



# PROSPECTUS

**M.Sc. (Ag.) & Ph.D Degree Programme**

**2023-24**

**Bihar Agricultural University, Sabour**  
**Bhagalpur - 813210 (Bihar)**

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## 1. ABOUT UNIVERSITY:

Bihar Agricultural University, Sabour, established on 5th August, 2010 by an Act (No. 20 of 2010) State Legislature of Bihar as a State University specified by the UGC under section 22 of the UGC Act. 1956, is one of the premier Agricultural University of the country working for accelerating the growth of agriculture sector through technological interventions. The university within a short span of nine years of its establishment has achieved several milestones and attained 18<sup>th</sup> rank among the State Agricultural Universities (SAUs) of the country. The University established at Historical Bihar Agricultural College Campus located at Sabour, Bhagalpur, Bihar. Bihar Agricultural University is basic and strategic institution supporting more than 500 researchers and educationist towards imparting education at graduate and post graduate level, conducting basic, strategic, applied and adaptive research activities, ensuring effective transfer of technologies and capacity building of farmers and extension personnel. The degree programmes of the university and its colleges have been accredited by ICAR in 2020-25. The university is also an ISO 9001:2015 certified organisation with International standard operating protocols for maintaining highest standards in teaching, research, extension and training. The university has 8 colleges (5 Agriculture, 1 Agril. Biotech, 1 Agril. Engg. and 1 Horticulture), 12 research stations spread in 3 agro-ecological zones of Bihar. The University also has 22 KVKs established in 20 of the 25 districts falling under the jurisdiction of the University.

**Bihar Agricultural University, Sabour is having following colleges:**

### A. Agriculture Colleges

1. Bihar Agricultural College, Sabour, Bhagalpur.
2. Mandan Bharti Agricultural College, Agwanpur, Saharsa.
3. Veer Kunwar Singh College of Agriculture, Dumraon, Buxer.
4. Bhola Paswan Shastri Agricultural College, Purnea.
5. Dr. Kalam Agricultural College, Kishanganj.
6. College of Agricultural Biotechnology, Sabour, Bhagalpur
7. College of Agricultural Engineering, Ara, Buxar
8. College of Agri Business Management, Sabour, Bhagalpur

### B. Horticulture College

1. Nalanda College of Horticulture, Noorsarai, Nalanda.

The University offers courses for the award of Under Graduate, Post Graduate & Ph. D. Degree programme/The Master's Degree and Ph.D. Degree/ under Agriculture Faculty are being carried out in Bihar Agricultural College, Sabour Campus.

This University is situated about 8 km east of Bhagalpur and the nearest railway station is Sabour. Sabour is directly connected by road, rail and air links. The National Highway No. 80 passes through Sabour which links Guwahati (Assam) and Patna (Bihar).



The nearest Air Port (Patna) is located about 230 kms away from the University campus.

## 1.1 Photo Gallery



Bihar Agricultural University, Sabour, Bhagalpur



Bihar Agricultural College, Sabour, Bhagalpur



Nalanda Horticulture College, Noorsarai, Nalanda





Nano Technology Lab., BAC, Sabour



Tissue Culture Lab., BAC, Sabour



Molecular Biology Lab., BAC, Sabour

## 1.2 VISION

Bihar Agricultural University (BAU) was established with a vision of Improving quality of life of the people of the state specially the farming community which constitute more than two-third of the population. Having set of ultimate goal of benefiting society at large the university intends to achieve it by imparting world-class need based agricultural education, research, extension and training.

## 1.3 MANDATE

- a) **Education:** Developing quality human ware and suitably trained human resources through professional programmes in agriculture and allied field.
- b) **Research:** Undertaking mutually reinforced basic, applied and adaptive research and developing, acquiring and refining technologies along with the value chain to address the present and emerging problems and to capture new opportunities.
- c) **Extension:** Ensuring effective transfer and adoption of appropriate technologies and knowledge through dynamic extension services consistent with socio-economic (income, inclusiveness and employment) and agro-ecological security.
- d) **Training:** Establishing centre for excellence in training for capacity building of extension professional paraprofessionals as well as vocational training of adults, youth and women through conventional as well as open and distance learning.

## 1.4 MILESTONES

- a) Bihar Agricultural College, erstwhile Bengal Agricultural College established on 17th August 1908 is one of the five oldest agricultural colleges, started three years Diploma Course 'Licentiate in Agriculture' for making employment in Agriculture Department.
- b) One of the India's first Fruit Research Station was established in 1934.
- c) B. Sc. (Ag) degree course started at Bihar Agricultural College in 1945 and first batch of 28 students passed out under Patna University in 1948.
- d) The world's first mango hybrids, Prabhashankar and Mahmud Bahar developed through planned hybridization programme was released in 1951.
- e) The Extension Education in the college was introduced in the PG course curriculum for the first time in the country.
- f) For the first time in the State, Post Graduate degree programme was introduced in the college in 1955 and first session started with five subjects viz., Agronomy, Horticulture, Plant Pathology, Entomology and Extension Education. First batch of 23 students passed out in 1957.
- g) In 2010, The Bihar Agricultural University, Sabour was established and Bihar Agricultural College became one of its constituent colleges.

## 1.5 EDUCATION:

Bihar Agricultural University offers under graduate, Master and Ph.D Programmes. BAU is endeavouring to produce well trained and quality human resources in the form of Agricultural Graduates having knowledge, skills, proficiencies and also entrepreneurship abilities in vital areas of agriculture and allied discipline by imparting B.Sc.(Hons.)Ag. and B.Sc.(Hons.), Horticulture degrees at six different colleges. Postgraduate(Master) Programme are offered in **fourteen** disciplines of agricultural science. **The present intake capacity at undergraduate level is 410 students while in Masters, it is 104 and 29 in Ph.D.** The library at university and colleges are equipped with services like E-access, CDROM, book bank, references, circulation, resource sharing, repography, clipping etc.

It is also hosting Centre of Excellence for Teaching and Learning (CETL) aiming towards Personal Branding and Soft Skills development among Agricultural Students. It is one of the first State Agricultural Universities to have started centre for Teaching Excellence in collaboration with University of Illinois USA to train faculty members in Teaching Technology and propagate good / teaching practices for quality learning.

Besides advocating basic institutional knowledge students are also exposed to international organizations under sandwich programme to get an idea on research advances at global level and to prepare them for national and international competition. Entrepreneurship development through experiential learning in the disciplines of Horticulture (Commercial Horticulture, Protected Cultivation); Plant Pathology; Food Science and Post-harvest Technology, Animal Clinic and Communication Skills & Personality Development to provide holistic development of students is also provided regularly. Most recently BAU has started an electronic Media Production Centre under Rashtriya Krishi Vikas Yojana (RKVY) programme using Information & Communication Technologies, which is a modern Centre for open and distance learning with the use of e-learning, video conferencing and multimedia learning materials.

## 1.6 RESEARCH

The university research addresses almost every component of agriculture and is executed with six key programs including crop improvement, natural resource management, crop protection, product development and marketing, social sciences and animal science through a total of **203 projects including 153 in-house, 38 nationally and 12 internationally** funded projects. The research activities in the university is typically targeted to cater the special needs, crops and ecologies of diverse farming communities at local, state and national level. As a symbol of growing confidence, several international partners like CIMMYT.

ICRISAT, IRRI, IPNI, ACIAR, ICARDA have expressed their interest and have joined in alliance with BAU to operate in collaborative mode.

#### **1.6.1 CROP IMPROVEMENT**

Crop improvement programme is taking account of major cereals, pulses, oilseeds, fibres and horticultural crops of the state including rice, wheat, maize, pulses, oilseeds, fiber crops, fruits and vegetables. Inter-disciplinary and multi location testing of elite breeding lines and improved management practices like aerobic rice, direct seeded rice for different rice ecosystems to enhance the rice productivity, terminal heat tolerance in wheat, heat and cold tolerance in maize going in together with production and livelihood security based on the demand of target group. Grain quality, bio-fortification and improvement for major biotic and abiotic stresses have been attempted to address the needs of ecology; conventional heterosis and molecular breeding the genetic potential. Addressing the nutritional security and self-sufficiency in pulse production in the state as well in country, the research activity in pulse crops like chick pea, pigeonpea, mungbean for improving production and productivity is being carried out. Pigeonpea genotype breeding for cold and submergence tolerance and approaches are intensively pursued to improve breeding for increasing the production and productivity of lentil and chickpea is also under process. Germplasm conservation of local illustrious cultivars like Katarni rice, Zardalu mango, Shahi litchi. Magadhi Pan etc. as well as their purification are also the paramount objective of the crop improvement programme.

Bihar Agricultural University initiated some innovative work in rice improvement viz., development of transgenic rice resistant to glyphosate (N-phosphonomethyl glycine) herbicide, engineered resistance in rice against fungal pathogens, Brassinosteroid-mediated mutational analysis for abiotic stress alleviation in rice using modern cutting edge technology, molecular biology and biotechnology.

#### **1.6.2 NATURAL RESOURCE MANAGEMENT**

Natural resource management aims with the efficient utilization of natural resources for higher agricultural productivity, profitability and environmental sustainability. With the surging food security issues and associated production challenges in wide spread rice fallow area, vast area under Tal and Diara and arsenic and fluoride contaminated ground water in many districts are being administered by the university. Crop diversification, optimization of agro-techniques, moderations of management practices to mitigate greenhouse gas emission, improving productivity and nitrogen use efficiency through precision nutrient management, resource conservation technologies and remote sensing and GIS approach are being advocated at BAU for enhancing sustainability. Pressing on the climate change issue, special tasks have



been taken up in form of research activities on carbon sequestration and greenhouse gas studies under various agro-ecological systems by exploiting opportunities for reducing or removing greenhouse gas emissions where feasible. As a long term sustainable strategy and environmental safety, conservation agriculture practices are being standardized for understanding and planning for adaptive transitions into new farming systems or livelihoods. Promotion of zero tillage and adoption of modern machineries are being advocated to reduce soil and labour drudgery. University has also been focusing on strengthening local institutions to enable farmer for management of climate risks and adoption of context suitable agricultural practices technologies and systems.

Capturing new futuristic opportunities, a new dimension have also been included in the University research activities as Nanotechnology. Development of multi nutrient nano-clay polymer composite fertilizer for enhancing nutrient use efficiency, hydrogels for improving soil moisture retention capacity, use of partially acidulated nano-rock phosphate for enhancing phosphorus use efficiency, novel nano-polymer for increasing shelf life of fruits are the few initiatives under the aegis of the nanotechnology.

#### **1.6.3 CROP PROTECTION**

Crop Protection made significant contributions in survey and surveillance for key insect pests and diseases of major crops in Bihar and integrated management of important agricultural pests and pathogens. Integrated pest management modules in some cereals, pulses, vegetables and fruits developed are in vogue.

Crop Protection aims with basic and applied research leading to detection, identification, documentation of microbial bio-diversity. It also deals the virulence and genetic diversity of insect pests and pathogens, climate change impact on disease and pest dynamics, biological control of plant diseases and insect pests introgression of disease & pests resistance genes and production of pathogens free planting material.

#### **1.6.4 SOCIAL SCIENCES**

Social Sciences provide a window for transferring technology from laboratory to farm. Bihar Agricultural University conceived new innovative approaches like leadership development among farmers and rural youth, promotion of agri-entrepreneurs for proper dissemination of agricultural technology, provision of adequate capital for attracting youth towards agriculture. Mobilizing cutting edge sciences are being promoted at BAU to develop sustainable farming, reducing hunger and poverty and improving human nutrition, health and protecting the environment.

#### **1.6.5 PRODUCT DEVELOPMENT AND MARKETING**

Product development and marketing aims to enhance post-harvest quality preservation of vegetable crops, shelf life enhancement in fruit crops and development of value added

products are being conducted to improve the marketability of the commodities. Mechanization plays a paramount role in uprising agricultural profitability. Designed and developed numbers of machines like Self-propelled secondary tillage machine, manual-cum-power operated maize-cum-paddy thresher are few achievements of Bihar Agricultural University.

## **1.7 EXTENSION AND OUTREACH**

BAU Sabour has a statutory role to play with regards to extension. Extension service carried out by the KVKs, Colleges and research station of the BAU Sabour is the vehicle which carries scientific agricultural technology interventions developed by the university to the farm, for the overall benefit of the farming community. This major function of extension is accomplished through dissemination of farm information training of farmers and extension functionaries educating the farmers through field activities. In order to carry out these extension, twenty KVKs twelve regional research stations and six colleges are working on and off the field. In order to enhance the farm profitability on sustainable basis, BAU delivers its extension services through innovative group approaches, modern ICT infrastructure and on field educational activities.

## **2. GENERAL INSTRUCTIONS:**

- A). Admission to the University implies acceptance without any modification by the candidate and his/her parents/guardians of all provisions given in the prospectus or any change in the University rules, regulation, fees, etc. that are made from time to time.
- B). The students who have been temporarily dismissed or permanently dropped from this/other University either on account of poor academic performance or on account or act(s) or indiscipline or those who have been debarred from seeking admission in this/other University shall not be eligible to apply for admission to any programme of this University.
- C). If any document submitted by the candidate is found to be false at any stage during his/her stay in this University, his/her admission will be cancelled.
- D). The information indicated in this prospectus is only for general guidance and could be modified/ changed from time to time by the University without giving any notice.
- E). For correspondence regarding admission, contact

**REGISTRAR**

**Bihar Agricultural University, Sabour – 813 210, Bhagalpur**

**Phone: - 0641 –2452614, Fax:-0641 – 2452614**

**Website: [www.bausabour.ac.in](http://www.bausabour.ac.in)**

**Email:**

## 2.2 IMPORTANT DATES (Tentative) to be informed latter on

A.	Online Application through University Website(www.bausabour.ac.in)	14 Aug- 13 September
B.	Downloading of Admit Card from University Website	To be Informed later
C.	Date of Examination	To be Informed later

## 2.3 APPLICATION FEE

Degree Programme	For UR & Others	For SC / ST
Master Degree	Rs. 1000/-	Rs. 500/-
Ph.D. Degree	Rs. 1200/-	Rs. 600/-

NOTE: Application fee is payable through online mode only.

### RESERVATION CATEGORY (ABBREVIATION)

UR – Unreserved

EWS – Economically Weaker Section

BC – Backward Class

EBC – Extremely Backward Class

SC – Scheduled Caste

ST – Scheduled Tribe

RCG/RCF – Backward Class Girl / Female

### 3. MASTER DEGREE PROGRAMME

#### 3.1 ELIGIBILITY CRITERIA

- A candidate should possess at least 60% marks in aggregate or 6.0/10.0 in Bachelor's Degree and in the case of SC/ST, 55% marks in aggregate or 5.5/10.0 OGPA.
- The candidate must possess the Bachelor Degree from ICAR's accredited College/ Institution / University/ Constituent College of UGC affiliated Universities.
- The Candidate appearing for the Bachelor Degree Examination is also eligible to apply provisionally for admission and appear in the Competitive Test. However, he/she must have final result with required CGPA (Provisional Degree Certificate and Transcript) on or before **the date of 1<sup>st</sup> counselling.**
- Admission to Master Degree Programme is open for Domicile of Bihar only.

#### 3.2 SUBJECT WISE SEATS AND ELIGIBILITY CRITERIA

Sl. No.	Subjects	BAU Seats	ICAR Seats	Total Seats	Eligibility Criteria
<b>A. Agriculture Faculty</b>					
1.	Molecular Biology & Biotechnology	4	1	5	Bachelor's Degree in Agriculture/ Bachelor's Degree in Horticulture
2.	Agricultural Economics	4	1	5	
3.	Statistics /Agricultural Statistics	3	1	4	
4.	Agronomy	9	3	12	
5.	Entomology	4	2	6	
6.	Agricultural Extension	4	1	5	
7.	Horticulture (Floriculture & Landscaping Architecture)	2	0	2	
8.	Horticulture (Fruit Science)	8	2	10	
9.	Horticulture (Post Harvest Technology)	3	1	4	
10.	Horticulture (Vegetable Science)	8+2*	3	13	
11.	Genetics & Plant Breeding	9	3	12	
12.	Plant Pathology	6	2	8	
13.	Plant Physiology	3	1	4	
14.	Seed Science & Technology	2	0	2	
15.	Soil Science	9	3	12	
	<b>Total</b>	<b>80</b>	<b>24</b>	<b>104</b>	

\*Two Seats in Master's Degree in Horticulture (Vegetable Science) are for NCOH, Noorsarai.



### 3.3 CATEGORY WISE DISTRIBUTION OF SEATS

Sl. No.	Subject	BAU Seats	UR	EWS	BC	EBC	SC	ST	RCG /RCF	Roaster Point**
A. Categories wise seats for M.Sc. (Ag.) Degree Programme										
1.	Molecular Biology & Biotechnology	4	2			1	1			32-35
2.	Agricultural Economics	4	1	1	1	1				36-39
3.	Statistics /Agricultural Statistics	3	1			1	1			40-42
4.	Agronomy	9	5	1	1	1	1			43-51
5.	Entomology	4	2			1			1	52-55
6.	Agricultural Extension	4	1	1	1		1			56-59
7.	Horticulture (Floriculture & Landscaping Architecture)	2	1			1				60-61
8.	Horticulture (Fruit Science)	8	3	1	1	1	2			62-69
9.	Horticulture (Post Harvest Technology)	3	1		1	1				70-72
10.	Horticulture (Vegetable Science)	10	4	1	1	2	2			73-82
11.	Genetics & Plant Breeding	9	4	1	1	1	1		1	83-91
12.	Plant Pathology	6	2	1	1	1	1			92-97
13.	Plant Physiology	3	1			1	1			98-100
14.	Seed Science & Technology	2	1			1				01-02
15.	Soil Science	9	4	1	1	1	2			03-11
	<b>Total</b>	<b>80</b>	<b>33</b>	<b>8</b>	<b>9</b>	<b>15</b>	<b>13</b>	<b>0</b>	<b>2</b>	

Note: - The University reserves the right to make addition or deletion in number of seats without any notice.

\*\* As per 100 points Model Roster of Government of Bihar

### 3.4 SELECTION CRITERIA:

- Selection will be made on the basis of competitive entrance examination.
- Candidate will have to choose 5 subjects of his choice for admission. Seat allotment will make on merit cum choice basis. Reservation policy of Government of Bihar will be applicable.
- Merit list shall be prepared on the basis of marks obtained in competitive entrance examination.
- Cut off marks for SC/ST candidate is 40% and 45% for all other categories in the merit list of competitive entrance examination.
- In case of same marks in the merit list of Competitive entrance examination, , date of birth shall be given priority.
- Candidate may be sent off-campus for completing the research work.

#### 4. Ph.D. DEGREE PROGRAMME

##### 4.1 ELIGIBILITY REQUIREMENT:

- A candidate should possess at least 70% marks in aggregate or 7.0/10.0 in Master's Degree Programme and in case of SC/ST, 65% marks in aggregate or 6.5/10.00 OGPA.
- The candidate must possess the Bachelor Degree from ICAR's accredited College/ Institution / University/ Constituent College of UGC affiliated Universities.
- The Candidate appearing in the Master Degree Examination is also eligible to apply provisionally for admission and appear in the Competitive Entrance Examination for admission in Ph. D. Degree Programme. However, he/she must have final result with required CGPA (Provisional Degree Certificate and Transcript) on or before the date of 1<sup>st</sup> counselling.
- Admission to Ph.D. is open for all eligible candidates.
- A candidate can apply for admission to only one subject. No change would be allowed thereafter.

##### 4.2 SUBJECT WISE NUMBER OF SEATS AND ELIGIBILITY CRITERIA

Sl. No.	Subjects	BAU Seats	ICAR Seats	Total Seats	Eligibility Criteria
<b>A. Agriculture Faculty</b>					
1.	Agricultural Economics	2	0	2	M. Sc. (Ag) in Agriculture Economics
2.	Agronomy	3	1	4	M. Sc. (Ag) in Agronomy
3.	Entomology	2	0	2	M. Sc. (Ag) in Entomology
4.	Agricultural Extension	1	1	2	M. Sc. (Ag) in Agricultural Extension/ Extension Education
5.	Horticulture (Fruit Science)	3	1	4	M. Sc. (Ag) in Pomology/ Horticulture / Horticulture with specialization in Fruit Sciences/ Horticulture with specialization in Post Harvest Technology.
6.	Horticulture (Vegetable Science)	3	1	4	M. Sc. (Ag) in Olericulture/ Vegetable Sciences/ Horticulture/ Horticulture with specialization in Vegetable Sciences/ Horticulture with specialization in Post Harvest Technology
7.	Genetics & Plant Breeding	2	1	3	M. Sc. (Ag) in Plant Breeding/ Genetics/ Genetics and Plant Breeding/ Plant Breeding & Genetics.
8.	Plant Pathology	2	0	2	M. Sc. (Ag) in Plant Pathology
9.	Soil Science	4	2	6	M. Sc. (Ag) in Soil Sciences/ Agricultural Chemistry/ Agricultural Physics / Soil Microbiology/ Soil Chemistry/ Water Science and Technology/ Soil & Water Conservation/ Soil Science & Agricultural Chemistry
	<b>Total</b>	<b>22</b>	<b>7</b>	<b>29</b>	

### 4.3 Category wise distribution of seats

Sl. No.	Subject	BAU Seats	UR	EWS	BC	EBC	SC	ST	RCG/ RCF	Roaster Point**
<b>A. Categories wise seats for Ph. D Degree Programme</b>										
1	Agricultural Economics	2		1		1				<b>26-27</b>
2	Agronomy	3	1		1		1			<b>28-30</b>
3	Entomology	2	1			1				<b>31-32</b>
4	Agricultural Extension	1	1							<b>33</b>
5	Horticulture (Fruit Science)	3	1			1	1			<b>34-36</b>
6	Horticulture (Vegetable Science)	3	1	1	1					<b>37-39</b>
7	Genetics & Plant Breeding	2	1				1			<b>40-41</b>
8	Plant Pathology	2	1			1				<b>42-43</b>
9	Soil Science	4	2	1	1					<b>44-47</b>
	<b>Total</b>	<b>22</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>3</b>			

Note: - The University reserves the right to make addition or deletion in number of seats without any notice.

\*\* As per 100 points Model Roster of Government of Bihar

### 4.4 SELECTION CRITERIA

- Selection will be made on the basis of Competitive Entrance Exam. Candidates willing to secure admission will have to appear in Competitive Entrance Test. Counselling and Admission will be allowed in the subject applied for admission on the basis of seat availability and reservation policy of Government of Bihar.
- Merit list shall be prepared on the basis of marks obtained in Competitive Entrance Exam.
- The cut off marks for all other Categories except SC/ST Category is 45% and for SC/ST Category is 40% in the merit list of Competitive Entrance Examination.
- In case of same marks in the merit list of competitive Entrance Examination, date of birth shall be given priority.
- Candidate may be sent off-campus for completing the research work.

## **5. IMPORTANT INSTRUCTION**

### **5.1 REFUSAL OF ADMISSION**

- A). The Vice-Chancellor reserves the right to refuse the admission of any candidate despite his/her fulfillment of the academic requirements for admission on the basis of Competitive Examination-cum Academic performance, for reasons to be recorded in writing, whose admission in the opinion of the Vice-Chancellor shall not be in the best interest of the University. The decision of the Vice-Chancellor shall be final.
- B). The students who have been permanently dropped or temporarily dismissed from BAU, Sabour University either on account of poor academic performance or on account of act of indiscipline or those who have been debarred from seeking admission in this University shall not be allowed to appear in the Competitive Entrance Examination or shall also not be allowed to seek admission as a sponsored candidate. Even if such candidate has appeared in the competitive Entrance Examination either by concealing the facts or due to oversight, shall not be eligible for admission.
- C). Candidates found using unfair means in Competitive Entrance Examination of this University shall be permanently debarred from appearing in the Competitive Entrance Examination of the University in Future.
- D). It is the responsibility of the candidate to furnish full and correct information on the application form. Any admission made on the basis of wrong or concealed information, provided by the candidates or due to any oversight or error in the Registrar office and detected subsequent to the admission or joining of the candidate would be cancelled at the cost and risk of the candidate.

### **6. RESERVATION OF SEATS**

The Category (UR/EWS/BC/EBC/RCG/SC/ST) declared by the candidate in application form will be final. No subsequent change will be allowed. Reservation of seats shall be given as per the Policy of the Government of Bihar.

### **7. INSTRUCTIONS FOR FILLING THE APPLICATION FORM**

Instructions to the candidates for filling the application form are given in **Appendix – I**. (Instructions for Online Submission of Application form).

### **8. SYLLABUS**

Syllabus for competitive Entrance Examination for admission to Master's Degree Programme is appended in **Appendix – II**

Syllabus for competitive Entrance Examination for admission to Ph. D. Degree Programme is appended in **Appendix – III**

### **9. SCHEME OF EXAMINATION**

Competitive Entrance Examination will carry 200 multiple choice questions each of 0.5 marks. The duration of examination will be 2 hours. **Candidates have to mark answer on the OMR Sheet with Blue/Black Ball Pen.**



## **10. RESIDENTIAL REQUIREMENT**

A minimum of Three (3) semesters shall be the residential requirement for completing the courses in Master Degree programme and the maximum period in which the regular student must obtain his/her degree shall be of eight (8) semester.

A minimum period of Five (5) semesters shall be the residential requirement for completing the courses in Ph. D. Degree Programme and the maximum period in which the regular student must obtain his/her degree shall be of Twelve (12) semesters.

It is compulsory for the students to stay in the University/College Hostel. The students may have move to other campus also for one or more semesters for particular courses or completing research work in there degree Programme .

## **11. UNIVERSITY FELLOWSHIP**

The University Fellowship shall be awarded as per university rules on the basis of their performance.

## **12. COUNSELLING**

Candidates called for counselling will be required to submit their relevant documents in original as given below with one set of self-attested photocopies.:-

- a) High School/equivalent examination mark sheet as well as certificate for proof of age.
- b) 10+2/Intermediate Examination certificate and marks sheet.
- c) Bachelor Degree Certificate/ Provisional Degree Certificate and Transcript.
- d) Master Degree Certificate/ Provisional Degree Certificate and Transcript (For Ph.D. Programme)
- e) Character Certificate from Head of the Institution last attended.
- f) Domicile Certificate issued by the Competent Authority.
- g) Caste certificate issued by the Competent Authority. (in case candidates claiming reservation).
- h) AADHAR Card of Candidate.

Counselling does not guarantee admission. It depends on merit and availability of seats in a particular Stream/ Faculty. In case, candidates fail to attend the counselling his/her candidature shall automatically stand rejected.

## **13. DIRECTIONS FOR CANDIDATE**

- a) Duplicate Admit card will be issued by the Registrar one day before the date of examination on payment of Rs. 50.00 for which two photographs and proof of application submission have to produce by the candidate himself/herself.
- b) The candidate shall be present at the centre 30 minutes before the commencement of the Competitive Entrance Examination.
- c) Candidate will not be admitted to the Examination Hall after 30 minutes from the commencement of the Examination.
- d) Candidate who does not produce the Admit Card shall not be allowed to sit in the examination hall by the Centre Superintendent/Invigilator.

- e) Candidate must preserve the Admit Card till his/her admission in the institution/Department.
- f) Candidates are not allowed to leave the Examination Hall before Completion of the duration of Competitive Entrance Examination and handing over the OMR sheet and Question paper (Test Booklet) to the concerned Invigilator.
- g) The candidate shall not remove any page(s) from the Test Booklet and if any page(s) is/are found missing from his/her booklet, he/she will be prosecuted against and shall be liable for cancellation of his/her candidature and legal action.
- h) The candidate must fill in the Box with black ballpoint pen of good quality.
- i) Candidates are not allowed to bring any books, notes or calculator, cell phone etc. in the Examination Hall.
- j) Candidate must follow the instructions strictly as given by the invigilators in the examination hall.
- k) No cutting or overwriting is allowed.
- l) Impersonation in any form will lead to cancellation of candidature and legal action.

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## Appendix – I

### Instructions for Online Submission of Application Form

- Please read the prospectus carefully before you start filling the Application Form.
- Candidate can apply for BAU (Master / Ph.D)-2023 'ON-LINE' only through official website ([www.bausabour.ac.in](http://www.bausabour.ac.in)).
- Please ensure your eligibility as per the criteria laid down in prospectus.
- Examination Fees**

The fee (in Indian Rupees) is as follows:

EXAMINATION FEE DETAIL	Fee (Rs.)	
	For UR & Others	For SC / ST
For Master Programme Degree	Rs. 1000/-	Rs. 500/-
For Ph.D. Programme Degree	Rs. 1200/-	Rs. 600/-

\*Reservation category is applicable only for Domicile of Bihar

- Application fee is payable only through online mode.
- Application Procedure: Steps to be followed for apply online**

#### Step – I

- Enter Your Mobile Number
- Enter OTP to complete the Registration.

#### Step – II

- Select your domicile state.
- Select the program (Master Degree/Ph.D. Degree) you wish to apply.
- Select your Category (UR/EWS/BC/EBC/SC/ST/ RCG)

#### Step – III

- Fill your personal details in English as per application form.
- Provide your 12 digit AADHAR Number.
- Fill particulars of academic qualification correctly

#### Step – IV

- Upload your recent colour photograph and signature.
- Photograph and signature should be in JPG/JPEG format.
- Size of photograph should be between 10 kb to 300 kb.
- Size of signature should be between 10 kb to 100 kb.

#### Step – V

- Make Payment.
- Application fee is payable online mode using Debit/ Credit Card/ Net Banking.

**Note:**

- a) Take a print out of your application form for your record.
- b) Candidates will not submit Hard copy of application form or certificate to this office at the time of online application.
- c) Candidate will have to carry a copy of application print out along with necessary documents at the time of counselling.

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## Appendix – II

### SYLLABUS FOR BAU ENTRANCE EXAMINATION FOR ADMISSION TO MASTER'S DEGREE PROGRAMME

#### 1 . Agriculture Faculty

##### General Agriculture

Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, potato and mango. Major soils of India, role of NPK and their deficiency symptoms. General structure and function of cell organelles; mitosis and meiosis; Mendelian genetics. Elementary knowledge of growth, development, photosynthesis, respiration and transpiration; Elements of economic botany. General structure and function of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Organic farming; bio-fertilizers; bio-pesticides. Recombinant DNA technology; transgenic crops. Food and industry; composting and biogas production. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India. Elements of statistics. Measures of central tendency and dispersion, regression and correlation; concept of probability, sampling techniques and tests of significance.

##### Agronomy

Principles of Agronomy, Crop ecology and geography and Agricultural Meteorology: Agronomy – meaning and scope, National & International agricultural research institutes in India, Agro climatic zones of India, Tillage, crop stand establishment and planting geometry and their effect on crop, Physiological limits of crop yield and variability in relation to ecological optima, organic farming, Precision farming, Integrated farming systems, Principles of field experimentation. Principles of crop ecology and crop adaptation, climate shift and its ecological implications, Agro-ecological regions in India, Geographical distribution of crop plants, Greenhouse effect, Climatic factors and their effect on plant processes and crop productivity, Role of GIS and GPS in agriculture. Weather & climate, Earth's atmosphere, Solar radiation, Atmospheric temperature and global warming. Crops and atmospheric humidity, Weather forecasting.

Field crops: Origin, distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of cereals ( rice, wheat, maize, sorghum, pearl millet, minor millets, barley), pulses (chickpea, lentil, peas, Pigeon pea, mungbean, urdbean), oilseeds (groundnut, sesame, soybean, rapeseed & mustard, sunflower, safflower, linseed), fiber crops (cotton, jute, sun hemp), sugar crops(sugarcane), fodder & forage crops (sorghum, maize, napier, berseem, Lucerne, oats), medicinal & aromatic plants (menthe, lemon grass and isabgol) and commercial crops(potato, tobacco).

Weed management: Principles of weed management, Classification, biology and ecology of weeds, crop weed competition and allelopathy, concepts and methods of weed control, Integrated weed management, Classification, formulations, selectivity and resistance of herbicides, Herbicide persistence in soil and plants, Application methods and equipments, Weed flora shifts in cropping systems, Special and problematic weeds and their management in cropped and non-cropped situations, Weed management in field crops. Water management: Principles of irrigation, Water resources and irrigation development in India, Water and irrigation requirements, Concepts and approaches of irrigation scheduling, Methods of irrigation, Measurement of irrigation water, application, distribution and use efficiencies, Conjunctive use of water, Irrigation water quality and its management, water management in major field, crops (rice, wheat, maize, groundnut, sugarcane) Agricultural drainage. Dryland Agronomy: Characteristics of Dryland farming and delineation of Dryland tracts, constraints of Dryland farming in India, Types of drought and their management, contingency crop planning and mid- season corrections for aberrant weather and its recycling. Watershed management.

Sustainable land use systems: Sustainable agriculture: parameters and indicators, Conservation agriculture, safe disposal of agri-industrial waste for crop production, Agro-forestry systems, shifting cultivation, Alternate land use systems, Wastelands and their remediation for crop production.

### **Plant Breeding & Genetics/Plant Biotechnology/Plant Physiology & Biochemistry**

Characteristics of prokaryotic and eukaryotic organisms; differences between fungi, bacteria, mycoplasmas and viruses. Physical and chemical basis of heredity; chromosome structure. DNA replication, transcription and translation; genetic code; operon concept; protein biosynthesis. Genetic engineering; restriction enzymes; vectors; gene cloning; gene transfer. Plant cell and tissue culture; micro-propagation; somaclonal variation. Transformation; recombination; Heterosis. General application of biotechnology. Molecular and immunological techniques. Concept of bioinformatics, genomics and proteomics.

Elements of economic botany; integrated diseases management; sterilisation, disinfection and pasteurization; Koch's postulates; etiological agents of rusts, smuts, powdery/downy mildews, wilts, yellows, mosaic, necrosis, enations, blights and witches- broom; pH, buffer, vitamins, role of plant hormones in seed germination and dormancy; pollination/ fertilization in flowering plants; methods of seed testing; breeders, foundation and certified seeds; seed production in self and cross pollinated crops. Importance of biochemistry in agriculture. Acid-base concept and buffers; pH. Classification, structure and metabolic functions of carbohydrates, lipids and proteins. Structure and function of nucleic acids. Enzymes: structure, nomenclature, mechanism of action; vitamins and minerals as coenzymes and cofactors. Metabolic pathways: glycolysis, TCA cycle, fatty acid oxidation, triglyceride biosynthesis. Electron transport chain; ATP formation. Photosynthesis: C-3, C-4 and CAM pathways. Nitrate assimilation; biological nitrogen fixation. Colorimetric and chromatographic techniques.

### **Plant Physiology**

importance in agriculture. Seed germination, viability and vigour. Photosynthesis- significance of C-3, C-4 and CAM pathway; photorespiration and its implications. Translocation of assimilates; dry matter partitioning; Harvest index of crops. Growth and development; growth analysis; crop-water relationship. Plant nutrients and their functions. Phytohormones and their physiological role. Photo-periodism, vernalisation; pollination/ fertilization in flowering plants. Post-harvest physiology and its significance.

### **Soil Science**

Volumetric and gravimetric analysis including complexometric methods, periodic classification of element, Basic principle of instrumental analysis including spectro-photometry (Absorption and emission spectrography), Atomic structure –elementary concept of radioactivity, element and compound common ion effect, solubility product—hydrolysis of salts, buffer solution indicates equivalent weights and standard solution. Elementary concepts of organic compounds- nomenclature and classifications including hydrocarbons, alcohol, aldehydes, acids and esters, carbohydrates, fats and liquids, amino acids, nucleic acids. Pesticides, their classification and uses; biopesticides and botanical pesticides.

Soil as a medium for plant growth, composition of earth's crust, weathering of rocks and minerals, components of soil- their importance, soil profile, soil partials- physical mineralogical and chemical nature. Mechanical analysis, Stokes law, assumptions, limitations and applications. Soil, physical properties- density, porosity, texture, soil structure and their brief descriptions. Rheological properties in soils, calculations of porosity and bulk density. Soil air-Aeration, causes of poor aeration, factors affecting aeration, importance for plant growth. Soil temperature - sources and losses of soil heat. Factors affecting soil temperature, its importance in plant growth. Soil water- structure of water, soil-water-energy relationship, classifications, surface tension and movement in soil. Soil colloids- properties, structure of silicate clay minerals, sources of negative charges, properties, kaolinite, illite, montmorillonite and vermiculite clay minerals, milli-equivalent concept, cation exchange capacity, anion exchange capacity, buffering of soils. Problem soils and their distribution in India - acid, saline, sodic and

acid sulphate soils – their characteristics, formation, problems and management. Irrigation, water quality and its evaluation. Waterlogged soils- basic features, distinction with upland soils.

Essential plant nutrients- criteria of essentiality, functions for plant growth, mechanisms for movement and uptake of ions in soils and plants, Forms of nutrients in soils, deficiency symptoms on plants, luxury consumption, nutrient interactions and chelated micronutrients. Soil fertility, evaluation and management for plant growth, soil testing and fertilizer recommendations. Soil classifications- diagnostic surface and sub- surface horizons, soil survey- types, objectives, uses, land capability classifications. Remote sensing and its application in agriculture, SIS, GIS and GPS- basic features and uses in agriculture, Elementary concepts of radio isotopes and uses in agriculture.

Soil micro-organisms, Classifications and their roles. Organic matter- decomposition, C:N ratios, mineralization and immobilization processes, humus, role of organic matter in soil quality. Soil erosion, types and control measures. Fertilizers and manures- classifications, NPK fertilizers, their reactions in soils, green manuring, recycling of organic wastes, composting. Soil and water pollution- sources, brief idea about different pollutants in soils and their managements Soil fertility and fertilizer use: Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, Indicators of soil fertility and productivity, Fertilizer materials and their availability to plants, slow release fertilizers, Nitrification inhibitors, Principles and methods of fertilizer application, Integrated nutrient management, site specific nutrient management.

## **Entomology**

Classification of animal kingdom up to class; distinguishing characters up to orders in class Insecta; general organization of an insect external morphology with special reference to lepidopteran larvae, coleopteran adults; and honeybee; metamorphosis and moulting; different physiological systems; insect-plant relationship; insect pests of agricultural and horticultural crops, and their stored/processed products, insect vectors of plant diseases- identification, biology, nature of damage, and their management tactics; and pests of household, medical and veterinary importance and their control; useful and beneficial insects like honeybee, lac insect, silkworm and pollinators; Nematode taxonomy, biology of important plant parasitic nematodes and their control; entomopathogenic nematodes, basic principles of insect and nematode pest management-cultural, biological, insecticidal, quarantine, and regulatory aspects; insecticide classification and insecticide resistance management; and insect protective transgenic crops.

## **Plant Pathology**

Introduction of important plant pathogenic organisms - fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroid, algae, Protozoa and phanerogamic parasites with examples of diseases caused by them; Prokaryotes: classification of prokaryotes according to Bergey's; General characters, Manual of reproduction and classification of fungi; Definition and objectives of Plant Pathology; Survival and Dispersal of Plant Pathogens; Plant disease epidemiology; General principles of plant diseases management; Integrated plant disease management (IPDM); Economic importance, symptoms, cause, epidemiology and disease cycle and important diseases of important field crops (rice, maize, sorghum, pearl millet, minor millets, wheat, barley; pigeon pea, green gram, black gram, chickpea, lentil, peas, bean, ground nut, sesame, soybean, rapeseed and mustard, sunflower, safflower and linseed sugarcane); vegetables (tomato, brinjal, chillies, okra, cucurbitaceous vegetables, cole crops, bulb crops, tuber crops, root crops, beans), orchard and plantation crops (mango, banana, guava, citrus, litchi, papaya, palms) and their management.

## **Agricultural Economics**

Theory of consumer behaviour, theory of demand, elasticity of demand, indifference curve analysis, theory of firm, cost curves, theory of supply, price determination, market classification, concept of macroeconomics, money and banking, national income. Agricultural marketing—role, practice, institutions, problems and reforms, role of capital and credit in agriculture, crop insurance, credit institutions, cooperatives, capital formation in agriculture, agrarian reforms, globalization, WTO & its impact on Indian agriculture.

Basic principles of farm management, concept of farming system and economics of farming systems, agricultural production economics-scope and analysis, factor-product relationship, marginal cost and marginal revenue, farm planning and budgeting, Agricultural finance: nature and scope. Time value of money, Compounding and discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's, 5C's and 7 P's of credit, repayment plans. History of financing agriculture in India. Commercial banks, nationalization of commercial banks. Lead bank scheme, regional rural banks, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank, role of capital and credit in agriculture; credit institutions, co-operatives and agrarian reforms in India.

### **Extension Education**

Extension Education- concept, meaning, principles, philosophy, scope and importance; Extension programme planning and evaluation- steps and principles, models of organizing agricultural extension; historical development of extension in USA, Japan and India. Rural development, meaning, importance and problems; Rural development programmes in India- Pre-independence era to recent ones; Extension teaching methods, definition and concept of sociology, differences between rural & urban communities, social stratification., social groups, social organization and social change. Rural leadership, educational psychology- learning and teaching, role of personality in agricultural extension Indian rural system- its characteristics; value system, cost and class; structure and customs; rural group organization and adult education.

Communication, principles, concepts, process, elements and barriers in teaching methods. Different kinds of communication methods and media and AV aids/materials. Media mix, Campaign, Cyber extension- internet, cybercafé, Kisan Call Centers, teleconferencing, agriculture journalism, diffusion and adoption of innovations- adopter categories, capacity building of extension personnel and farmers- training to farmers, women and rural youth.

### **Agricultural Statistics**

Statistics – definition, use and limitations; Frequency Distribution and Curves; Measures of Central Tendency: Arithmetic mean; Geometric mean, Harmonic mean, Median, Mode; Measures of Dispersion: Range, Mean deviation, Quartile deviation, Variance and Coefficient of Variation; Probability: Definition and concepts, law of addition and multiplication, conditional probability, Bayes' theorem; Binomial, multinomial, Poisson and normal distribution; Introduction to Sampling: Random Sampling; Standard Error; Tests of Significance - Types of Errors, Null Hypothesis, Level of Significance, Testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples; Student's t-test for Single Sample, Two Samples and Paired t test. F test; Chi-Square Test for goodness of fit and independence of attributes; Correlation and Regression and associated tests of significance. Experimental Designs: basic principles, Analysis of variance, Completely Randomized Design (CRD), Randomized Block Design (RBD).

Introduction to Computers, Operating Systems, definition and types, Applications of MS-Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/ output operations, e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology for generating valuable agri-information. Decision support systems(DSS); concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems for supporting Farm decisions. Preparation of contingent crop-planning using IT tools.



## Horticulture

Layout and establishment of orchards; pruning and training; propagation, climatic requirement and cultivation of fruits like mango, banana, citrus, guava, grape, pineapple, papaya, apple, pear, peach and plum; cultivation of plantation crops like coconut and cashew nut and spices like black pepper, coriander, turmeric, important physiological disorders; major vegetable crops of tropical, subtropical and temperate regions like cole crops (cauliflower, cabbage and knol khol), cucurbits (pumpkin, bottlegourd, bittergourd, luffa, muskmelon and watermelon, cucumber), root crops (radish, tapioca sweet potato and potato), leafy vegetables (fenugreek and spinach); solanaceous crops (tomato, chillies and brinjal); techniques for raising the nursery; nutritive value of fruits and vegetables and their role in human nutrition; basic physiology of ripening in fruits and vegetables and their products; type of fruits and vegetable products and control of fungal and bacterial diseases; major floricultural crops grown in India for commercial purposes like rose, carnation, chrysanthemum, marigold, tuberose, gladiolus, orchids; establishment and maintenance of lawns, trees, shrubs, creepers, hedges and annuals; type of gardens, methods of crop improvement; male sterility and incompatibility; pure line and pedigree selection; backcross, mass selection; heterosis; plant nutrients, deficiency symptoms of nutrients, manures and fertilisers, systems of irrigation, management of important pests and diseases of fruits and vegetables.

General chemistry of food constituents, physical properties of foods, properties of colloidal systems, gels and emulsions. Minerals in foods, physicochemical changes in foods during processing and storage, functions of food nutrients, dietary allowances and nutritional requirements. Metabolism of carbohydrates, lipids and protein. Biological value and PER. Food additives, contaminants and anti-nutritional factors. Food flavors and puff- flavors.

National and international food standards, modern analytical techniques in food analysis. Preparation and manufacturing technology of cereals and bakery products, beef, pork, poultry, fish & sea foods and egg, sausages and table ready meats, dairy products, fresh fruits, fresh vegetables, processed fruits, processed vegetables, Post Harvest Handling and storage of Fruits and Vegetables. Sugars, sweets, fats and oils, fermented foods, alcoholic and non-alcoholic beverages, indigenous foods, fast, readymade and fashion foods. Dehydration and concentration methods, irradiation, microwave and solar processing of foods, food by-products & downstream processing, flavoring and pigment technology. Judging of food products, food plant management and legal aspects, food plant safety, risk and hazards. Effluent treatment and environment pollution, waste solids upgrading and treatment, food storage, functions of packaging, packaging operations, types of containers, FFS, hermetics closures, canning packaging materials and package testing, transportation and marketing food products.

Role of intrinsic and extrinsic properties of food in relation to microbial growth. Microbiology of fruits, fruit products, vegetables, soft drinks, bakery products, milk and milk products, milk, fish, egg and marine produces. Spoilage of foods, food pathogens and their toxins in relation to human health. Food preservation by sugar, salt, chemicals, heat, cold, irradiation, dehydration and packaging. Microbiology of fermented foods and beverages and factors affecting their quality. Methods for microbiological examination of foods, food hygiene and safety regulations. Water quality and waste disposal in food industry.

## Agricultural Engineering

Basic concepts of various forms of energy; unit and dimensions of force, energy and power; IC Engines: Basic principles of operation of compression, ignition and spark ignition engines, two strokes and four stroke engines; cooling and lubrication system, power transmission system, broad understanding of performance and efficiency of tractors, power tillers and their types and uses; Tillage: objectives, methods of ploughing; Primary tillage implements: construction and function of mould board ploughs, disc and rotary ploughs; Secondary tillage implements: constructions and function of tillers, harrows, levellers, ridges and bund formers; Sowing and transplanting equipment: seed drills, potato planters, seedling transplanter; Grafting, pruning and training tools and equipments; Inter-cultural equipments: sweep, Junior hoe, weeders, long handle weeders etc.

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## **Appendix – III**

### **SYLLABUS FOR BAU ENTRANCE EXAMINATION FOR ADMISSION TO Ph. D. DEGREE PROGRAMME**

#### **GENETICS & PLANT BREEDING**

##### **Unit 1: General Genetics and Plant Breeding**

Mendelian inheritance. Cell structure and division, Linkage, its detection and estimation. Epistasis. Gene concept, allelism and fine structure of gene. Extra chromosomal inheritance. DNA – structure, function, replication and repair. Genetic code. Gene-enzyme relationship. Replication, Transcription and Translation. Gene regulation in prokaryotes and eukaryotes. Nuclear and cytoplasmic genome organization. Spontaneous and induced mutations and their molecular mechanisms. Crop domestication, evolution of crops and centres of diversity. Emergence of scientific plant breeding. Objectives and accomplishments in plant breeding and the role of National and International institutes. Gametogenesis and fertilization. Modes of sexual and asexual reproduction and its relation to plant breeding methodology. Apomixes, incompatibility and male sterility systems and their use in plant breeding.

##### **Unit 2: Economics Botany and Plant Breeding Methods**

Origin, distribution, classification, description and botany of cereals (wheat, rice, maize, sorghum, pearl millet, minor millets); pulses (pigeonpea, chickpea, black gram, green gram, cowpea, soyabean, pea, lentil, horse gram, lab-lab, rice bean, winged bean, lathyrus, Lima bean; oilseeds (groundnuts, sesamum, castor, rapeseed mustard, sunflower, Niger, linseed); fibers and sugar crops, fodder and green manures; Breeding methods for self-pollinated, cross-pollinated and clonally propagated crops. Component, recombinational and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance, Hybrid breeding and genetic basis of heterosis. Ideotype breeding. Mutation breeding, Concept of tree breeding.

##### **Unit 3: Genome Organization and Cytogenetics of Crop Plants**

Chromosome structure, function and replication. Recombination and crossing over. Karyotype analysis. Banding techniques. *In situ* hybridization. Special types of chromosomes. Chromosomal interchanges, inversions, duplications and deletions. Polyploids, haploids, aneuploids and their utility. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre-and post- fertilization barriers in wide hybridization. Genome organization and cytogenetics of important crop species- wheat, maize, rice, sorghum, Brassica, cotton, Vigna, potato and sugarcane. Principles and procedures of genome analysis. Cytogenetic techniques for gene location and gene transfer, Construction and use of molecular marker based chromosome maps. Comparative mapping and genome analysis.

##### **Unit 4: Quantitative and Biometrical Genetics**

Quantitative characters. Multiple factors inheritance. Genetic control of polygenic characters. Genetic advance and types of selection and correlated response. Hardy Weinberg law. Linkage disequilibrium. Genetic load. Polymorphism. Breeding value, heritability. Response to selection, correlated response. Estimates of variance components and covariance among relatives. Mating designs with random and inbred parents. Estimation of gene effects and combining ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects. Genotype-environment interactions and stability of performance. Heterosis and its basis. Mating system and mating design- diallel, line X tester, NC-1, NC-II and NC-III designs, approaches to estimate and exploit component of self and cross pollinated crops. Genotype X environment interaction and stability analysis.

## **Unit 5: Genetic Engineering and Biotechnological Tools in Plant Breeding**

Somatic hybridization, micropropagation, somaclonal variation in vitro mutagenesis. Artificial synthesis of gene. Genetic and molecular markers, generations of molecular markers and their application in genetic analyses and breeding. Molecular markers in genetic diversity analysis and breeding for complex characters. Gene tagging, QTL mapping and marker aided selection. Genome projects and utilization of sequence formation. Vectors. DNA libraries, DNA fingerprinting, DNA sequencing. Nuclei acid hybridization and immunochemical detection. Chromosome walking, Recombinant DNA technology, Gene cloning strategies. Genetic transformation and transgenics. Antisense RNA, RNAi and micro RNA techniques in crop improvement.

## **Unit 6: Plant Breeding for Stress Resistance and Nutritional Quality**

Genetic basis and breeding for resistance to diseases and insect-pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for resistance to heat, frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for these traits. Role of molecular markers in stress resistance breeding: MAS, MARS and MABB.

## **Unit 7: Plant Genetic Resources and their Regulatory System; Varietal Release and Seed Production**

Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights. Biodiversity Act. Plant Variety Protection and Farmers' Rights Act. System of variety release and notification. Types of seeds and seed chain. Seed production and certification.

## **Unit 8: Statistical Methods and Field Plot Techniques**

Frequency distribution. Measures of central tendency, probability theory and its applications in genetics. Probability distribution and tests of significance. Correlation, linear, partial and multiple regression. Genetic divergence. Multivariate analysis. Design of experiments- basic principles, completely randomized design, randomized block design and split plot design. Complete and incomplete block designs. Augmented design, Grid and honeycomb design. Hill plots, unreplicated evaluation. Data collection and interpretation.

## **PLANT PATHOLOGY**

### **Unit 1: History and Principles of Plant Pathology**

Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Historical developments of chemicals, legislative, cultural and biological protection measures including classification of plant diseases. Physiologic specialization, Koch's postulates. Growth, reproduction, survival and dispersal of plant pathogens. Factors influencing infection, colonization and development of symptoms.

### **Unit 2: Laboratory and Analytical Techniques**

Preparation and sterilization of common media. Methods of isolation of pathogens and their identification. Preservation of microorganisms in pure culture. Methods of inoculation. Measurement of plant disease. Molecular detection of pathogens in seeds and other planting materials: Nucleic acid probes, Southern, Northern and Western hybridization, ELISA, ISEM and PCR. Laboratory equipment and their use: autoclave, hot air oven, laminar flow, spectrophotometer, electrophoresis, light and electron microscopy, incubator, ultracentrifuge, ELISA Reader.

### **Unit 3: Physiological and Molecular Plant Pathology**

Altered metabolism of plants under biotic and abiotic stresses. Molecular mechanisms of pathogenesis: elicitors, recognition phenomenon, penetration, invasion, primary disease determinant. Enzymes and toxins in relation to plant disease. Mechanisms of resistance, Structural and Biochemical defense mechanisms. R-Genes, Phytoanticipins. Phytoalexins. PR proteins, Hydroxyproline rich glycoproteins (HRGP). Antiviral proteins. SAR and ISR. HR and active oxygen radicals. Tissue culture. Somaclonal variation and somatic hybridization. Elementary genetic engineering. Management of pathogens through satellite, antisense - RNA. Ribozymes, coat protein, RNA interference, plantibodies, hypovirulence, cross protection. Useful genes and promoters, plant transformation techniques, biosafety and bioethics.

### **Unit 4: Mycology**

Classification of fungi. Life cycles of important phytopathogenic fungi. Economic mycology, edible fungi and entomogenous fungi. Mycorrhizal associations. Cell organelles, their morphology, functions and chemical composition.

### **Unit 5: Plant Bacteriology**

Identification and classification of bacteria. morphology, ultrastructure and chemical composition of prokaryotic cell in relation to function. Growth curve, nutrition and auxotrophic mutants. Resting cells in prokaryotic, elementary bacterial genetics and variability: transformation, conjugation, transduction. Biology of extra chromosomal elements: plasmid borne genes and their expression: avr, her, vie and pat genes. Bacteriophages: lytic and lysogenic cycles. Prokaryotic inhibitors and their mode of action. Economic uses of prokaryotes. Morphology, biochemical characteristics, reproduction and life cycle of phytoplasma and other fastidious prokaryotes.

### **Unit 6: Plant Virology**

Nature, composition and architecture of viruses and viroids. Properties of viruses. Variability in viruses. Satellite viruses and satellite RNA. Assay of plant viruses including biological, physical, chemical, serological and molecular methods. Conventional and biotechnological techniques used in detection and diagnosis. Behaviour of viruses in plants including infection, replication and movement. Histopathological changes induced by viruses in plants, inclusion bodies. Transmission of viruses: virus - vector relationships. Nomenclature and classification of viruses.

### **Unit 7: Plant Disease Epidemiology**

Concepts in epidemiology. Development of disease in plant population. Monocyclic and polycyclic pathogens. Role of environment and meteorological factors in the development of plant disease epidemics. Survey, surveillance (including through remote sensing), and prediction and forecasting of diseases. Epidemic analysis and prediction models. Crop loss assessment: critical and multiple point models.

### **Unit 8: Phanerogamic Parasites and Non-parasitic Diseases**

Diseases caused by Phanerogamic parasites and their management. Diseases due to unfavourable soil environment, drought and flooding stress etc. Nutritional deficiencies. Primary /secondary air pollutants and acid rain.

### **Unit 9: Fungal Diseases of Crop Plants**

Fungal diseases of cereals, millets, oilseeds, pulses, fruits, vegetables, plantation, fiber, spices and ornamental crops with special reference to etiology, disease cycle, perpetuation, epidemiology and management. Post-harvest diseases in transit and storage; aflatoxins and other mycotoxins and their integrated management.

## **Unit 10: Bacterial and Viral Diseases of Crop Plants**

Crop diseases of cereals, pulses, oilseeds, vegetables, fruits, plantation and fiber crops caused by bacteria, viruses, viroids, phytoplasmas and other fastidious prokaryotes. Mode of transmission and pathogen vector relationships. Epidemiology and management.

## **Unit 11: Management of Plant diseases**

General principles of plant quarantine. Exotic pathogens and pathogens introduced into India. Sanitary and phytosanitary issues under WTO, TRIPS and PRA. Genetic basis of disease resistance and pathogenicity: gene for gene hypothesis; parasite mediated frequency -dependent selection concept of QTL mapping; breeding for disease resistance. Production of disease free seeds and planting materials. Seed certification. Chemical nature and classification of fungicides and antibiotics: their bioassay and compatibility with other agricultural chemicals; resistance to fungicides/ antibiotics; effect on environment. Spraying and dusting equipments, their care and maintenances. Important cultural practices and their role in disease management, solarization, integrated disease management. Microorganisms antagonistic to plant pathogens in soil, rhizosphere and phyllosphere and their use in the control of plant diseases; soil fungistasis. Plant growth promoting Rhizobacteria. Biotechnology for crop disease management.

## **AGRICULTURAL ENTOMOLOGY/ENTOMOLOGY**

### **Unit 1: Systematic**

History and development of Entomology, Evolution of insects, position of insects in the animal world, characteristics of phylum Arthropoda, structural features of important arthropod groups such as Trilobita, Chelicerata and Mandibulata, structural features of important classes of phylum Arthropoda viz. Arachnida, Crustacea, Chilopoda, Diplopoda and Hexapoda. Classification of insects up to order level, habits, habitats and distinguishing features of different Order and important Families.

### **Unit 2: Morphology**

Body wall, its structure, outgrowths, endoskeleton, Body regions, segmentation, sclerites and sutures, Insect Colors. Head and head appendages, types of mouth parts, antennae, their structure and types. Thorax structure, thoracic appendages and their modification. Wings, their modification and venation, Abdomen; structure, abdominal appendages both in Pterygota and Apterygota. External genitalia, general structure and modification in important insect orders.

### **Unit 3: Embryology, Internal Anatomy and Physiology**

Embryonic and post embryonic development, types of metamorphosis, physiology of ecdysis. General features and types of larvae and pupae. Structure, function and physiology of Digestive, Circulatory, Respiratory, Reproductive, Nervous and Excretory systems, Sense Organs; structure and types. Insect food and nutrition; minerals, carbohydrates, proteins and amino acids, lipids, vitamins and their role in growth and development, artificial diets.

### **Unit 4: Ecology**

Concept of ecology, Environment and its components-biotic and abiotic factors and their effects on growth, development, population dynamics, distribution and dispersal. Principle of biogeography and insects biodiversity. Assessment of diversity indices. Biotic potential and environmental resistance. Ecosystems, agroecosystems analysis, their characteristics and functioning. Intra and inter specific relationship; competition, predator-prey and host-parasite interactions, ecological niche. Life table studies, population models. Food chain and food web. Arthropod population monitoring, pest forecasting. Diapause and causes of pest outbreaks.



## **Unit 5: Biological Control**

Importance and scope of biological control, history of biological control: Biocontrol agents-parasites, predators and insect pathogens. Important entomophagous insect Orders and Families. Ecological, biological, taxonomic, legal and economic aspects of biological control, phenomena of multiple parasitism, hyperparasitism, superparasitism and their applied importance. Principles and procedures of using exotic biocontrol agents. Utilization of natural biocontrol agents: conservation, habitat management and augmentation. Mass multiplication techniques and economics. Effective evaluation techniques, Biocontrol organizations in world and India. Successful cases of biological control of pests. Use of biotechnological tools in enhancing the potentials of Bio-Control Agents.

## **Unit 6: Chemical Control and Toxicology**

History, scope and principles of chemical control. Insecticides and their classification. Formulations of insecticides. Susceptibility of insects to the entry of insecticides. Physical, chemical and toxicological properties of different groups of insecticides: chlorinated hydrocarbons, organophosphates, carbamates, synthetic pyrethroids, chlordimeform, chitin synthesis inhibitors, avermectins, nitroguanidines, phenylpyrrozzoles, botanicals (natural pyrethroids, rotenone, neem products, nicotine, pongamia spp. etc). Chloronicotinyl, pyroazole, phenylpyrrozzoles, oxadiazines, benzamidazole, neristoxin, rodenticides, insect hormones, Insecticide induced resurgence. Combination insecticides. Problems of pesticide hazards and environmental pollution. Safe use of pesticides, precautions and first aid treatments. Insecticides Act 1968, registration and quality control of insecticides. Evaluation of toxicity, methods of toxicity testing, determination of LD 50, LT 50, RL 50 etc. Pesticides residues in the environment and their dynamics of movements, methods of residue. Pharmacology of insect poisons. Mode of action of different groups of insecticides; neuroactive (axonal and synaptic) poisons, respiratory poisons, chitin synthesis inhibitors. Metabolism of insecticides; activative and degradative metabolism, detoxification enzymes and their role in metabolism. Selectivity of insecticidal actions; insecticide resistance; mechanism, genetics and management of insecticide resistance.

## **Unit 7: Host Plant Resistance**

Chemical ecology: mechano- and chemoreceptors. Host plant selection by phytophagous insects. Secondary plant substances and their defenses against phytophagous insect. Basis of resistance (Antixenosis, Antibiosis, Tolerance). Biotypes development and its remedial measures. Tritrophic interactions, induced resistance. Breeding for insect resistant plant varieties. Resistance development and evaluation techniques. Genetics of Resistance: vertical resistance, horizontal resistance, oligogenic resistance, polygenic resistance. Biotechnological approaches and development of transgenic insect resistant plants, its advantages and limitations. Case histories. Insect resistance to transgenic plants and its management.

## **Unit 8: Innovative Approaches in Pest Control**

Behavioral control: pheromones-types and uses, advantages and limitations. Hormonal control: types and function of insect hormones, insect hormone mimics, advantages and limitations. chemosterilants, antifeedants, attractants, repellents; their types, method of applications, advantages and limitations. Genetic control: concepts and methods, case histories, advantages and limitations. Potentialities of IPM.

## **Unit 9: Integrated Pest Management**

History, concept and principles of IPM. Components of IPM: Host plant resistance, agronomic manipulations, mechanical and physical methods, chemical methods, biocontrol agents utilization, genetic and behavioral control strategy etc. IPM strategies for field and horticultural crops. IPM case histories. Concept of damage levels- Economic threshold levels (ETL), Economic injury levels (EIL) and their determination. System approach, Agro ecosystem and cropping system vs. IPM. Constraints and Strategies of IPM implementation. Plant quarantine laws and regulations.



## **Unit 10: Pesticide Application Equipments**

Types of appliances: sprayers, dusters, fog generators, smoke generators, soil injecting guns, seed treating drums, flame throwers, etc. Power operated sprayers and dusters. Types of nozzles and their uses. Maintenance of appliances. Aerial application of pesticides, principles of aerial application, factors affecting the effectiveness of aerial application. Equipments for aerial applications. Advantages and disadvantages of aerial application.

## **Unit 11: Pests of Field Crops and their Management**

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of cereals, Oilseed, pulses and fibre crops, sugarcane and tobacco. Polyphagous pests: locusts, termites, hairy caterpillars, cut worms and white grubs.

## **Unit 12: Pests of Horticultural Crops and their Management**

Distribution, host range, biology and bionomics, nature of damage and management of arthropod pests of vegetables, fruits and plantation crops, spices, condiments and ornamentals, Vertebrate Pests.

## **Unit 13: Pests of Stored Products and their Management**

Fundamentals of storage of grains and grain products. Storage losses, sources of infestation/infection, factors influencing losses, insect and non-insect pests, their nature of damage and control. Microflora in storage environment and their control. Storage structures, bulk storage and bag storage, their relative efficacy and demerits. Grain drying methods and aeration. Non-insect pests (rodents, birds, mites) of stored products and their control. Regulated and quarantine pests. Integrated management of storage pests.

## **Unit 14: Arthropod Vectors of Plant Diseases**

Common arthropod vectors viz., aphids, leaf hoppers, plant hoppers, whiteflies, thrips, psyllids, beetles, weevils, flies, bees and mites and their relationship with the plant pathogenic fungi, bacteria, viruses, mycoplasma. Mechanism of pathogen transmission : Active mechanical transmission, biological transmission. Toxicogenic insects, mites and phytotoxemia. Some important arthropod vector transmitted diseases and their epidemiology in India. Management of vector and its effect on control of diseases.

## **Unit 15: Honey Bees and Bee-keeping**

Honey bees and their economic importance. Bee species, their behaviour, habit and habitats. Bee Keeping: bee pasturage, hives and equipments, seasonal management. Bee enemies including diseases and their control.

## **Unit 16: Silkworms and Sericulture**

Silkworm species, their systematic position and salient features. Rearing techniques of mulberry - muga, eri and tassar silkworms. Nutritional requirements of silkworms. Sericulture: rearing house and appliances, silkworm breeds, principles of voltinism and bivoltinism, seed production and its economics. Different molecular approaches in developing silkworm breeds. Silkworm genomics- a model genetic system- transgenic silkworm- production of foreign proteins. Mulberry pests, diseases and their management. By products of sericulture and its value addition, uses in pharmaceutical industry. Enemies and diseases of silkworms and their management. Sericulture organization in India.

## **Unit 17: Lac Insect**

Lac insect, its biology, habit and habitats. Host Trees: pruning, inoculation, lac cropping techniques, and harvesting. Enemies of lac insect and their control.

## **Unit 18: Other Useful Insects**

Pollinators, biocontrol agents of weeds, soil fertility improving agents, scavengers. Use of insects and insect products in medicines. Usefulness of insects in scientific investigations, insects as food.

## **Unit 19: Statistics and Computer Application**

Frequency distribution, mean, mode and median. Standard, normal, binomial and Poisson's distribution, Sampling methods and standard errors. Correlation and regression: Partial and multiple, tests of significance; t, F, chi-square, Duncan's multiple range tests. Design of experiments: Principles of Randomized block design, Completely randomized block design, Latin square design, Split-plot designs. Probit analysis. Use of software packages like SPSS, SAS, etc. for the above tests and designs of experiments for analysis.

## **VEGETABLE SCIENCE/OLERICULTURE**

### **Unit 1. Production Technology of Cool Season Vegetable Crops**

Introduction, climatic and soil requirement, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of: potato, cole crops: cabbage, cauliflower, knob, sprouting broccoli, Brussels sprout, root crops: carrot, radish, turnip, and beetroot, bulb crops: onion and garlic, Peas and beans, leafy vegetables: palak, methi and coriander cool season vegetables.

### **Unit 2. Production Technology of Warm Season Vegetable Crops**

Introduction, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production of: Tomato, eggplant, hot and sweet pepper, Okra, cowpea and cluster bean, Cucurbitaceous crops, and sweet potato, amaranths.

### **Unit 3. Breeding of Vegetable Crops**

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, biotechnology and their use in breeding in vegetable crops - molecular marker, genomics, marker assisted selection and QTLs. Potato and tomato, Eggplant, hot pepper, sweet pepper and okra, Peas and beans, lettuce, gourds, melons, pumpkins and squashes, cabbage, cauliflower, carrot and radish.

### **Unit 4. Growth and Development**

Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production; Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscisic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production; Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance; Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening; Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops. sex expression in cucurbits and checking flower and fruit drops and improving fruit set in Solanaceous vegetables.

## **Unit 5. Seed Production**

Introduction; modes of propagation in vegetables; Seed morphology and development in vegetable seeds; Floral biology of these plant species; classification of vegetable crops based on pollination and reproduction behavior; steps in quality seed production; identification of suitable areas/locations for seed production of these crops; Classification based on growth cycle and pollination behavior; methods of seed production; comparison between different methods e.g. pollination mechanisms; sex types, ratios and expression and modification of flowering pattern in cucurbits; nursery raising and transplanting stage; Seed production technology of vegetables viz. solanaceous, cucurbitaceous, leguminous, malvaceae, cole crops, leafy vegetables, root, tuber and bulb crops; harvesting/picking stage and seed extraction in fruit vegetables; clonal propagation and multiplication in tuber crops e.g. Potato and sweet potato, seed-plot technique in potato; hybrid seed production technology of vegetable crops, TPS (true potato seed) and its production technique; hybrids in vegetables; maintenance of parental lines; use of male sterility and self-incompatibility in hybrid seed production, importance and present status of vegetable industry.

## **Unit 6. Systematics of Vegetable Crops**

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 various tropical, subtropical and temperate vegetables; Cytological level of various vegetable crops; descriptive keys for important vegetables; Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops.

## **Unit 7. Production Technology of Underexploited Vegetable Crops**

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, planting time and method, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of: Asparagus and leek; Brussels sprout, Chinese cabbage, broccoli and kale; Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella and bathu (chenopods); lima bean, winged bean, vegetable pigeon pea and sword bean; Sweet gourd, spine gourd, pointed gourd, little gourd (kundru).

## **Unit 8. Post-Harvest Technology of Vegetable Crops**

Importance and scope of post-harvest management of vegetables; Maturity indices and standards for different vegetables; methods of maturity determinations; biochemistry of maturity and ripening, enzymatic and textural changes, ethylene evolution and ethylene management, respiration, transpiration, regulation methods; Harvesting tools, harvesting practices for specific market requirements; post-harvest physiological and biochemical changes, disorders-chilling injury in vegetables, influence of pre-harvest practices and other factors affecting post-harvest losses, packaging house operations, commodity pretreatments- chemicals, wax coating, prepackaging and irradiation; packaging of vegetables, post-harvest, diseases and prevention from infestation, principles of transport; Methods and practices of storage-ventilated, refrigerated, MA, CA storage, hypobaric storage, pre-cooling and cold storage, zero energy cool chamber; storage disorders.

## **Unit 9: Organic Vegetable Production Technology**

Importance, principles, prospective, concept and component of organic production of vegetable crops, managing soil fertility, pest, disease and weed problem in organic farming system, crop rotation in organic vegetable production. Method of enhancing soil fertility, mulching, raising green manure crops, indigenous methods of compost, panchgavya, biodynamics preparation, ITKs organic farming. Role of botanicals and bio-control agents. GAP and GMP, opportunity and challenges in organic production of vegetables

## **Unit 10: Hi-tech Production Technology of Vegetable Crops**

Importance and scope of protected cultivation of vegetable crops, principles used in protected cultivation and greenhouse technology, effect of temperature, carbon dioxide, humidity; energy management, low cost structures, training methods, engineering effects, Use of plastics, structures including low cost poly-house/green houses and other structures in vegetable production. Drip and sprinkler irrigation, fertigation, shading, hydroponics and other production technologies for enhancing productivity and off-season of high value vegetable crops like tomato, capsicum and cucumber.

## **FRUIT SCIENCE/POMOLOGY**

### **Unit 1. Tropical and Dry Land Fruit Production**

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bio-regulators, abiotic factors limiting fruit production, physiology of flowering, pollination, fruit set and development, honeybees in cross pollination, physiological disorders – causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports.

Crops: Mango, banana, citrus, papaya, guava, sapota, jackfruit, pineapple, annonas, avocado, aonla, ber and minor fruits of tropics.

### **Unit 2. Subtropical and Temperate Fruit Production**

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators, abiotic factors limiting fruit production, physiology of flowering, pollination, fruit set and development, honeybees in cross pollination, physiological disorders – causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial supports.

Crops: Apple, pear, quince, grapes, plums, peach, apricot, cherries, litchi, loquat, persimmon, kiwifruit, strawberry, walnut, almond, pistachio, hazelnut, mangosteen, carambola, bael, wood apple, fig, jamun, rambutan and pomegranate.

### **Unit 3. Biodiversity and Conservation**

Biodiversity and conservation; issues and goals, centres of origin of cultivated fruits; primary and secondary centres of genetic diversity; present status of gene centres; exploration and collection of germplasm; conservation of genetic resources – conservation *in situ* and *ex situ*. Germplasm conservation – problem of recalcitrancy – cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine; intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group; GIS and documentation of local biodiversity, geographical indication.

Crops: Mango, sapota, citrus, guava, banana, papaya, grapes, jackfruit, custard apple, ber, aonla, Malus & Prunus sp., litchi and nuts.

### **Unit 4. Canopy Management in Fruit Crops**

Canopy management – importance and advantages; factors affecting canopy development; Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies; Spacing and utilization of land area – canopy classification; Canopy management through rootstock and scion; Canopy management through plant growth inhibitors, training and pruning and management practices; Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, mango, sapota, guava, citrus and ber.

## Unit 5. Breeding of Fruit Crops

Origin and distribution, taxonomical status – species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement – introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops: Mango, banana, pineapple, citrus, grapes, guava, sapota, jackfruit, papaya, custard apple, aonla, avocado, ber, litchi, jamun, phalsa, mulberry, raspberry, apple, pear, plums, peach, apricot, cherries and strawberry.

## Unit 6. Post-Harvest Technology

Maturity indices, harvesting practices and grading for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, transpiration; Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling; Treatment prior to shipment, viz., chlorination, waxing, chemicals, bio-control agents and natural plant products, fungicides, hot water, vapour heat treatment, sulphur fumigation and irradiation. Methods of storage – ventilated, refrigerated, MAS, CA storage, physical injuries and disorders; Packing methods and transport, quality evaluation, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, candies; Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards.

## Unit 7. Growth and Development

Definition, parameters of growth and development, growth dynamics, morphogenesis; Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism, vernalisation, effect of temperature, heat units, thermoperiodism; Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors, developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development; Growth and developmental process during stress – manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

## Unit 8. Biotechnology of Fruit Crops

Harnessing bio-technology in horticultural crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture; Callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis; Use of bioreactors and *in vitro* methods for production of secondary metabolites, suspension culture, nutrition of tissues and cells, regeneration of tissues, *ex vitro*, establishment of tissue cultured plants; Physiology of hardening – hardening and field transfer, organ culture – meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion; Construction and identification of somatic hybrids and cybrids, wide hybridization, *in vitro* pollination and fertilization, haploids, *in vitro* mutation, artificial seeds, cryopreservation, rapid clonal propagation, genetic engineering and transformation in horticulture crops, use of molecular markers. *In vitro* selection for biotic and abiotic stress, achievements of biotechnology in horticultural crops.

## Unit 9. Protected Fruit Culture

Greenhouse – world scenario, Indian situation; present and future, different agro-climatic zones in India, environmental factors and their effects on plant growth; Basics of greenhouse design, different types of



structures – glasshouse, shade net, poly tunnels – Design and development of low cost greenhouse structures; Interaction of light, temperature, humidity, CO<sub>2</sub>, water on crop regulation – Greenhouse heating, cooling, ventilation and shading; Types of ventilation – Forced cooling techniques – Glazing materials – Micro irrigation and Fertigation; Automated greenhouses, microcontrollers, waste water recycling, management of pest and diseases - IPM.

## **Unit 10. Principles and Practices of Plant Propagation**

Introduction, life cycle in plants, cellular basis for propagation. Sexual propagation – apomixis, polyembryony, chimeras. Factors influencing seed germination, hormonal regulation of germination and seedling growth. Seed quality, treatment, packing, storage, certification and testing. Rooting of cuttings under mist and hot beds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Selection of elite mother plants. Establishment of bud wood bank. Stock, scion and interstock relationship and incompatibility. Physiology of dwarfing rootstocks. Rejuvenation, progeny orchard and scion bank. Micropropagation ---- in vitro clonal propagation, direct organogenesis, embryogenesis, micrografting and meristem culture. Hardening, packing and transport of micro-propagules.

## **AGRONOMY**

### **Unit 1 : Crop Ecology and Geography**

Principles of crop ecology; Ecosystem concept and determinants of productivity of ecosystem; Physiological limits of crop yield and variability in relation to ecological optima; Crop adaptation; Climate shift and its ecological implication; Greenhouse effect; Agro-ecological and agro climatic regions of India; Geographical distribution of cereals, legumes, oilseeds, vegetables, fodders and forages, commercial crops, condiments and spices, medicinal and aromatic plants; Adverse climatic factors and crop productivity; Photosynthesis, respiration, net assimilation, solar energy conversion efficiency and relative water content, light intensity, water and CO<sub>2</sub> in relation to photosynthetic rates and efficiency; Physiological stress in crops; Remote sensing: Spectral indices and their application in agriculture, crop water stress indices and crop stress detection.

### **Unit 2 : Weed Management**

Scope and principles of weed management; Weeds' classification, biology, ecology and allelopathy; Crop weed competition, weed threshold; Herbicides classification, formulations, mode of action, selectivity and resistance; Persistence of herbicides in soils and plants; Application methods and equipment; Cultural, physical, mechanical weed control, Biological weed control, bio-herbicides: Integrated weed management; Special weeds, parasitic and aquatic weeds and their management in cropped and non-cropped lands; weed control schedules in field crops, vegetables and plantation crops; Role of GM crops in weed management.

### **Unit 3 : Soil Fertility and Fertilizer Use**

History of soil fertility and fertilizer use; Concept of essentiality of plant nutrients, their critical concentrations in plants, nutrient interactions, diagnostic techniques with special emphasis on emerging deficiencies of secondary and micro-nutrients; Soil fertility and productivity and their indicators; Fertilizer materials including liquid fertilizers, their composition, mineralization, availability and reaction products in soils; Water solubility of phosphate fertilizers; Slow release fertilizers, nitrification inhibitors and their use for crop production; Principles and methods of fertilizer application including fertigation; Integrated nutrient management and bio-fertilizers; Agronomic and physiological efficiency and recovery of applied plant nutrients; Criteria for determining fertilizer schedules for cropping systems direct, residual and cumulative effects; Fertilizer related environmental problems including ground water pollution; Site-specific nutrient management; Contamination of heavy metals in peri-urban soils and their remediation.



#### **Unit 4 : Dryland Agronomy**

Concept of dryland farming; dryland farming vs rainfed farming; History, development, significance and constraints of dryland agriculture in India; Climatic classification and delineation of dryland tracts; Characterization of agro-climatic environments of drylands; Rainfall analysis and length of growing season; Types of drought, drought syndrome, effect on plant growth, drought resistance, drought avoidance, drought management; Crop Planning including contingency, crop diversification, varieties, cropping systems, conservation cropping and mid-season corrections for aberrant weather conditions; Techniques of moisture conservation in-situ to reduce evapotranspiration, runoff and to increase infiltration; Rain water harvesting and recycling concept, techniques and practices; Timelines and precision key factors for timely sowing, precision in seeding, weed control; Fertilizer placement, top dressing and foliar application, aqua-fertigation; Concept and importance of watershed management in dryland areas.

#### **Unit 5 : Crop Production in Problem Soils**

Problem soils and their distribution in India, acid, saline, waterlogged and mined - soils; Response of crop to acidity, salinity, sodicity, excess water and nutrient imbalances; Reclamation of problem soils, role of amendments and drainage; Crop production techniques in problem soils - crops, varieties, cropping system and agronomic practices; Effects of water table fluctuation on crop growth; Degraded lands and their rehabilitation.

#### **Unit 6 : Crop Production**

Crop production techniques for cereals, millets, legumes, oilseeds, fiber crops, sugarcane, tobacco, fodder and pasture crops including origin, history, distribution, adaptation, climate, soil, season, modern varieties, Seed rate, fertilizer requirements, crop geometry, intercultural operations, water requirement, weed control, harvest, quality components, industrial use, economics and post-harvest technology.

#### **Unit 7 : Agricultural Statistics**

Frequency distribution, standard error and deviation, correlation and regression analyses, co-efficient of variation; Tests of significance-t, F and chi-square ( $\chi^2$ ); Data transformation and missing plot techniques; Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs; Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

#### **Unit 8 : Sustainable Land Use Systems**

Concept of sustainability; Sustainability parameters and indicators; Conservation agriculture; Alternate land use systems; Types, extent and causes of wasteland; Shifting cultivation; Agro forestry systems; Agricultural and agro-industrial residues and its recycling, safe disposal; Allelopathy and biomass production.

#### **Unit 9 : Basics of Soil and Water**

Soil and water as vital resources for agricultural production; Occurrence of groundwater, groundwater aquifers, exploration of groundwater; Hydrological cycle; Soil-plant water relationship; Fate of rain water received at the soil surface, runoff and infiltration reciprocity, factors affecting infiltration, means to enhance infiltrability of soil, mechanical and biological means to reduce runoff and soil loss; Water harvesting for crop lifesaving irrigations; watershed management; Soil and water conservation; Contingent crop plans and other strategies for aberrant weather conditions; Cropping patterns, alternate land use and crop diversification in rainfed areas; Analysis of hydrologic data and their use.

## **Unit 10 : Soil Water Relationship**

Soil water relations, water retention by soil, soil moisture characteristics, field capacity, permanent wilting point, plant available water and extractable water; Soil irrigability, classifications, factors affecting profile water storage; Determination of soil water content, computation of soil water depletion, soil water potential and its components, hydraulic head; Movement of soil water saturated and unsaturated water flow; Field water budget, water gains and water losses from soil, deep percolation beyond root zone, capillary rise; Evapotranspiration (ET), scope for economizing water, measures for reducing direct evaporation from soil and crop canopies; Soil physical properties in relation to plant growth and development; Erodability of soils and their prevention.

## **Unit 11 : Plant Water Relationship**

Plant water relations: Concept of plant water potential, cell water relations, plant water potential and its components; Significance of osmotic adjustment, leaf diffusive resistance, canopy temperature, canopy temperature depression (CTD); Water movement through soil - plant atmosphere systems, uptake and transport of water by roots; Development of crop water deficit, crop adaptation to water deficit, morpho-physiological effect of water deficit; Drought tolerance, mechanisms of drought tolerance, potential drought tolerance traits and their measurements. management and breeding strategies to improve crop productivity under different patterns of drought situations of limited water supplies; Effect of excess water on plant growth and production; Types of droughts, drought indices.

## **Unit 12 : Irrigation Water Management**

Management of irrigation water; History of irrigation in India; Major irrigation projects in India; Water resources development; Crop water requirements; Concepts of irrigation scheduling, Different approaches of irrigation scheduling; Soil water depletion plant indices and climatic parameters; Concept of critical stages of crop growth in relation to water supplies; Crop modeling, crop coefficients, water production functions; Methods of irrigation *viz.* surface methods, overhead methods, drip irrigation and air conditioning irrigation, merits and demerits of various methods, design and evaluation of irrigation methods; Measurement of irrigation water, application and distribution efficiencies; Management of water resources (rain, canal and ground water) for agricultural production; Agronomic considerations in tile-design and operation of irrigation projects, characteristics of irrigation and family systems affecting irrigation management; irrigation legislation; Water quality, conjunctive use of water, irrigation strategies under different situation of water availability, optimum crop plans and cropping patterns in canal command areas; Socio-economic aspects of on-farm water management; Irrigation water distribution, Estimation of ET by direct and indirect methods, Irrigation efficiencies; Design of irrigation canals, design of irrigation structures; Interaction between irrigation and fertilizers.

## **Unit 13 : Management of Problematic Soils and Water**

Problem soils and their distribution in India; Salt-affected, acidic, water logged soils; Ground water resources, water quality criteria and use of brackish waters in agriculture; Excess salt and salt tolerant crops; Hydrological imbalances and their corrective measures; Concept of critical water table depths for crop growth; Contribution of shallow water table to crop water requirements; Management strategies for flood prone areas crop and crop calendar for flood affected areas; Drainage for improving water logged soils for crop production; Crop production and alternate use of problematic soils and poor quality water for agricultural and fish production; Amelioration of salt affected soils.

## **OIL SCIENCES/SOIL SCIENCE & AGRICULTURAL CHEMISTRY**

### **Unit 1: Pedology**

Concept of land, soil and soil science. Composition of earth crust and its relationship with soils; Rocks, minerals and other soil forming materials; Weathering of rocks and minerals; Factors of soil formation; Pedogenic processes and their relationships with soil properties; Soil development; Pedon, polypedon, soil profile, horizons and their nomenclature. Soil Taxonomy - epipedons, diagnostic subsurface horizons and other diagnostic characteristics, soil moisture and temperature regimes, categories of the system and their criteria; Interpretation of soil survey data for land capability and crop suitability classifications, Macro-morphological study of soils, Application and use of global positioning system for soil survey. Soil survey- types, techniques. Soil series- characterization and procedure for establishing soil series, benchmark soils and soil correlations. Study of base maps: cadastral maps, toposheets, aerial photographs and satellite imageries. Use of geographical information system for preparing thematic maps. Application of Remote Sensing in soil survey and mapping.

### **Unit 2: Soil Physics**

Soil physical constraints affecting crop production. Soil texture – textural classes. Soil structure – classification, soil aggregation and significance, soil consistency, soil crusting, bulk density and particle density of soils and porosity, their significance and manipulation. Soil water- retention and potentials. Soil moisture constants. Movement of soil water - infiltration, percolation, permeability, drainage and methods of determination of soil moisture. Darcy's law. Thermal properties of soils, soil temperature, Soil air- composition, gaseous exchange, influence of soil temperature and air on plant growth. Soil erosion by water- types, effects, mechanics. Rain erosivity and soil erodibility. Runoff - methods of measurement, factors and management, runoff farming. Soil conservation measures.

Characterization and evaluation of soil and land quality indicators; Causes of land degradation; Management of soil physical properties for prevention/restoration of land degradation; Identification, monitoring and management of waste lands; Land use-land cover mapping and land use planning using conventional and remote sensing techniques; Concept of watershed – its characterization and management.

### **Unit 3: Soil Chemistry**

Chemical composition of soil; Soil colloids - structure, composition, constitution of clay minerals, amorphous clays and other non-crystalline silicate minerals, oxide and hydroxide minerals; Charge development on clays and organic matter; pH-charge relations; Buffer capacity of soils.

Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics. Inorganic and organic colloids- surface charge characteristics, diffuse double layer theories, zeta potential stability, coagulation/ flocculation, peptization, electrometric and sorption properties of soil colloid. Soil organic matter-fractionation, clay-organic interactions. Cation exchange- theories, adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, anion and ligand exchange- inner sphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions. Nitrogen, potassium, phosphate and ammonium fixation in soils and management aspects. Chemistry of acid, salt-affected and submerged soils and management aspects.

### **Unit 4: Soil Fertility**

Essential elements in plant nutrition; Nutrient cycles in soil; Transformation and transport of nutrients (Macro and micro nutrients) in soil; Manures and fertilizers; Fate and reactions of fertilizers in soils; Chemistry of production of different fertilizers; Slow release fertilizers and nitrification retarders; Quality control of fertilizers.

Soil fertility evaluation – soil testing, plant and tissue tests and biological methods; Common soil test methods for fertilizer recommendation; Soil test-crop response correlations; Integrated nutrient management; Use of isotopic tracers in soil research; Nature, properties and development of acid, acid

sulphate, saline and alkali and their management; Lime and gypsum requirements of soils; Irrigation water quality - EC, SAR, RSC and specifications. Fertility status of major soil groups of India. Application of Remote Sensing in Soil fertility mapping, Watershed management, Degraded land and soil erosion studies. Remote sensing and GIS in Carbon sequestration studies.

Pollution: types, causes, methods of measurement, standards and management. Heavy metal toxicity and soil pollution; Chemical and bio-remediation of contaminated soils; Soil factors in emission of greenhouse gases; Carbon sequestration in mitigating greenhouse effect; Radio-active contamination of soil.

## **Unit 5: Soil Microbiology**

Soil biota, soil microbial ecology, types of organisms. Soil microbial biomass, microbial interactions, unculturable soil biota. Microbiology and biochemistry of root-soil interface. Phyllosphere. Soil enzymes, origin, activities and importance. Soil characteristics influencing growth and activity of microflora. Microbial transformations of N, P, K, S, Fe and Zn in soil. Biochemical composition and biodegradation of soil organic matter and crop residues. Humus formation. Cycles of important organic nutrients. Biodegradation of pesticides, organic wastes and their use for production of biogas and manures. Biofertilizers – definition, classification, specifications, method of production and role in crop production.

Methods of soil analysis - particle size distribution, bulk and particle density, moisture constants, Modern methods of soil, plant and fertilizer analysis; Flame photometry and inductively coupled plasma optical emission spectroscopy; Spectrophotometry - visible, ultra-violet and infrared; Atomic absorption spectrophotometry; Potentiometry and conductimetry; X-ray diffractometry; Mass spectrometry.

## **Unit 6: Statistics**

Experimental designs for pot culture and field experiments; Statistical measures of central tendency and dispersion; Correlation and regression; Tests of significance - t and F tests; Computer use in soil research, Geostatistics.

# **AGRICULTURAL ECONOMICS**

## **Unit 1: Economic Theory**

Scope and methods of economics and agricultural economics, Characteristics of modern production, Problems of application of economic theory of agriculture. Production and consumption units and their peculiarities, Basic economics concepts - statistics. Comparative statics and dynamics equilibrium. Comparative economic systems, Development of economic theory and models. Themes of consumer behaviour -marginal utility, indifference curve (IC) and other models of utility maximization. Price and income consumption curves, Engel curves Elasticity of demand-substitution and income effects, Application of IC analysis -rationing, taxation and subsidy. Theory of production and cost optimizing behaviour of firm, output maximization, cost minimization and profit maximization. Elasticity of supply-substitution, output and profit maximization and profit maximization. Elasticity of supply-substitution, output and profit maximization effects. Optimally approach for joint products. Market classification-pure and perfect competition. Behaviour of the firm and industry. Supply-demand functions. Imperfect competition, monopolistic competition, monopoly, duopoly. Pricing and output decisions. Pricing and output decisions. Price discrimination. Product differentiation applications. Micro and macroeconomic analysis. Working of macro-economic systems. National income accounting. Theory of employment-classical. Keynesian and post Keynesian theories of income determination. Optimal saving and investments. Theory of income distribution and factor shares inflation, deflation, inflationary gap, monetary policy and banking systems.

## **Unit 2: Economic and Agricultural Development**

Concept of economic and agricultural development, characteristics of developing countries, dualism and development, stages and theories of economic development, economic growth models, neo-classical growth models, role of technology in development and choice of techniques, human capital and

development, inequality, poverty and migration in developing countries, trade and development, capital and growth, development challenges in developing countries, role of state, markets and civil society in development, institutions and economic development, international development institutions. Objective and processes for economic planning in India, economic and trade reforms in India.

Role of agriculture in economic development, theories of agricultural development, agricultural development challenges, planning and techniques for agricultural development, agricultural development, poverty and environment, application of institutional economics in agricultural development, institutional issues in natural resource management, agricultural policies (price, land, credit, R&D, trade, subsidy, etc.), role of innovations, investment and institutions in agricultural development, agricultural development programmes in India, issues of water, energy, environment, food and nutrition security, agro-eco -regional planning, assessment of ecosystem services, farm-non-farm linkages. Agricultural development in India, China, Latin America and East Asian countries.

### **Unit 3: Public Finance and International Economics**

Public Finance: Public and private finance. General principles of public finance. Principle of maximum social advantage. Public revenue. Incidence of tax and financial policies. Public expenditure and economic development. Balanced and unbalanced budgets. Limitations of fiscal policies. Fiscal policy as an instrument of development. Structure of development taxation. Public debt policy and economic development, international Economics: Principle of comparative advantage. Factor endowment theory, Balance of payments. Problems of international monetary systems, Foreign trade and foreign capital. Export promotion and input substitution. Past experiences and future strategies.

### **Unit 4: Farm Management Economics**

Definition of farm management and its relationship to technical and social sciences. Characteristics of modern farming. Role and functions of farm management under Indian condition. Measurement of management. Measures of farm efficiency. Cost concepts. Evaluation of farm assets and liabilities. Decision theory and decision making models. Decision making under different knowledge situations. Tools and techniques in farm decision making. Farm planning and budgeting-sources of data and illustration. Linear programming. Problem formulation in farm planning. Farm records and accounts. Farm inventory with applications to farming enterprises. Farm cost accounting for managerial analysis. Management of farm resources-land, labour, capital and machinery. Review of farm management research, education and extension in relation to changing needs. Systems approach in agriculture. Farming systems, identification of farming system inputs and outputs, sub-systems and the circuitry connecting these systems. Systems analysis to find out needed changes in policies and programmes.

### **Unit 5: Agricultural Production Economics**

Nature and scope of agricultural production economics vis-à-vis farm management. Relative importance of farm production economics and farm management in developed and developing countries. Economics of farm production- resource allocation and use under static and dynamic conditions. Resource — product relationships in agriculture. Types of production functions. General rules of their economics application. Technological change and production function analysis. Principles of choice and allocation of resources. Resource combination and cost minimization. Types of risk in agriculture, resource allocation and enterprise combination under risk and risk diffusion mechanisms. Nature of costs and family farm theory. Returns to scale and farm size. Derivation of cost and supply functions.

### **Unit 6: Agricultural Finance and Co-operation**

Role of credit in agriculture and rural development. Estimates of agricultural credit requirements-investment, production, marketing and consumption. Role of public and private section banks and cooperatives in development financing. Classification of agricultural credit. Rural credit structure. Principles of agricultural finance and financial management. Agricultural finance as a part of public finance. Agricultural taxation and subsidies, capital in agriculture and sources of capital. Credit and saving -legal aspects of credit. Credit instruments. Farm planning as a basis for extension of agriculture credit. Nexus between commercial banks and cooperative credit institutions. Recent innovations in



extension of credit to agriculture. Rural credit supply and credit gap. Multiagency approach and coordination of credit structure at different levels. Agriculture credit policy. Principles and practices of cooperation. Success and failure of cooperative sector in India. Credit and non-credit institutions. National federations of cooperative organizations. Review of reforms in cooperative structure. Single window approach in agricultural input supply and output marketing. Bureaucracy and cooperatives. Management of cooperative institutions. Professionalization and revitalization of cooperatives. Role of cooperatives under new economic policy.

### **Unit 7: Agricultural Marketing**

Nature and scope of marketing in a developing economy. Classification of markets. Problems of marketing agricultural produce. Functions of marketing. Marketable surplus and marketed surplus. Channels of marketing agricultural produce and price spread. Marketing institutions, their role and functions. Regulated markets and other state interventions in agricultural marketing. Role of commission on agriculture cost and prices and parastatal organizations in agricultural marketing. Cooperative marketing. Marketing practices and cost-marketing of grains, pulses, commercial crops, fruits, vegetables, livestock and livestock products and inputs. Processing, transportation, storage and warehousing, equity aspects of marketing. Marketing efficiency. Marketing finance-methods and practices. Forward trading and speculation. Future markets. Market management. Agricultural price analysis. Seasonal and spatial variations in prices in agricultural price policy. Agricultural exports, problems and prospects.

### **Unit 8: Agricultural Project Analysis**

Definition of project in agriculture. Need for project approach for agricultural development. Project cycle. Project identification and formulation. Project appraisal-ex-ante and ex-post. Projection worth measures-discounting techniques. Project monitoring and mid-course corrections. Project funding.

### **Unit 9: Research Methodology and Econometrics**

Agricultural economics research, steps and themes, collection and analysis of economic data, scientific report writing. Optimization, econometric and statistical methods, differential and integral calculus; sampling methods, probability theory. Multiple regression analysis, ordinary and generalized least squares estimators, multicollinearity, heteroscedasticity, autocorrection, dummy variable. Simultaneous equation methods.

## **AGRICULTURAL EXTENSION/EXTENSION EDUCATION**

### **Unit 1: Fundamentals of Extension and Communication**

Concepts and scope of extension and communication particularly for primary and secondary agriculture. Historical and emerging perspectives of agricultural, veterinary and animal husbandry extension education in India and other countries. Community Development and Integrated Rural Development-concept, principles and objectives. Role of agricultural extension in different sectors of agriculture and rural development. Agricultural Extension in the context of enhancing productivity, Quality, Nutrition, post-harvest technology, product processing, Profitability, Income and Employment. Concepts of yield gaps. FLD and OFT in relation to TOT programmes. Farming System Research and Extension (FSR&E) and participatory development approaches. Concept and modules of communication, credibility, fidelity, empathy and feedback in communication. Similarities and dissimilarities among extension education, adult education and continuing/distance education. Andragogy and theories of adult learning. Human behavioural dimensions and gender sensitivity in extension education programmes. Meaning and characteristics of attitude, factors affecting attitude change; Understanding of basic rural institutions, social structure, culture and norms. Social and technological change processes, group dynamics, concepts and theories of rural leadership. Group and mass communication, Interpersonal and Intrapersonal Communication Skills, Key communicators and their role in agriculture and animal husbandry development. Acquiring communication skills for development of local leaders and key communicators



for agriculture and livestock development. Organizational communication. Rapport building with clientele. Problems and barriers in communication; distortion and noise in communication. Importance of feedback in agriculture and veterinary extension, impact analysis of extension programmes.

## **Unit 2: Extension Methods & Farm Journalism**

Concepts of teaching and learning processes—principles of learning as applied to agricultural extension. Individual, group and mass approaches in extension, audio-visual aids- classification, selection, use and production. Traditional media for communication in development programmes. Modularized communication- concept, approach, need, process of designing instruction for transfer of communication. Basics of agricultural journalism, types of publications – bulletins, folders, leaflets, booklets, newsletters, popular and scientific articles. Selection, planning and use of different extension teaching methods like demonstration, exhibition, farmers fairs, field days, tours, extension literature, etc. Preparation and presentation of different projected and non-projected audio-visual aids. Public speaking. Preparation of radio/video script. Principles of photography and its use in extension.

## **Unit 3: Information Communication Technologies (ICT)**

Concept of ICT and its role in agriculture and rural development. ICT tools- print and electronic media, e-mail, Internet, use of multimedia, use of mobile phony, *video* and teleconferencing, computer-assisted instructions, touch screens, micro-computers, web technologies and information kiosks. Networking system of information and challenges in the use of ICT. E-learning, information resources, sharing and networking. Types of network – PAN, LAN, WAN, Internet, AGRINET, AKIS, Indian National Agricultural Research database. ICT programmes in agriculture and livestock development, Problems and prospects of ICTs in agriculture and livestock development, Digitization, Simulation models, Utilization of Internet for promoting advanced agriculture, veterinary and animal husbandry practices; communication with farmers and rural, semi-urban and urban livestock owners.

## **Unit 4: Training & Human Resource Development**

Human resources and their importance in agricultural development. Concept of human resource management. Training and development of human resources. Identifying training needs and assessment of training impact. Training – principles, importance, methods and factors. Phases of training - pre training and post training. Developing training modules, training requirements, training methods. Lecture cum demonstration method, case method, group brain storming, syndicate method, business games, simulation exercises, in basket exercise, programmed instruction, experiential learning techniques such as sensitivity training, T-group, transactional analysis and fish bowl exercise. Evaluation of training - types and techniques of training evaluation. Motivation, stress management and organizational behaviour as facilitators of human resource development. Capacity Building in relation to agriculture, Dairying, Poultry, Piggery, Goat and Sheep farming, cottage industries, Rabbit farming, Apiculture, Sericulture, Biofertilizer, Floriculture, and Biopesticides.

**Unit 5: Research Methodology in Extension Education** Social research- concept, principles and approach. Selection and identification of research problems, methods of data collection- interview method and mailed questionnaires, variables -meaning and types, independent, dependent and intervening variables. Hypothesis – concept, characteristics, types and testing. MAXMINCON principle, Research design - concept and types, field studies, case studies and survey method. Measurement – meaning and levels. Methods of sampling and statistical tests. Reliability and validity of tests, normal distribution, tests of significance, ANOVA, correlation and regression, scaling techniques. Processing of data, coding - tabulation. Analysis and interpretation. Writing scientific reports, citing references. Participatory approaches, PRA, RRA, PLA and PTD.

## **Unit 6: Programme Planning, Evaluation & Diffusion and Adoption of Innovations**

Concept, steps, principles and theories of programme planning. Steps in programme planning for agriculture and livestock development, organizing campaigns, mass vaccination programmes and variety of extension activities, evaluation of veterinary extension programmes, compilation and report writing. Evaluation of agriculture and animal husbandry development programmes and schemes. Monitoring and evaluation – concept, significance, types, methods and tools. Theoretical models of programme planning. Felt needs; need-based programmes. Social action. Five Year Plans – critical analysis with special reference to programmes for women, children and youth. SWOT/TOWS analysis of development programmes. Concept and elements of diffusion and adoption for social change. Diffusion process, adoption process, models of diffusion and adoption, adopter categories and their characteristics. Factors influencing adoption and attributes of innovations. Concept and stages of Innovation-decision process, consequences of innovations.

## **Unit 7: Extension Management**

Concept and principles of administration and management, classical and modern theories, schools of management thought. Functions of management – planning, organizing, staffing, directing and leading, controlling, coordinating, reporting and budgeting. Types and methods of administrative communication. Decision-making in organization. Organizational effectiveness, organizational climate, organizational behaviour, organizational development, job satisfaction and morale. Time management. Performance appraisal. Coordination at different levels of extension management, methods of coordination. Management by Objective (MBO) and Total Quality Management (TQM). Project Evaluation and Review Technique (PERT). Logical Frame Working (LFW) and Project Management Techniques. Personal management, scope of Agribusiness Management and Institutions - National Institute of Agricultural Extension and Management (MANAGE). Indian Institute of Plantation Management (IIPM), NIRD, EEL and NAARM. Monitoring, evaluation and impact analysis of extension programmes. Critical analysis of organizational set up of extension administration at various levels. Agricultural Technology Information Centers (ATIC). Technology Parks. Management Information System. Management of Agricultural Knowledge System (MAKS) and use of Expert System. Traditional media for communication in development programmes. Problem Solving Techniques / Negotiation, Motivational Theories & Techniques, Work motivation Organizational climate; Resource management: concept and methods; Team building: process and strategies at organizational and village levels. Mobilization and empowerment skills: concept and strategies in mobilization, concretisation and empowerment of rural people.

## **Unit 8: Entrepreneurial Development**

Concept, significance and scope. Programmes and agencies promoting entrepreneurship. Types and techniques of training for developing entrepreneurial activities in various areas. Self Help Groups – concepts, organization, mobilization, micro-finance and functioning of SHG for empowerment and sustainability. Agripreneurship- agriclinics and agribusiness centers. International cooperation in agriculture - SAIC, Commonwealth, FAO, USAID, DFID and CGIAR system. Critical analysis of extension systems of SAARC, BRICS and other selected countries (USA, UK, Japan, Philippines, Israel etc.).

## **Unit 9: Developmental Strategies and Issues in Extension**

Extension policies. National Agricultural Extension System and Networking of State development Departments, NARS, NGOs, Farmers Organizations, producers companies, agricultural cooperatives, rural banks, insurance and private sectors. History of Agriculture and Veterinary extension programmes- NPCBB, PM assistance livestock development programmes and rural development programmes. Developmental strategies such as Watershed Development Programmes; Technology Mission, Horticulture Mission. Front Line Extension Programmes of ICAR/TAR-IVLP, NATP, NAIP, IRDP, ATMA, ITD, SREP, Research-Extension-Farmer-Interface. Identification, characterization, documentation and validation of ITKs. Privatization of extension, market led extension, production to

consumption and end to end innovative approaches. Issues related to globalization and IPR. Rural, Agricultural, Animal Husbandry, Dairy and Women Developmental Programmes implemented by Govt. of India. Krishi Vigyan Kendras (KVKs).

### **Unit 10: Gender Sensitization and Empowerment**

Gender and empowerment: meaning, gender related definitions and importance for empowering women; need and focus on gender sensitization, gender in community diversity and its implication for empowerment. Gender perspectives in development of women, social characteristics, roles, responsibilities, resources, constraints, legal issues and opportunities; economical, educational and other parameters. Gender tools and methodologies: Dimensions and methodologies for empowerment; gender budgeting; gender analysis framework- context, activities, resources and programme action profile; technologies and empowerment - gender specific technologies, household technology interface, socio-cultural interface and women as consumer of technologies. Gender issues and development: health and nutrition, violence, governance, education and media, Gender Audit.

**NOTE: The syllabus mentioned above is illustrative only. Questions relating to recent/current developments taking place in agriculture and allied sciences in general and in the concerned subject areas in particular can also be included in the question papers as may be deemed appropriate by subject-paper experts.**

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# Registrar

Bihar Agricultural University, Sabour  
Bhagalpur - 813210 (Bihar)