wet lands, National parks, and wild life sanctuaries.
Flori. 591 Seminar
Flori. 600 Master’s Research
Flori. 700 Ph.D. Research
FOOD SCIENCE AND TECHNOLOGY

PROGRAMMES
1. B.Tech. (Food Technology)
2. M.Sc.
3. Ph.D.

COURSE REQUIREMENTS

M.Sc.
Field of Specialization: Cereal Technology, Fruit and Vegetable Technology, Dairy Technology, Egg and Meat Technology
Required Courses: FT 501, FT 502, FT 503, FT 504, FT 505, FT 506
Supporting Courses: Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to the area of special interest and research problem
Minor Fields: Microbiology, Biochemistry, Processing and Food Engineering, Food and Nutrition or any other as approved by the Dean, Postgraduate Studies
Deficiency courses for students with elective field other than Post Harvest Technology and Value Addition: As recommended by the students Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.
Field of Specialization: Cereal Technology, Fruit and Vegetable Technology, Dairy Technology, Egg and Meat Technology
Required Courses: FT 601, FT 602, FT 603, FT 604
Supporting Courses: Courses from subject matter fields (other than minor) relating to area of special interest and research problem
Minor Fields: Microbiology, Biochemistry, Processing and Food Engineering, Food and Nutrition or any other as approved by the Dean, Postgraduate Studies
Deficiency courses for Students with M.Sc. (Agri.) in a discipline other than Food Science and Technology: FT 501, FT 502, FT 503, FT 504, FT 505, FT 506 and other courses as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

FT 51 Elementary Food Technology 1+1 Sem. II
Practical: Quality assessment of cereals, fruits, vegetables, egg, meat and poultry. Value added products from cereals, fruits, vegetables, milk, egg and meat. Visit to local food processing units.

Undergraduate Courses

FT 101 Food Science and Processing 1+1 Sem. I
Definition: Food and nutrition; Food production and consumption trends in India; Major deficiencies of calories, proteins, vitamins and micronutrients; food groups and concept of balanced diet; RDA.
Causes of food spoilage; principles of processing and preservation of food by heat, low temperature, drying and dehydration, chemicals and fermentation; preservation through ultraviolet and ionizing radiations. Post-harvest handling and technology of fruits, vegetables, cereals, oilseeds, milk, meat and poultry; food safety, adulteration and food laws; status of food industry in India.
Practical: Quality assessment of cereals, fruits, vegetables, egg, meat and poultry. Value added products from cereals, fruits, vegetables, milk, egg and meat. Visit to local processing units.

FT 102 Food Chemistry of Macroconstituents 2+1 Sem. II

FT 201 Fundamentals of Food Processing 1+1 Sem. I
Scope and importance of food processing. Sources, types and perishability of foods. Causes and types of food spoilage. Food preservation - principles, methods, benefits, effects on food quality and
equipments. Methods of preservation: salt and sugar, heat treatment, low temperature, drying, dehydration, concentration, fermentation, irradiation, chemicals - acidulants, antioxidants, mold inhibitors and antibodies. Principles, methods and equipments for thermal processes - blanching, canning, pasteurization and sterilization. Principles and equipments for non-thermal processes - pulsed electric field and pulsed intense light, ultrasound, dielectric heating, ohmic heating, infrared heating, high pressure processing and microwave processing. Quality tests and shelf-life of preserved foods.

Practical: Demonstration of various perishable food items and assessment of degree of spoilage. Blanching of selected food items. Preservation of food by heat treatment- pasteurization and sterilization. Preservation of food using high concentration of sugar (jam), salt (pickle), acidulants (pickling by vinegar or acetic acid) and chemical preservatives. Preservation of bread and cake using mold inhibitors. Drying of foods - fruit slices (pineapple and apple) and green leafy vegetables in cabinet dryer, mango/other pulp by foam-mat dryer, semisolid foods by roller dryers and vegetable slices by freeze dryer. Preserving foods under cold and freezing process. Processing of foods using fermentation technique - sauerkraut. Effect of high pressure on microbes. Effect of pulse electric field on food.

**FT 202 Processing Technology of Liquid Milk**  
1+1  
Sem. I


**FT 203 Food Additives and Preservatives**  
1+1  
Sem. I


FT 204 Food Chemistry of Microconstituents 2+1 Sem. I


FT 205 Processing Technology of Meat and Poultry Products 2+1 Sem. II


FT 206 Technology of Bakery, Confectionery and Snack Foods 2+1 Sem. II

Bakery products - types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing. Confectionery and chocolate products - types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing. Product quality characteristics, defects, causes and corrective measures. Snack foods - types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing. Snack food seasonings. Breakfast cereals, macaroni products and malts - specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing. Practical: Identification and composition of various ingredients for snacks, bakery and confectionery products. Flours, their classifications and characterization. Preparation, packaging and quality evaluation of selected snack items, bakery items, confectionery items, selected chocolates, traditional Indian confection. Visit to bakery, confectionary and snack units (industry).

FT 207 Processing Technology of Legumes and Oilseeds 2+1 Sem. II

Present status and future prospects of legumes and oilseeds. Morphology, classification, types, chemical composition, nutritional value and anti-nutritional compounds in legumes and oilseeds.


FT 208 Processing Technology of Spices and Plantation Crops     1+1   Sem. II

FT 301 Processing Technology of Fruits and Vegetables   2 +1  Sem. I
Production and processing scenario of fruits and vegetables in India and world. Scope of fruit and vegetable processing industry in India. Overview of principles and preservation methods of fruits and vegetables. Supply chain of fresh fruits and vegetables. Primary processing and pack house handling of fruits and vegetables. Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables. Minimal processing of fruits and vegetables. Blanching operations and equipment. Canning-definition, processing steps, equipment, cans and containers, quality assurance and defects in canned products. FSSAI specifications, preparation, preservation and equipments used for juices, squashes, syrups, sherbets, nectars, cordials, crystallized fruits preserves, jam, jelly, marmalades, candies, chutney, pickles, sauce, puree, paste, ketchup, toffee, fruit cheese, leather, dehydrated products, wafers, papads and soup powders. Production of pectin and vinegar. Commercial processing technology of selected fruits and vegetables for production of various value added processed products.

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FT 302 Processing Technology of Cereals 2+1 Sem. I

FT 303 Processing Technology of Dairy Products 2+1 Sem. I
Classification of dairy products. Butter - definition, composition, processing, equipment, overrun, quality testing, defects - causes and their prevention, packaging and storage. Butter oil and ghee - definition, composition, processing, equipment and quality tests. Paneer and cheese - definitions, composition, types, processing, equipment, quality defects- causes and prevention, packaging and storage. Ice cream and frozen desserts - definition, composition, types, processing, equipment, quality testing, defects - causes and prevention, packaging and storage. Condensed and dried milk - definition, composition, role of milk constituents in condensed milk, manufacture of condensed milk, types of standards for dried milk, manufacture of skim milk powder (SMP) and whole milk powder (WMP) using roller and spray drying, instantization, recent developments in drying, quality testing, defects- causes and prevention, packaging and storage. Traditional Indian dairy products - definitions, composition, processing, packaging, storage, equipment and quality testing. Byproducts of dairy industry and their utilization (lassi, whey and ghee residue).

FT 304 Sensory Evaluation of Food Products 2+1 Sem. I
Requirements of sensory evaluation. Sampling procedures. Factors influencing sensory measurements. Consumer research – effective tests, objectives, methods, types and development of questionnaires. Comparison of laboratory testing and consumer studies along with their limitations. Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests. Application of sensory testing. Sensory evaluation in food product development and quality control.

Practical: Determination of threshold value for basic tastes and odours. Selection of judging panel. Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests- difference test (Paired Comparison (PC), Duo-trio, triangle). Descriptive analysis methodology. Sensory evaluation of various food products using different scales, score cards and tests. Texture profile methodology. Estimation of colour. Relationship between objective and subjective methods. Designing a sensory laboratory.

FT 305 Techniques and Instruments for Food Analysis 1+2 Sem. I


FT 306 Food Plant Sanitation 1+1 Sem. II

Practical: Determination of BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) of industrial effluents. Determination of hardness of water. Good Manufacturing Practices (GMPs) and personal hygiene. Primary, secondary, tertiary and quaternary aerobic and anaerobic sludge

**FT 307 Processing Technology of Fish and Marine Products 1+1 Sem. II**


**FT 308 Processing Technology of Beverages 2+1 Sem. II**

History, importance and status of beverages industry. Packaged drinking water, juice based beverages, synthetic beverages, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based beverages, alcoholic beverages, fruit beverages, specialty beverages, tea, coffee, cocoa, spices, plant extracts, etc. FSSAI (Food Safety and Standards Authority of India) specifications for beverages. Ingredients, manufacturing, packaging processes and equipment for different beverages. Water treatment and quality of process water. Sweeteners, colourants, acidulants, clouding, clarifying and flavouring agents for beverages. Carbon dioxide and carbonation. Quality tests and control in beverages. Miscellaneous beverages - sugar cane juice, coconut beverages and flavoured syrups.


**FT 309 Food Quality, Safety Standards and Certification 2+0 Sem. II**

procedures. Consumer measurement - factors influencing acceptance and preference, objectives of consumer preference and information obtained from consumer study. Development of the questionnaire, types of questionnaires and serving procedures. Laboratory panels versus consumer panels. Limitations of consumer survey. Physical, chemical and microbial quality of raw material and processed products. Colour, taste, texture, flavor and appearance. Factors influencing the food quality - soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. Quality - inspection and control. Quality management and quality assurance - total quality management (TQM), good manufacturing practices (GMP), good agricultural practices (GAP), and good laboratory practices (GLP). Quality management systems - quality services and solutions (QSS). Quality circles and statistical quality control (SQC). ISO system. HACCP - principles, implementation, plan documentation and record keeping. Auditing - surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors. Certification - procedures, certifying bodies, accrediting bodies and international bodies.

FT 310 Food Packaging Technology and Equipment  2+1  Sem. II

FT 313 Principles of Food Science and Nutrition  2+0  Sem. I

FT 314 Food Safety and Standards  2+1  Sem. II
Food safety - definition and importance. Scope and factors affecting food safety. Hazards and risks. Types of hazards - biological, chemical, physical hazards and management. Control of parameters - temperature, pH etc. Food storage. Product design. Hygiene, sanitation in food service. Establishments - introduction. Sources of contamination and their control, waste disposal, pest and rodent control. Personnel hygiene, food safety measures. Food safety management tools - basic concepts, PRPs, GHPs, GMPs, SSO'Ps, etc. HACCP. ISO series. TQM - concept and need for quality,

**FT 491 Agro-industrial Attachment**

0+4 Sem. I

i. Fruits and Vegetables Industry
ii. Beverages Industry
iii. Cereal Industry
iv. Milk Industry

**FT 492 Experiential Learning in Food Technologies**

0+20 Sem. II

Experiential Learning in processing of Cereals, Fruits and Vegetables in pilot plants. This shall include development of detailed project report on setting up of enterprise in the selected areas of product manufacture and evaluation of the module. The experiential learning is intended to build practical skills and entrepreneurship attributes among the students with an aim to deal with work situations and for better employability and self-employment.

**FT/ Mgt 493 Entrepreneurship Development**

2+1 Sem. I


**FT 494 Student READY-Experiential Learning Programme - I**

0+7 Sem. I
Student READY - Experiential Learning in processing of fruits and vegetables in pilot plants. This shall include development of detailed project report on setting up of enterprise in the selected areas of product manufacture and evaluation of the module. The experiential learning is intended to build practical skills and entrepreneurship attributes among the students with an aim to deal with work situations and for better employability and self- employment.

**FT 495 Student READY- Experiential Learning Programme - II 0+7 Sem. I**
Student READY - Experiential learning in processing of grains in value added food products in pilot plants. This shall include development of detailed project report on setting up of enterprise in the selected areas of product manufacture and evaluation of the module. The experiential learning is intended to build practical skills and entrepreneurship attributes among the students with an aim to deal with work situations and for better employability and self-employment.

**FT 496 Student READY - Research Project 0+3 Sem. I**

**FT 497 Student READY - Seminar 0+1 Sem. I**
A power point presentation on any topic chosen from the subjects studied from vocational package to be prepared and delivered to the group of staff and students of department. Organization of topic. Presentation of data. Oral presentation. Delivery, language, explanation of figures. Ability to grasp and understand the subject and depth of understanding the topic.

**FT 498 Student READY- Industrial cum Educational Tour 0+2 Sem. I**
Student READY - Educational tour of two-three industries within and outside the state of the university and submission of report on industrial tour carrying a weightage of 0+2 credit hours.

**FT 499 Student READY- In-Plant Training 0+20 Sem. II**
Student READY - In-plant training of one semester duration with a credit load of 0+20 credit hours at relevant food processing industry, machinery manufacturer, marketing or other agencies. The In-plant training is intended to expose the students to an environment in which they are expected to be associated in their future career. The students will be required to have hands-on-experience in one or more commercial establishment.

**Postgraduate Courses**

**FT 501/FN 512 Principles of Food Processing 2+1 Sem. I**
Scope of food processing and historical developments. Principles and methods of food processing and preservation - blanching, pasteurization, sterilization and UHT processing, aseptic processing, canning, extrusion, baking, roasting, frying, drying, concentration and evaporation dielectric and microwave heating, refrigeration, freezing, controlled atmosphere (CA), modified atmosphere (MA), and dehydrofreezing. Non-thermal methods- irradiation, high pressure, pulsed electric field, hurdle technology, minimal processing and membrane technology. Food fermentations, pickling, smoking and chemical preservation. Practical: Canning, freeze drying, dehydration, concentration, refrigeration and freezing of foods. Determination of thermal inactivation time of enzymes. Use of chemicals in preservation of foods. Extrusion cooking. Preparation of intermediate moisture and fermented foods. Visit to a food processing plant.

**FT 502 Food Additives and Ingredients 2+1 Sem. I**
Food additives - definition, classification and functions. Preservatives, antioxidants, colours, flavours, emulsifiers, sequestrants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anticaking agents - their food uses and functions in formulations. Toxicological evaluation of food additives. Flavours-types, generation during processing and reactions. Flavour composites. Stability of flavours during food


FT 503 Food Quality Systems and Management 2+1 Sem. II


FT 504 Enzymes in Food Processing 2+1 Sem.II
Enzymes- classification, properties, nature and mode of action. Sources and production of enzymes. Natural enzymes in foods - their significance in food processing. Commercial enzymes and their application in fruits (cell wall degrading enzymes for liquefaction, clarification, debittering, decolourization of very dark coloured juices), vegetables, milk (cheese making, whey processing), meat, poultry (tenderization) and egg, malting, brewing, baking (fungal β- amylase for bread making, maltogenic? - amyloses for anti-staling, xylanases, pentosanases and lipases as dough conditioners, oxidases as replacers of chemical oxidants) and confectionery. Enzymes for corn syrup solids (liquefaction, saccharification, isomerization for production of high-fructose-corn-syrup), fructose and fructo-oligosaccharides. Enzyme processing for flavours. Enzymatic approach to tailor- made fats.

Practical: Assay of enzymes in raw and processed foods. Applications of commercial enzymes in food product preparation- baking, starch hydrolysis, meat tenderization, cheese making and juice clarification.

FT 505 Nutraceuticals and Health Foods 2+1 Sem. I


FT 506 Inplant Training 0+1 (NC) Sem. I & II
After the completion of theory, and research work, M.Sc. students would undergo compulsory inplant training in a food industry for a duration of six weeks. On completion of industrial inplant training the
students will be required to submit a written training report. The students will be evaluated for awarding the grade on the basis of project report, industry manager's report, oral presentation and viva-voce.

**FT 507 Technology of Fruit and Vegetable Processing**

Indian and global scenario on production and processing of fruits and vegetables. Quality requirements of raw materials for processing. Post harvest handling, grading and treatments. Storage of fruits and vegetables- controlled atmosphere (CA) and modified atmosphere (MA) storages. Physiological and enzymological aspects of juice extraction. Fruit and vegetable processing for pulp, puree and concentrates using aseptic packaging, canning, RTS fruit beverages, IQF and frozen fruits and vegetables. Technology for processed products - pickles, chutneys, sauces. Processing of fruits for candies, bars, toffees, jams and jellies, squashes, syrups, cordials, nectars, vinegar and tomato products. Dehydration of fruits and vegetables using various drying technologies. Intermediate moisture fruits and vegetables. Food ingredients and chemicals from fruits, vegetables and their wastes. Effluent treatment. Trends in health aspects related to fruits and vegetables.


**FT 508 Technology of Cereals, Pulses and Oil seeds**


**FT 509 Technology of Milk and Milk Products**


FT 510 Technology of Meat, Poultry and Fish 2+1 Sem. I

FT 511/PFE 510 Food Packaging 2+1 Sem. II

FT 601 Advances in Food Technology 2+0 Sem.II
Membrane technology—micro-filtration, ultra-filtration, nano-filtration, reverse osmosis and their applications in food industry. Supercritical fluid extraction—concept and extraction methods. Microwave and radio frequency processing—mechanism and application in food processing. Hurdle technology—concept and its applications. High Pressure processing—concept, equipments for HPP treatment, mechanism and its application. Ultrasonic processing—properties and applications. New techniques—high intensity light, pulse electric field, ohmic heating, infra red heating, inductive heating and pulsed X-rays and nanotechnology in food processing. Techniques in fortification and stability of nutrients in relation to processing. Flavour stabilization.

FT 602 Advanced Food Analysis 0+2 Sem. I
Sample preparation for food analysis. Measurement of colour, viscosity/texture and water activity of raw and processed foods. Rheological techniques and instrumentation in food. Determination of browning reaction, food additives, residues and deleterious factors in raw and processed foods. Enzymatic, Thermal and Chromatographic methods in food analysis. Microscopic, Fluorimetric and polarimetric techniques in food analysis. Application and operating parameters of spectrophotometer, AAS (Atomic absorption spectroscopy), GC (Gas chromatography), HPLC (high performance liquid
chromatography), NMR (nuclear magnetic resonance), FTIR (Fourier transform infrared spectroscopy),
GC-MS (gas chromatography-mass spectroscopy), LC-MS (liquid chromatography-mass spectroscopy).

FT 603 Product Design and Development  2+0  Sem.II

FT 604 Carbohydrate Technology  2+1  Sem. II
Different carbohydrates in food products such as starch, cellulose, sugars, pectin, fibres (significance in diet, isolation from natural sources, and changes therein during processing). Chemical & enzymatic modification of carbohydrates especially starches and celluloses, manufacture of maltodextrins and corn syrups, Cyclodextrins - chemistry, technology and food applications. Interactions with other food constituents and their implications; Newer carbohydrates for food applications such as xanthan, dextran, pullulan, gellan, curdlan and ?-glucans (nutraceutical and functional properties) Stabilization of food systems, simulated and low-fat foods, Fat-substitutes based on carbohydrates, Carbohydrate-based biodegradable packaging.
Practical: Isolation and assay of food carbohydrates; analysis of modified carbohydrates such as starches and celluloses; evaluating gelling abilities of different polysaccharides, their blends and the effect of food ingredients such as salts, sugars and acids; development of food products with newer carbohydrates in relevant food systems.

FT 605 Lipid Technology  2+1  Sem. I
Nutritional aspects of food lipids and their sources- omega-3 and omega-6 fatty acids and their significance, Phytosterols and their nutraceutical significance. Measurement of lipid degradation parameters during deep-fat frying and storage of foods. Flavor emulsions and their stability. Fat powders like cream, butter, cod-liver oil etc. and techniques involved such as micro encapsulation, Fat substitutes based on carbohydrates and proteins. Formulation and characterization of low-fat spreads, whipped creams, margarines, mayonnaise, salad dressings etc. Bakery shortenings chemistry, formulation and technology. Trans-fatty acids- formation during processing and nutritional aspects, Enzymatic approach to tailor made fats.
Practical: Assay of lipid degradation and polymerization products in fried foods and fried oils; analysis of phytosterols, trans-fatty acids and omega fatty acids; preparation of fat and cream powders; formulation and stabilization of low fat spreads, margarines and mayonnaise based on locally available fats; applications of emulsifiers in industrially produced foods.

FT 606 Protein Technology  2+1  Sem. I
Protein structure and chemistry; protein -protein interactions, methods of evaluation of protein quality and amount, Conventional and novel sources of protein. Production of proteins, protein concentrates/isolates from legumes, oilseeds, fish, seafood, leaf, microbes. Functional properties of proteins and their applications; Structure-function relationships of different food proteins, textured vegetable proteins and different methods of texturization. High protein food formulations, Modification of proteins by enzymic (manufacture of protein hydrolysates, their characterization and applications), chemical and physical methods. Interactions of proteins with flavours, polysaccharides, lipids and their technological effects, Protein-based fat substitutes, Protein engineering.
Practical: Isolation of proteins from different raw materials such as soybeans, oilseed meals, fish, leaves, milk; preparation of protein isolates, concentrates and hydrolysates and evaluation of their nutritional and functional properties; development of high-protein food formulations; visits to industrial units manufacturing protein-based products.

FT 591 Seminar
FT 600 Master's Research FT 700 Ph.D. Research
FORESTRY AND NATURAL RESOURCES

PROGRAMMES
M. Sc.

COURSE REQUIREMENTS

Field of Specialization

Required Courses
Forst. 501, Forst. 502, Forst. 503, Forst. 504, Forst. 505, Forst. 506

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Agronomy, Biotechnology, Botany, Economics, Plant Breeding and Genetics, Vegetable Science, Fruit Science, Floriculture and Landscaping, Soil Science or any other as approved by the Dean, Postgraduate Studies

Deficiency courses for students with elective other than Agronomy, Soil Science and Forestry
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Forst. 51 Elementary Agroforestry 1+1 Sem. I

Undergraduate Courses

Forst. 102 Introduction to Forestry 1+1 Sem. II


Forst. 103 Forest Resource Management 1+1 Sem. II
(For students of COBS & H)


Forst.491 Agro-industrial Attachment (0+4) Sem. I
The students opting for this module under 491 series courses as Agroindustrial attachment will be attached for hands on training at either of the following locations/industries:

i. Forest based Industry (Ply wood/ Furniture/Paper & Pulp, etc.)
ii. High-tech Nursery (Tree Planting Stock Production) in public/private nurseries/farms

Forst.492 Experiential Learning in Nursery Production of Agro-forestry trees (0+20) Sem. II
The students opting for this module under Experiential Learning Modules shall raise the nursery of assigned agro-forestry tree(s) as per the recommended PAU Packages of Practices for Forest Trees.
Postgraduate Courses

Forst. 501 Silviculture

Forst. 502 Forest Biometry and Management
Definition, importance and scope. Measurement of tree parameters. Estimation of volume, growth and yield of individual tree and forest stands. Preparation of volume, yield and stand tables and their application. Forest inventory, sampling methods adopted in forestry, use of GPS in forest inventory and computer analysis of inventory data. Measurement of stand density. Simulation techniques. Growth and yield prediction models - their preparation and applications. Principles of forest management; scope and objective of forest management, development of forest management in India. Need for man-made forests. Site quality evaluation and importance. Stand growth, classical approaches to yield regulation in forest management, salient features and strategies. Forest valuation and appraisal in regulated forests. Forests and its importance, forest societies, interactions between forests and people, social and cultural factors of forest management. Gender dimension of forest management, tribal economy and forests. Forests and food security, eco-tourism and local development, land use change and forestry.

Forst. 503 Forest Ecology and Biodiversity Conservation

Forst. 504 Forest Protection and Conservation

Practical: Collection, identification and preservation of important insect-pests and disease specimens of forest trees, extraction of spores of VAM from soil and assessment of mycorrhizal root infestation, detection of insect infestation and seed borne mycoflora; estimation of losses caused by insects and diseases, laboratory tests for estimating decay resistance in wood, demonstration of power operated sprayer, spray technology for trees, fire control methods and devices.

Forst. 505 Tree Improvement 1+1 Sem. I

Forst. 506 Agroforestry 1+1 Sem. II

Forst. 507/ Econ 520 Forest Resource Management and Economics 1+1 Sem. I
Importance of Forests, use of economic principles in forest resources problems. Forest products, demand and supply analysis, forest products marketing, forest capital theory. Inter-regional and international trade in forest products. Impact of economics and physical variables upon forest appraisal and management decisions. Externalities and property rights. Natural and environmental resource accounting –methods and implications. Application of operations research tools in evaluating forest management alternatives in public and private forest planning.
Practical: Exercises on estimation of demand and supply functions; biodiversity valuation, valuation of non-marketed forest products. Exercises on financial and economic appraisal of forestry projects. Exercises on marketing of forest products and international trade competitiveness. Computer applications for using programming techniques in evaluating forest management alternatives.
Forst. 508 Forest Policy, Laws and International Conventions 2+0 Sem. I

Forst. 509 Forests and People 2+0 Sem. I
Forest societies, people and forests interactions between forests and people. Importance of forests in traditional farming systems, livestock economy and forests, social and cultural factors of forest management. Afforestation programmes and forest conflicts, wildlife and human conflicts, important forest movements like Chipko movement. Gender dimension of forest management. Pastoralists and their dependence on forests. Forests and economic security of tribals. Forests and food security, ecotourism and local development, land use change and forestry. Forest rights, customary rights of people, community participation, ethanobotany, Joint Forest Management, global environmental change and land use, dams, forests and resettlement of tribals and non-tribals - case study. Poverty alleviation and forests, role of NGOs and other community based organizations in forest management.

Forst. 510 Forest Products - Chemistry and Industries 2+1 Sem. II
(Collaboration: Deptt. of Chemistry)
Practical: Estimation of cell wall contents - Hemicellulose and lignin, extraction of essential oils, resins, tannins, acetylation of wood. Moisture content, specific gravity and calorific value determination of wood samples. Determination of strength properties of wood. Visit to State Forest Corporation's saw mill and wood fabrication unit.

Forst. 591 Seminar

Forst. 600 Master's Research
FRUIT SCIENCE

PROGRAMMES
1. M. Sc.
2. Ph. D.

COURSE REQUIREMENTS

M. Sc.

Field of Specialization  
Fruit Breeding, Fruit Production, Orchard Management, Horti.-Agro Techniques, Nursery Production, Post- harvest Handling

Required Courses
Hort. 501, Hort. 502, Hort. 503, Hort. 504, Hort. 505

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Botany, Biochemistry, Biotechnology, Plant Breeding and Genetics, Soil Science, Vegetable Science or any other as approved by Dean, postgraduate Studies.

Deficiency Courses for the Student's with elective other than Horticulture
As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph. D.

Field of Specialization  
Fruit Breeding, Fruit production, Orchard Management, Horti.-Agro Techniques, Nursery Production, Post- harvest Handling

Required Courses
Hort. 601, Hort. 602, Hort. 603

Supporting Courses
Courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Botany, Biochemistry, Biotechnology, Plant Breeding and Genetics, Soil Science, Vegetable Science or any other as approved by Dean, postgraduate Studies.

Deficiency courses for students with M. Sc. (Agri.) in a discipline other than Pomology
Hort. 501, Hort. 502, Hort. 503, Hort. 504, Hort. 505 and other courses as recommended by Student's Advisory Committee

DESCRIPTION OF COURSE CONTENTS

Diploma Courses
Hort. 51 Elementary Fruit Cultivation 2+1 Sem. I
Fruits: Importance, scope and their role in human nutrition. Fruit zones of Punjab. Planning, planting and after-care of fruit plants. Important hints (varieties, soil, irrigation, manuring and fertilization, weed management, training and pruning, harvesting, post-harvest handling, insect-pests and diseases) for the cultivation of fruit plants such as citrus, mango, pear, peach, plum, guava, grapes, litchi, loquat, ber, amla and papaya.
Practical: Identification of different fruit plants. Layout, digging and filling of pits. Planting of young plants and protection from adverse weather conditions. Training and pruning, manuring and fertilization, and methods of irrigation to different fruit plants. Identification and management of important diseases and pests of fruit plants.

Hort. 52 Nursery Production of Fruit Crops 0+1 Sem. II

Undergraduate Courses
Hort. 101 Fundamentals of Horticulture 1+1 Sem. I

Hort. 201 Production Technologies of Horticultural Crops 2+1 Sem. I
(For students of B.Tech. (Biotechnology) : Importance and scope of fruit, vegetable and flower crops. Classification and climatic requirements for cultivation of horticultural crops. Importance of fruits and vegetables for nutritional security. Selection of site, fencing, wind break, layout and planting systems for orchards. Sexual and asexual methods of plant propagation. Production technology of important fruit crops: tropical - guava, mango, banana, papaya, pineapple and sapota; Sub-tropical-citrus, litchi, ber and grapes; temperate - apple, pear, peach, plum, almond and walnut. Production technology of important vegetable crops-potato, peas, tomato, chilli, onion, brinjal, okra, cabbage, cauliflower, muskmelon, watermelon, cucumber, carrot, radish and leafy vegetables. Production technology of important flower crops-rose, chrysanthemum, gladiolus, marigold, gerbera, carnation, lilium, jasmine, anthurium and orchids.
Practical: Identification of important fruit, vegetable and flower crops. Layout and planning for planting orchards. Preparation of seed beds. Raising of seedlings, rootstocks. Propagation techniques of major fruit, vegetable and flower crops. Visit to commercial nurseries and orchards.

Hort. 202 Production Technology for Fruit and Plantation Crops 1+1 Sem. II
Horticulture-Definitions, Importance and scope of fruit and plantation crop industry in India, Selection
of site, layout and planting methods, Training and pruning of fruit and plantation crops, Importance of rootstocks. Propagation methods. Production technologies for the cultivation of major fruits - mango, banana, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, plum, ber, walnut and almond. Minor fruits- date, pineapple, pomegranate, jackfruit, strawberry and plantation crops - coconut, arecanut, cashew, tea, coffee and rubber


Hort. 301 Post-harvest Management and Value Addition of Fruits & Vegetable 1+1 Sem. I
Importance of post-harvest management and processing of fruits and vegetables, extent and possible causes of post-harvest losses; pre and post-harvest factors affecting storage life and quality. Maturity, ripening and changes occurring during ripening; Harvesting, grading, pre-cooling, packing and transport, Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept; Principles and methods of preservation; Concepts and standards of intermediate moisture food - jam, jelly, marmalade, preserve, candy; tomato products, drying/dehydration of fruits & vegetables, osmotic drying and canning. Fermented and non-fermented beverages, packaging of products.


Hort. 302 Hi-tech Horticulture 2+1 Sem. II
Introduction and importance, Containerized nursery production and mechanization, Micro-propagation of horticultural crops, Field preparation and improved planting methods, Protected cultivation-advantages, controlled conditions, methods and techniques, Micro-irrigation systems and their components, Fertigation EC and pH-based fertilizer scheduling, Canopy management, high density planting, Components of precision farming-remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate Applicators (VRA), Application of precision farming in fruit, vegetables and ornamental crops, Mechanized harvesting.


Hort. 491 Agro-industrial Attachment 0+4 Sem. I
(i) Commercial Fruit Nurseries
Hort. 492 Experiential Learning in Commercial Horticulture 0+20 Sem. II

Postgraduate Courses
Hort. 501 Tropical and Dry Land Fruit Production 2+1 Sem. I
Quality improvement. Storage and ripening techniques. Industrial and export potential, Agri. Export Zones (AEZ) and industrial support. Fruit crops- citrus, mango, papaya, pineapple, banana, avocado, sapota, guava, ber, amla, Jack fruit, anonnas and minor fruits of tropics.


**Hort. 502 Sub-tropical and Temperate Fruit Production**


**Hort. 503 Nutrient and Canopy Management in Fruit Crops**


Practical: Leaf sampling techniques, Determination of nutrient status through soil and plant analysis. Study of different types of canopies. Training of plants for different canopy types. Canopy development through pruning, use of plant growth inhibitors and, geometry of planting. Effect of canopy types on production and quality of fruits.

**Hort. 504 Principles and Practices of Plant Propagation.**


Practical: Anatomical studies in rooting of cutting and graft union. Propagation structures. Use of media and PGR. Micropropagation and hardening of plants. Explant preparation, media preparation, culturing invitro,
clonal propagation, meristem culture, shoot tip culture, axillary bud culture., Micro grafting and hardening. Visit to TC labs and nurseries.

**Hort. 505 Breeding of Fruit Crops 2+1 Sem. I**

Origin and distribution, taxonomical status of species and cultivars. Cytogenetics and genetic resources. Blossom biology, breeding objectives, systems and ideotypes. Crop improvement through introduction, selection, hybridization, mutation breeding, polyploid breeding and rootstock breeding. Improvement of quality traits. Resistance breeding for biotic and abiotic stresses. Biotechnological interventions, achievements and future thrust. The important temperate, sub-tropical and tropical fruit crops will be covered.


**Hort. 506 Post-harvest Technology for Fruit Crops 2+1 Sem. II**


**Hort. 507 Growth and Development of Horticultural Crops 2+1 Sem. I**

(In collaboration with Department of Botany)


**Hort. 508 Orchard Management and Organic Horticulture 2+1 Sem. I**


Hort. 601 Advances in Breeding of Fruit Crops (pre-requisite Hort. 505) 3+0 Sem. I
Evolutionary mechanisms, adaptation and domestication. Genetic resources, cytogenetics, cytomorphology, chemotaxonomy, genetics of important traits and their inheritance pattern. Variations and natural selection, spontaneous mutations, incompatibility systems in fruits. Recent advances in crop improvement through introduction and selection, chimeras, apomixis, clonal selections, intergeneric, interspecific and intervarietal hybridization, mutation and polyploid breeding, resistance breeding to biotic and abiotic stresses. Breeding for improving quality. Molecular and transgenic approaches in improvement of selected fruit crops: Mango, banana, papaya, grapes, citrus fruits, guava, sapota, pineapple, avocado, apple, pear, plums, peaches, apricot, cherries and strawberry.

Hort. 602 Advances in Production of Fruit Crops 3+0 Sem. II

Hort. 603 Advances in Growth Regulation of Fruit Crops 3+0 Sem. II

Hort. 604 Advances in Nutrition of Fruit Crops 3+0 Sem. I

Hort. 605 Biotic and Abiotic Stress Management in Fruit Crops. 3+0 Sem. I

Hort. 591 Seminar
Hort. 600 Master's Research
Hort. 700 Ph.D. Research
PLANT BREEDING AND GENETICS

PROGRAMMES:

1. M. Sc.
2. Ph. D.

COURSE REQUIREMENT

M. Sc.

<table>
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<tr>
<th>Field of Specialization</th>
<th>Plant Breeding, Genetics, Cytogenetics</th>
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<tr>
<td>Required Courses</td>
<td>PBG 501, PBG 502, PBG 503, PBG 504 and PBG 505</td>
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<tr>
<td>Supporting Courses</td>
<td>Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) related to area of special interest and research problem.</td>
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Minor Fields

| Minor Fields                  | Biotechnology, Statistics, Plant Pathology, Entomology, Botany, Biochemistry, Microbiology, Agronomy or any other as approved by the Dean, Postgraduate Studies |

Deficiency courses for students with elective other than Plant Breeding, Genetics Studies and Biotechnology

As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.

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<th>Plant Breeding, Genetics, Cytogenetics</th>
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<tr>
<td>Required courses</td>
<td>PBG 601, PBG 602, PBG 603</td>
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<tr>
<td>Supporting Courses</td>
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</tr>
<tr>
<td>Minor Fields</td>
<td>Biotechnology, Statistics, Plant Pathology, Entomology, Botany, Biochemistry, Microbiology, Agronomy or any other as approved by the Dean, postgraduate Studies.</td>
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Deficiency courses for with M. Sc. in discipline other than Plant Breeding and Genetics

PBG 501, PBG 502, PBG 503, PBG 504, PBG 505 and other courses students as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

PBG 51 Hybrid Seed Production – I 2+2  Sem. I
Hybrid seed production – history, importance, types of hybrids, development of inbred lines, single cross, double cross, three way cross etc. Concept of heterosis and advantages of hybrid cultivars. Systems of pollination control. Male sterility – inheritance, maintenance and utilization of genetic, cytoplasmic and cytoplasmic genetic of male sterility in seed production, sources of male sterility in different crops. Foundation and certified seed production in inbreds, hybrids, synthetics and composites in maize and bajra.
Practical: Handling hybrid production programme in maize hybrids - climate, soil, seed source, seed rate and spacing, isolation distance, border rows, planting ratios, methods of planting and earthing up, non-synchronization of flowering, manures, fertilizers and micronutrients, field inspections, weeding, irrigation, pests and diseases, precautions to be taken while detasseling, roguing, harvesting of seed crop, post harvest operations, grading, seed treatment, storage, field standards, seed standards for hybrids, standards for germination test. Hybrid seed production of vegetable crops.

PBG 52 Seed testing and Quality Control 2+2  Sem. I
Deterioration of crop varieties/hybrids. Factors responsible for loss of genetic purity, maintenance of genetic purity during seed production, safeguards for maintenance of genetic purity. Seed quality standards - Importance of good quality seed, characters of good quality seed, factors affecting seed quality, seed quality components and field standards. Seed sampling. Receipt and registration of samples, Physical purity analysis. Moisture test, Quick viability test. Testing for coated/pelleted seeds. Grow-out test. Seed health including pathogen and insect damage. Seed dormancy, types and methods to break it. Weed seed identification.. Seed Act and seed rules and law enforcement. Role of Punjab State Seed certification Authority (PSSCA), Inspection procedures and equipments required.
Practical: Sampling and submission of samples to seed testing laboratory, Obtaining working sample, physical purity analysis and reporting results. Germination test Methods of breaking dormancy, Tetrazolium test. Moisture testing. Visit to state seed testing laboratory. Field inspection at different crop growth stages for off types, pollen shedders, designated seed borne diseases, counts of the male and female plants in hybrid seed production, field inspection report for different crops, isolation distances. Seed priming treatment.

PBG 53 Visits to Seed Production and Processing Units-I 0+2  Sem. I
In order to give a practical exposure to the students and make them aware of the seed production techniques, the visits will be conducted to:
-University Seed production Farms at Ladhowal.
-Private seed growers/progressive farmers.
-Various organizations in both private/public sectors in order to make them aware of working of seed industry and its problems.

PBG 54 Project on Seed Production 0+4  Sem. I/ II
The class will be divided into groups of 4-5 students each. Each group will be allotted a project(s) on seed production in the hybrids of field and vegetable crops. These groups will be raising the seed crop on their own by practically doing all the operations from the seed treatment, sowing, inspection, roguing, harvesting, processing, testing and packaging of the seed and finally they will submit a detailed report of the work done. Their performance will be closely monitored and assessed for final evaluation.
PBG 55 Hybrid Seed Production – II 2+2 Sem. II
Practical: Handling of Seed production planning in sunflower and summer vegetables with special reference to agronomic practices such as selection of field, seed rate and seed treatment, season and time of sowing, nursery raising, transplanting, optimum stage of harvesting, land and isolation requirements, rouging, harvesting, post harvest operations, grading. Seed treatment, storage, field standards, seed standards for hybrids, standards for germination test. Seed certifications procedures, seed drying, processing, cleaning, testing packaging, storage and marketing.

PBG 56 Seed health 2+2 Sem. II

PBG 57 Seed processing and Storage 2+2 Sem. II
Practical: Operation and handling of mechanical drying equipments. Effect of drying on seed quality during storage. Seed processing equipment. Seed treating equipments. Seed extraction.

PBG 58 Visits to Seed Production and Processing Units-II 0+2 Sem. II
In order to give a practical exposure to the students and make them aware of the seed production techniques, the visits will be conducted to:
- Vegetable Seed Production Programmes under contract growing by NSC in Saparoon valley of Solan or Katrain valley of Kullu.
- Various processing plants at University Seed Farms/State processing Units and ICAR Regional Research Station, Karnal.

PBG 59 Elementary Plant Breeding and Seed Production 2+1 Sem. I


Undergraduate Courses

PBG 102 Fundamentals of Genetics 2+1 Sem. II


PBG 201 Fundamentals of Plant Breeding 2+1 Sem. I

Practical: Plant breeder’s kit. Study of germplasm of various crops. Study of floral structure of self-pollinated and cross-pollinated crops. Emasculation and hybridization techniques in self and cross-

PBG 301  Crop Improvement – I (Kharif Crops)  1+1  Sem. I
(For students of B.Sc. (Hons) Agri., and B. Tech. Biotechnology - In collaboration with Department of Fruit Science & Vegetable Science)
Centre of origin, distribution of species, wild relatives, utilization and conservation of plant genetic resources, major breeding objectives and procedures, study of genetics of qualitative and quantitative characters, innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional) in rice, maize, pigeonpea, mungbean, soybean, groundnut, castor, cotton, jute, sorghum, pearl millet, tobacco, brinjal, okra, muskmelon, guava and banana. Ideotype concept and climate resilient crop varieties for future.
Practical: Floral biology and crossing techniques in rice, maize, cotton, pearl millet, pigeonpea, mungbean, soybean, groundnut, brinjal, okra, muskmelon/bottle gourd, guava and banana. Maintenance breeding in different kharif crops. Study of field techniques for seed production. Hybrid seed production technologies in maize, cotton, rice and brinjal. Estimation of heterosis and inbreeding depression. Layout of field experiments. Study of quality traits. Important donors for different characters. Visit to seed production farms and research experiments.

PBG 302 Crop Improvement – II (Rabi Crops)  1+1  Sem. II
(For students of B.Sc. (Hons) Agri. and B. Tech. Biotechnology - In collaboration with Department of Fruit Science & Vegetable Science)
Centre of origin, distribution of species, wild relatives, utilization and conservation of plant genetic resources, study of genetics of qualitative and quantitative characters, major breeding objectives and procedures, innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional) in wheat, barley, chickpea, lentil, rapeseed mustard, sunflower, sugarcane, oat, berseem, potato, chilli, onion, mango and citrus. Ideotype concept and climate resilient crop varieties for future.
Practical: Floral biology and crossing techniques in wheat, barley, rapeseed mustard, sunflower, sugarcane, chickpea, lentil, oat, berseem, potato, tomato chilli and onion. Maintenance breeding in different rabi crops. Study of field techniques for seed production. Hybrid seed production technologies in sunflower, mustard and chilli. Estimation of heritability. Layout of field experiments. Study of quality traits. Important donor parents for different characters. Visit to seed production farms and research experiments.

PBG 303 Intellectual Property Rights  1+0  Sem. I
PBG 304 Principles of Seed Technology  
1+1  
Sem. II  

PBG 305 Molecular Breeding Technologies  
2+1  
Sem. II  
In collaboration with School of Agricultural Biotechnology)  
(Optional course)  

PBG 491 Agro-industrial Attachment  
0+4  
Sem. I  
- Commercial Hybrid Seed Production Units

PBG 492 Experiential Learning in Seed Production And Technology  
0+20  
Sem. II

Postgraduate Courses

PBG 501 Principles of Genetics  
2+1  
Sem.I  


PBG 502 Principles of Cytogenetics 2+1 Sem. II


PBG 503 Principles of Plant Breeding 2+1 Sem. I


PBG 504 Principles of Quantitative Genetics 2+1 Sem. II


**PBG 505 Heterosis Breeding**
2+1 Sem. II


**PBG 506 Mutagenesis and Mutation Breeding**
1+1 Sem. I


Practical: Mutagenic agents. Visit to radio isotope laboratory. Treating the plant propagules at different doses of physical and chemical mutagens. Raising the crop for observation- Study of M_1, M_2 generation - Parameters to be observed. Mutation breeding in cereals, pulses, oilseeds, cotton, forage crops and vegetatively propagated crops. Procedure for detection of mutations for polygenic traits in M_2 and M_3 generations

**PBG 507 Population Genetics**
2+1 Sem. II


**PBG 508 Cell Biology and Molecular Genetics**
2+1 Sem. II


**PBG 509 Breeding for Biotic and Abiotic Stress Resistance**  
2+1  Sem. II


Practical: Phenotypic screening techniques for sucking pests, chewing pests, nematodes and borers. Use of standard MAS procedures. Phenotypic screening methods for diseases caused by fungi and bacteria. Screening crops for drought, flood resistance, acidity, alkalinity and temperature etc.

**PBG 510 Breeding Field Crops**  
3+1  Sem. II

Evolution and distribution of species and forms, wild relatives and germplasm, genetics, cytogenetics, genome relationship, breeding objectives, achievements and hybrid breeding in wheat, rice, maize, sugarcane, forage legumes, chickpea, other pulses, groundnut, rapeseed and mustard, sunflower, soybean and cotton. Distinguishing features of popular released varieties in rice, wheat, maize, sugarcane, pulses, oilseeds and cotton and their application to DUS testing. Maintenance of seed purity and seed production.


**PBG 511 Breeding for Quality Traits**  
2+1  Sem. II

Developmental biochemistry and genetics of carbohydrates, proteins, fats, vitamins, amino acids and anti-nutritional factors. Nutritional improvement. Breeding for grain quality parameters in rice, golden rice and aromatic rice, wheat, barley, oats, maize, forage crops, pulses, cotton, groundnut, rapeseed mustard,


PBG 512 Gene Regulation and Expression 2+0  Sem. I

PBG 513 Maintenance Breeding and Concepts of Variety Release and Seed Production 1+1  Sem. I

Practical: Identification of suitable areas for seed production. Ear-to-row method and nucleus seed production. Main characteristics of released and notified varieties, hybrids and parental lines. Identification of important weeds/objectionable weeds. Determination of isolation distance and planting ratios in different crops. Seed production techniques of varieties in different crops. Hybrid seed production technology of important crops.

PBG 514 Collection, Management and Utilization of Plant Genetic Resources 3+1  Sem. II

Practical: Plant exploration and collection. Introductions. Techniques of coarse and fine grid surveys. Identification of wild relatives of crop plants. Estimation of sample size during plant explorations, impact of sampling, sequential sampling. Sample size for storage and viability testing. Test cases to understand quarantine regulations. Techniques for the detection of insects, mites, nematodes, bacteria, weeds,
pathogens and viruses on seed and planting materials and salvaging. Use of visual, qualitative, quantitative, microscopic, molecular and plant growth related techniques (controlled green houses/ growth chambers, etc). Detection of GMOs and GEPs. Study of post-entry quarantine operation, seed treatment and other prophylactic treatments and preparation of herbarium specimens. Analysis of genetic diversity. Information management

PGS 502 Intellectual Property Management, Biodiversity and Biosafety  2+0    Sem. I & II

PBG 601 Genomics in Plant Breeding  2+1    Sem. II

PBG 602 Molecular and Chromosomal Manipulations for Crop Breeding  2+0    Sem. II
introgression in crop improvement. Recent advances, analysis and manipulation of crop genomes in wheat, rice, pearl millet, maize, cotton, oilseed, Brassicas, sunflower, soybean, pigeon pea, Vigna species and sugarcane. Current research topics in cyto genetics.

**PBG 603 Advances In Plant Breeding Systems**  
2+0  Sem. I


**PBG 604 Breeding Designer Crops**  
2+1  Sem. II

Breeding of crop ideotypes. Genetic manipulations through recombination breeding, genomics and transgenics for physiological efficiency, nutritional enhancement: proteins, vaccines, gums, starch and fats. Physiological efficiency, parametric and whole plant physiology for improvement in nutrient use efficiency, water use efficiency, osmotic adjustment, photosynthetic efficiency, stay green trait and its significance in crop improvement. Improvement in yield potential under sub-optimal conditions by manipulating source and sink, canopy architecture, plant-water relationships. Enhancing input use efficiency through genetic manipulations. Breeding for special traits viz., oil, protein, vitamins, amino acids etc. Biopharming and development of varieties producing vaccines, modified sugars, gums and starch. Biosafety management, segregation and isolation requirements in designer crop production and post-harvest management.

Practical: Demonstration of plant responses to stresses through recent techniques. Water use efficiency, transpiration efficiency, screening techniques under stress conditions such as electrolyte leakage, TTC, chlorophyll fluorescence, canopy temperature depression, stomatal conductance, chlorophyll estimation, heat/drought/salt shock proteins.

**PBG 605 Plant Genetic Resources and Crop Evolution**  
2+0  Sem. I


**PBG 606 Advanced Biometrical and Quantitative Genetics**  
2+1  Sem. I


**PBG 607 Advances in Breeding of Major Field Crops** 3+0 Sem. I

History, description, classification, origin and phylogenetic relationship, genome status in cultivated and alien species of major cereals and millets like rice, wheat, maize, pearl millet, sorghum, pulses, oilseeds, cotton, sugarcane, arid legumes and other forage crops etc. Breeding objectives of major crops. Genetic resources and their utilization. Genetics of quantitative and qualitative traits. Breeding for value addition and resistance to abiotic and biotic stresses. Conventional (line breeding, population improvement, hybrids) and other approaches (DH Populations, Marker Assisted Breeding, Development of new male sterility systems and transgenics). National and International accomplishments in genetic improvement of major field crops and their seed production.

**PBG 608 Microbial Genetics** 2+1 Sem. I


**PBG 609 In Situ and Ex Situ Conservation of Germplasm** 2+1 Sem. II


Practical: In situ conservation of wild species - case studies at National and International levels - ex situ techniques for active and long-term conservation of collections. Preparation and handling of materials, packaging, documentation. Design of cold storage modules. Conservation protocols for recalcitrant and
orthodox seeds. Cytological studies for assessing genetic stability, in vitro cultures-embryo, cell/suspension cultures, pollen cultures, study of cryotank facility and vitrification techniques. Visit to NBPR/NBAGR.

**PBG 591 Seminar**

**PBG 600 Master's Research**

**PBG 700 Ph. D. Research**
PLANT PATHOLOGY

A. PLANT PATHOLOGY PROGRAMME

1. M.Sc.
2. Ph.D

COURSE REQUIREMENTS

M. Sc.
Field of Specialization
Fungal Pathology, Plant Bacteriology, Plant Virology.

Required Courses

Supporting Courses
Stat.421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Agrometeorology, Biochemistry, Entomology, Fruit Science, Nematology, Plant Breeding and Genetics, Biotechnology, Vegetable Science, or any other as approved by the Dean, Postgraduate Studies.

Deficiency courses for students with the elective other than Crop Protection
As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Ph.D.

Field of Specialization
Fungal Pathology, Plant Bacteriology, Plant Virology.

Required Courses

Supporting Courses
Courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Agrometeorology, Biochemistry, Entomology, Fruit Science, Nematology, Plant Breeding and Genetics, Biotechnology, Vegetable Science, or any other as approved by the Dean, Postgraduate Studies.

Deficiency courses for students with M. Sc. (Agri.) in a discipline other than Plant Pathology
Pl.Path.501, Pl.Path.502, Pl.Path.503, Pl.Path.504, Pl. Path. 505, and other courses as recommended by Student's Advisory Committee.
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Pl. Path. 51 Diseases of Field Crops 1+1 Sem. I
Importance and concept of plant diseases. Study of important diseases of wheat, rice, maize, barley, cotton, sugarcane, sorghum, gram, moong, maize, red gram, rapeseed and mustard and groundnut. Economic aspects of disease control.

Practical: Diagnosis by studying symptoms of important diseases of field crops. Demonstration of important methods of plant disease management. Practical field training in the use and operation of plant protection equipments.

Pl. Path. 52 Diseases of Fruit and Vegetable Crops 1+1 Sem. II
Symptomatology, etiology, and management of diseases of citrus, guava, mango, pear, plum, berry, papaya, grapes, potato, tomato, brinjal, chillies, okra, cabbage, cauliflower, carrot, radish, turnip, onion, garlic and cucurbitaceous vegetables.

Practical: Diagnosis by studying symptoms of important diseases of fruit and vegetable crops. Preparation of fungicidal formulations.

Undergraduate Courses

Pl. Path. 102 Fundamentals of Plant Pathology 3+1 Sem. II


Pl. Path. 301 Diseases of Field and Horticultural Crops & their Management – I 2+1 Sem. I
Symptoms, etiology, disease cycle and management of diseases of following crops:

i). Field crops: Rice - blast, brown spot, bacterial blight, sheath blight, false smut, foot rot, khaira, tungro; Maize - stalk rots, downy mildews, leaf spots; Sorghum - smuts, grain mold, anthracnose; Bajra - downy mildew, ergot; Cotton - anthracnose, vascular wilt, black arm, leaf curl; Groundnut - early and late leaf spots, wilt, collar rot, peanut bud necrosis; Soybean - Rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic; Pigeonpea - Phytophthora blight, wilt, sterility mosaic; Finger millet – blast, leaf spot; Black gram and Green gram - Cercospora leaf spot, anthracnose, web blight, yellow mosaic; Castor - Phytophthora blight; Tobacco - black shank, black root rot, mosaic.

ii) Horticultural crops: Guava - wilt, anthracnose; Banana - Panama wilt, bacterial wilt, Sigatoka, bunchy top; Papaya - foot rot, leaf curl, mosaic; Pomegranate - bacterial blight; Brinjal - Phomopsis blight and fruit rot, Sclerotinia blight, little leaf, root knot nematode; Tomato - damping off, wilt, early and late blight, buck eye rot, leaf curl, mosaic; Okra - yellow vein mosaic; Beans - anthracnose, bacterial blight; Ginger - soft rot; Turmeric - leaf spots; Colocasia - Phytophthora blight; Coconut - wilt, bud rot; Tea - blister blight; Coffee - rust.


Pl. Path. 302 Diseases of Field and Horticultural Crops & their Management - II 2+1 Sem. II

Symptoms, etiology, disease cycle and management of diseases of following crops:

i). Field crops: Wheat - rusts, smuts, bunts, powdery mildew, Alternaria blight, ear cockle; Barley – smuts, stripe disease; Sugarcane - red rot, smut, wilt, grassy shoot, ratoon stunting, Pokkah boeng; Sunflower - Sclerotinia stem rot, Alternaria blight; Mustard - Alternaria blight, white rust, downy mildew, Sclerotinia stem rot; Gram - wilt, grey mould, Ascochyta blight; Lentil – rust, wilt; Pea - downy mildew, powdery mildew, rust; Berseem- stem rot.

ii). Horticultural crops: Mango - anthracnose, malformation, bacterial blight, powdery mildew, black tip; Citrus-gummosis, scab, die back, canker, greening; Grape vine - downy mildew, powdery mildew, anthracnose; Apple - scab, powdery mildew, fire blight; Peach - leaf curl, crown gall; Strawberry - leaf spot; Potato - early & late blight, black scurf, common scab, leaf roll, mosaic; Cruciferous vegetables- Alternaria leaf spot, black rot; Cucurbits - downy mildew, powdery mildew, wilt, mosaic; Onion and garlic - purple blotch, Stemphylium blight, downy mildew; Chillies -anthracnose and fruit rot, wilt, leaf curl; Coriander - stem gall; Marigold- Botrytis blight; Rose - dieback, powdery mildew, black leaf spot; Gladiolus - Botrytis blight

Practical: Identification of symptoms and pathogens of selected diseases of wheat, barley, sugarcane, sunflower, mustard, gram, lentil, peas, berseem, mango, citrus, grapevine, apple, peach, strawberry, potato, cruciferous vegetables, cucurbits, onion, garlic, chilli, coriander, marigold, rose and gladiolus. Field visits for the diagnosis of field problems. Collection and preservation of plant diseased specimens for herbarium.

Ent.-Pl. Path. 202 Principles of Integrated Pest and Disease Management 2+1 Sem. II

and validation of IPM module. Implementation and impact of IPM. IPM modules for insect pests and diseases. Safety issues in pesticide uses. Political, social and legal implications of IPM. Case histories of important IPM programmes.


**Ent.-Pl. Path. 203 Fundamentals of Crop Protection**  
2+1 Sem. I  
(For students of B. Tech. Biotechnology)


**Ent.-Pl.Path. 491 Agro-Industrial Attachment**  
0+4 Sem I  

i. Pesticide and Biopesticide Industries  
ii. Biocontrol Agents Production Units  
iii. Plant Quarantine Station  
iv. Virus free Potato Tuber Production Units

**Ent.-Pl.Path.492: Experiential Learning in Production Technology for Bioagents**  
0+20 Sem II
Postgraduate Courses

Pl. Path. 501 Mycology 2+1 Sem.I

Practical: Comparative study of different groups of fungi up to generic level of Divisions Myxomycota and Eumycota emphasizing sub-divisions Mastigomycotina Zygomyctotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Collection, identification and preservation of specimens. Isolation and identification of plant pathogenic fungi.

Pl. Path. 502 Plant Virology 2+1 Sem. II

Practical: Study of symptoms caused by viruses, transmission, assay of viruses, physical properties, isolation and purification, method of raising antisera, serological tests, electron microscopy and ultratomy, molecular diagnostics. Diagnosis of representative viral diseases.

Pl. Path. 503 Plant Bacteriology 2+1 Sem. II


Pl. Path. 504 Principles of Plant Pathology 3+0 Sem. I

Pl. Path. 505 Principles of Plant Disease Management 2+1 Sem.I
Principles of plant disease management by cultural, physical, biological, chemical, organic amendments

Practical: *In vitro* and *in vivo* evaluation of chemicals against plant pathogens. Foliage, seed and soil application of chemicals. Role of stickers, spreaders and other adjuvants. ED and MIC values. Study of structural details of sprayers and dusters. Environmental hazards, residual effects and safety measures.

**Pl. Path. 506 Detection and Diagnosis of Plant Diseases** 0+2 Sem. II


**Pl. Path. 507 Integrated Disease Management** 2+1 Sem. I

Introduction, definition, concept and tools of disease management. Components of integrated disease management, their limitations and implications. Development of IDM and its adaptation in important crops, rice, wheat, cotton, sugarcane, chickpea, rapeseed mustard, pearl millet, Kharif pulses, vegetable and fruit crops.

Practical: Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM. Demonstration of IDM in certain crops as project work.

**Pl. Path. 508 Epidemiology and Forecasting of Plant Diseases** 2+0 Sem. II

Epidemic concept and historical development, pathometry and crop growth stages, epidemic growth and analysis. Common and natural logarithms, function fitting area under disease progress curve and correction factors, inoculum dynamics, population biology of pathogens, temporal spatial variability in plant pathogens. Survey, surveillance and vigilance, crop loss assessment and models. Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting, some early forecasting, procedures based on weather and inoculum potential, modelling disease growth and disease prediction.

**Pl. Path. 509/Ent. 509/Nem. 509 Molecular Approaches in Plant Protection** 2+1 Sem.II


Practical: Isolation, characterization and maintenance of important post-harvest pathogens. Role of different storage conditions for disease development. Application of antagonists against pathogens under in vitro and in vivo conditions. Comparative efficacy of different chemicals, fungicides, phyto-extracts and bioagents.

Nomenclature, classification and general characterization of fungi. Description of important phytopathogenic genera. Study of representative fungal diseases with emphasis on their distribution, symptomatology, etiology, epidemiology and control. Post harvest diseases in transit and storage and their management.

Practical: Characteristics of important phytopathogenic genera of fungi and their identification. Macro and microscopic diagnosis of representative diseases of various crops.

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Dispersal, survival and dormancy of plant pathogens. Types of biocontrol agents. Inoculum potential and density in relation to host and soil variables, competition, predation, antibiosis and fungistasis. Role of rhizosphere, phylloshere and spermosphere in disease development in relation to crop sequences. Suppressive soils, biological control, concepts and potentialities for managing soil borne pathogens.

Importance and role of biotechnological tools in Plant Pathology. Basic concepts and principles to study host pathogen relationship. Molecular basis of host-pathogen interaction, fungi, bacteria and viruses. Recognition system and signal transduction. Induction of defense responses, pathogenesis

**PI. Path. 603 Principles and Procedures of Certification**

2+0 Sem.II

Introduction to certification. International scenario of certification and role of ISTA, EPPO, OECD etc. in certification and quality control. Case studies of certification systems of USA and Europe. National regulatory mechanism and certification system including seed certification, minimum seed certification standards. National status of seed health in seed certification. Methods for testing vegetative propagules and *in vitro* cultures and genetic identity, physical purity, germination percentage, seed health etc. Fixing tolerance limits for diseases and insect pests in certification and quality control programmes. Accreditation of seed testing laboratories. Role of seed/ planting material health certification in national and international trade.

**PI. Path. 604 Advanced Systematic Mycology**

3+0 Sem.I


**PI. Path. 605 Advanced Plant Virology**

2+0 Sem. II


**PI. Path. 606 Advanced Plant Bacteriology**

2+0 Sem.I


Pl. Path. 591 Seminar
Pl. Path. 600 Master's Research
Pl. Path. 700 Ph. D. Research
B. NEMATOLOGY PROGRAMME

M.Sc.

COURSE REQUIREMENTS

Field of Specialization  

Required Courses  

Supporting Courses  
Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields  
Entomology, Fruit Science, Microbiology, Plant Pathology and Vegetable Science or any other as approved by the Dean, Postgraduate Studies.

Deficiency courses for students with elective other than Crop Protection  
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies.

Postgraduate Courses

**Nem. 501 Structural and Functional Organization of Nematodes**  
2+1 Sem.I  

Practical: Studies on variation in nematode shapes and sizes, morphological details of cuticle, cuticular markings and ornamentation, variations in stoma, esophagus, rectum; types and parts of female and male reproductive systems, sense organs, and excretory system.

**Nem. 502 Classification of Nematodes**  
2+1 Sem.I  
Nematode systematics and comparison with its allies. Comparative study of morphological and allometric variations and evaluation of characters of classification. Classification of Phylum Nematoda. Orders of class Adenophorea and Secernentea. Diagnosis of order Tylenchida- Suborder Tylenchina, Hoplolaimina and Criconematina, their families and genera. Diagnosis of genera and families of orders Aphelenchida, Dorylaimida, Enoplida, Rhabditida with emphasis on economically important taxa.

Practical: Identification of common plant parasitic nematodes belonging to orders Tylenchida, Dorylaimida, Aphelenchida and Enoplida up to generic level and up to species level for major nematode pests of crops with the help of keys and illustrations. Identification of Entomopathogenic nematodes belonging to Order Rhabditida.

**Nem. 503 Nematological Techniques**  
1+2 Sem.I


Nem. 504 Nematode Diseases of Crops 2+1 Sem.II


Practical: Diagnosis of causal organisms. Identification of different life cycle stages. Study of symptoms and histopathology of nematode damage in different crops and field diagnosis of nematode problems.

Nem. 505 Nematode Management 2+1 Sem.II


Practical: In vitro screening of synthetic chemicals and plant products for nematicidal activity, and their application methods. Methods for screening of crop germplasm for resistance against nematodes. Laboratory exercises on biocontrol potential of fungal, bacterial parasites, predaceous fungi and nematodes.

Nem. 506 Principles of Taxonomy 2+0 Sem.I

**Nem. 507 Nematode Biology and Physiology** 1+1 Sem.I


**Nem. 508 Nematode Ecology** 1+1 Sem.II


**Nem. 509/Ent.509/Pl.Path.509 Molecular Approaches in Plant Protection** 2+1 Sem.II


**Nem. 510/Ent.510/Pl.Path.510 Quarantine in Plant Protection** 2+0 Sem.II

Definition of pest and pesticides and transgenics as per Government notification. Relative importance and domestic & international quarantine. Quarantine restrictions in the movement of agricultural produce.

**Nem.511 Nematode Interaction with Other Organisms**  
1+1 Sem.II


Practical: Green-house experiments to study the role of plant parasitic nematodes in wilt or rot causing fungal and bacterial pathogens.

**Nem. 512 Beneficial Nematodes**  
1+1 Sem.II

Beneficial nematode fauna, predators, parasites of insects, molluscs and other pests; Entomophilic nematodes, their important groups and types of associations. Taxonomic characteristics of nematode parasites of insects. Host-parasite relations and life cycle of mermithids, entaphelenchids, thelastomids, sphaerularids and tylenchids. *Steinernema* and *Heterorhabditis*, their morphological characteristics, taxonomic status, biology and mode of action. Entomopathogenic nematodes- mass multiplication techniques, formulations, field applications and efficacy, and commercial products. Nematodes as biological models and as indicators of pollution. Role of nematodes in organic matter recycling.

Practical: Isolation, identification, mass rearing and application methods of entomopathogenic nematodes. Evaluating in vitro survival and on other culture media.

**Nem. 591 Seminar**

**Nem. 600 Master's Research**
SOIL SCIENCE

PROGRAMMES
1. M.Sc.
2. Ph.D.

COURSE REQUIREMENTS

M.Sc.

Field of Specialization

Pedology, Soil Chemistry, Soil Conservation, Soil Fertility, Soil Microbiology, Soil Physics

Required Courses

Soils 501, Soils 502, Soils 503, Soils 504, Soils 505,

Supporting Courses

Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to special interest and research problem

Minor Fields

Agronomy, Biochemistry, Botany, Chemistry, Microbiology, Soil and Water Engineering, Vegetable Science or any other as approved by Dean, postgraduate Studies

Deficiency courses for the students with elective other than Soil Science, Agronomy Studies and Agroforestry

As recommended by Student's Advisory Committee and approved by the Dean, Postgraduate

Ph.D.

Field of Specialization

Pedology, Soil Chemistry, Soil Conservation, Soil Fertility, Soil Microbiology, Soil Physics

Required Courses

Soils 601, Soils 602, Soils 603

Supporting Courses

Courses from subject matter fields (other than minor) relating to area of special interest and research problem

Minor Fields

Agronomy, Biochemistry, Botany, Chemistry, Microbiology, Soil and Water Engineering, Vegetable Science or any other as approved by Dean, postgraduate Studies

Deficiency Courses for other students with M.Sc. (Agri.) in a discipline other than Soil Science

Soils 501, Soils 502, Soils 503, Soils 504, Soils 505 and courses as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Soils 51 Elementary Soil Fertility 2+1 Sem. I

Soils 52 Elementary Soil Physics and Conservation 2+1 Sem. II

Undergraduate Courses

Soils 101 Fundamentals of Soil Science 2+1 Sem. I
Soil as a natural body, pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density, porosity, soil colour and consistence; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects.
Env 101 Environmental Studies and Disaster Management  2+0  Sem. I and II
(For students B.Sc. (Hons) Agri./B.Tech.(Biotechnology)/ B.Tech. (Food Technology)/Integrated M.Sc
(Hons.)/B.Sc. (Hons) Community Science & B.Sc. (Hons) ND)  Definition, scope and importance of
environmental science. Natural Resources - renewable and non-renewable resources. Forest
resources - use and over-exploitation. Water resources - use and over-utilization of surface and
ground water, floods, drought. Mineral resources - use, exploitation and their environmental effects.
Food resources - world food problems, challenges of modern agriculture. Energy resources -
renewable and non-renewable. Land resources - land degradation and restoration. Ecosystems -
concepts, types, structures and functions. Biodiversity at global, national and local levels, hot-spots of
biodiversity, threats to biodiversity. Environmental Pollution - air, water, soil, marine, noise, thermal
pollution and nuclear hazards. Solid waste management - causes, effects and control. Social issues
and the environment - unsustainable to sustainable development. Water conservation - rain water
harvesting, watershed management. Environmental ethics - issues and possible solutions, climate
change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
Environment Protection Acts - air, water, wildlife protection, forest conservation. Human population
and environment. Role of information technology in environment and human health. Natural disasters -
nature, types and their effects. Climatic change - ozone depletion, global warming, sea level rise.
Man-made disasters - types and their effects. Disaster management - concept of disaster
management, national disaster management framework, financial arrangements, role of Government,
NGOs, media and other organizations in disaster management.
Visits to ecologically important places and management organizations during weekends as a part of
advisory and class tours by the respective departments/class incharges.

Soils 102 Principles of Soil Science                    1+1       Sem. I
(For students of B.Tech. Agricultural Engg.)
Concepts of soil; soil forming rocks and minerals, their classification and composition, soil forming
processes; soil physical properties and their importance; soil inorganic colloids – their composition,
properties and origin of charge; ion exchange in soil and nutrient availability; soil reaction – acidic,
saline and sodic soils; soil organic matter – its composition and decomposition, effect on soil fertility;
quality of irrigation water; essential plants nutrients – their functions and deficiency symptoms in
plants; important inorganic fertilizers and their fates in soils.
Practical: Identification of rocks and minerals; Examination of soil profile in the field; Collection of Soil
Sample; Determination of bulk density; particle density and porosity of soil; Determination of organic
carbon of soil; Determination of Nitrogen, Determination of Phosphorus and Determination of
Potassium; Identification of nutrient deficiency symptoms of crops in the field; Determination of water
quality parameters.

Soils 202 Problematic Soils and their Management                 2+0       Sem. II
Soil quality and health. Distribution of waste land and problem soils in India, their categorization based
on properties. Reclamation and management of saline, sodic, acid, acid sulphate, eroded, compacted,
flooded, waterlogged and polluted soils. Irrigation water – quality and standards. Utilization of saline
and sodic water in agriculture. Remote sensing and GIS in diagnosis and management of problem
Land suitability classification. Problematic soils under different agro-ecosystems.

Soils 301 Manures, Fertilizers and Soil Fertility Management       2+1          Sem. I
Introduction and importance of organic manures. Properties and methods of preparation of bulky and
concentrated manures. Green/leaf manuring. Fertilizer recommendation approaches. Integrated
nutrient management. Chemical fertilizers - classification, composition and properties of major

Soils 302 Precision Farming, Geoinformatics and Nano-technology  1+1  Sem. II

Soils 303 Biofertilizers and Biopesticides  2+1  Sem. II


Soils 491 Agro-Industrial Attachment
(i) Fertilizer Industries
(ii) Vermicompost Units
(iii) Biofertilizer Units

Soils 492 Experiential Learning in Soil, Plant, Water and Seed Testing

Postgraduate Courses

Soils 501 Soil Physics


Soils 502 Soil Fertility and Fertilizer Use
Soil quality in relation to sustainable agriculture.

**Practical:** Laboratory and greenhouse experiments for evaluation of indices of nutrient availability and their critical values in soils and plants. Chemical analysis of soil for total and available nutrients. Analysis of plants for essential elements.

**Soils 503 Soil Chemistry 2+1 Sem. I**

**Soils 504 Soil Mineralogy, Genesis, Classification and Survey 2+1 Sem. II**

**Soils 505 Soil Biology and Biochemistry 2+1 Sem. II**


**Soils 506 Soil Erosion and Conservation**  
2+1  
Sem. II


**Soils 507 Geomorphology and Geochemistry**  
2+0  
Sem. I


**Soils 508 Soil, Water and Air Pollution**  
2+1  
Sem. II


Practical: Sampling of sewage waters and sludge, industrial wastes, polluted soils and plants. Estimation of dissolved and suspended solids, COD, BOD, nitrate and ammonical N and P, heavy metal content in effluents. Heavy metals in contaminated soils and plants. Air sampling and determination of particulate matter and oxides of S. Visit to various industrial sites to study the impact of pollutants on soil and plants.

**Soils 509 Analytical Techniques and Instrumental Methods in Soil and Plant Analysis**  
1+2  
Sem. II

inductively coupled plasma spectrometry, chromatographic techniques, mass spectrometry and X-ray defractrometery.


Soils 510 System Approaches in Soil and Crop Studies 2+0 Sem. I

Systems concepts- definitions, general characteristics, general systems theory. Systems - thinking, dynamics, behavior and study. Model - definition and types. Mathematical models and their types. Modeling-concepts, objectives, processes, abstraction techniques. Simulation models, their verification and validation, calibration. Representation of continuous systems simulation models- procedural and declarative. Simulation-meaning and threats, experiment, design and analysis. Application of simulation models in understanding system behavior, optimizing system performance, evolution of policy options under different soil, water, and nutrient, climatic and cultural conditions. Decision support system, use of simulation models in decision support system.

Soils 511 Management of Problem Soils and Water 2+1 Sem. I


Soils 601 Advances in Soil Physics 3+0 Sem. II


Soils 602 Advances in Soil Fertility 3+0 Sem. II

Soils 603 Physical Chemistry of Soils 2+0 Sem. I


Soils 604 Soil Genesis and Micropedology 2+0 Sem. I


Soils 605 Biochemistry of Soil Organic Matter 2+0 Sem. I


Soils 606 Land Use Evaluation and Planning 2+0 Sem. II


Soils 591 Seminar
Soils 600 Master's Research
Soils 700 Ph.D. Research
VEGETABLE SCIENCE

PROGRAMMES
1. M.Sc.
2. Ph.D.

COURSE REQUIREMENTS
M.Sc.

Field of Specialization
Vegetable Breeding, Vegetable Production, Post-harvest Handling

Required Courses
Veg. 501, Veg. 502, Veg. 503, Veg. 504, Veg. 505

Supporting Courses
Stat. 421, PGS 501 and other courses from subject matter fields (other than minor) relating to the area of special interest and research problem.

Minor Fields
Plant Breeding and Genetics, Biotechnology, Botany, Agronomy, Horticulture, Soil Science or any other as approved by Dean, postgraduate Studies.

Deficiency courses for students with elective other than Horticulture
As recommended by the Student's Advisory Committee and approved by the Dean, Postgraduate Studies

Ph.D.

Field of Specialization
Vegetable Breeding, Vegetable Production, Post-harvest Handling

Required Courses
Veg. 601, Veg. 602, Veg. 603

Supporting Courses
Courses from subject matter fields (other than minor) relating to area of special interest and research problem.

Minor Fields
Plant Breeding and Genetics, Biotechnology, Botany, Agronomy, Horticulture, Soil Science or any other as approved by Dean, postgraduate Studies.

Deficiency courses for students with M.Sc.(Agri.) in a discipline other than Vegetable Science
Veg. 501, Veg. 502, Veg. 503, Veg. 504, Veg. 505 and other courses as recommended by Student's Advisory Committee
DESCRIPTION OF COURSE CONTENTS

Diploma Courses

Veg. 51 Elementary Vegetable Cultivation 2+1 Sem. I
Role of vegetables in human nutrition and agricultural economy. Types of vegetable gardens including home garden, market garden, truck garden, seed garden and processing garden. Roof top cultivation. Production practices of winter season vegetable crops i.e. potato, cole crops (cabbage, cauliflower, knol khol, broccoli), root crops (radish, carrot, turnip, beetroot), bulb crops (onion, garlic), garden peas, lettuce, palak, methi, and summer season vegetable crops i.e. tomato, brinjal, chilli, sweet pepper, okra, beans (cowpeas, French bean, cluster bean), sweet potato and amaranthus.

Veg. 52 Protected Cultivation of Vegetable Crops 0+1 Sem. II

Undergraduate Courses

Veg. 202 Production Technology for Vegetable and Spices 1+1 Sem I
Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, origin, area, climate, soil, improved varieties of regional importance and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting, yield and important physiological disorders of vegetable and spices (Tomato, Brinjal, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas, Okra; Cole crops - Cabbage, Cauliflower, Knol-khol; Bulb crops - Onion, Garlic; Root crops - Carrot, Radish, Beetroot; Tuber crops - Potato; Leafy vegetables - Amaranth, Palak; Perennial vegetables.

Veg. 301 Vegetable Breeding 2+1 Sem II
(Optional course)
Veg. 302 Protected Cultivation  2+1  Sem. II
In collaboration with Department of Floriculture)
(Optional course)

Veg.491 Agro-industrial Attachment  (0+4)  Sem I
The students opting for this module under 491 series of Agro-industrial Attachment will be attached for hands on training at either of the following locations:
   i. Commercial Vegetable Nurseries
   ii. Farms of Progressive Vegetable Growers

Veg.492 Experiential Learning in Commercial Vegetable Production  (0+20)  Sem II
The students opting for this module under Experiential Learning programme shall raise the vegetable(s) following the recommended PAU package of practices for vegetable crops.

Postgraduate Courses

Veg. 501 Production Technology of Winter Season Vegetable Crops  2+1  Sem. I
Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/ transplanting time, seed rate and seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, post-harvest management, plant protection measures and seed production of potato, cole crops; cabbage, cauliflower, knol khol, broccoli, brussels' sprout, chinese cabbage, root crops; carrot, radish, turnip, beet root, bulb crops; onion and garlic, peas and beans, green leafy cool season vegetables.

Veg. 502 Production Technology of Summer Season Vegetable Crops  2+1  Sem. II
Introduction, nutritional value, origin, botany and taxonomy, important countries and states growing vegetables along with area, climate and soil requirements, commercial varieties/hybrids evolved by private and public sector, sowing/ transplanting time, seed rate, seed treatment, nutritional and irrigation requirements, chemical weed control, mulching, physiological disorders, harvesting techniques, post-harvest management, plant protection measures and seed production of warm season vegetable crops i.e. solanaceous crops, okra, cucurbitaceous crops, cowpea, sweet potato, cluster beans, amaranth,
basella, kang-kong, tapioca. Poly-house, net-house and low tunnel technology for off-season production of summer vegetables


Veg. 503 Breeding of Self Pollinated and Vegetatively Propagated Vegetable Crops 2+1 Sem. II

History of vegetable breeding. Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), quality improvement in self-pollinated crops viz. tomato, brinjal, cowpea, pea, beans, okra, salad crops and asexually propagated crops like potato, sweet potato, colocasia and tapioca. Molecular marker, marker assisted breeding and QTLs, biotechnology and their use in breeding in self pollinated and vegetatively propagated vegetable crops. Issue of patenting, PPV& FRA. Concept of ideotypes. Present status of varietal/hybrid development in India. New approaches in breeding of self pollinated vegetables.

Practical: Selection of desirable plants from breeding population. Observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations. Induction of flowering. Selfing and crossing techniques in vegetable crops. Hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops. Demonstration of sib-mating and mixed population. Molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques.

Veg. 504 Breeding of Cross Pollinated Vegetable Crops 2+1 Sem. I

History of vegetable breeding. Origin, botany, taxonomy, cytogenetic, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), quality improvement, in cross-pollinated crops viz. capsicum, chilli, cucurbits (muskamelon, watermelon, cucumber, bottle gourd, long melon, bitter gourd, sponge gourd, summer squash), cole crops (cabbage, cauliflower, broccoli, brussels' sprouts), root crops (carrot radish, turnip), bulb crops (onion, garlic), asparagus, leafy vegetables and spices (black pepper, turmeric, cardamom, coriander). Molecular marker, marker assisted breeding and QTLs, biotechnology and their use in breeding cross pollinated vegetable crops. Present status of varietal/hybrid development in India. New approaches in breeding of cross pollinated vegetables.


Veg. 505 Systematics of Vegetable Crops 2+1 Sem. I

Principles of classification, different methods of classification, salient features of international code of nomenclature of vegetable crops. Origin, history, evolution and distribution of vegetable crops, botanical description of families, genera and species covering self and cross pollinated vegetable crops viz. brinjal chilli, tomato, muskmelon, water melon, bottle gourd, cucumber, bitter gourd, onion, cabbage, cauliflower, carrot, radish, turnip, amaranth, palak, peas, beans, okra and vegetatively propagated vegetables like potato, garlic, sweet potato and spices (turmeric, coriander); cytological level of various vegetable crops, descriptive blanks for describing various varieties of important vegetable crops.

Veg. 506 Seed Production Technology of Vegetable Crops 2+1 Sem. I

Definition of seed and its quality; DUS test, scope of vegetable seed industry in India. Agronomical principles and methods of seed production in important vegetable crops; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production. Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control. Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology.

Practical: Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, germination, physical purity) and seed health testing. Notification procedures of varieties. Floral biology. Rouging off-types. Methods of hybrid seed production in important vegetable crops. Seed extraction techniques. Handling of seed processing and seed testing equipments. Visit to seed processing units. Seed testing laboratory and seed production farms.

Veg. 507 Production Technology of Under Exploited Vegetable Crops 2+0 Sem. I

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of asparagus, artichoke, leek, Brussels sprout, chinese cabbage, broccoli, kale, amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu (chenopods), elephant foot, yam, lime bean, winged bean, vegetable pigeon pea, jack bean, sword bean, spine gourd, pointed gourd, oriental pickling melon and little gourd (kundru).

Veg. 508 Organic Vegetable Production Technology 2+1 Sem. II


Veg. 509 Post-harvest Handling of Vegetable Crops 2+1 Sem. II

Determination of maturity in different vegetable crops, assessment of post-harvest losses, pre-harvest methods and practices effecting post-harvest shelf life of vegetables, mechanized harvesting of vegetables, pre-cooling of vegetables using different techniques, post-harvest chemical and non-chemical treatments to enhance shelf life, sorting and grading for packaging, ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including latest techniques like CA storage, food safety and quality, non-destructive methods of quality analysis, quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh-cut vegetables.

Veg. 601 Advances in Vegetable Production  
3+0  Sem. II


Veg. 602 Advances in Vegetable Breeding  
3+0  Sem. II

Evolution, distribution, cytogenetic, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, hybridization, inter-varietal, inter-specific and inter-genetic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, in vitro breeding; breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for insect pests, disease, nematode and multiple resistance of Tomato, brinjal, chilli, sweet pepper and potato; cucurbits, cabbage, cauliflower and knol-khol, bhindi, onion, peas, beans, amaranthus, drumstick, carrot, beet root, radish, sweet potato tapioca, elephant foot yam and taro.

Veg. 603 Laboratory Techniques in Vegetable Crops  
1+2  Sem. I

Use of laboratory equipments for determining the various bio-chemical constituents. Principles and procedures for determination of various biochemical constituents including protein, ascorbic acid, dry matter, colouring matter, beta carotene, lycopene, oleoresin content, capsaicin, sugars (total and reducing), chlorophyll, chromatography, electrophoresis and determination of enzymes relevant to post-harvest handling and processing.

Practical: Determination of sugars (reducing and non-reducing), protein, capsaicin, ascorbic acid, titrable acidity, phenols, O-dihyodroxy phenols, carotene and pigments, dry matter, colour, lycopene, colouring matter, texture, oleoresin content, TSS, flavonols, chromatography including TLC, GLC, column chromatography. Electrophoresis, PCR and isolation of plant DNA. Respiration and ethylene measurements.

Veg. 604 Abiotic Stress Management in Vegetable Crops  
2+1  Sem. I

Environmental stress and its types, soil parameters including pH, classification of vegetable crops based on susceptibility and tolerance to various types of stresses, root stock, use of wild species, use of anti-transpirant. Mechanism and measurements of tolerance to drought, water logging, soil salinity, frost and heat stress in vegetable crops; Soil-plant-water relations under different stress conditions in vegetable crops production and their management practices. Techniques of vegetable growing under water deficit, water logging, salinity and sodicity. Techniques of vegetable growing under high and low temperature conditions, use of chemicals in alleviation of different stresses.
Practical: Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops. Measurement of tolerance to various stresses in vegetable crops. Short term experiments on growing vegetable under water deficit, water-logging, salinity and sodicity, high and low temperature conditions and use of chemicals for alleviation of different stresses.

**Veg. 605 Seed Certification, Processing and Storage of Vegetable Crops** 2+1 Sem. I

Seed certification, objectives, organization of seed certification, minimum seed certification standards, field inspection, specification for certification; Seed processing, study of seed processing equipments seed cleaning and upgrading, seed packing and handling, equipment used for packaging of seeds, procedures for allocating lot number; Pre-conditioning, seed treatment, benefits, types and products, general principles of seed storage, advances in methods of storage, quality control in storage, storage containers, seed longevity and deterioration, sanitation, temperature and relative humidity control, Seed testing; ISTA rules for testing, moisture, purity, germination, vigor test, seed sampling, seed viability, seed health testing; seed dormancy, factors responsible for dormancy. Seed marketing, demand forecast, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy, project formulation on vegetable seed production.

Practical: Seed sampling, purity, moisture testing, seed viability, seed vigour tests, seed health testing, seed cleaning, grading and packaging. Handling of seed testing equipment and processing machines. Seed treatment methods, seed priming and pelleting. Field inspection. Practices in rouging. Seed storage. Isolation distances. Mixing and dividing instruments. Biochemical tests. Visit to seed testing laboratories and processing plants. Visit to warehouse to know about sanitation standards.

**Veg. 591 Seminar**

**Veg. 600 Master's Research**

**Veg. 700 Ph.D. Research**
DEFICIENCY COURSES

BASIC SCIENCES AND HUMANITIES

Th + Pr

For PCM base
1. Bio. 102 Introductory Biology 1+1

1+1=2

For PCB base
1. Math. 103 Elementary Mathematics 2+0

2+0=2

REGIONAL LANGUAGE

For students with domicile of Punjab who have not taken Punjabi at Matric/10+2 level
1. Pbi. 101 Basic Punjabi 0+2 (NC)

For ICAR nominees and foreign students
1. Pbi. Cul 101 Punjabi Culture 2+0 (NC)

REQUIRED COURSES

BASIC SCIENCES AND HUMANITIES

Th+Pr

1. Biochem. 101 Introduction to Biochemistry 2+1
2. Bot. 104 Fundamentals of Crop Physiology 1+1
3. Econ. 102 Fundamentals of Agricultural Economics 2+0
4. Econ. 204 Agricultural Marketing, Trade and Prices 2+1
5. Econ. 205 Agricultural finance and Cooperation 2+1
6. Econ. 304 Farm Management, Production and Resource Economics 1+1
7. Eng. 101 General English 1+1
8. Eng. 201 Communication Skills and Personality Development 1+1
9. Micro. 102 Elementary Microbiology 2+1
10. Mgt. 201 Entrepreneurship Development and Business Management 2+1
11. Soc. 101 Rural Sociology and Educational Psychology 2+0
12. Stat. 206 Basic Statistics 1+1

19+10=29
AGRICULTURAL ENGINEERING AND INFORMATION TECHNOLOGY  Th+Pr
1. EST 202  Renewal Energy and Green Technology  1+1
2. CSE 101  Information and Communication Technology in Agriculture  1+2
3. FMP 102  Farm Power and Machinery  1+1
4. PFE 303  Protected Cultivation and Secondary Agriculture  1+1
5. SWE 102  Soil and Water Conservation Engineering  1+1

5+6=11

HORTICULTURE  Th+Pr
1. Forst. 102  Introduction to Forestry  1+1
2. Flori. 202  Production Technology for Ornamental Crops and Landscaping  1+1
3. Hort. 103  Fundamentals of Horticulture  1+1
4. Hort. 202  Production Technology for Fruit and Plantation Crops  1+1
5. Hort. 301  Post-harvest Management and Value Addition of Fruits and Vegetables  1+1
6. Veg. 202  Production Technology for Vegetables and Spices  1+1

6+6=12

AGRICULTURE  Th+Pr
1. AS 201  Livestock and Poultry Management  2+1
2. Agromet. 102  Introductory Agrometeorology and Climate Change 1+1
3. Agron. 101  Fundamentals of Agronomy  3+1
4. Agron. 201  Production Technology for Kharif Crops  1+1
5. Agron. 202  Crop Production Technology for Rabi Crops  1+1
6. Agron. 203  Farming Systems and Sustainable Agriculture  1+0
7. Agron. 301  Practical crop Production-I (Kharif Crops)  0+2
8. Agron. 302  Practical crop Production-II (Rabi Crops)  0+2
9. Agron. 303  Rainfed Agriculture and Watershed Management  1+1
10. Agron. 304  Principles of Organic Farming  1+1
11. Biotech. 206  Fundamentals of Plant Biotechnology  2+1
12. Ent. 201  Fundamentals of Entomology  3+1
13. Ent.-Pl. Path. 202  Principles of Integrated Pest and Disease Management  2+1
14. Ent. 301  Pest of Crops and Stored Grains and their Management  2+1
15. Ent. 302  Management of Beneficial Insects  2+1
16. Ext. 101  Agricultural Heritage  1+0
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<tr>
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<th>Credits</th>
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<tr>
<td>17. Ext. 201</td>
<td>Fundamentals of Agricultural Extension Education</td>
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<tr>
<td>18. FT 313</td>
<td>Principles of Food Science and Nutrition</td>
<td>2+0</td>
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<tr>
<td>19. PBG 102</td>
<td>Fundamentals of Genetics</td>
<td>2+1</td>
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<tr>
<td>20. PBG 201</td>
<td>Fundamentals of Plant Breeding</td>
<td>2+1</td>
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<tr>
<td>21. PBG 301</td>
<td>Crop Improvement-I (Kharif Crops)</td>
<td>1+1</td>
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<tr>
<td>22. PBG 302</td>
<td>Crop Improvement-II (Rabi Crops)</td>
<td>1+1</td>
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<tr>
<td>23. PBG 303</td>
<td>Intellectual Property Rights</td>
<td>1+0</td>
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<td>24. PBG 304</td>
<td>Principles of Seed Technology</td>
<td>1+1</td>
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<tr>
<td>25. Pl. Path. 102</td>
<td>Fundamentals of Plant Pathology</td>
<td>3+1</td>
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<td>26. Pl. Path. 301</td>
<td>Diseases of Field and Horticultural Crops and Their Management –I</td>
<td>2+1</td>
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<tr>
<td>27. Pl. Path. 302</td>
<td>Diseases of Field and Horticultural Crops and Their Management –II</td>
<td>2+1</td>
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<tr>
<td>28. Soils 101</td>
<td>Fundamentals of Soil Science</td>
<td>2+1</td>
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<tr>
<td>29. Soils 202</td>
<td>Problematic Soils and their Management</td>
<td>2+0</td>
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<tr>
<td>30. Soils 301</td>
<td>Manures, Fertilizers and Soil Fertility Management</td>
<td>2+1</td>
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<td>31. Soils 302</td>
<td>Precision farming, Geoinformatics and Nano-technology</td>
<td>1+1</td>
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<td>32. Env. 101</td>
<td>Environmental Studies and Disaster Management</td>
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<td>33. Optional Course-1</td>
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<td>2+1/1+2</td>
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<tr>
<td>34. Optional Course-2</td>
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<td>2+1/1+2</td>
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<tr>
<td>35. RAWE 401</td>
<td>General Orientation and On-campus Training</td>
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<tr>
<td>36. RAWE 402</td>
<td>Village Attachment</td>
<td>0+8</td>
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<tr>
<td>37. RAWE 403</td>
<td>KVK and Research Station Attachment</td>
<td>0+5</td>
</tr>
<tr>
<td>38. RAWE 404</td>
<td>Plant Clinic</td>
<td>0+2</td>
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<tr>
<td>39. AIA 491</td>
<td>Agro-Industrial Attachment</td>
<td>0+4</td>
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<tr>
<td>40. ELP 492</td>
<td>Experiential Learning Modules</td>
<td>0+20</td>
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<tr>
<td>41. Educational Tour</td>
<td>Compulsory Educational Tour</td>
<td>0+2(NC)</td>
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**COMMUNITY SCIENCE**

<table>
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<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>1</td>
<td>HDFS 106</td>
<td>Human Values 1+0</td>
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**NCC/NSO/NSS**

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<th>Course Title</th>
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<tbody>
<tr>
<td>1</td>
<td>NCC/NSO/NSS (SEM-I)</td>
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<td>NCC/NSO/NSS (SEM-II)</td>
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<td>NCC/NSO/NSS (SEM-III)</td>
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<td>4</td>
<td>NCC/NSO/NSS (SEM-IV)</td>
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</tbody>
</table>
Total credit hours requirement for B.Sc.(Hons.) Agri. Programme: 180 + 2NC* + 2NC** + 4NC*** = 188

* Educational Tour
** Pbi 101/Pbi Cul 101/
*** NCC/NSS/NSO
SEMESTER- WISE STUDY PROGRAMME OF 
B.Sc. (Hons) Agri. 4 YEAR PROGRAMME

**FIRST YEAR**

<table>
<thead>
<tr>
<th>SEM I</th>
<th>SEM II</th>
</tr>
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<tbody>
<tr>
<td>1. Bio. 102* /Math. 103*</td>
<td>1. Agromet. 102</td>
</tr>
<tr>
<td>2. Agron. 101</td>
<td>2. Env. 101</td>
</tr>
<tr>
<td>3. Ext. 101</td>
<td>3. Forst. 102</td>
</tr>
<tr>
<td>4. Hort. 103</td>
<td>4. PBG 102</td>
</tr>
<tr>
<td>5. Soils 101</td>
<td>5. Pl. Path. 102</td>
</tr>
<tr>
<td>7. Eng. 101</td>
<td>7. SWE 102</td>
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<tr>
<td>9. HDFS 106</td>
<td>9. Econ. 102</td>
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<tr>
<td>11. NCC/NSO/NSS</td>
<td>11. NCC/NSS/NSO</td>
</tr>
</tbody>
</table>

\[20+2(\text{NC})+1(\text{NC})=23\]
\[16+8+1(\text{NC})=25\]

*Remedial Course Bio 102 for Non Medical stream and Math 103 for Medical stream students
** For students with Punjab domicile who have not taken Punjabi at Matric/10+2 level
*** For students admitted through ICAR and foreign students

**SECOND YEAR**

<table>
<thead>
<tr>
<th>SEM III</th>
<th>SEM IV</th>
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<tr>
<td>1. Agron. 201</td>
<td>1. Agron. 202</td>
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<tr>
<td>2. AS 201</td>
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<td>3. Ent. 201</td>
<td>3. Biotech. 206</td>
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<td>4. Ext. 201</td>
<td>4. Ent. -Pl. Path. 202</td>
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<td>5. PBG 201</td>
<td>5. Flori. 202</td>
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<td>7. Econ. 205</td>
<td>7. Soils 202</td>
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<tr>
<td>8. Mgt. 201</td>
<td>8. Veg. 202</td>
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<tr>
<td>9. NCC/NSO/NSS 0+1 NC</td>
<td>9. EST 202</td>
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<tr>
<td>10. Econ. 204</td>
<td>10. EST 202</td>
</tr>
<tr>
<td>12. NCC/NSO/NSS</td>
<td>12. NCC/NSO/NSS</td>
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\[15+9+1(\text{NC})=25\]
\[15+9+ (\text{NC})=25\]
### THIRD YEAR

<table>
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<tr>
<th>S.No.</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>Agron. 301</td>
<td>0+2</td>
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<tr>
<td>2.</td>
<td>Agron. 303</td>
<td>1+1</td>
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<td>3.</td>
<td>Ent. 301</td>
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<td>4.</td>
<td>FT 313</td>
<td>2+0</td>
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<td>5.</td>
<td>Hort. 301</td>
<td>1+1</td>
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<td>6.</td>
<td>PBG 301</td>
<td>1+1</td>
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<td>7.</td>
<td>PBG 303</td>
<td>1+0</td>
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<td>8.</td>
<td>Pl. Path. 301</td>
<td>2+1</td>
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<td>9.</td>
<td>Soils 301</td>
<td>2+1</td>
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<tr>
<td>10.</td>
<td>Eng. 201</td>
<td>1+1</td>
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<tr>
<td>11.</td>
<td>Edu. Tour</td>
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</table>

Total credit hours: 13+9+2(NC)= 24

### FOURTH YEAR

<table>
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<tr>
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<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>1.</td>
<td>RAWE 401</td>
<td>0+1</td>
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<tr>
<td>2.</td>
<td>RAWE 402</td>
<td>0+8</td>
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<tr>
<td>3.</td>
<td>RAWE 403</td>
<td>0+5</td>
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<td>4.</td>
<td>RAWE 404</td>
<td>0+2</td>
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<tr>
<td>5.</td>
<td>Agro-Industrial Attachment</td>
<td>0+4</td>
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</table>

Total credit hours: 0+20=20

### Optional Courses

(A student will have to opt for any two of the following courses during VI semester)

<table>
<thead>
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<th>S.No.</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>1.</td>
<td>Agromet. 301</td>
<td>System Simulation and Agro-advisory</td>
<td>2+1</td>
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<tr>
<td>2.</td>
<td>Agron. 305</td>
<td>Weed Management</td>
<td>2+1</td>
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<tr>
<td>3.</td>
<td>Biotech. 308</td>
<td>Micropropagation Technologies</td>
<td>1+2</td>
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<td>4.</td>
<td>Flori. 301</td>
<td>Landscaping Grading</td>
<td>2+1</td>
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<tr>
<td>5.</td>
<td>FT 314</td>
<td>Food Safety and Standards</td>
<td>2+1</td>
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<tr>
<td>6.</td>
<td>Hort. 302</td>
<td>Hi-tech Horticulture</td>
<td>2+1</td>
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<tr>
<td>7.</td>
<td>PBG 305</td>
<td>Molecular Breeding Technologies</td>
<td>2+1</td>
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<tr>
<td>8.</td>
<td>Soils 303</td>
<td>Biofertilizers and Biopesticides</td>
<td>2+1</td>
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<tr>
<td>9.</td>
<td>Veg. 301</td>
<td>Vegetable Breeding</td>
<td>2+1</td>
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<tr>
<td>10.</td>
<td>Veg. 302</td>
<td>Protected Cultivation</td>
<td>2+1</td>
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<td>11.</td>
<td>Chem. 308</td>
<td>Chemistry of Agrochemicals</td>
<td>2+1</td>
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<td>12.</td>
<td>Jour. 302</td>
<td>Agricultural Journalism</td>
<td>2+1</td>
</tr>
</tbody>
</table>
Agro-Industrial Attachment
(A student will opt for only one module out of the following 491 series courses under Agro-Industrial Attachment during VII semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Modules</th>
</tr>
</thead>
</table>
| Agron. 491 | Agro-industrial Attachment | 0+4                      | (i) Seed Industries  
(ii) Herbicide Formulators |
| Ent. 491 | Agro-industrial Attachment | 0+4                      | (i) Commercial Honey Production, Hive and Apicultural Equipment and Honey Processing Manufacturing Units; Honey Trading, Processing, Packaging, Exporting and Marketing Units. |
| Ent.-Pl.-Path. 491 | Agro-industrial Attachment | 0+4                      | (i) Pesticide and Biopesticide Industries  
(ii) Biocontrol Agents Production Units  
(iii) Plant Quarantine Station  
(iv) Virus free Potato Tuber Production Units |
| FT 491 | Agro-industrial Attachment | 0+4                      | (i) Fruit and Vegetables Industry  
(ii) Beverages Industry  
(iii) Cereal Industry  
(iv) Milk Industry |
| Flori. 491 | Agro-industrial Attachment | 0+4                      | (i) Commercial Flower Nurseries  
(ii) Flower Marketing Firms  
(iii) Flower Seed Production and Landscaping Units |
| Forst. 491 | Agro-industrial Attachment | 0+4                      | High-tech Nursery (Tree Planting Stock Production) |
| Hort. 491 | Agro-industrial Attachment | 0+4                      | (i) Commercial Fruit Nurseries |
| PBG 491 | Agro-industrial Attachment | 0+4                      | Commercial Hybrid Seed Production Units |
| Soils 491 | Agro-industrial Attachment | 0+4                      | (i) Fertilizer Industries  
(ii) Vermicompost Units  
(iii) Biofertilizer Units |
| Veg. 491 | Agro-industrial Attachment | 0+4                      | (i) Commercial Vegetable Nurseries  
(ii) Farms of Progressive Vegetable Growers |
| Micro. 491 | Agro-industrial Attachment | 0+4                      | Mushroom Production Units |
Experiential Learning Modules

(A student will opt for only one of the following Experiential Learning Modules during VIII semester)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agron. 492</td>
<td>Experiential Learning in Organic Production Technology</td>
<td>0+20</td>
</tr>
<tr>
<td>2.</td>
<td>Ent. 492</td>
<td>Experiential Learning in Commercial Apiculture</td>
<td>0+20</td>
</tr>
<tr>
<td>3.</td>
<td>Ent.-Pl. Path. 492</td>
<td>Experiential Learning in Production Technology for Bioagents</td>
<td>0+20</td>
</tr>
<tr>
<td>4.</td>
<td>Flori. 492</td>
<td>Experiential Learning in Commercial Floriculture and Landscaping</td>
<td>0+20</td>
</tr>
<tr>
<td>5.</td>
<td>Forst. 492</td>
<td>Experiential Learning in Nursery Production of Agro-forestry Trees</td>
<td>0+20</td>
</tr>
<tr>
<td>6.</td>
<td>Hort. 492</td>
<td>Experiential Learning in Commercial Horticulture</td>
<td>0+20</td>
</tr>
<tr>
<td>7.</td>
<td>PBG 492</td>
<td>Experiential Learning in Seed Production and Technology</td>
<td>0+20</td>
</tr>
<tr>
<td>8.</td>
<td>Soils 492</td>
<td>Experiential Learning in Soil, Plant Water, and Seed Analyses</td>
<td>0+20</td>
</tr>
<tr>
<td>9.</td>
<td>Veg. 492</td>
<td>Experiential Learning in Commercial Vegetable Production</td>
<td>0+20</td>
</tr>
<tr>
<td>10.</td>
<td>FT 492</td>
<td>Experiential Learning in Food Technologies</td>
<td>0+20</td>
</tr>
<tr>
<td>11.</td>
<td>EST 492</td>
<td>Experiential Learning in Agricultural Waste Management</td>
<td>0+20</td>
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<tr>
<td>12.</td>
<td>Micro. 492</td>
<td>Experiential Learning in Mushroom Production</td>
<td>0+20</td>
</tr>
<tr>
<td>13.</td>
<td>Micro. 493</td>
<td>Experiential Learning in Production Technology for Biofertilizers</td>
<td>0+20</td>
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</table>

Semester Wise Total Credit Hours

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>20(14+6/15+5)+2(NC**)+1(NC***)=23</td>
</tr>
<tr>
<td>II</td>
<td>24(16+8)+1(NC***)=25</td>
</tr>
<tr>
<td>III</td>
<td>24(15+9)+1(NC***)=25</td>
</tr>
<tr>
<td>IV</td>
<td>24(15+9)+1(NC***)=25</td>
</tr>
<tr>
<td>V</td>
<td>22(13+9)+2(NC*)=24</td>
</tr>
<tr>
<td>VI</td>
<td>26(14+12)</td>
</tr>
<tr>
<td>VII</td>
<td>20(0+20)</td>
</tr>
<tr>
<td>VIII</td>
<td>20(0+20)</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>TOTAL</td>
<td>180+2NC*+2NC**+4NC***=188</td>
</tr>
</tbody>
</table>

*Educational Tour  
**PBI 101/PBI Cul 101/  
***NCC/NSS/NSO
## COLLEGE OF AGRICULTURE

### CORE COURSES FOR FIRST TWO YEARS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Th+Pr</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Or. 91</td>
<td>Orientation</td>
<td>0+1NC</td>
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### BASIC SCIENCES AND HUMANITIES

<table>
<thead>
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<th>Course Title</th>
<th>Th+Pr</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Bot. 91</td>
<td>Introduction to Morphology and Reproductive Botany</td>
<td>3+1</td>
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<tr>
<td>Bot. 92</td>
<td>Basics of Systematic Botany and Ecology</td>
<td>3+1</td>
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<tr>
<td>Bot. 93</td>
<td>Introduction to Plant Histology and Genetics</td>
<td>3+1</td>
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</tr>
<tr>
<td>Bot. 94</td>
<td>Basics of Plant Physiology</td>
<td>3+1</td>
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<tr>
<td>Chem. 91</td>
<td>Fundamentals of Inorganic Chemistry</td>
<td>3+1</td>
<td></td>
</tr>
<tr>
<td>Chem. 92</td>
<td>Introductory Organic Chemistry</td>
<td>3+1</td>
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<tr>
<td>Chem. 93</td>
<td>Fundamentals of Physical Chemistry</td>
<td>3+1</td>
<td></td>
</tr>
<tr>
<td>Chem. 94</td>
<td>Fundamentals of Organic Chemistry</td>
<td>3+1</td>
<td></td>
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<tr>
<td>Eng. 91</td>
<td>General Reading, Vocabulary Building and Translation</td>
<td>2+1</td>
<td></td>
</tr>
<tr>
<td>Eng. 92</td>
<td>Reading, Comprehension, Paragraph Writing and Applied Grammar</td>
<td>2+1</td>
<td></td>
</tr>
<tr>
<td>Eng. 93</td>
<td>Conversational Structure and Communicative Function</td>
<td>2+1</td>
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<tr>
<td>Eng. 94</td>
<td>Discourse Patterns in Spoken English</td>
<td>1+2</td>
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<tr>
<td>Phys. 91</td>
<td>Mechanics</td>
<td>3+1</td>
<td></td>
</tr>
<tr>
<td>Phys. 92</td>
<td>Matter Properties and Thermodynamics</td>
<td>3+1</td>
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<tr>
<td>Phys. 93</td>
<td>Electricity and Magnetism</td>
<td>3+1</td>
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<tr>
<td>Phys. 94</td>
<td>Modern Physics</td>
<td>3+1</td>
<td></td>
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<tr>
<td>Zoo. 91</td>
<td>Elementary Cell Biology</td>
<td>3+1</td>
<td></td>
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<tr>
<td>Zoo. 92</td>
<td>Elementary Animal Diversity</td>
<td>3+1</td>
<td></td>
</tr>
<tr>
<td>Zoo. 93</td>
<td>Elementary Animal Physiology</td>
<td>3+1</td>
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<tr>
<td>Zoo. 94</td>
<td>Human Welfare and Environment</td>
<td>3+1</td>
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### SEMESTER-WISE STUDY PROGRAMME OF B.Sc. (Hons) Agri. 2+4 year programme for first two years

<table>
<thead>
<tr>
<th>SEM I</th>
<th>SEM II</th>
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<tbody>
<tr>
<td>1</td>
<td>Phys. 91 3+1</td>
</tr>
<tr>
<td>2</td>
<td>Chem. 91 3+1</td>
</tr>
<tr>
<td>3</td>
<td>Bot. 91 3+1</td>
</tr>
<tr>
<td>4</td>
<td>Zoo. 91 3+1</td>
</tr>
<tr>
<td>5</td>
<td>Eng. 91 2+1</td>
</tr>
<tr>
<td>6</td>
<td>Or. 91 0+1NC</td>
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</table>

**Total Credits:** 14+5=19 + 1NC

---

234
<table>
<thead>
<tr>
<th></th>
<th>SEM I</th>
<th></th>
<th>SEM II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phys. 93</td>
<td>3+1</td>
<td>Phys. 94</td>
</tr>
<tr>
<td>2</td>
<td>Chem. 93</td>
<td>3+1</td>
<td>Chem. 94</td>
</tr>
<tr>
<td>3</td>
<td>Bot. 93</td>
<td>3+1</td>
<td>Bot. 94</td>
</tr>
<tr>
<td>4</td>
<td>Zoo. 93</td>
<td>3+1</td>
<td>Zoo. 94</td>
</tr>
<tr>
<td>5</td>
<td>Eng. 93</td>
<td>2+1</td>
<td>Eng. 94</td>
</tr>
</tbody>
</table>

14+5=19  13+6=19

**Note:**

1. All courses given in RIB 2016 for B.Sc. (Hons) Agri. 4-year programme will also be applicable to B.Sc. (Hons) Agri. 2+4 programme from 3rd year onwards.

2. The students of B.Sc. (Hons) Agri. 2+4 programme will be exempted from clearing Bio. 102 (1+1) courses equivalent to 10+2 medical stream as they will clear 16 credit hours each in Botany (Bot. 91, Bot. 92, Bot. 93 and Bot. 94) and Zoology (Zoo 91, Zoo. 92, Zoo. 93 and Zoo. 94) during initial two years.

3. The students who join 3rd year of B.Sc. (Hons) Agri. 2+4 programme at PAU, Ludhiana after completion of two years at IOA, Bathinda and IOA, Gurdaspur will register compulsory three fold programme of NCC /NSO /NSS (0+1 NC) during their first four semesters at PAU, Ludhiana.
### COURSE CURRICULUM FOR B.Tech. (Food Technology)
**4 YEAR PROGRAMME (CORE COURSES)**

#### DEFICIENCY COURSES

#### BASIC SCIENCES AND HUMANITIES

**Regional Language**

For student with domicile of Punjab who have not taken Punjabi at Matric/10+2 level

<table>
<thead>
<tr>
<th>Th + Pr</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pbi. 101</td>
<td>Basic Punjabi</td>
<td>0+2(NC)</td>
</tr>
</tbody>
</table>

For ICAR nominees and foreign students

<table>
<thead>
<tr>
<th>Th + Pr</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pbi. Cul 101</td>
<td>Punjabi Culture</td>
<td>2+0 (NC)</td>
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</table>

#### REQUIRED COURSES

#### BASIC SCIENCES AND HUMANITIES

<table>
<thead>
<tr>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Math. 101</td>
<td>Basic Mathematics - I</td>
<td>3+0</td>
</tr>
<tr>
<td></td>
<td>2 Env. 101</td>
<td>Environmental Studies &amp; Disaster Management</td>
<td>2+0</td>
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<tr>
<td></td>
<td>3 Eng. 101</td>
<td>General English</td>
<td>1+1</td>
</tr>
<tr>
<td></td>
<td>4 Micro.103</td>
<td>General Microbiology</td>
<td>2+1</td>
</tr>
<tr>
<td></td>
<td>5 HDFS 106</td>
<td>Human Values</td>
<td>1+0</td>
</tr>
<tr>
<td></td>
<td>6 Math. 102</td>
<td>Basic Mathematics - II</td>
<td>3+0 NC</td>
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<tr>
<td></td>
<td>7 Micro. 104</td>
<td>Food Microbiology</td>
<td>2+1</td>
</tr>
<tr>
<td></td>
<td>8 Eng.201</td>
<td>Communication Skills and Personality Development</td>
<td>1+1</td>
</tr>
<tr>
<td></td>
<td>9 Mgt. 202</td>
<td>Marketing Management and International Trade</td>
<td>2+0</td>
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<tr>
<td></td>
<td>10 Math. 205</td>
<td>Higher Mathematics - I</td>
<td>2+0</td>
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<tr>
<td></td>
<td>11 Stat. 205</td>
<td>Statistical Methods and Numerical Analysis</td>
<td>2+1</td>
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<tr>
<td></td>
<td>12 Biochem. 208</td>
<td>Food Biochemistry and Nutrition</td>
<td>2+1</td>
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<tr>
<td></td>
<td>13 Math. 206</td>
<td>Higher Mathematics - II</td>
<td>2+0</td>
</tr>
<tr>
<td></td>
<td>14 Mgt. 204</td>
<td>Business Management and Economics</td>
<td>2+0</td>
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<tr>
<td></td>
<td>15 Micro. 308</td>
<td>Fundamentals of Industrial Microbiology</td>
<td>2+1</td>
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</table>

#### AGRICULTURE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Agron. 105</td>
<td>Crop Production Practices</td>
<td>2+1</td>
</tr>
<tr>
<td>2 FT 102</td>
<td>Food Chemistry of Macroconstituents</td>
<td>2+1</td>
</tr>
<tr>
<td>3 FT 201</td>
<td>Fundamentals of Food Processing</td>
<td>1+1</td>
</tr>
<tr>
<td>4 FT 202</td>
<td>Processing Technology of Liquid Milk</td>
<td>1+1</td>
</tr>
<tr>
<td>5 FT 203</td>
<td>Food Additives and Preservatives</td>
<td>1+1</td>
</tr>
<tr>
<td>6 FT 204</td>
<td>Food Chemistry of Microconstituents</td>
<td>2+1</td>
</tr>
<tr>
<td>7 FT 205</td>
<td>Processing Technology of Meat and Poultry Products</td>
<td>2+1</td>
</tr>
<tr>
<td>8 FT 206</td>
<td>Technology of Bakery, Confectionery and Snack Foods</td>
<td>2+1</td>
</tr>
<tr>
<td>9 FT 207</td>
<td>Processing Technology of Legumes and Oilseeds</td>
<td>2+1</td>
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</table>

26+7+3NC=36
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>FT 208</td>
<td>Processing Technology of Spices and Plantation Crops</td>
<td>1+1</td>
</tr>
<tr>
<td>FT 301</td>
<td>Processing Technology of Fruits and Vegetables</td>
<td>2+1</td>
</tr>
<tr>
<td>FT 302</td>
<td>Processing Technology of Cereals</td>
<td>2+1</td>
</tr>
<tr>
<td>FT 303</td>
<td>Processing Technology of Dairy Products</td>
<td>2+1</td>
</tr>
<tr>
<td>FT 304</td>
<td>Sensory Evaluation of Food Products</td>
<td>2+1</td>
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<tr>
<td>FT 305</td>
<td>Techniques and Instruments for Food Analysis</td>
<td>1+2</td>
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<tr>
<td>FT 306</td>
<td>Food Plant Sanitation</td>
<td>1+1</td>
</tr>
<tr>
<td>FT 307</td>
<td>Processing Technology of Fish and Marine Products</td>
<td>1+1</td>
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<tr>
<td>FT 308</td>
<td>Processing Technology of Beverages</td>
<td>2+1</td>
</tr>
<tr>
<td>FT 309</td>
<td>Food Quality, Safety Standards and Certification</td>
<td>2+0</td>
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<tr>
<td>FT 310</td>
<td>Food Packaging Technology and Equipment</td>
<td>2+1</td>
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<tr>
<td>Biotech. 308</td>
<td>Food Biotechnology</td>
<td>2+1</td>
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<tr>
<td>FT/Mgt 493</td>
<td>Entrepreneurship Development</td>
<td>2+1</td>
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<tr>
<td>FT 494</td>
<td>Student READY - Experiential Learning Programme - I</td>
<td>0+7</td>
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<tr>
<td>FT 495</td>
<td>Student READY - Experiential Learning Programme – II</td>
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<tr>
<td>FT 496</td>
<td>Student READY - Research Project</td>
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<tr>
<td>FT 497</td>
<td>Student READY - Seminar</td>
<td>0+1</td>
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<tr>
<td>FT 498</td>
<td>Student READY - Industrial cum Educational Tour</td>
<td>0+2</td>
</tr>
<tr>
<td>FT 499</td>
<td>Student READY - In-Plant Training</td>
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**AGRICULTURAL ENGINEERING AND TECHNOLOGY**

<table>
<thead>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>EE 101</td>
<td>Electrical Engineering</td>
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<tr>
<td>ME 101</td>
<td>Workshop Technology</td>
<td>1+2</td>
</tr>
<tr>
<td>CSE 204</td>
<td>Computer Programming and Data Structures</td>
<td>1+2</td>
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<tr>
<td>EE 206</td>
<td>Applied Electronics and Instrumentation</td>
<td>2+1</td>
</tr>
<tr>
<td>ME 102</td>
<td>Engineering Drawing and Graphics</td>
<td>0+3</td>
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<tr>
<td>ME 106</td>
<td>Food Thermodynamics</td>
<td>2+1</td>
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<tr>
<td>PFE 102</td>
<td>Post Harvest Engineering</td>
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<tr>
<td>ME 201</td>
<td>Heat and Mass Transfer in Food Processing</td>
<td>2+1</td>
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<tr>
<td>PFE 201</td>
<td>Unit Operations in Food Processing - I</td>
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<tr>
<td>PFE 202</td>
<td>Unit Operations in Food Processing - II</td>
<td>2+1</td>
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<tr>
<td>PFE 203</td>
<td>Food Refrigeration and Cold Chain</td>
<td>2+1</td>
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<tr>
<td>CSE 101</td>
<td>Information and Communication Technology in Agriculture</td>
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<td>PFE 301</td>
<td>Food Process Equipment Design</td>
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<tr>
<td>PFE 302</td>
<td>Food Storage Engineering</td>
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<tr>
<td>EE 304</td>
<td>Instrumentation and Process Control in Food Industry</td>
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<tr>
<td>ME 305</td>
<td>Fluid Mechanics</td>
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**COMMUNITY SCIENCE**

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<tbody>
<tr>
<td>HDFS 106</td>
<td>Human Values</td>
<td>11+0</td>
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**NCC/NSO/NSS**

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<td>NCC/NSO/NSS</td>
<td>SEM II</td>
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<td>3</td>
<td>NCC/NSO/NSS</td>
<td>SEM III</td>
</tr>
<tr>
<td>4</td>
<td>NCC/NSO/NSS</td>
<td>SEM IV</td>
</tr>
</tbody>
</table>

Total credit hours requirement for B.Tech. (Food Technology) 4 year Programme:

185 + 4(NC**) + 2(NC)* = 191

*Pbi 101/Pbi Cul 101/**NCC/NSS/NSO
## SEMESTER-WISE STUDY PROGRAMME OF B.Tech. (Food Technology) PROGRAMME

### FIRST YEAR

<table>
<thead>
<tr>
<th>SEM I</th>
<th>SEM II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Math 101</td>
<td>1. Math 102</td>
</tr>
<tr>
<td>2. Agron 105</td>
<td>2. FT 102</td>
</tr>
<tr>
<td>3. Env 101</td>
<td>3. CSE 204</td>
</tr>
<tr>
<td>4. EE 101</td>
<td>4. EE 206</td>
</tr>
<tr>
<td>5. ME 101</td>
<td>5. ME 102</td>
</tr>
<tr>
<td>6. Eng 101</td>
<td>6. ME 106</td>
</tr>
<tr>
<td>7. Micro 103</td>
<td>7. PFE 102</td>
</tr>
<tr>
<td>8. HDFS 106</td>
<td>8. Micro 104</td>
</tr>
<tr>
<td>10. NCC/NSO/NSS</td>
<td>0+1 NC</td>
</tr>
</tbody>
</table>

14+6+2NC+1NC=23
11+10+4NC=25=25

### SECOND YEAR

<table>
<thead>
<tr>
<th>SEM III</th>
<th>SEM IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT 201</td>
<td>1. FT 205</td>
</tr>
<tr>
<td>2. FT 202</td>
<td>2. FT 206</td>
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<tr>
<td>3. FT 203</td>
<td>3. FT 207</td>
</tr>
<tr>
<td>4. FT 204</td>
<td>4. FT 208</td>
</tr>
<tr>
<td>5. ME 201</td>
<td>5. PFE 202</td>
</tr>
<tr>
<td>6. PFE 201</td>
<td>6. PFE 203</td>
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<td>10. Stat.205</td>
<td>10. NCC/NSO/NS</td>
</tr>
<tr>
<td>11. NCC/NSO/NSS</td>
<td>0+1 NC</td>
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16+8+1NC=25
17+7+1NC=25
## THIRD YEAR

<table>
<thead>
<tr>
<th>SEM V</th>
<th>SEM VI</th>
</tr>
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<tbody>
<tr>
<td>FT 301 2+1</td>
<td>1. FT 306 1+1</td>
</tr>
<tr>
<td>2. FT 302 2+1</td>
<td>2. FT 307 1+1</td>
</tr>
<tr>
<td>3. FT 303 2+1</td>
<td>3. FT 308 2+1</td>
</tr>
<tr>
<td>4. FT 304 2+1</td>
<td>4. FT 309 2+0</td>
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<tr>
<td>5. FT 305 1+2</td>
<td>5. FT 310 2+1</td>
</tr>
<tr>
<td>6. CSE 101 1+2</td>
<td>6. Biotech. 308 2+1</td>
</tr>
<tr>
<td>7. PFE 301 2+1</td>
<td>7. EE 304 2+1</td>
</tr>
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<td>8. PFE 302 2+1</td>
<td>8. ME 305 2+1</td>
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<tr>
<td>9. Micro 308 2+1</td>
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<tr>
<td>14+10=24</td>
<td>16+8=24</td>
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## FOURTH YEAR

<table>
<thead>
<tr>
<th>SEM VII</th>
<th>SEM VIII</th>
</tr>
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<tbody>
<tr>
<td>FT/Mgt 493 2+1</td>
<td>1. FT 499 20 (0+20)</td>
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<tr>
<td>2. FT 494 0+7</td>
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</tr>
<tr>
<td>3. FT 495 0+7</td>
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</tr>
<tr>
<td>4. FT 496 0+3</td>
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<tr>
<td>2+21=23</td>
<td>0+20=20</td>
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*For students with the domicile of Punjab who did not study Punjabi at matric or 10+2 level.

### Semester Wise Total Credit Hours

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Semester</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester – I</td>
<td>20 (14+6)+2NC+ 1NC=23</td>
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</tr>
<tr>
<td>Semester – II</td>
<td>21 (11+10)+4NC=25</td>
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<tr>
<td>Semester – III</td>
<td>24 (16+8)+1NC=25</td>
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<tr>
<td>Semester – IV</td>
<td>24 (17+7) +1NC=25</td>
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</tr>
<tr>
<td>Semester – V</td>
<td>24 (14+10) =24</td>
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</tr>
<tr>
<td>Semester – VI</td>
<td>24 (16+8) =24</td>
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</tr>
<tr>
<td>Semester – VII</td>
<td>23 (2+21) =23</td>
<td></td>
</tr>
<tr>
<td>Semester – VIII</td>
<td>20 (0+20) = 20</td>
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</tr>
<tr>
<td>Total</td>
<td>180 (90+90)+7NC***+2NC*=186</td>
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</table>

*Pbi 101/Pbi Cul 101/

**NCC/NSS/NSO
DEFICIENCY COURSES

BASIC SCIENCES AND HUMANITIES

For PCM base

<table>
<thead>
<tr>
<th>Cr. Hrs.</th>
<th>Th + Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bot. 101 Basic Botany</td>
<td>2 + 1</td>
</tr>
<tr>
<td>2. Zoo. 101 Basic Zoology</td>
<td>2 + 1</td>
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<tr>
<td><strong>4 + 2 = 6</strong></td>
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</tr>
</tbody>
</table>

For PCB base

<table>
<thead>
<tr>
<th>Cr. Hrs.</th>
<th>Th + Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Math. 101 Basic Mathematics-1</td>
<td>3 + 0</td>
</tr>
<tr>
<td>2. Math. 102 Basic Mathematics-II</td>
<td>3 + 0</td>
</tr>
<tr>
<td><strong>6 + 0 = 6</strong></td>
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</table>

Regional Language

For students with domicile of Punjab who have not taken Punjabi at Matric/10+ 2 level

<table>
<thead>
<tr>
<th>Cr. Hrs.</th>
<th>Th + Pr</th>
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<tbody>
<tr>
<td>1 Pbi. 101 Basic Punjabi</td>
<td>0 + 2 (NC)</td>
</tr>
<tr>
<td>1 Pbi. Cul. 101 Punjabi Culture</td>
<td>2 + 0 (NC)</td>
</tr>
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</table>

REQUIRED COURSES

AGRICULTURE

<table>
<thead>
<tr>
<th>Cr. Hrs.</th>
<th>Th+Pr</th>
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</thead>
<tbody>
<tr>
<td>1. Agron. 103 Crop Production Technology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>2. AS 201 Livestock Production Management</td>
<td>2 +1</td>
</tr>
<tr>
<td>3. Biotech. 101 Cell Biology</td>
<td>2 + 0</td>
</tr>
<tr>
<td>4. Biotech. 102 Molecular Biology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>5. Biotech. 103 Introduction to Biotechnology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>6. Biotech. 104 Plant Tissue Culture</td>
<td>2 + 1</td>
</tr>
<tr>
<td>7. Biotech. 106 Electronics and Instrumentation in Biotechnology</td>
<td>1 + 1</td>
</tr>
<tr>
<td>8. Biotech. 201 Recombinant DNA Technology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>9. Biotech. 202 Introductory Bioinformatics</td>
<td>2 + 1</td>
</tr>
<tr>
<td>10. Biotech. 203 Plant Genetic Transformation</td>
<td>2 + 1</td>
</tr>
<tr>
<td>11. Biotech. 204 Classical and Molecular Cytogenetics</td>
<td>2 + 1</td>
</tr>
<tr>
<td>12. Biotech. 301 Molecular Genetics</td>
<td>2 + 0</td>
</tr>
<tr>
<td>13. Biotech. 302 Nanobiotechnology</td>
<td>2 + 0</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
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</tr>
<tr>
<td>Biotech. 303</td>
<td>Molecular Marker Technology</td>
</tr>
<tr>
<td>Biotech. 304</td>
<td>Genomics and Proteomics</td>
</tr>
<tr>
<td>Biotech. 305</td>
<td>Biosafety, Bioethics and IPR</td>
</tr>
<tr>
<td>Biotech. 306</td>
<td>Computational Biology</td>
</tr>
<tr>
<td>Biotech. 310</td>
<td>Applications of Genomics and Proteomics</td>
</tr>
<tr>
<td>Biotech. 311</td>
<td>Molecular Breeding</td>
</tr>
<tr>
<td>Biotech. 312</td>
<td>Epigenetics and Gene Regulation</td>
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<tr>
<td>Biotech. 313</td>
<td>Programming for Bioinformatics</td>
</tr>
<tr>
<td>Biotech. 314</td>
<td>Next Generation Sequencing and Data Analysis</td>
</tr>
<tr>
<td>Biotech. 491</td>
<td>In-house Skill Development in Plant Biotechnology/</td>
</tr>
<tr>
<td>Biotech. 492</td>
<td>In-house Skill Development in Bioinformatics</td>
</tr>
<tr>
<td>Biotech. 493</td>
<td>Project Formulation, Execution and Presentation</td>
</tr>
<tr>
<td>Biotech. 494</td>
<td>Entrepreneurial Development in Biotechnology</td>
</tr>
<tr>
<td>Ent.-Pl. Path. 203</td>
<td>Fundamentals of Crop Protection</td>
</tr>
<tr>
<td>Env. 101</td>
<td>Environmental Studies and Disaster Management</td>
</tr>
<tr>
<td>FT 101</td>
<td>Food Science and Processing</td>
</tr>
<tr>
<td>Hort. 201</td>
<td>Production Technologies for Horticultural Crops</td>
</tr>
<tr>
<td>PBG 102</td>
<td>Fundamentals of Genetics</td>
</tr>
<tr>
<td>PBG 201</td>
<td>Fundamentals of Plant Breeding</td>
</tr>
<tr>
<td>PBG 301</td>
<td>Crop Improvement-I (Kharif Crops)</td>
</tr>
<tr>
<td>PBG 302</td>
<td>Crop Improvement-II (Rabi Crops)</td>
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<tr>
<td>Edu. Tour</td>
<td>Educational Tour</td>
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**AGRICULTURAL ENGINEERING AND TECHNOLOGY**

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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CSE 101</td>
<td>Information and Communication Technology in Agriculture</td>
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**BASIC SCIENCES AND HUMANITIES**

<table>
<thead>
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<th>Credits</th>
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<tbody>
<tr>
<td>Biochem. 207</td>
<td>Basic Biochemistry</td>
<td>3 + 1</td>
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<tr>
<td>Biochem. 304</td>
<td>Enzymology and Enzyme Technologies</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Bio. 103</td>
<td>Biodiversity and its Conservation</td>
<td>2 + 0</td>
</tr>
<tr>
<td>Bot. 201</td>
<td>Plant Physiology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Econ. 201</td>
<td>Economics and Marketing</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Eng. 101</td>
<td>General English</td>
<td>1 + 1</td>
</tr>
<tr>
<td>Eng. 201</td>
<td>Communication Skills and Personality Development</td>
<td>1 + 1</td>
</tr>
<tr>
<td>Math. 207</td>
<td>Biomathematics</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Mgt. 201</td>
<td>Entrepreneurship Development and Business Management</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Micro. 102</td>
<td>Elementary Microbiology</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Course Code</td>
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<td>Credits</td>
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<tr>
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</tr>
<tr>
<td>Micro. 201</td>
<td>Microbial Genetics</td>
<td>2 + 1</td>
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<td>Phy. 202</td>
<td>Fundamentals of Biophysics</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Stat. 206</td>
<td>Basic Statistics</td>
<td>1 + 1</td>
</tr>
<tr>
<td>Stat. 302</td>
<td>Fundamentals of Biostatistics</td>
<td>2 + 1</td>
</tr>
<tr>
<td>Zoo. 312</td>
<td>Immunology</td>
<td>2 + 1</td>
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<tr>
<td>Zoo. 313</td>
<td>Animal Biotechnology</td>
<td>3 + 1</td>
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<tr>
<td></td>
<td></td>
<td>31 + 15 = 46</td>
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**COMMUNITY SCIENCE**

1. HDFS 106 Human Values 1 + 0 
   1 + 0 = 1

**NCC/NSO/NSS**

1. NCC/NSO/NSS (SEM-I) 0 + 1 (NC)
2. NCC/NSO/NSS (SEM-II) 0 + 1 (NC)
3. NCC/NSO/NSS (SEM-III) 0 + 1 (NC)
4. NCC/NSO/NSS (SEM-IV) 0 + 1 (NC)

Total credit hour requirements for B.Tech. (Biotechnology) 4 year Programme 177+2NC++ 2NC**+4NC*** =185

*Educational Tour
**Pbi 101/Pbi Cul 101/
***NCC/NSS/NSO
# SEMESTER-WISE STUDY PROGRAMME OF
# B.Tech. (Biotechnology) PROGRAMME

## FIRST YEAR

<table>
<thead>
<tr>
<th>SEM- I</th>
<th>SEM- II</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Bot. 101/</td>
<td>1. *Zoo. 101/</td>
</tr>
<tr>
<td>2+1/</td>
<td>2+1/</td>
</tr>
<tr>
<td>*Math. 101</td>
<td>*Math. 102</td>
</tr>
<tr>
<td>3+0</td>
<td>3+0</td>
</tr>
<tr>
<td>Biotech.101</td>
<td>2+0</td>
</tr>
<tr>
<td>Biotech. 103</td>
<td>2+1</td>
</tr>
<tr>
<td>Agron. 103</td>
<td>2+1</td>
</tr>
<tr>
<td>4. **Biotech. 106</td>
<td>1+1</td>
</tr>
<tr>
<td>Eng. 101</td>
<td>1+1</td>
</tr>
<tr>
<td>Env. 101</td>
<td>2+0</td>
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<td>PBG 102</td>
<td>2+1</td>
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</tr>
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<tr>
<td>**Pbi 101/</td>
<td>0+2 (NC)/</td>
</tr>
<tr>
<td>***Pbi. Cul. 101</td>
<td>+0 (NC)</td>
</tr>
<tr>
<td>NCC/NSO/NSS</td>
<td>0+1(NC)</td>
</tr>
<tr>
<td>15+6/16+5=21+2NC+1NC=24</td>
<td>15+9/16+8=24+1NC=25</td>
</tr>
</tbody>
</table>

## SECOND YEAR

<table>
<thead>
<tr>
<th>SEM- I</th>
<th>SEM- II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ent.-Pl.Path. 203</td>
<td>2+1</td>
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<tr>
<td>1. **Biotech. 201</td>
<td>2+1</td>
</tr>
<tr>
<td>Hort. 201</td>
<td>2+1</td>
</tr>
<tr>
<td>Biotech. 203</td>
<td>2+1</td>
</tr>
<tr>
<td>Bot. 201</td>
<td>3. Biotech. 204</td>
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<tr>
<td>Econ. 201</td>
<td>2+1</td>
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<tr>
<td>Math. 207</td>
<td>5. Biochem. 207</td>
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<tr>
<td>Micro. 201</td>
<td>6. Mgt.201</td>
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<td>*Biotech. 202</td>
<td>7. Ph. 202</td>
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<td>0+1(NC)</td>
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<tr>
<td>14+7=21+1NC=22</td>
<td>16+8=24+1NC=25</td>
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NCC/NSO/NSS: National Cadet Corps/National Service Organization/National Service Scheme
### THIRD YEAR

<table>
<thead>
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<th></th>
<th>SEM-II</th>
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<tr>
<td>Biotech. 301</td>
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<td>1. Biotech. 306</td>
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<td>Biotech. 302</td>
<td>2+0</td>
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<td>2+1</td>
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<tr>
<td>Biotech. 303</td>
<td>2+0</td>
<td>3. Biotech. 311</td>
<td>2+1</td>
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<tr>
<td>Biotech. 304</td>
<td>3+0</td>
<td>4. Biotech. 312</td>
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<td>6. Biotech. 314</td>
<td>2+1</td>
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</tr>
<tr>
<td>Biochem. 304</td>
<td>2+1</td>
<td>7. PBG 302</td>
<td>1+1</td>
<td></td>
</tr>
<tr>
<td>Zoo. 312</td>
<td>2+1</td>
<td>8. Stat. 302</td>
<td>2+1</td>
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</tr>
<tr>
<td>Zoo. 313</td>
<td>3+1</td>
<td>19+4=23</td>
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<tr>
<td></td>
<td></td>
<td>16+8=24</td>
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### FOURTH YEAR

<table>
<thead>
<tr>
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<th>SEM-I</th>
<th></th>
<th>SEM-II</th>
<th></th>
</tr>
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<tr>
<td>Biotech. 491</td>
<td>0+20</td>
<td>1. Biotech. 493</td>
<td>10(0+10)</td>
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</tr>
<tr>
<td>Biotech. 492</td>
<td>0+20</td>
<td>2. Biotech. 494</td>
<td>10(0+10)</td>
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</tr>
<tr>
<td>Edu Tour</td>
<td>0+2(NC)</td>
<td>0+20=20</td>
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<tr>
<td></td>
<td></td>
<td>0+20+2NC=22</td>
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</tbody>
</table>

A student will opt for only one module among the following:
- Micropropagation
- DNA Fingerprinting
- Testing for Genetic Purity
- Marker Assisted Selection
- Haploid Production
- Database Management

*Remedial courses

**For students with domicile of Punjab who have not studied Punjabi at Matric/10+2 level

***For students admitted through ICAR and foreign students
### Summary Semester Wise Total Credit Hours

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Semester</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Semester-I</td>
<td>15+6/16+5=21+2NC+1NC=24</td>
</tr>
<tr>
<td></td>
<td>Semester-II</td>
<td>15+9/16+8=24+1NC=25</td>
</tr>
<tr>
<td></td>
<td>Semester-III</td>
<td>14+7=21+1NC=22</td>
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<tr>
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<td>Semester-IV</td>
<td>16+8=24+1NC=25</td>
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<tr>
<td></td>
<td>Semester-V</td>
<td>19+4=23</td>
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<tr>
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<td>Semester-VI</td>
<td>16+8=24</td>
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<tr>
<td></td>
<td>Semester-VII</td>
<td>0+20+2(NC) =22</td>
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<tr>
<td></td>
<td>Semester-VIII</td>
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<td></td>
<td>Total</td>
<td>177+2NC++ 2NC**+4NC*** =185</td>
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</table>

*Educational Tour

**Pbi 101/Pbi Cul 101/

***NCC/NSS/NSO
Course curriculum for 2 year Diploma in Agriculture

CORE COURSES

BASIC SCIENCES AND HUMANITITES

1. Bot. 51 Agricultural Botany 1+1
2. Econ 51 Elementary Farm Management and Finance 2+1
3. Econ 52 Marketing of Farm Products 2+0
4. Mgt 51 Agribusiness and Entrepreneur Development 2+1
5. Micro 51 Mushroom Cultivation 1+1
6. Zoo 51 Fish Production 1+1
9+5= 14

COLLEGE OF AGRICULTURE

1. Agron. 52 Elementary Agronomy 2+1
2. Agron. 53 Crop Production-I 2+1
3. Agron. 54 Crop Production-II 2+1
4. Agromet. 51 Elementary Agronomy 1+1
5. Biotech. 51 Elementary Plant Tissue Culture 1+1
6. Ext. 51 Elementary Extension Education 2+2
7. Ent. 51 Elementary Agricultural Entomology 2+1
8. Ent. 52 Useful Insects 2+1
9. Forst. 51 Elementary Agroforestry 1+1
10. Flori. 51 Lanscaping and Floriculture 1+1
11. FT 51 Elementary Food Technology 1+1
12. Hort. 51 Elementary Fruit Cultivation 2+1
13. Hort. 52 Nursery Production of Fruit Crops 0+1
14. Pl. Path. 51 Diseases of field Crops 1+1
15. Pl. Path. 52 Diseases of Fruit and Vegetable Crops 1+1
16. PBG 59 Elementary Plant Breeding and Seed Production 2+1
17. LPM 51 Elementary Livestock and Poultry Production 3+1
18. Soils 51 Elementary Soil Fertility 2+1
19. Soils 52 Elementary Soil Physics and Conservation 2+1
20. Veg. 51 Elementary Vegetable Cultivation 2+1
21. Veg. 52 Protected Cultivation of Vegetable Crops 0+1
32+22=54

COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

1. FPM 51 Farm Mechanization 2+1
2. PFE 51 Elementary Agro-processing 1+1
2. SWE 51 Farm Irrigation and Drainage 2+1 5+3=8

**SEMESTER WISE STUDY PROGRAMME OF**

2-year Diploma in Agriculture

**FIRST YEAR**

<table>
<thead>
<tr>
<th>SEM I</th>
<th>SEM II</th>
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<tbody>
<tr>
<td>1 Bot. 51</td>
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<td>2 Agron. 52</td>
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<td>12+7=19</td>
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**SECOND YEAR**

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<tr>
<td></td>
<td>8 Zoo. 51</td>
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<tr>
<td>12+6=18</td>
<td>11+9=20</td>
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Course curriculum for Diploma Course in Hybrid Seed Production Technology (Two Semesters)

CORE COURSES

COLLEGE OF AGRICULTURE

1. Agron. 51 Elementary Agriculture 1+1
2. PBG 51 Hybrid Seed Production-I 2+2
3. PBG 52 Seed testing and Quality Control 2+2
4. PBG 53 Visits to Seed Production and Processing Units-I 0+2
5. PBG 54 Project on Seed Production 0+4
6. PBG 55 Hybrid Seed Production-II 2+2
7. PBG 56 Seed health 2+2
8. PBG 57 Seed processing and Storage 2+2
9. PBG 58 Visits to Seed Production and Processing Units-II 0+2

11+19=30

SEMESTER WISE STUDY PROGRAMME OF

Diploma in Hybrid Seed Production Technology (Two Semesters)

<table>
<thead>
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<th>SEM II</th>
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<tbody>
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<td>1+1</td>
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<td>4 PBG 53</td>
<td>0+2</td>
<td>4 PBG 58</td>
<td>0+2</td>
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<tr>
<td>5 PBG 54</td>
<td>0+4</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>5+11=16</strong></td>
<td><strong>Total</strong></td>
<td><strong>6+8=14</strong></td>
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