

2021-22

PROSPECTUS

M.Sc. & Ph.D. Degree Programme



Bihar Agricultural University
Sabour, Bhagalpur

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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 18th 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 2015-16. 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 6 colleges (5 Agriculture and 1 Horticulture), 12 research stations spread in 3 agro-ecological zones of Bihar. The University also has 21 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. Bholu Paswan Shastri Agricultural College, Purnea.
5. Dr. Kalam Agricultural College, Kishanganj.

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 325 students while in Masters, it is 102 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, reprography, 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.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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

Email: registrarbau2015@gmail.com

2.2 IMPORTANT DATES (Tentative) to be informed latter on

A.	Online Application through University Website(www.bausabour.ac.in)	20 July – 20 Aug, 2021
B.	Downloading of Admit Card from University Website	01 Sep – 05 Sep, 2021 (Tantative)
C.	Date of Examination	05 Sep, 2021 (Sunday) (Tantative)

2.3 APPLICATION FEE

Degree Programme	For UR & Others	For SC / ST
Master Degree	Rs. 800/-	Rs. 400/-
Ph.D. Degree	Rs. 1000/-	Rs. 500/-

NOTE: Application fee is payable through on line mode only. (*Cash, Cheque, Postal orders and money order shall not be accepted*).

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 1st 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
A. Agriculture Faculty					
1.	Agricultural Biotechnology	4	1	5	Bachelor's Degree in Agriculture/ Bachelor's Degree in Horticulture
2.	Agricultural Economics	4	1	5	
3.	Agricultural Statistics	3	1	4	
4.	Agronomy	9	3	12	
5.	Entomology	4	2	6	
6.	Extension Education	4	1	5	
7.	Horticulture (Floriculture & Landscaping)	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.	Plant Breeding & Genetics	9	3	12	
12.	Plant Pathology	6	2	8	
13.	Plant Physiology	2	0	2	
14.	Seed Science & Technology	2	0	2	
15.	Soil Science	9	3	12	
	Total	79	23	102	

*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.	Agricultural Biotechnology	4	1	1		1	1			34 – 37
2.	Agricultural Economics	4	2		1	1				38 – 41
3.	Agricultural Statistics	3	2			1				42 – 44
4.	Agronomy	9	4	1	1	1	1		1	45 – 53
5.	Entomology	4	1	1		1	1			54 – 57
6.	Extension Education	4	2		1	1				58 – 61
7.	Horticulture (Floriculture & Landscaping)	2	1				1			62 – 63
8.	Horticulture (Fruit Science)	8	3	1	1	2	1			64 – 71
9.	Horticulture (Post Harvest Technology)	3	1		1		1			72 – 74
10.	Horticulture (Vegetable Science)	10	4	1	1	2	1		1	75 – 84
11.	Plant Breeding & Genetics	9	4	1	1	1	2			85 – 93
12.	Plant Pathology	6	2	1	1	1	1			94 – 99
13.	Plant Physiology	2	1			1				100 – 01
14.	Seed Science & Technology	2	1			1				02 – 03
15.	Soil Science	9	3	1	2	1	2			04 – 12
	Total	79	32	8	10	15	12	0	2	

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 1st 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
A. Agriculture Faculty					
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.	Extension Education	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.	Plant Breeding & Genetics	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
	Total	22	7	29	

4.3 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 Ph. D Degree Programme										
1	Agricultural Economics	2		1			1			67 – 68
2	Agronomy	3	2			1				69 – 71
3	Entomology	2	1		1					72 – 73
4	Extension Education	1					1			74
5	Horticulture (Fruit Science)	3	1	1		1				75 – 77
6	Horticulture (Vegetable Science)	3	1		1		1			78 – 80
7	Plant Breeding & Genetics	2	1			1				81 – 82
8	Plant Pathology	2	1						1	83 – 84
9	Soil Science	4	1	1		1	1			85 – 88
	Total	22	8	3	2	4	4	0	1	

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 Four (4) 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 six (6) 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)-2021 'ON-LINE' only through official website (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. 800/-	Rs. 400/-
For Ph.D. Programme Degree	Rs. 1000/-	Rs. 500/-

*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)
- In case of Master Degree Programme choose maximum five subjects of your choice.

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.

Appendix – II

SYLLABUS FOR COMPETITIVE TEST FOR ADMISSION TO MASTER'S DEGREE PROGRAMME

1 . Agriculture Faculty

i General Agronomy

National and International Agricultural Research Institutes of India; Agro-climatic zones of Bihar and India; Area, production and productivity of major crops in India and Bihar; Weather and climate, microclimate, weather elements, basics of weather forecasting; Dry land agriculture; Tillage; crop stand establishment; Classification of crops; Definition and concept of cropping system, cropping pattern, multiple cropping, mixed cropping, inter-cropping, multi storied cropping, relay cropping and alley cropping and their importance in relation to food production; Basic elements of crop production; Factors affecting crop production. Irrigation- definition and objectives; Water resources and irrigation development in India and Bihar, Soil plant-water relationships; Methods of soil moisture estimation; Water requirement of crops; Scheduling of irrigation; Methods of irrigation-surface, sprinkler and drip; Irrigation efficiency and water use efficiency; Irrigation water quality and its management; drainage; Water management of important crops.

Weeds - introduction, characteristics, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop- weed competition and allelopathy; Concept of weed prevention, control and eradication; Method of weed control - physical, cultural, chemical and biological methods; Integrated weed management; Herbicide-classification, formulations, methods of application; selectivity of herbicides; Weed management in major field crops and horticultural crops; Aquatic and problematic weeds and their control.

Organic farming - definition, concept, relevance in present context, principles and components; Organic production requirement; Biological intensive nutrient management, organic manures, vermicomposting, green manuring, recycling of organic residues, bio-fertilizers; Soil improvement and amendments; Integrated diseases and pest management-use of bio-control agents, bio-pesticides, pheromones, trap crops; bird perches, Quality considerations, certification, labelling and accreditation process, marketing, exports. Sustainable agriculture - introduction, definition, goal and current concepts, factors affecting ecological balance and ameliorative measures; Land degradation and conservation of natural resources. Farming system—definition, principles and components; Useful integrated farming system (IFS) models for lowland, upland and dry land situations; Principles of integration of different enterprises for the preparation of farming system modules; Utilization of wasteland through farming system approach.

Field crops - Origin, economic importance, soil and climatic requirement, varieties and cultural practices of crops, Cereals : rice, maize, sorghum, pearl millet, minor millets, wheat, barley; Pulses: pigeon pea, green gram, black gram, chickpea, lentil, peas, beans; Oilseeds: ground nut, sesame, soybean, rapeseed and mustard, sunflower, safflower and linseed ; Sugar crop: sugarcane; Forage crops : sorghum, maize, cowpea, cluster bean, napiergrass, berseem and oat; Calculation of seed rate, fertilizers, herbicide and yield estimation; Preparation of cropping scheme for irrigated and dry land situations.

ii Horticulture

Definition and importance; Classification of horticultural crops; Area and production of different fruit, vegetable and flower crops; Planting systems, high density planting, planning and establishment of new orchard; Principles and methods of training and pruning of fruit crops; propagation methods and use of growth regulators in horticultural crops; Package of practices of important fruits (mango, banana, guava, citrus, litchi, papaya, strawberry etc.), vegetables (potato, tomato, brinjal, chillies, okra, cucurbitaceous vegetables, Cole crops, bulb crops, tuber crops, root crops, peas and beans, leafy vegetables etc.), ornamental crops (trees, shrubs, climbers, palms and seasonal flowers) and spices (turmeric, coriander, fenugreek, ginger); Medicinal and aromatic crops – Ashwagandha, asparagus, aloe, costus, cinnamon, periwinkle, isabgol, mint, lemon grass, citronella, palma rosa, ocimum, rose, geranium, vetiver; cultivation technology of plantation crops like Coconut, Arecanut, Betel vine, Cashew, Cocoa, Oil palm; importance of post-harvest technology in horticultural crops; Maturity indices, harvesting and post-harvest handling of fruits and vegetables; Pre harvest factors affecting quality on post-harvest shelf life of fruits and vegetables; Principles of preservation by heat, low temperature, chemicals and fermentation; Preparation of jams, jellies, preservatives, pickles, ketchup, sauce.

iii Soil Science

Pedological and edaphological concept of soil; Composition of rocks; Weathering of rocks and minerals; Soil formation - factors and processes; Type of soil - importance and their management; Soil physical properties - Soil texture, Textural classes, Particle size analysis, Soil structure : classification, Soil aggregates : significance, Soil consistency, Soil crusting, Bulk density and particle density of soils & porosity : their Significance and manipulation, Soil compaction, soil colour; Soil moisture – retention and potentials, soil moisture constants, infiltration, percolation, permeability, drainage; Soil temperature, soil air, gaseous exchange, influence of soil temperature and air on plant growth; Soil colloids: properties, nature, types and significance; Layer silicate clays, their genesis and sources of charges, adsorption of ions, ion exchange, CEC & AEC factors influencing ion exchange and its significance; Soil organic matter: composition, decomposability,

humus, fractionation of organic matter, carbon cycle, C: N ratio. Soil biology: biomass, soil organisms and their beneficial and harmful roles; Types of soil micro-organism, their role in different geochemical transformations; biological nitrogen fixation, bio-fertilizers, Rhizosphere, Phyllosphere, plant-microbe interaction; Microbial pesticides, Microbial composting, Microbial agent to control plant diseases. Soil health assessment techniques; Soil as a source of plant nutrients - essential and beneficial elements, criteria of essentiality of plant nutrient, forms of nutrients in soil, functions and deficiency symptoms of essential nutrients and measures to overcome deficiency, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants; Problem soils –acid and salt affected soils : their characteristics, nutrient availabilities, reclamation methods (mechanical, chemical and biological methods); Use of saline water for agriculture; Soil fertility– approaches for soil fertility evaluation and methods; Critical limits of plant nutrients in soil; Factors influencing nutrient use efficiency for different soil and crops grown under rainfed and irrigated conditions; Fertilizers and manures - types, application methods; Integrated Nutrient Management (INM); Bio-fertilizers and their advantage; Preparation of organic manures, Vermicompost, FYM, green maturing.

iv Plant Breeding & Genetics

Major objectives and achievements of plant breeding in India; Centre of diversity and its importance in crop improvement; Modes of reproduction: Sexual, Asexual; Modes of pollination; genetic consequences, differences between self and cross pollinated crops; Nature of Pollination of crops; Parthenocarpy in plants; Germplasm conservation and its utilization; Concept of gene and gene pool; Hybridization & methods of handling segregating generations; Pure line selection, Mass selection, Heterosis breeding, Hybridization, pedigree method, bulk method, modified bulk method, back cross method, recurrent selection; Male sterility and self-incompatibility-mechanism and their utilization in crop improvement; Heterosis –concepts, estimation and genetic basis of heterosis; Clonal selection; Polyploidy breeding and its importance in crop breeding; Mutation breeding; Hybrid production and importance in different crop plants; Wide hybridization and constraints related to it; Synthetics and composites, their development; Plant ideo-types concept and importance, IPR and its related issues, Genetic basis of adaptability to unfavourable environments; Definition of biometrics, assessment of variability i.e., additive, dominance and epistasis and their differentiation; Genotype x Environment interaction and influence on yield performance. Hardy-Weinberg Law; Study in respect of origin, distribution of species, wild relative and forms of Vegetables (Tomato, okra, chilli, cucumbers); Flower crops (Chrysanthemum, rose, gaillardia, gerbera & marigold); fruit crops (aonla, guava, mango, custard apple, banana, papaya); Breeding for resistance to biotic and abiotic stresses variability in pathogens and pests; Mechanisms of resistance in plant to pathogens and pest; Quantitative and qualitative characters; Components of genetic variation, correlation and

regression; Cell division-mitosis and meiosis; Mendel's laws of inheritance, Multiple alleles, linkage and crossing over; except Cytoplasmic inheritance, Chromosome: structure, morphology, number and types. Structure of DNA and RNA and its replication; Concept of Plant Biotechnology: Tissue Culture and Plant Genetic Engineering; Totipotency in plant, meristem culture, anther culture, pollen culture, embryo culture, callus culture, cell culture; Somaclonal variation; Transgenic- achievements and future prospects.

v Seed Science

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

vi Plant Physiology

Transpiration: significance, Transpiration in relation to crops productivity, Water Use Efficiency, WUE in C₃, C₄ and CAM plants, Factors affecting WUE; Photosynthesis, Significance of C₃, C₄ and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops; Respiration and its significance, Brief account of Growth respiration and maintenance respiration, Hydroponics, Introduction of Photo-periodism and Vernalization in relation to crop productivity; Photo-periodism, Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinin, ABA, Ethylene, Novel plant growth regulators, Commercial application of plant growth regulators in Agriculture, Senescence and abscission.

vii Entomology

Economic importance of insects; General morphology and anatomy of insect; Classification of insects; Apiculture, sericulture and lac culture; Important insect and non-insect pests 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; Storage pests and their management; Integrated Pest Management(IPM); Biological control of pests; Plant quarantine measures; Different categories of pesticides, their formulation and modes of action; Insect toxicology and concept of LD50/ LC50 MRL and waiting period; Recent techniques of pest management; Plant protection equipments and its application in pest management; Insecticide Act, 1968 & Puts, 1971. General characteristics of plant pathogenic nematodes, its morphology and biology; Classification of nematodes up to family level with emphasis on groups containing economically important genera; General symptoms caused by nematodes and their management.

viii 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.

ix Agricultural Economics

Meaning, definition; Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare; Wants: Meaning, characteristics, classification, importance; Law of Diminishing Marginal Utility, law of equi-marginal utility; Consumer equilibrium; Demand: meaning, definition, kinds of demand, demand schedule, demand curve, market demand, Price, income and cross elasticities; Public

Finance–Meaning, Principle, Sources, Direct Tax, Indirect Tax; Public expenditure; Inflation; Nationalized and Commercial Banking System. Agricultural credit; Agricultural co-operative: structure and function;

x Agricultural Marketing

Definition, classification; Marketable surplus & marketed surplus, Marketing channel, Types and systems of farming, Farm planning and budgeting, Risk and Uncertainty; Principles of production and costs, Cost of cultivation, net returns, Farm records, Balance sheet, Profit –loss analysis.

xi Extension Education

Meaning, definition; Agricultural extension & its importance; Rural development-meaning, definition, objectives and importance; Different extension programmes - Etawah Pilot Project, Community Development Programme, Panchayati Raj System, High Yielding Variety Programme, National Demonstration, Frontline Demonstration, Krishi Vigyan Kendra(KVK), ATMA, Institutional Village Linkage Programme (IVLP), Integrated Rural Development Programme (IRDP); Communication-meaning, definition, elements and selected models; Extension Programme-planning-meaning, scope, principles and steps; Monitoring and evaluation of Extension programme; Extension teaching methods; Leadership, Attitude, Knowledge, Skill, Training, Communication skill; Local leaders, Adoption and Diffusion, Innovations and their characteristics, Kisan Call Centers, Entrepreneurship in Agriculture, SWOT analysis; Capacity building of extension Personnel

xii Agricultural Statistics

Definition of statistics , its use and limitations; Graphical representation- Histogram, Frequency polygon, Frequency curve, Ogive; Measures of Central Tendency – Mean, Median, Mode, Geometric Mean, Harmonic Mean; Measures of Dispersion –Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Variation; Concept of Probability; Simple Random Sampling; Standard Error, Type I and Type II Error; Null Hypothesis, Level of Significance; Test of Significance based on Chi-Square, t and F test; Correlation Coefficient , Regression Coefficient, Experimental Designs –CRD, RBD, Factorial RBD, Split Plot Design and LSD.

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.

xiii 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.

Appendix – III
SYLLABUS FOR COMPETITIVE TEST FOR ADMISSION
TO Ph. D. DEGREE PROGRAMME

A. AGRICULTURAL ECONOMICS

UNIT – I Micro Economic Theory and Applications

Theory of Consumer Behaviour - Cardinal Utility Approach - Ordinal Utility Approach – Income effect and substitution effect – Applications of Indifference curve approach - Revealed Preference Hypothesis – Consumer surplus - Derivation of Demand curve – Elasticity of demand. Theory of Production – Production functions – Returns to scale and economies of scale – Technical progress – Theory of Costs – Cost curves– Profit maximization and cost minimization – Derivation of supply curve – Law of Supply – Producers’ surplus. Market Equilibrium - Behaviour of Firms in Competitive Markets – Perfect Competition- Effect of Taxation and Subsidies on market equilibrium - Monopoly- Monopolistic - Oligopoly- Theory of Factor Markets. General Equilibrium Theory - Welfare Economics - Pareto Optimality – Social welfare criteria - Social Welfare functions.

UNIT – II Macro Economics and Policy

Nature and Scope of Macro Economics - Methodology and Keynesian Concepts National Income - Concepts and measurement- Classical theory of Employment and Say’s Law-Modern theory of Employment and Effective Demand. Consumption function- Investment and savings - Concept of Multiplier and Accelerator - Output and Employment - Rate of interest - Classical, Neo classical and Keynesian version- Classical theory Vs Keynesian theory – Unemployment and Full employment. Money and classical theories of Money and Price - Keynesian theory of money and Friedman Restatement theory of money - Supply of Money - Demand for Money -Inflation: Nature, Effects and control. IS & LM frame work - General Equilibrium of product and money markets - Monetary policy - Fiscal policy- Effectiveness of Monetary and Fiscal policy – Central banking. Business cycles - Balance of Payment - Foreign Exchange Rate determination.

UNIT – III Agricultural Production Economics

Nature, scope and significance of agricultural production economics- Agricultural Production processes, character and dimensions-spatial, temporal - Centrality of production functions, assumptions of production functions, commonly used forms - Properties, limitations, specification, estimation and interpretation of commonly used production functions. Factors of production, classification,

interdependence, and factor substitution - Determination of optimal levels of production and factor application –Optimal factor combination and least cost combination of production - Theory of product choice; selection of optimal product combination. Cost functions and cost curves, components, and cost minimization –Duality theory – cost and production functions and its applications -Derivation of firm's input demand and output supply functions -Economies and diseconomies of scale. Technology in agricultural production, nature and effects and measurement – Measuring efficiency in agricultural production; technical, allocative and economic efficiencies - Yield gap analysis concepts- types and measurement - Nature and sources of risk, modeling and coping strategies.

UNIT – IV Agricultural Marketing and Price Analysis

Review of Concepts in Agricultural Marketing - Characteristic of Agricultural product and Production – Problems in Agricultural Marketing from Demand and Supply and Institutions sides. Market intermediaries and their role - Need for regulation in the present context - Marketable & Marketed surplus estimation. Marketing Efficiency - Structure Conduct and Performance analysis - Vertical and Horizontal integration - Integration over space, time and form-Vertical coordination. Marketing Co-operatives – APMC Regulated Markets - Direct marketing, Contract farming and Retailing - Supply Chain Management - State trading, Warehousing and other Government agencies -Performance and Strategies – Market infrastructure needs, performance and Government role - Value Chain Finance. Role of Information Technology and telecommunication in marketing of agricultural commodities - Market research-Market information service - electronic auctions (e-bay), e-Chaupals, Ag-market and Domestic and Export market Intelligence Cell (DEMIC) – Market extension. Spatial and temporal price relationship – price forecasting – time series analysis – time series models – spectral analysis. Price policy and economic development – non-price instruments. Theory of storage - Introduction to Commodities markets and future trading - Basics of commodity futures – Operation Mechanism of Commodity markets – Price discovery - Hedging and Basis - Fundamental analysis – Technical Analysis - Role of Government in promoting commodity trading and regulatory measures. WTO & its impact on Indian agriculture.

UNIT – V Agricultural Finance and Project Management

Role and Importance of Agricultural Finance. Financial Institutions and credit flow to rural/priority sector. Agricultural lending – Direct and Indirect Financing - Financing through Co-operatives, NABARD and Commercial Banks and RRBs. District Credit Plan and lending to agriculture/priority sector. Micro-Financing and Role of MFI's - NGO's, and SHG's. Lending to farmers – The concept of 3 C's, 7 P's and 3 R's of credit. Estimation of Technical feasibility, Economic viability and repaying capacity of borrowers and appraisal of credit proposals. Understanding lenders and developing better

working relationship and supervisory credit system. Credit inclusions – credit widening and credit deepening. Financial Decisions – Investment, Financing, Liquidity and Solvency. Preparation of financial statements - Balance Sheet, Cash Flow Statement and Profit and Loss Account. Ratio Analysis and Assessing the performance of farm/firm. Project Approach in financing agriculture. Financial, economic and environmental appraisal of investment projects. Identification, preparation, appraisal, financing and implementation of projects. Project Appraisal techniques – Undiscounted measures. Time value of money – Use of discounted measures - B-C ratio, NPV and IRR. Agreements, supervision, monitoring and evaluation phases in appraising agricultural investment projects. Net work Techniques – PERT and CPM. Risks in financing agriculture. Risk management strategies and coping mechanism. Crop Insurance programmes – review of different crop insurance schemes – yield loss and weather based insurance and their applications.

A. AGRONOMY

UNIT – I

Crop growth analysis in relation to environment; agro-ecological zones of India. Quantitative agrobiological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit. Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modelling for desired crop yield. Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress. Integrated Farming Systems(IFS), Organic farming, and Resource Conservation Technologies (RCTs) including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture; crop residue recycling and management, sustainable agriculture and good agricultural practices.

UNIT – II

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions. Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients. Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management. Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient

interactions. Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermi-compost and residue wastes in crops.

UNIT - III

Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices. Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides. Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelo-chemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation. Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control. Integrated weed management; cost: benefit analysis of weed management.

UNIT - IV

Water and its role in plants; water resources of India and Bihar, major irrigation projects of India and Bihar, extent of area and crops irrigated in India and different states. Irrigation and irrigation management definition, objectives and limitations. Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress conditions. water requirement of crops. Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and poly houses. Concept of ET, CU, PET, ETc, Epan, and their importance in assessing WR, IW/ CPE ratio and its importance. Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; leaching requirement , irrigation efficiencies and methods of increasing field water efficiency, Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops , drainage coefficient and methods of field drainage, their layout and spacing.

B. EXTENSION EDUCATION

UNIT- I

Approaches of Agricultural Extension: A critical analysis of different approaches of agricultural extension. Importance and relevance of indigenous knowledge system, identification and documentation of ITK, Integration of ITK system in research formulation, Concept of Agricultural Knowledge and Information System, Training of Stakeholders of AKIS. Cyber Extension - Concept of cyber extension, national and international cases of extension projects using ICT and their impact of agricultural

extension, alternative methods of financing agricultural extension - Scope, limitations and experience and cases. Research – Extension -Farmer - Market linkage: Importance, Scope, Implications etc., Market - Led Extension, Farmer – Led Extension, Concept of Farm Field School, Farm School, Public - Private Partnership: Meaning, Models, Identification of various areas for partnership. Stakeholder's analysis in Extension. Main streaming gender in Extension - Issues and Prospects. Implications of WTO - AOA for extension services, re-orientation of extension services for agri-business and marketing activities, GOI- NGO collaboration to improve efficiency of extension. Extension and contemporary issues: Extension and issues related to rural poverty. Privatization of Extension. Intellectual Property Rights (IPRs). Extension Reforms in India - Decentralized decision making, Bottom up planning, Farming System and Situation based Extension Delivery System, Extension delivery through Commodity Interest Groups. Organization innovations in Extension - ATIC, IVLP, Kisan Call Centres.

UNIT- II

Scaling technique - meaning, types, principles, steps and quality, techniques of attitude scale construction - Paired comparison, Equal appearing intervals, Successive Intervals, Summated ratings, Scalogram analysis, Scale discrimination technique, Reliability and Validity of Scales. Sociometrics, content analysis, case studies, Q-sort techniques, Semantic different technique. Projective and Semi projective techniques, Critical incident techniques, Computer packages for analysis - usage in Extension Research. Knowledge scale measurement. Participatory tools and techniques in behaviour Research - Data collection and Evaluation. Impact analysis, e-data collection and information analysis.

UNIT- III

Paradigm shift in training - learning scenario, Training Approaches - Experiential learning - laboratory - organization development (system) approaches; Training Design, Designing an effective training programme, harmonizing training needs, Course Objective, content and methods. Designing an effective training session - the semantics involved, Designing experiential training sessions, simulation exercises, and openness in training transaction - managing dilemmas, ambivalence and conflicts and confusion (for both trainers and trainees).Recent Training Techniques for understanding and facilitation team building, group dynamics, motivation and empowerment, laboratory methods: micro-lab process work, and sensitivity training, Psychological instruments as training tools: TAT, Inventories, Cases, etc. Participatory Training Techniques - Lecture, Brainstorming, Group discussion and Training Games. Role Play, Psycho-drama, Coaching, Counselling, etc., Trainer's roles and dilemmas, Factors Effecting Training Effectiveness and Training Evaluation.

UNIT- IV

Introduction to organizations: Concept and Characteristics of organizations, Organizational Behaviour Context and concept - levels of organizations - formal and informal organizations, Theories of

organizations: Nature of organizational theory - classical theories - features of Bureaucracy - administrative theory and Scientific management - Neo-classical theories - the human relations movement - modern theory. Systems approach to study organization needs and motives - Attitude, values and ethical behaviour - alienation and work - work motivation - communication and interpersonal behaviour - organization communication – leadership behaviour -decision making, problem solving techniques - organizational climate - change proneness and resistance to change, Organizational change, Organizational structure - Process in organizing - Dimension of Motivation Climate. Departmentation - Span of Management - Delegation of authority – Centralization and decentralization - line and staff organization - functional organization divisionalisation - Project organization - Matrix organization - free form organization - top management structure. Individual behaviour in organization. Fundamentals of Human relations and Organizational behaviour, Groups and teams - Organisational culture and performance. Dynamics of Organization behaviour - leadership conflict situations and inter group behaviour- Organisational Development - Factors effecting organization effectiveness. Creativity, leadership, motivation and organization development.

UNIT- V

Concepts in Instructional Technology, Scope of Instructional Technology. History of agricultural education in India. Guidelines for curriculum development in Agricultural Universities. Curriculum design development. Course outline, Lesson plans for theory and practical. Teaching and learning styles. Theories of learning. Cognitive levels. Instructional Course Objective. Motivation of students. Instructional Methods. Experiential learning cycle. Innovative Instructional Aids. Computer Assisted Instruction. Programmed instruction technique. Team Teaching. E-Learning, Art of Effective Communication. Distance education. Student evaluation - Question Bank. Appraisal of Teacher Performance. Review of research in Instructional Technology. Introduction to organizations: Concept and Characteristics of organizations, Organizational Behaviour- Context and concept - levels of organizations - formal and informal organizations, Theories of organizations: Nature of organizational theory - classical theories - features of Bureaucracy - administrative theory and Scientific management - Neo-classical theories - the human relations movement - modern theory. Systems approach to study organization needs and motives - Attitude, values and ethical behaviour - alienation and work - work motivation - communication and interpersonal behaviour - organization communication – leadership behaviour - decision making, problem solving techniques - organizational climate - change proneness and resistance to change, Organizational change, Organizational structure - Process in organizing - Dimension of Motivation Climate. Departmentation - Span of Management - Delegation of authority – Centralization and decentralization- line and staff organization - functional organization divisionalisation- Project organization- Matrix organization-free form organization - top management structure. Individual behaviour in organization. Fundamentals of Human relations and Organizational behaviour, Groups and

teams - Organisational culture and performance. Dynamics of Organization behaviour - leadership conflict situation and inter group behaviour- Organisational Development - Factors effecting organization effectiveness. Creativity, leadership, motivation and organization development.

C. HORTICULTURE (Vegetable Science)

UNIT - I

Introduction, botany and taxonomy, 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 and seed production of cool season vegetables: Potato, cabbage, cauliflower, knol khol, sprouting broccoli, Brussels sprouts, Root crops: carrot, radish, turnip, beetroot, Bulb crops: onion and garlic, Peas and beans, green leafy vegetables.

UNIT – II

Introduction, botany and taxonomy, 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, and economics of crop production and seed production of Warm Season Vegetables- Tomato, Eggplant, Hot and Sweet Peppers, Okra, Beans, Cowpea and Cluster Bean, Cucurbitaceous Crops, Tapioca and Sweet Potato, Green Leafy vegetables.

UNIT – III

Classification of vegetables, Principles of breeding of vegetable crops; Heterosis, mutation breeding, polyploidy, male sterility system, self incompatibility: mechanisms favouring self and cross pollination; origin, botany, taxonomy, floral biology, cytogenetic, genetics, breeding objectives; Various breeding methods(introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR Act for the crops viz. Potato, Tomato, Eggplant, Hot Pepper, Sweet Pepper, Okra, Peas & Beans, Amaranth, Chenopods, Lettuce, Gourds, Melons, Pumpkins & Squashes, Cabbage, Cauliflower, Carrot, Beetroot, Radish, Sweet Potato and Tapioca.

UNIT – IV

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, ethylene and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, 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.

UNIT – V

Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed industry in India; Genetical and agronomical principles of seed production; methods of seed production; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production; Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control; Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/ packets), storage and cryopreservation of seeds, synthetic seed technology; Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, Cole crops, bulb crops, leafy vegetables, okra and vegetatively propagated vegetable crops.

D. HORTICULTURE (Fruit Science)

UNIT – I

Area, production and productivity, nutritional values, commercial varieties of regional, national and international importance, eco-physiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, critical stages of 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. Intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group; Origin and distribution, taxonomical status - species and cultivars, cytogenetic, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploidy 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. Mango, banana, citrus, papaya, guava, sapota, jackfruit, pineapple, annonas, avocado, aonla, pomegranate, phalsa, ber, apple, pear, quince, grapes, Plums, peach, apricot, cherries, hazelnut Litchi, loquat, persimmon, kiwifruit,

strawberry, Nuts- walnut, almond, pistachio, pecan, Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan, pomegranate, custard apple, carambola, and Plantation crops-coconut, arecanut, tea, coffee and cocoa.

UNIT – II

Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras, Bud sport. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth. Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods. Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship –Graft Incompatibility. Rejuvenation through top working – Progeny orchard and scion bank. Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques - *in vitro* clonal propagation, direct organogenesis, embryogenesis, micro grafting, meristem culture. Hardening, packing and transport of micro-propagules. Physiological disorder of national importance.

UNIT – III

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, thermo-periodism. Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscissic 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; Analytical technique in horticulture research.

E. PLANT BREEDING & GENETICS

UNIT – I

Cell- structure and its type; Mendel's laws; Chromosomal theory of inheritance.; Multiple alleles, Gene interactions, Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage detection, estimation; Recombination and genetic mapping in eukaryotes, Somatic cell genetics, Extra chromosomal inheritance; Population - Mendelian population – Random mating

population -Frequencies of genes and genotypes Hardy-Weinberg equilibrium; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis; Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters; Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Molecular chaperones and gene expression. Gene regulation in eukaryotes, RNA editing; Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCR based cloning, positional cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro-RNAs (miRNAs); Genomics and proteomics; Functional and pharmacogenomics;

Metagenomics; Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts; Concepts of Eugenics, Epigenetic, Genetic disorders and Behavioural genetics; Architecture of chromosome in prokaryotes and eukaryotes; Artificial chromosome construction and its uses; Special types of chromosomes; Cell Cycle and cell division; synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over and recombination models, cytological basis, Structural and numerical variation in chromosomal number and its Evolutionary significance, Introduction to techniques for karyotyping; Chromosome banding and painting – *in situ* hybridization and various applications; euploidy - haploids, diploids and polyploids ; Utilization of aneuploids in gene location, somatic segregation and chimeras – endomitosis and somatic reduction ; balanced lethals and chromosome complexes; Inter-varietal chromosome substitutions; Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of autopolyploids vs allopolyploids — Role of aneuploids in basic and applied aspects of crop breeding, Alien addition and substitution lines; Apomixis - Evolutionary and genetic problems in crops with apomixes; Reversion of autopolyploids to diploids; Genome mapping in polyploids - Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica) – Hybrids between species with same chromosome number, alien translocations - Hybrids between species with different chromosome number; Gene transfer using amphidiploids – Bridge species; Fertilization barriers in crop plants at pre-and post fertilization levels- *In vitro* techniques to overcome the fertilization barriers in crops; Chromosome manipulations in wide hybridization ; case studies –Production and use of haploids, dihaploids and doubled haploids in genetics and breeding.

UNIT – II

Ultra structure of the cell; Differences between eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles; Bioenergetics; Ultra structure and function; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Cell division and physiology of cell division; Historical

background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation, Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes – ribosomes, t-RNAs and translational factors; Transposable elements; Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes – DNA content variation; Gene amplification and its significance; Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging; Biotechnology and its relevance in agriculture ;Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation; Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers, mapping populations ;Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene Pyramiding; Genomics and genoinformatics for crop improvement; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs; Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, physical methods of gene transfer. Production of transgenic plants in various field crops & commercial release; Biotechnology applications in male sterility/hybrid breeding, molecular farming; MOs and related issues; GMO; International regulations, bio safety issues of GMOs; Intellectual property rights; Nanotechnology and its applications in crop improvement programmes.

UNIT – III

History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, characteristics improved by plant breeding; Centres of Origin-biodiversity and its significance; Genetic basis of breeding self and cross - pollinated crops including mating systems and response to selection, Plant introduction and role of plant genetic resources in plant breeding; Self-incompatibility and male sterility in crop plants and their commercial exploitation; Pure line theory, pure line selection and mass selection methods; pedigree, bulk, backcross, single seed descent and multiline method; Population breeding in self-pollinated crops (diallel selective mating approach);Breeding methods in cross pollinated crops; progeny selection schemes, recurrent selection schemes for intra and interpopulation improvement and development of synthetics and composites; Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbred; Breeding methods in asexually/clonally propagated crops; Concept of plant ideotype and its role in crop improvement; Transgressive breeding; Mutation breeding its nature and its classification; Breeding for abiotic and biotic stresses; Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and

farmers rights; Mendelian traits vs polygenic traits - its inheritance - Multiple factor hypothesis; Variations associated with polygenic traits; Nature of gene action; Principles of Analysis of Variance (ANOVA) - Expected variance components, random and fixed models; MANOVA, biplot analysis; Designs for plant breeding experiments – principles and applications; Genetic diversity analysis – Association analysis; Path analysis and Parent - progeny regression analysis; Discriminant function and principal component analyses; Selection indices - selection of parents; Simultaneous selection models- concepts of selection - heritability and genetic advance; Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC; Concepts of combining ability and gene action; Analysis of genotype x environment interaction; Models for G x E analysis and stability parameters; AMMI analysis – principles and interpretation; QTL mapping in Genetic analysis; Marker assisted selection (MAS) in Plant breeding and factors influencing MAS.

F. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

UNIT – I

Soil as a three phase system; Soil texture, textural classes, mechanical analysis, specific surface; Soil consistence; dispersion and workability of soils; Soil structure - genesis, types and management soil structure; soil aggregation, and stability; soil tilth, characteristics of good soil tilth; Soil water: potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

Water flow in saturated and unsaturated soils; Poiseuille's law; Darcy's law; hydraulic conductivity, permeability; measurement of hydraulic conductivity in saturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum; Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Energy balance; thermal properties of soil; measurement of soil temperature. Soil Consistency, Atterbergs' limits and its practical significance, Plasticity; Soil crusting; types, measurement and management. Soil erosion: Wind and water erosion, factors, types .Soil conservation measures Watershed: concepts and its implication in modern context Water Use Efficiency: Concept

UNIT – II

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Nutrient interactions and plant growth. Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; fertilizer use efficiency. Soil and fertilizer phosphorus - forms, immobilization,

mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behaviour in soils and management under field conditions. Potassium - forms, equilibrium in soils and its agricultural significance; potassium fixation; management of potassium fertilizers under field conditions. Sulphur - source, forms, fertilizers and their behaviour in soils; calcium and magnesium— factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability. Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site-specific nutrient management; integrated nutrient management. Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture. Fertilizer control order (FCO), Specifications, Methods of fertilizers and manures analysis, Fertilizer dose calculation.

UNIT – III

Composition of the earth's crust and soils. Elements of equilibrium thermodynamics, chemical equilibrium, electrochemistry and chemical kinetics. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter, clay-organic interactions. Ion exchange processes in soil; cation exchange- theories based on law of mass action, adsorption isotherms, donnanmembrane equilibrium concept, clay membrane electrodes and ionic activity measurement, Schofield's ratio law and its implication in plant nutrition ; Suspension effect. Thermodynamics, statistical mechanics; anion and ligand exchange, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; Problem soils (Acid Soils, Acid sulphate soils, Saline soils, Saline alkali Soils, Alkali soils etc), their characteristics and their management strategies. Chemistry of acid soils; active and potential acidity; lime potential, salt affected soils and amendments; soil pH, E_{ce}, ESP, SAR and important relations; soil management and amendments, submerged soils. Quality of irrigation water, different parameters and its measurement. D value and its practical implication.

UNIT – IV

Crystallography, space lattice, coordination theory, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals. Rocks and minerals : origin, Classification and its implication in soil genesis. Factors of soil formation, soil forming processes; weathering of rocks and mineral; soil profile; weathering sequences of minerals.

Concept of soil individual; soil classification systems - soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps. Landform – soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) – concept and application.

UNIT – V

Soil microbial ecology, types of organisms in different soils; biochemistry of root-soil interface; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora. Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese 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; biotic factors in soil development; microbial toxins in the soil. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost. Biofertilizers – definition, classification, specifications, method of production and role in crop production. Concept of Soil Quality and Soil health. Soil Quality assessment techniques. Biological degradation of soils and its implication in crop production

UNIT – VI

Soil, water and air pollution problems. Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc. Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as a sink for waste disposal. Pesticides – their classification, behaviour in soil and effect on soil microorganisms. Toxic elements – their sources, behaviour in soils, effect on nutrients availability, effect on plant and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases – carbon dioxide, methane and nitrous oxide. Carbon sequestration-Concepts, approaches and potential Remediation/amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution. Soil degradation: types, Physical, Chemical and Biological, factors of degradation, management option.

G. ENTOMOLOGY

UNIT – I Insect Morphology

- i. Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation.
- ii. Head-Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites.

- iii. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications.
- iv. Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemo-receptors).

UNIT – II Insect Anatomy, Physiology and Nutrition

- i. Scope and importance of insect anatomy and physiology.
- ii. Structure, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands.
- iii. Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause.
- iv. Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular micro-organisms and their role in physiology; artificial diets.

UNIT – III Classification of Insects

- i. Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta- Orders contained.
- ii. Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera – Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera.
- iii. Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them (Continued). Division Neoptera – Subdivision Endopterygota, Section Neuropteroid-Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.

UNIT – IV Insect Ecology

- i. History and Definition. Basic Concepts. Organisation of the Biological world. Plato's Natural Balance vs Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between the two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology.
- ii. Basic concepts of abundance- Model vs Real world. Population growth- basic models – Exponential vs Logistic models. Discrete vs Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies of insect life tables. Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) - aestivation, hibernation.
- iii. Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Inter specific interactions- Basic factors governing the inter specific interactions- Classification of inter specific interactions - The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of niche- ecological homologues, competitive exclusion. Prey-predator interactions- Basic model- Lotka-Volterra Model, Volterra's principle. Functional and numerical response. Defence mechanisms against predators/parasitoids- Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies.
- iv. Community ecology- Concept of guild, Organisation of communities- Hutchinson Ratio, May's d/w, Relation between the two and their association with Dyar's Law and Przibram's law. Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity- stability debate, relevance to pest management. Pest management as applied ecology

UNIT – V Biological Control of Crop Pests and Weeds

- i. History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation.
- ii. Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects.
- iii. Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation.

- iv. Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

UNIT – VI Toxicology of Insecticides

- i. Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.
- ii. Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organo-chlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, etc.
- iii. Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticide synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.
- iv. Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.
- v. Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

UNIT – VII Principles of Integrated Pest Management

- i. History and origin, definition and evolution of various related terminologies.
- ii. Concept and philosophy, ecological principles, economic threshold concept, and economic consideration.
- iii. Tools of pest management and their integration- legislative, cultural, physical and mechanical methods; pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; case studies of successful IPM programmes.

UNIT – VIII Pests of Field Crops

- i. Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors.
- ii. Insect pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

- iii. Insect pests of pulses, tobacco, oilseeds and their management.
- iv. Insect pests of fibre crops, forages, sugarcane and their management.

UNIT – IX Pests of Horticultural and Plantation Crops

- i. Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops.
- ii. Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, ber, fig, citrus, aonla, pineapple, apple, peach and other temperate fruits.
- iii. Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, french beans, chow- chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc.
- iv. Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc.
- v. Ornamental, medicinal and aromatic plants and pests in polyhouses/protected cultivation.

H. PLANT PATHOLOGY

UNIT – I Mycology

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology. Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi. The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

UNIT – II Plant Virology

History of plant viruses, composition and structure of viruses. Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship. Virus nomenclature and classification, genome organization, replication and movement of viruses. Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics. Mycoviruses, phytoplasma and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-microscope and ultramicrotome. Origin and evolution, mechanism of resistance, genetic engineering, ecology, and listing of important diseases and their management.

UNIT – III Plant Bacteriology

History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria. Evolution, classification and nomenclature of phytopathogenic procarya and list of important diseases caused by them. Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among

phytopathogenic procarya. General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios. Procaryotic inhibitors and their mode of action against phytopathogenic bacteria. Survival and dissemination of phytopathogenic bacteria.

UNIT – IV Principles of Plant Pathology

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. Genetics of resistance; ‘R’ genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. Disease management strategies.

UNIT – V Detection and Diagnosis of Plant Diseases

Methods to prove Koch’s postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of centrifuge, pH meter, micrometer, haemocytometer, camera lucida. Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of manuscripts.



Registrar

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